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KANTIAN MOTIFS
IN LOGIC AND PHILISOPHY
OF SCIENCE.
THE IDEA OF UNITY
OF A PRIORI
AND EMPIRICAL
ELEMENTS OF COGNITION

Kant insisted on the inherent unity of a priori and empirical elements of cognition. To what extent further progress of philosophy and exact sciences confirmed (or modified) original Kant ideas?

I'm inclined to judge that apriorism in its modest version does not contradict a modest type of empiricism. Real practice of logical and mathematical reasoning provides pry conjunctions of a priori and empirical elements of cognitive processes. We can find the harmonic combinations of mentioned stand-points and thus to confirm the validity of Kant's idea related to inherent unity of a priori and empirical elements within contemporary philosophy of science. Apriorism along with empiricism contains powerful heuristic potential.

Key words: activity of the subject of cognition, apriorism, empiricism, unity of a priori and empirical elements of cognitive process.

I. Kant's philosophical ideas refer to the most concealed features and elements of cognitive process. Their feasibility is proved by the significant changes that have happened in science in general and philosophy in particular since those ideas appeared. Meanwhile Kantian motifs (directly or indirectly) revealed themselves in various fields of science, which actually didn't exist when the great thinker was alive.

So, ethology (and even biology in general) has integrated the idea that "any process of adjustment is a cognitive one and an apparatus given to us a priori to acquire experience has actually been predetermined by a huge load of information obtained in evolution process..." [8, p. 419]. A distinguished biologist K. Lorenz even wrote an article "Kant's Doctrine of the A Priori in the Light of Modern Biology", where he analysed this doctrine in relation to the achievements of biological science in the 20th century [9].

A well-known linguist R. Langacker makes a point that a man creates his environment through his psyche, he interprets this world using his assumptions which were shaped in his earlier experiences; a man always relies on some covert, background knowledge of somebody, who is the addressee of the information [21].

Similar ideas work in psychology. U. Neisser states that the information received by a man (even in his early childhood) is included as a sort of prerequisite for the perception of new information in the future. A subject of cognition makes up some schemes of perceiving information, which are applied to reality at every moment of perception: "A perceiving agent is active. To a great extent he identifies what he sees, choosing the items for more careful studying and getting some features rather than others... Constructing a *pre-expecting scheme* (my italics – V.B.), a perceiving agent performs an act which includes both environment information and his personal cognitive mechanisms" [11, p. 76]. Similar ideas can be found with J. Piaget when he writes about some particular features of perception in early childhood. Cognition constructs the images of external reality, using past and current experience as background and scaffold.

Philosophy of science has long known the fact of theoretical overload of experiment. This assumption does not have a speculative character (which is not possible in the context of positivist philosophy, which introduced and reflected on this idea), but rather a psychological foundation [19].

M. Friedman of Stanford university (USA) actively develops a modern form of Kantianism with its primary motif being the idea of universal rationality, which is defined by ever growing level of personal self-reflection and, therefore, by the growth of understanding one's personal responsibility [20, p. 68].

Historical science also speaks about unavoidable influence of environment onto a historian and his cognition within the spirit of active learning/cognition (see: [14, p. 41–46]). It has been long noticed that the understanding of one and the same text by different generations is defined by features of the time when people live. Even L. Feuerbach noted that every epoch reads itself from the Bible which means it has its own Bible.

Attempting to summarize the above-given opinions, we can state that the mind organizes the world according to its own structure, and, therefore, structures itself while communicating with the world outside.

Kant's ideas are actively implemented in logic and philosophy of science. It is especially concerns one of the central provisions of Kant's cognition theory – the idea of his a priori theory, which presupposes active involvement of the subject of cognition, active involvement of his mind.

Speaking about apriorism in methodology of science, we can't ignore the opposite point of view, empiricism, which is set radically apart from empiricism in the philosophy of logic and mathematics. Meanwhile, I. Kant claimed the unity of the a priori and the empirical. To what extent did further development of philosophy and exact sciences confirm (or correct) Kant's point of view?

Historical retrospection makes us think whether it is justified to set apriorism and empiricism in logical and mathematical knowledge and its development so much antagonistically apart, as it is often done in works on the philosophy of logic and mathematics. What is the actual (though it might be non-universal) practice of logical and mathematical discourse, seen through the unity of a priori and empirical components of creative process? Is it possible to speak about the harmony between these traditionally opposed (in spite of Kant's view) positions? And, finally, is it reasonable to insist on a heuristic potential of either (or both) points of view – whether it is apriorism or empiricism, the potential, which reveals itself in a situation of cognition?

I'm inclined to suggest (intentionally categorically) that a certain form of apriorism (in a moderate, so to say, version) does not contradict empiricism (again, in a moderate version). The actual practice of logical-mathematical discourse can demonstrate very interesting combinations of a priori and empiricist compo-

nents in a creative process. This practice demonstrates the harmonious combination of these positions, and thus confirms the validity of Kant's ideas about the unity of the a priori and empirical both for the modern logic and philosophy of science. Apriorism, as well as empiricism, considered in terms of their unity, in certain situations, has considerable heuristic potential.

Apriorism (a moderate version)

Extreme, radical form of apriorism declares "the primacy of the intuitive basis of mathematical reasoning" and "ahistorical nature of this basis" [10, p. 80], and indeed incompatible with the extreme, radical empiricism, the essence of which is expressed, for example, by William James in a statement that the content of knowledge is completely determined by experience or is narrowed down to it, and only this very knowledge can be a worthy subject of philosophical discourse and form the foundation of science. Meanwhile the a priori point of view has a deep meaning and suggests far-reaching consequences of epistemological character.

Kant is well known to have been the first to propose a specific interpretation of the subject's active role in any act of knowing, the activity of consciousness in the process of cognition. The modern interpretation of Kant's apriorism assumes that the reality (object) is not seen as an object of passive contemplation, but it is subjected to active rethinking on the part of the cognitive agent, and that logical categories become a shaping factor in relation to the objects of cognition, that the theoretical system, being "imposed" on the empirical material, forms a system of objects of scientific knowledge [16, p. 180–184], and the physical reality is not identical to the objective reality, but represents a certain theorized world of physics [3, p. 190–192]. In other words, the knowledge and concepts, which are currently shared by a cognitive agent, form a sort of lens to make the reality "visible" (in the case of logic and mathematics it is called, for example, the universum of discourse). This knowledge and concepts can be compared to a drag-net, which is thrown into reality and catches everything that commensurates with its size. Here, of course, what matters is the goal-setting intention of the cognitive agent, which subjects his cognitive activity to specific tasks and reforms his system of a priori categories in accordance with the specific objectives. As N. Bohr once mentioned in relation to an issue resembling the above-going discussion, "when a boy has a *hammer*, everything looks *like a nail*", and A. Einstein said, "Only the theory decides what we can observe". You can also recall the "Kuleshov's effect" seen in the early days of cinematography, when the technology of combined shots was being introduced: the background against which the object is being filmed, sets the mode of the audience's perception. This effect points at the active nature of both the conscious and the subconscious. Similarly, we can argue for the active character of language that is used in cognitive process, keeping in mind the fact that the language to a certain extent shapes cognition according to its immanent properties and features, and does so quite effectively (see [4; 18; 22]).

One cannot disagree with the idea of E. Mamchur that "it was the thorough reading of Kant's philosophy at Western universities that facilitated the perception and acceptance of quantum theory by the Western theoretical physicists. A quantum theory was hard and tight to accept for many Soviet physicists, which can be partly explained by the fact that they did not actually know the philosophy of Kant, but rather studied dogmatic and extremely simplified ver-

sion of dialectical materialism... " [10, p. 130–131]. Kantian ideas deposited (in converted form) in the (sub) consciousness of famous physicists of the future in the form of the belief that human perception of the world is mediated by a kind of world of ideas, which in a sense is the premise (a priori) to any particular cognitive act.

Moderate apriorism does not assume the primacy of intuitive base and its ahistorical nature; rather it consists of the recognition of the agent's activity, determined by the sum of his knowledge and concepts, which has, of course, a historical character – activity that requires certain angle of vision and dismemberment of reality. Activity of a cognitive agent is not absolute, but relative of his own "fulfilling" and goal-setting, and the activity itself is modified as a result of interaction with the object of his activity. In fact, the very activity towards the outside world can be regarded as an object of cognition.

It could have been quite interesting to establish the conceptual correlation between the moderate apriorism and mathematical Platonism, but this is a separate issue, which would have taken me away from the main goal of the present paper.

Empiricism (moderate version)

An extreme form of empiricism suggests that the content of knowledge is completely determined by experience or reduced to it. In the history of philosophy starting points of this variety of empiricism originate, apparently, from the philosophical system of D. Hume. Meanwhile, the actual practice of logical-mathematical reasoning is indicative of the fact that sometimes a breakthrough into new areas of logical-mathematical research takes place in a context that meets the position of moderate empiricism.

Moderate empiricism implies that experience, the main component of which is predetermined by the conceptual background of the agent, plays a crucial role (including heuristic one) in the formation of knowledge, the nature of the agent's cognitive activity, and often has a decisive (including heuristic) impact on the development of the agent's system of theoretical concepts and his schemes, of his "anticipated" perception in U. Neisser's terms. In fact, the point is that some activities build assumptions, which can be actively used in the subsequent activity, including cognitive one, and they serve as a kind of template for a person to "process" this or that piece of reality, and the reality determines possibility and margins to such processing.

"Cognition, – notes M. Rozov, – is the process of development of the content of social memory. By content I thus understand the fixation of activity in one form or another... Cognition is not a reflection but rather the *construction* of other types of activity, real ones or at the level of mental experiments... The term "reflection" takes on a slightly different meaning here: reflection as a description of the activities that *we create in collaboration with the world around us* (my italics – V.B.) " [13, p. 123]. Thus, cognition is a "two-way street," which is regulated by both the subject and the object, and the allowed ways are defined as the (explicit or implicit) attitudes of the subject and the ontology of the object.

Similar assumptions are typical for enactivism, a very young philosophical field (in the constructivist framework), which interprets the data of cognitive sciences.

Enactivism insists that the subject (agent) does not construct representations, that is, does not "reflect" in the literal sense of the world, he is self-contained, and therefore he builds and re-constructs immanent patterns of activity, and thus constructs his own world, and designs himself. The strategy of the agent in relation to the world is selective; he pulls out meanings and actively creates them, constructing a kind of a niche (a natural one in the case of an animal and a cognitive one in the case of humans). Meanings are involved in the creation of the world, which adapts to the subject (agent) in accordance with his goals and desires. World, the external environment is a continuation of the subjects (agents) themselves, and therefore cognitive systems are structurally and operationally self-enclosed, autopoietic. Cognition is creation, production of the world, which is not the scene of action, but a sort of "completion" of the subject (agent) on the outside to a more or less satisfying shape (see [7, p. 350–351]).

The heuristic value of empiricism and apriorism in the development of logic and mathematics

Analysis of N. Lobachevsky's creative heritage can definitely reveal the scientist's internal support to the empiricism. His imaginary geometry did not proceed from abstract concepts, but from a specific fact – a contact of bodies, and his scientific motto was based on Francis Bacon's thought: «... ask nature, it stores all of the truth and it will certainly and comprehensively answer your questions». For example, in "On the Foundations of Geometry," he writes, "the initial concepts that some science begins with should be clear and brought down to the smallest number.... Such concepts are acquired through senses; the inborn ones should not be trusted". Or in "New Foundations of Geometry" Lobachevsky notes that "the first data, no doubt, will always be the concepts that we learn from nature through our senses" (cit: [5, p. 208]). Geometrical dependencies, in his opinion, are no different from the dependencies that are studied in physics.

This ideological orientation and methodological setting of Lobachevsky did not block, but rather placed a special emphasis on the need to develop and maintain strict canons of mathematical proof, and on the particular attitude towards the basis of mathematical knowledge. "Lobachevsky's views are close to the ones of the English empirical school (Locke, Hume, Berkeley), and Condillac's sensationalism", wrote Alexander Vassiliev, the most profound researcher of the scientist's heritage [5, p. 209].

The main thing is that this explicitly expressed, as it now should be called, moderate empiricist position of Lobachevsky provided heuristic influence on his thoughts during the creation and development of non-Euclidean geometry. It explains why he named the new system of geometry "imaginary", and why he assumed that it was relevant to the real space and time, and attempted to define their geometry, foreseeing that it had to be non-Euclidean.

N. Vassiliev, the conceptual precursor to several non-classical logics (multi-valued, para-nonconsistent, multidimensional), was an explicit supporter of moderate empiricism (in the version that corresponds to the idea of psychologism in logic). In his works on logic, he directly linked the new formal system with the structures of imaginary worlds. The creatures of these worlds, as N. Vassiliev emphasized, have "perceptive" abilities different from those of the earthlings, and they actually dictate the need to adopt a new logic (see [1; 14]). The imaginary world of n-dimensions and the corresponding psychological con-

struction of living beings, according to N. Vassiliev, suggest new types of negations and new logics that make up a plurality of equally equitable and logical systems (see [6, p. 86–89]). In these logics the laws of (non)contradiction and/or the excluded middle are no longer valid: their empirical foundations require adoption of other laws (and, therefore, other logics).

One could argue that Lobachevsky and N. Vassiliev used single "imaginary" methodology, let heuristically rich, but not typical and not indicative of the logical-mathematical discourse. Not daring to make far-reaching generalizations, I'm still inclined to state that empiricism can and does play a heuristic role in implicit situations.

To a certain extent, even Platonism may be considered a special kind of empirical philosophy, which implies a-priori background. After all, we are talking about some pre-defined universum, which generates an appropriate type of experience (let's say, the set-theoretic).

Even if there is a need to create an apparatus to describe a particular subject area, empirical considerations backed up by a priori conditions can play a major role. Here the establishment of relevant logic can serve as a vivid example.

I. Orlov, who praised – which is only natural in the intellectual atmosphere of 1920–1930's – the dialectical method of thinking, strived at constructing a special type of logic, built on intentional (rather than extensional, typical up to a certain point) principle, which would correspond to dialectics in the formal sense. This meant a shift from the "logic of reference" to the "logic of sense". In other words, this logic, which he called the logic of compatibility of propositions should take into account the intentional relationship of antecedent and consequent and thus get closer to the dialectical logic (dictating the laws of natural science, which was processed by Orlov). The latter should be committed to a meaningful aspect that was defined by a particular subject area. In logic, later known as relevant and inspired by the desire to apply formal means to recreate the particular logic of science, coinciding with the theory of knowledge and dialectics, Orlov tried to overcome the paradox of material implication and to bind components of reasoning through semantic dependence (see [2]). Thus, the experience of the dialectical interpretation of natural science dictated certain restrictions on Orlov's formal structures of logic of compatibility of propositions. However, the mere interpretation of natural science took place in the context of dialectical "dissection" of reality. Orlov in this case was similar to the boy with a hammer – a character that appeared in Niels Bohr's aphorism.

The situation with Orlov's logic of compatibility of propositions seems to be quite clear (although it is by no means a textbook one like imaginary geometry or imaginary logic) to demonstrate the mechanism of weaving together a priori and empiricist components of the creative process. The former determine the angle of the cut section of reality, and the latter – the experience extracted from it and defining the nature of cognitive structures.

It is worth recalling the forgotten and undervalued idea of V. Trostnikov of the biological (or, perhaps more accurately – neurophysiological) predetermination of mathematics and its individual fragments. Thus, V. Trostnikov, analyzing the structure of the human perceptual space, argued that, let's say, Cantor's nested interval theorem, underlying the theory of real numbers, must be forced upon our mental process. Particular features of human visual analyzer suggest that the system of nested intervals must necessarily have a common point – "the very point that in perceptual space is our system of intervals" [15, p. 247].

If such a predetermination does occur, it will force us to significantly revise many aspects of traditional epistemology (which, in fact, is already being done in modern constructivism and enactivism) and, in particular, the nature of relations between empiricism and apriorism, as well as refine the very notion of apriorism.

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