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LOGIC, HEURISTICS, AND DISCOVERY

The study is about determining the heuristic capabilities and limitations of logical methods of scientific cognition. The issue of the heuristicity of logic in general and heuristic capabilities and limitations of logical methods of scientific cognition arises, firstly, due to the history of the development of heuristics as a separate field of cognition and its complex relations with logic in terms of interdisciplinary interaction and, secondly, due to the lack of agreement among philosophers and scholars on the matter of what to consider logic (and logical) and what to consider heuristics (and heuristic). The first reason for the issue can be illustrated by the following examples: J. Jungius created heuretica (the first heuristics) as a logic of problem-solving, an alternative to the traditional logic applied to mathematics and natural science; G. Leibniz associated heuretica with the art of discovery, which he considered logic in the general sense; I. P. Reusch considered heuristics as the art of discovering hidden truths, appropriating some logical methods of research as his own. There are many other examples of this kind. Crucially, these examples show that heuristics can be considered as a kind of logic, as something that interacts to some extent with logic, or as a discipline distinct from logic. The second reason is evident from the variety of definitions of logic and heuristics. It is also evident from the fact that the philosophy of logic is not concerned with the question of what logic is, but rather with technical questions (“What is a formal system?”, “What is consequence?”, etc.). The philosophy of heuristics was not developed, to begin with. To solve the problem of logic's heuristicity, it is first required to develop operational definitions of the terms of logic and heuristics. In my view, logic studies the binding of thoughts or their expressions in natural or

artificial language to set up a logical form (abstraction and fixation of certain stable relationships or correlations in the form of laws, rules, schemes, figures, etc.), and the interrelations between logical forms. The binding of thoughts or their expressions in natural or artificial language sometimes looks like transitions from premises to conclusions (or, more broadly, as transitions from one thought or its expression to other thoughts or its expression). This is observed in argumentation, inference, demonstration, grounding, and refutation. This moment with transitions brings logic closer to heuristics.

Heuristics studies non-algorithmic means of solving problems. Problem-solving can be represented as a transition from a problem situation, presented in the form of a task, question, problem, etc., to the problem's solution. Argumentation, inference, demonstration, grounding, and refutation can be represented as solving problems of a certain kind (logical problems). Then it is possible to use certain logical methods (for example, forms of plausible reasoning (abduction, analogy, induction, etc.)) as heuristics. This enables heuristics to adopt some logical methods of research (often analogy or induction) as their means of solving problems.

Also, the process of scientific discovery can be represented as problem-solving, to which both algorithmic and non-algorithmic means can be applied. I propose to define discovery itself as obtaining novelty, new information, or new knowledge that meets specific requirements: 1) the discoverer or evaluator of the discovery must have the idea of discovery in his or her mind (i.e., know that there is such a thing as a discovery) so that the discoverer or evaluator of the discovery can recognize the discovery or assume that a discovery has been made; 2) a discovery is either (a) the discovery in the form of laws, facts, knowledge (i.e.,

stable relationships or correlations) of something that already exists in nature or culture; or (b) the finding and constitution of something that has not existed before at all; 3) for a discovery to be said to have been made, the data obtained in the process of discovery must be confirmed.

Some logical methods of research can be applied during the process of scientific discovery. Thus, the finding of stable relationships or correlations (regularities) in the form of laws, facts, and knowledge can be achieved through forms of plausible reasoning, which are simultaneously non-algorithmic means of cognition. Induction, for example, can serve as a guide to certain regularities. It is also possible to involve forms of plausible reasoning (deduction) at the stage of confirmation of the discovery (finding a certain regularity) to formalize the obtained regularity as the regularity (i.e., abstraction and fixation of the regularity through formalization). Plausible explanations of the content of the concept (characteristic, description, ostensive definition, family resemblance, metaphor, etc.) can also play an integral role in the discovery, especially in cases where it is not yet possible to define the concept of something new found. The operation of a valid explanation of the content of the concept (definition) can be used to confirm the result of the discovery.