A CORRELATION BETWEEN "LOGICAL" AND "ONTOLOGICAL" IN MODERN SCIENCE

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A logical and philosophical analysis of the concepts of "logical" and "ontological" in modern scientific cognition is realized and the scope of their application for the characterization of logical and ontological ways of constructing the two types of models of the world is outlined. It was found out that due to difference "logical" and "ontological" there arose a problem of determining their correlation in modern science, which in each sphere of science is a particularly obvious form. The functional features of a variety of logical and ontological models and establish correlation between them in modern logic, psychology, physics, and cosmology are considered. The correlation between «logical» and «ontological» as the problem of invariance of two types of models of the world based on the reference methods, interpretation of physical experiments is actualized.

Keywords: logical, ontological, modality, invariance, reference, interpretation, physical experiment.

The concepts of "logical" and "ontological" that constitute the construction of two types of "worlds", building models of the object; define "dualism" structuring the various systems and their states are clearly separated in modern science. "Logical" and "ontological" in the context of scientific research of natural and social systems, with varying degrees of complexity of structured worlds as megaworld, macrocosm, microcosm, gained universal appeal. Different conceptual approaches megaworld, macro, micro, modern science increasingly operates with such terms as "a logical theory of space-time" and "ontological theory of space-time", "logical and ontological (physical) geometry of the universe" [3, p. 67], "the logical and ontological model of the world", "an event that takes place in the logically possible world (a fictional event) and the event is happening in the physical world (real event)", "logical and ontological fatalism", "logical and ontological future's design", resulting in the need for updated logical and philosophical understanding of these concepts and identify their relationships.

Generalization of conceptual approaches allows trace that the "logical" (conceivable, that the knowledge of the mind, imaginary, hypothetical) understand as:

– logical-mathematical construction "possible worlds" and «idealized objects» (logical constructs);
– abstract models' construction of the world by means of formal languages of logic and mathematics;
– rational understanding of the universe based on the principles of determinism and causality;

–   search for order in the universe ("from chaos to order").

"Logical" as a concept of scientific knowledge means that the subject of science in the design of "possible worlds" or "idealized objects" in the construction of highly abstract models of the universe makes extensive use of "logical figures" – the forms and laws of abstract logical thinking and logical methods that have historically faced "deductively generated power" and perform a heuristic function. Accordingly, the "logic" there is a means of creating "conceptual reality" in the form of hypotheses, formal theories (formalism), i.e., logical-mathematical knowledge systems using special artificial language. Thus, the "logic" of science takes the form of an abstract hypothesis constructed hypothetical-deductive method, the formal system (formalism), built by formalization, forecasting future scenarios ("possible worlds") constructed by extrapolation and modeling. Such hypotheses logically designed, logically constructed formal systems or "possible worlds" can be set, and they faced each other alternatives, and thus competing concepts of science. Each abstract hypotheses created or constructed formal system formulate logical principles (requirements) that determine whether they meet certain rules for constructing such logical constructs. Thus, the hypotheses constructed hypothetical-deductive method, formulate the following requirements: 1) they must not conflict with the fundamental principles of scientific rationality are grounded and developing scientific knowledge and expertise. These include the principles of objectivity, validity of the laws of science, the consistency of the actual data, historicity, and 2) they should be, if possible, according to the simple principle of simplicity formulated G. Leibniz, the best hypothesis is the simplest. The hypothesis is considered simple if it has no additional assumptions, clarifications, corrections, etc., and 3) they must be such that they can be in principle verified for validity. Evidence (facts of science) is an objective criterion for hypotheses testing.

The formal system must comply with the following requirements as consistency (within a formal system S can not be removed at the same time kind of formula A and its negation – A), completeness (need to identify the necessary connection between identically-true and proven formulas within the system S); independence (within a single axiom system S can be derived from other sets of axioms) solveness (within a given system S must be a general method or algorithm, which allows relatively formula A to establish whether it outs or not).

The "ontological" (physical, actual, real) in scientific knowledge is:

–   the real existence of the objective world independent of thought and consciousness;
–   the real existence of a certain object (things) in its singularity, which belongs to a class of similar items;
–   the physical existence of objects, phenomena and processes in the space-time dimension.

"Ontological" as a concept of scientific knowledge means that the subject knows the science of actually existing objects, phenomena, processes in their space-time dimension, the events taking place in the world, exploring the empirical methods of observation in natural and laboratory conditions and under specifically the experiments. Empirical observations and the experiments is knowledge which takes the logical form of protocol statements, which express the facts.

Through the division «logical-ontological» in logical-mathematical sciences and sciences, which use logical-mathematical methods began to clearly distinguish between "physical space-time" and "mathematical space-time", "peeled" from the empirical givens investigated against "objects", the physical (real) life and "being a conceptual", "physical and conceivable (imaginary) the existence of objects", two types of reality – "physical (material)" and "conceivable" (logically constructed).

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For each of the types of structured space-time existence and the existence of objects of modern science develops specific language to describe their properties, classes, relationships and more.

Distinction between "logical" and "ontological" posed the problem of determining their value, which in each science becomes the following: the problem of determining the objective existence of objects whose properties are set purely logical, the problem of determining the objective content of hypotheses and theories created hypothetical-deductive method, the problem of the definition of "physical agent" that would become a real "starting point" that connects the logical structure of empirical scientific observations and experiments upon which determine the physical nature of the object.

Let's define the specific issues contained in those specific sciences, in which the distinction of concepts "logical" and "ontological" became especially apparent form.

In logic the distinction between "logical" and "ontological: and establish relationships between them "matured" gradually, according to how it has historically separated the proper object and methods. Traditional logic as a part of philosophical knowledge of the world during the period of its origin in ancient Greece was the unity of ontology and epistemology, under "logic" and "ontology" not yet a relatively independent status in relation to each other, but gradually philosophers and logic (F. Bacon, G. Leibniz, B. Russell, C. Lewis, R. Carnap, G. Frege) separated the "logical" and "ontological". In particular, it was in the impersonation of logical and ontological (physical) content and scope concepts, in distinction by G. Leibniz existence of things, which is known by the mind (logic and mathematics) and empirical (physical) existence, "truths of reason" and "truth of fact" possible and impossible in logic [6, p. 369], the dismemberment of the universal class of objects into subclasses of objects that exist in reality, and items that are not really there, and on the possible existence of subclasses of logical objects logically impossible the existence of objects (B. Russell, K. Lewis).

Let's consider in more detail how there are "reasonable" and "ontological" in modern logic.

First, the theory of concepts distinguish logical and factual content and scope of concepts and introduce the term "empty concept" to distinguish between logical and factual content and extent of terms. Some concepts can be logically empty and virtually empty if it does not cover in terms of real-world objects, events and processes. Logically empty content is the concept in which the subject is conceived, imagined, logically assumed, but really (actually, ontologically) does not exist (like "round square" or "perpetum mobile"). Self-controversial notion is logically and practically empty (such as "intelligent man who has no mind").

Secondly, the logical-mathematical theory of classes (sets) introduced the term "empty class" ("empty set") or "zero class" that is the class that actually does not contain any element.

Thirdly, the theory of logical truth introduces the term "logical truth" (L-true) and "actual truth" (F-true). These terms explicates the terms "truths of reason" and "true facts" that are introduced into the logic of G. Leibniz. In symbolic logic logically true find statements that take the value "true" for all possible interpretations for its variables , and thus of the truth value is determined by their most logical form of their construction. These regular expressions are called logical tautology or logical laws, demonstration and use of which has important methodological significance to solve the problem of solveness. In fact, there are true statements for which there is at least one interpretation under which they take the meaning of "true" and, therefore, of the truth of their value depends on the specific content of the constituent elements of speech and their consistency with reality.

Fourth, the term "logical truth" (L-true) and "actual truth" (F-true) explicates in modal logic by R. Carnap, in particular alethic logic that operates such modalities as "should", "could", "really",

"accidentally" [5]. In modern alethic logic is clear distinction between the logical and actual (ontological) modality: logical modality is associated with logical determinism of expression, where the degree of connections and relations characterizing the statements themselves, the rules and principles of their construction, while the actual (ontological) modality air' connected with the objective determination of expression, and the degree of connections and relationships characterizes itself an object of knowledge and its properties. At the same time alethic logic formulated definition of logical truth and the actual truth of the statements and alethic modalities based on logical analysis of statements within the meaning set that is logically necessary (that is an expression of logical laws) logically possible (that does not contradict the laws of logic) logically impossible (that is contrary to the laws of logic), which is actually necessary (that is fixed in the laws of different sciences, including the laws of physics, biology, history) is actually possible (that is consistent with current trends in the development of objects and phenomena) impossible (that contradicts the laws of science). Each of these types of modal expressions has its specific cognitive meaning. For example, the statement is logically possible means of constructing scientific hypotheses, mathematical objects of science fiction, "imaginary worlds", etc., which under certain conditions can be "materialized"; logically necessary statements "work" in all deductively constructed of thinking designs even if they are imaginary and at some stage of their existence have no interpretation (for example, N. Lobachevsky called imaginary created his non-Euclidean geometry, which found their interpretation only after 60–70 years) [7, p. 21].

However, discrimination, analysis and determination of the nature of logical and ontological modalities raises the need to establish relationships between them, which is reflected in the philosophical ideas of G. Leibniz, D. Hume, I. Kant, G. Hegel, R. Carnap, H. Reichenbach et al. These concepts are different, presenting the philosophical and ideological differences conceptions of their authors. For example, an idealist D. Hume, I. Kant and the positivists believed that there is only logical necessity, G. Leibniz, recognizing the existence of both the logical and ontological truth, clothed only essential nature of logical truth, while the truth of science considered random not necessary. And today deserves special attention analysis relation between modalities, it is made within the contemporary alethic logic. Although recognizing the specific logical and ontological modalities as certain types of research, in addition they also ascribe a unity that allows you to set the logical relationship between them, the transition from one modality to another. Each logically necessary statements can be correlated with a specific ontological necessity, but not all that ontologically necessary, is logically necessary. All that is ontologically possible is logically possible, but not vice versa – is not all that is logically possible, is ontologically possible. This approach has significant methodological value in scientific knowledge and makes it possible to carry out the interpretation of logical calculi of modal logic in various areas of cognitive activity.

Fifth, the logic being clearly distinguish logical (conceivable, imaginary, hypothetical) and ontological (actual) existence of objects by separating different types of objects exist. In particular, if B. Russell, who's had "a strong sense of reality" is not allowed in terms of the logic of the existence of imaginary objects like "unicorns" or "Gold Mountain" [8], modern modal logic allows for the existence of hypothetical objects. Under this assumption, there are following types of objects exist: object "x" actually exists (ontological, physical) object "x" exists logically (hypothetically possible) because of the assumption, the object "x" does not exist neither actually nor logical.

In modern logic clear distinction between empirical science and abstract objects. Empirical object – an object (object, phenomenon, process), which exists objectively outside of human

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thought in a space-time dimension and an abstract object – an object that exists imagined, as a product abstrahuvalnoyi of thinking, a product of imagination.

In modern philosophy and psychology, which formed a special study areas of consciousness – the "philosophy of mind" and "psychology of mind" in the knowledge of the phenomenon of consciousness there are "reasonable" and "ontological" by such way as:

a) provide theoretical and empirical meaning of "∶consciousness";
b) explication of the concept of "consciousness" in terms of "mental state" and "physical-chemical state" [1, p. 121–122]. Nonidentical "mental state" and "physical and chemical conditions", the study of the phenomenon of consciousness posed the problem of finding "physical agent" that would become the starting point, linking the logical design (abstract philosophical and psychological theory of consciousness) of the ontology of consciousness that seeks physical and chemical processes in the brains of human consciousness as physical media.

In modern physics, distinguishing between "logical" and "ontological" clearly evident in the field of mathematical physics and experimental physics. Mathematical physics constructs using logical-mathematical methods and hypothetical idealized objects (such implied logical) objects, which are given purely abstract certain properties and possible functions, and experimental physicists in the experimental situation, seeking physical (objective) the existence of such objects. Following this logic to quantum physics introduced hypothetical objects – quark, takhion et al.

In modern cosmology, which studies the origin of the universe and the "first moments of the universe since the beginning" of the origin of distinction "logical" and "ontological" was to build a hypothetical-deductive method cosmological hypotheses (models) of the origin of the universe and the search for material (physical) constants be ontologically confirmed the proposed hypothesis. Thus, in modern cosmology began to distinguish logically constructed a model of the universe and the physical, an actual universe, the universe as a physical phenomenon and the universe as something conceivable, thus determined that "there is infinite number of logically consistent universe, science and wondered where the universe we live in" [9, p. 181]. The most famous hypothesis in cosmology is the "Big Bang", which can be interpreted as a logical structure that theoretically describes and explains the origin of the universe [4, c. 11].

Modern scientific distinction between "logical" and "ontological" raises the problem of verification of logical constructs (hypotheses, idealized models), that is to find methods for determining whether "corresponds to a logical construct real (physical) world, or not" [3, p. 210]. Correlation between "logical" and "ontological" means the determination of the objective content of a logical construct. In modern science, a definition of the objective content of the logical construct carrying out of logical and semantic method for establishing reference theoretical term, by interpretation, by physical experiment.

Method of reference in logical semantics means searching objectively existing object, which are inherent properties that set a theoretical term that have entered into a specific science. If such an object is found in the process of concrete empirical research, the term for it is no longer "empty" and ontologically constituted. In the logical semantics of a specified period not only has a certain meaning, and shall designate an actual object, that have references. For example, in terms of the logical semantics, the terms "electron", "quark", "takhion", "mion" – a term of quantum physics – are hypothetical objects. Physicists have provided these objects certain abstract properties. An example of the ontological constitution of quantum physics is referencing term "quark" – a fundamental particle that has an electric charge aliquot 3, and is not observed in the free state.

The reality of the existence of quarks confirmed by physical experiments. Thus, the term "quark", which represents one of the fundamental elementary particles became not only an abstract sense, but his references (objective meaning).

The method of interpretation in modern symbolic logic (classical and nonclassical) is defined as the construction of semantic model for a particular type of formal logical system (formalism). In the context of correlation between "logical" and "ontological" the interpretation method in modern science is used to fill definite objective meaning formal system created in logic and mathematics. In fact, the interpretation or construction of semantic model is needed in order to determine the truth meaning of expressions formalized language specific formal system. To do this, create a special language and specific terms, by means of which describe the meanings in a particular field of scientific knowledge. An example of interpreted semantic model for three-valued logical system (three-valued logic) is a quantum logic [2].

The method of physical experiment for verification of logical constructs an artificially created situation in vivo or in vitro to determine the invariance logically constructed ontological models (physical) existence of objects and the development of specific language to describe this invariance.

Modern science for the sake of predict the future of the natural and social world by specific logical-mathematical methods develops predictive scenarios (predictive hypotheses, prognostic model). Definition of invariance of the logically constructed predictive models ("possible worlds") and a real future is a promising area of modern research.

Author's translation of the article

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