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PHILOSOPHICAL LOGIC AS PHILOSOPHY OF LOGIC

The paper examines questions which are essential for philosophical interpretation of the notion “philosophical logic” (PhL): How is PhL possible and relevant? What is PhL called? For what scientific and practical reasons did the term ‘PhL’ become popular? The common usage of the term ‘PhL’ and the common objections against it. Is PhL a kind of logic? What are the relations between PhL, logic and philosophy? We consider four meaningful interpretations of the term ‘PhL’: PhL as a collection of logical systems in connection with philosophy; ‘PhL’ as logic in (of) philosophy; ‘PhL’ as a philosophy of logic, the latter is the main goal of the second part of this paper. The development of logic is evaluated in respect to the popular conceptions of philosophy of science (Kuhn’s concept of scientific revolutions and Lacatos’ concept of proliferation connected to the problem of monism and pluralism in logic). We also survey two different revolutions in modern logic: a transition from traditional to classical logic and a transition from classical to non-classical logic. The reason for both revolutions was that the development of practical applications of logic has gone ahead in relation to logical theory. We propose the idea of “logical neofundamentalism”, concerning the problem of the universality of logic and classifications of logical systems.

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1. On the term ‘philosophical logic’

First of all, I will discuss the following questions: Why, for what reasons did the term ‘philosophical logic’ (PhL) appear and become popular? How is PhL possible and relevant? What is PhL called? I will analyze the common usage of the term PhL, the common objection against its usage, problems posed by using the term PhL. And finally I will explain my conception what PhL could be.

There are two main reasons the term PhL to be used: theoretical and practical. The main question appeared is “Is there a significant field of study where there is no suitable term?” From this it follows the next main

questions: “Where is the field of study named PhL in the philosophical map?” and “Is PhL either a kind of logic or pure philosophy?”

The introduction of a new term is possible only in the context of a newly developed and significant problem, which is not designated in a particular way. Is there such a significant problem field in logic of the 20th century and which is it? New philosophical problematics was developed because of the paradoxes in set theory and the limitative theorems (Tarski, Gödel). They necessitated the elaboration of new philosophical and conceptual investigation into the methods, nature and subject of mathematics and logic and the broad epistemological topics connected to them. But the really new research field in logic was non-classical logic. The non-classical logic and especially modal logic became a central topic of logical research in the mid-20th century and by the same token was considered as highly significant for philosophy.

In my opinion, the main arguments for use the term PhL are everyday-life reasons! Approving such a term is convenient and useful for a large group of scientists for their works and careers.

P1 People with a traditional, classical education without sufficient knowledge of modern logic (those who do not know well enough current logical researches), but working in the field of logic. Philosophers who have good knowledge in some other fields (ontology, epistemology, philosophy of science, history of philosophy), but for different reasons find job as logic lecturers.

P2 Scientists with good skills in formal (mathematical) methods, frequently having a mathematical education and working in the field of non-classical logics who find job as logic lecturers in philosophical departments.

The mathematicians often identify the concepts of ‘logic’ and ‘logic of mathematics’. However, many non-classical logics are not reduced to logic of mathematics, they (e.g. with the exception of intuitionistic logic) cannot play the role of the basis of mathematical theory (it is the reason why mathematicians were not interested in non-classical logics for a long time). In mathematics, there is no contextual ambiguity and modality! This is the reason why such notions are not interesting for the mathematicians. Moreover, this led to the employment of logicians interested in such problematics in philosophical faculties.

Publicity PhL sounds impressive and hardly provoking objection. It helps to earn money from machinery of government, foundation, deans, rectors and other university managers. The term PhL is attractive also for students.

The *main objections* against usage of the term PhL are as follows: Which problems do belong to logic but not to PhL? Are papers of Aristotle (Frege, Hilbert, Kripke, ...) PhL? What are relations between PhL, logic and philosophy? Is PhL a logic? By the way, if PhL is philosophy but not logic, it will conflict with people (*P1*) who want to be logical lecturers. PhL is unnecessary, logic is enough in any case. In my opinion, it is reasonable. In the almost all-common usage of the term PhL without any problems we can use 'logic'!

Let us consider *different uses of 'PhL'*

- PhL is traditional logic,
- PhL is what "philosophical logicians" are studying (a vicious circle),
- PhL is metaphysics,
- PhL is philosophy of language,
- PhL is non-classical logic (e.g. modal logic),
- PhL is general semantics for different logical systems, semantical foundations of logic,
- PhL is metalogic,
- PhL is philosophy of mathematics,
- PhL is philosophy of logic,
- PhL is a philosophical examination of systems of formal logic,
- PhL is a part of philosophical elucidation of those notions that are indispensable for the proper characterization of rational thought and its contents,
- PhL is a discussion of the undefinable,
- PhL is an analysis of the implicit presuppositions,
- PhL is an ontology of the logical forms and the objects of logic (their essence and nature),
- PhL is an area where the logical concepts and problems are discussed and analyzed in a phenomenological, hermeneutical or Hegelian style, rather than by the methods of analytical philosophy. Or more generally: philosophical studies in which questions and concepts of logic are discussed, but which do not comply with the established criteria for logical investigations. And in particular they don't use formal (mathematical) methods. But actually, Aristotle used formal methods, so we can claim that its work are not PhL. Mathematical methods allow explicating also essential logical moments of the extra-mathematical logical 'empirics'. Besides, in the most contemporary studies in logic, there coexist both the content-based reasoning and the formal methods! It is started with qualitative reasoning which justify the approach, then a logical system is defined and analyzed by

formal methods, but the results are analyzed at the informal level. Are they PhL?

Actually, there are so many ‘PhLs’ as ‘philosophical logicians’! So, is there any sense to introduce a new term if this concept proliferates?

I accept the term ‘PhL’, when it is motivated by practical goals. But at the theoretical level, the introduction of a special concept of ‘PhL’ leads to the unnecessary augmentation of essences (Ockam’s razor). But as long as the term ‘PhL’ is quite often used, I shall expose my view on the possible reasonable use.

If logic is a part of philosophy so why we must restrict logic by the more general concept ‘philosophy’ (PhL looks like ‘mathematical algebra’). In general there are two types of interpretation for ‘logic’: (i) restricted, as study of logical inference, argumentation, and the formal structure of reasoning, (ii) extended, as study including problems from other divisions of philosophy (ontology, epistemology, dialectics). The second interpretation makes inevitable the emergence of self-reflexivity and tautologies – PhL looks like ‘philosophical philosophy’. This means that we have to drop the convenient term ‘PhL’! The moral is: we may choose what conception of logic we want, but if we want to keep the term ‘PhL’, we would have to stick to the restricted interpretation of logic. And if we want to keep the extended conception of logic, we are forced to deify the term ‘PhL’.

The introduction of the term ‘PhL’ presupposes the elaboration of a complete and consistent conception about its nature, topic and subject. In this context, I can consider the following four meaningful interpretations of the term ‘PhL’:

1. *PhL as (a type of) logic and studying logical systems connected to philosophy. Especially, PhL as logic investigating non-mathematical reasoning.* It encompasses those thematic fields and divisions of contemporary logic in which the treatment of inference and the formal structure of reasoning is connected to philosophical problems and specific logical systems that are constructed and founded in this way. In this view, PhL is a collection of logical systems related to philosophical problems. By the way, it becomes proliferated and gives rise to many mutually independent “PhLs”. When they are interpreted as “divisions of logic”, we assume the informal idea and its different formal explications. For example, using the term ‘many-valued logics’ we designate both the idea that there is relativity and grades of truth-values and the different formal explications of this idea as presented by Łukasiewicz, Post, etc.

But what kind of logical systems can be called ‘PhLs’? Evidently that not all logics are philosophical, otherwise the term should be empty. Regrett-

ably, Gabbay and Guenther's famous 'Handbook of Philosophical Logic' does not solve the question which logical systems must not be treated as PhLs and encompasses all of the well-studied logical systems.

A fundamental criterion for the appellation of the term 'PhL' is a connection with philosophical problematics, the logical systems that treat specific problems should be excluded from consideration in this setting. Logical systems which aim is to provide a basis for the formal treatment of mathematics have not to be considered as PhL, too. They are an explication of logic that is used in the deductive sciences and expresses the deductive reasoning in them. In this context, the logical consequence is considered as some utterly abstract theories and as well as formal languages and presupposes as strong abstractions used primarily in mathematics. When philosophy treats too much specific topics it loses its characteristics, therefore I exclude the applied systems as deontic logic and logic of norms from the class of the PhLs. The same applies to the class of logical systems that are pure mathematical models and as well as to logical systems used as basis for mathematical theory and to systems created without philosophical justification. They are interesting at least because they allow us to set analogies with other systems interesting in philosophy. And also applied logic that does not claim to explicate logic in any general philosophical, epistemological or ontological sense, but its aim only to express logical relations involved in a particular field far from philosophy.

But the creation of many-valued, modal, intuitionistic logics is related to philosophical postulations! Logical systems that are attempts for the explication of logical inference (in philosophy) are PhL; logical systems expressing epistemological aspects and logical systems related to ontological aspects, too.

2. *'PhL' is a logic in (of) philosophy and explores the rules of the logical inference, the modes of deduction from and in philosophy.* In this sense, PhL is a study of logical consequence and argumentation in philosophy, and particularly the logical problems in epistemology, dialectics, the analysis and explication of the logical structure of specific philosophical theory or classes of such theories. As far as mathematical logic is "mathematical theory of the logical reasoning patterns that mathematicians use to prove their theorems" (Curry), PhL would be (by the same token) an analysis of those reasoning patterns that philosophers use to establish their conclusions. Then 'mathematical logic' (classical logic) is 'logic of mathematics' and 'PhL' (some non-classical logics) is 'logic of philosophy' and therefore both are different. PhL analyzes the forms of reasoning that are not mathematical. This, if PhL is confined to classical logic, would be lo-

gic of mathematics or philosophical analysis of logic of mathematics – too humble task for such a grandiose term. It is an explanation why PhL is to be non-classical logic but not a particular member of the family of non-classical logics. For instance, material implication does not show the content-relation between the two related judgments and therefore does not capture the logical consequence in philosophy. The philosophical reasoning is relevant, therefore the logical systems that embody a better explication of logical consequence have the right to be claimed using the title ‘PhL’. The classical logic is founded on the principle that any two statements can be combined, no matter what are their respective content, which is unacceptable if our aim is an explication of logical consequence outside mathematics. In this way, mathematical logic studies material implication and PhL relevant implication. The same is applied to the logical systems that express different epistemological situations: modal, many-valued, paraconsistent, temporal and fuzzy logics, i.e. the relativity of truth is focal points in philosophy but cannot be coordinated with the bivalence principle. The notions of ‘necessity’ and ‘possibility’ are the basic notions of philosophy. From this point of view, modal logics are closer to PhL. Other kinds of logic namely temporal, many-valued logics with their descriptions are closely connected to PhL, too. One of the aims of logical research is to find the words whose substitution is invariant for logical inference (logical terms). The logical terms of PhL are studied in non-classical logics and can be treated as philosophical terms. The language of philosophy is closer to the language of non-classical logic than to that of classical logic.

In the wide sense, ‘PhL’ is not logic, but an interdisciplinary field between logic and other philosophical areas: ontology, epistemology, philosophy of science, history of philosophy.

3. *‘PhL’ is a philosophy in logic*, a look at contemporary logic from the point of view of some well-known philosophical schools. For example, how can we look at contemporary logic from the point of view of Hegel or Kant? How do dialectics emerge in logic? What are merits of platonism, agnosticism, realism and nominalism, sensualism and rationalism, pragmatism, hermeneutics and existentialism in logic? PhL as philosophy **in** logic must analyze the mutual interweaving of logical and philosophical ideas. It considers the relationship between the results of modern logic and some basic philosophical categories and conceptions. And it tries also to find tangent points and common studies with established philosophical approaches, in which the word ‘logic’ is used, therefore some questions appear in relation to logic.

4. '*PhL*' is a philosophy of logic, i.e. a part of the general philosophy of science, similar to the philosophy of physics, of biology, of mathematics. In this view, PhL is an analysis of the development of contemporary logic from the point of view of philosophy of science. It is an analysis of the most important logical results from the standpoint of methodology and discussing questions that are essential for the philosophical interpretation of modern logic. Questions that are putted to philosophy by the development of modern logic, concerning the limits of the logical, the unity and the universality of logic, about the demarcation, etc. Answering these questions is the main goal of this paper.

2. Philosophical logic as philosophy of logic

The development of logic could be evaluated from the point of view of the popular conceptions of philosophy of science, i.e. Kuhn's conception of scientific revolutions and Lacatos' conception of principles of proliferation. Were there revolutions in logic? In my opinion, there were two different revolutions in modern logic: the transition from traditional to classical logic and the transition from classical to non-classical logic. The old tradition, after a considerable amount of time, has been replaced twice by a new tradition having its own language and based on a new conception of study of logic. The new paradigm has almost completely replaced twice the old one. The reason for both revolutions was that the development of the logical empirical sphere has gone considerably ahead in relation to logical theory. In evaluating the great development in contemporary logic, from a historical and methodological point of view, the word 'revolution' is suggested as the most precise description. In a sphere of knowledge deemed almost complete, whose basic postulates (dogmas) have been viewed as doubtless and have almost been canonized, totally new conceptions emerge! 'Revolution' corresponds to the scale of change and re-evaluation of values in modern logic, comparable to important moments in the development of other fields: Newton's theory, the periodic table of the elements, quantum mechanics, the transition from Newtonian physics to Einstein's theory of relativity, non-Euclidean geometry. The transition to non-classical logic has often been compared to the transition from Euclidean to non-Euclidean geometry but this is superficial and imprecise: the analogy is done by external signs while the essential question is left in the background, namely, what sphere precisely is concerned, and that is logic! The science studying the most general laws of thinking; the science studying the correlation of thoughts by their truth-value; a sphere

related to the laws and processes of cognition and knowledge, and to the question of truth. Geometry is only one of the disciplines of mathematics. In its relation to the universal philosophical concepts, to the world, to 'being'(existence), to the 'logos' and 'ontos', it cannot be compared to logic.

Such an evaluation is found in some papers. However, most authors acquire it and preserve it, without further analyzing what the revolution precisely consists in, what stages it has passed through, and whether or not this is the case of the two different revolutions. The development of contemporary logic is evaluated on a broader scale, without specifying or going into details of its separate stages. In my view, it would be more precise to speak of two revolutions, both leading to a replacement of one paradigm by another. The major cause for these revolutions is that logical empirical development has gone considerably ahead of logical theory. It has been debated many times whether logic has its 'empirical basis' or 'empirics'('empirical sphere') or whether it is a purely deductive structure. This question is important for the philosophy and methodology of logic. Some authors argue in favor that logic is a science without 'empirics'. My position is that logic does have 'empirics' and this is basically the language and methods of reasoning in scientific theories. Deduction is applied most consistently in mathematics; therefore the language and methods of reasoning in mathematics are 'empirics' for logic. However, it would be groundless to restrict the logical 'empirics' to reasoning in mathematics alone, the language and methods of reasoning in many non-mathematical theories are 'empirics' too. Logic deals with the transfer of truth from the premises to the conclusion in an objective and non-empirical way but this 'non-empirical transfer' has its own 'empirics'. It has been argued in favor that the concepts and ideas of logic are based on experience. If the 'empirics' of logic consist in the reasoning and justifiability (provability) of scientific theories, one should not forget that on their part they are the result of 'empirics'. It would seem that the 'empirics' of logic are logic itself but this is not dangerous, paradox-generating self-reflection: the demarcation is clear in reasonings and the theory that studies them. In the 18th and 19th centuries, very rich and elaborated 'empirics' were provided for logic by mathematics. This is why mathematical reasoning was taken as the basis for the construction of the first logical systems. In mathematics, 'empirics' were rich enough to be generalized and explicated into a logical system.

The 'empirics-and-theory' relationship is connected to the concepts of 'verification' and 'falsification'. In logic, 'empirics' have a more specific character; one cannot say that they provide a direct 'verification' and 'falsification' of the theory. There is an intermediate theory. However, taking into

account this intermediary theory, one can speak again of ‘verification’ and ‘falsification’. For the logical theory called ‘classical logic’, the mediating theory is mathematics, and its ‘empirics’ (the logic of mathematical reasoning) verify classical logic. However, in classical logic, the paradoxes of material implications were obtained, while for the bulk of scientific theories such a type of logical reasoning is unacceptable, and this is why, in my view, we can think that the logic of such a type of theory (i.e. its ‘empirics’) ‘falsifies’ classical logic (or, at least, casts doubt on its universality).

The lagging of the science of logic behind logical ‘empirics’, and especially behind the ‘empirics’ provided by mathematical reasoning started long ago. Euclid used, more logical forms and constructions than Aristotle: disjunction, conjunction, negation, multiple-place predicates such as ‘between’. They fell outside the scope of Aristotelian syllogistic and could not be described in its language. Subsequently, logical theory had for a long time been lagging behind logical ‘empirics’ in mathematics. Especially, it was in the 17th to 19th centuries when mathematics underwent a rapid development. The paradigm of traditional logic exhausted its capacities long before the first revolution eventually happened. The works of Boole, De Morgan, Frege, Russell, Hilbert are the result of the generalization of logical ‘empirics’ of mathematics. They eliminated the lagging in question. This is an example of how logical theory generalizes logical ‘empirics’. Since mathematics is related to (and is a result of) extensional theoretical structures that lie outside it, the mentioned results are the generalization of ‘empirics’ encompassing a larger area.

The revolution, *from traditional to classical logic*, consists mainly in the change of solutions, instruments, and methods. The system of classical logic uses a wider range of logical instruments. It allows working with multiple-place predicates, it provides the possibility to unite spheres that have therefore been considered in logical theories, in isolation, each for its own sake. In my opinion, it is exactly this possibility that presents the most significant result of the revolutionary transition.

A question is to what extent the new paradigm is commensurable with the old one. The system of classical logic does not deny traditional logic. It generalizes and essentially extends its capacities. This is why I believe that we cannot speak of a complete incommensurability. Some of the orthodox followers of Kuhn would conclude that there could be no talk of revolution here. However, in my view, a relative absence of incommensurability can be also observed in some changes that have been recognized as revolutions in science, especially in the transition from separate theses and works to a complete theory of a larger scale. Newton’s theory is of that

type. To a certain degree, incommensurability comes forward in the second revolution: the transition from classical to non-classical theory. Here, the incommensurability is much more often discussed and most scholars seem to accept it overtly or implicitly. I have a specific opinion concerning this point. There is a doubtless incommensurability but it could be sublimated into a suitable conception of logical neo-fundamentalism.

The *transition from classical to non-classical logic* is another revolution, and a much more important one, since it affects issues of fundamental nature. It is not a question of introducing qualitatively new methods; there are qualitatively new methods in the first revolution while here there is only a certain extension of these methods. The question is of qualitatively new conceptions, ideas that radically change our understanding of logic. In the first revolution, the introduction of new, mathematical methods makes theory clearer and all encompassing. Logical theory becomes, in style and method, closer to mathematics (the field where the ‘empirics’ show the greatest need for a new logical theory). Though rather later, this revolution was comparable to the works of Newton and the creation of classical physics, and also to the creation of the periodic table of the chemical elements. (The analogy comes naturally here – the transition from classical to non-classical logic can be compared to the theory of relativity and quantum mechanics.) In its spirit, it was a **fundamentalistic** revolution giving new foundations in logic. The second revolution, on the other hand (the transition from classical to non-classical logic), is strongly **anti-fundamentalistic** in its nature; it casts doubt on the basis that the first revolution propounded. It was provoked by the discrepancy between theory and ‘empirics’. However, logical ‘empirics’ became extra-mathematical: it was the logic of scientific research. The development of contemporary logic seems to be natural and consistent: the initial breakthrough has been performed in the area where logic is used most extensively, most systematically and most coherently, in the use of its means of expression (in the most extensive, systematic, and coherent way). Being aware of the efficiency and productivity of contemporary methods, contemporary logic continues to develop but this time it holds by going deeper and wider: mathematical methods allow us to explicate essential logical moments of the extra-mathematical logical ‘empirics’.

While the first revolution was a revolution concerning methods, the second revolution (the transition from classical to non-classical logic) was a revolution of ideas and postulations.

An important reason for considering the two revolutions as a one is that they are very near in time to each other and in fact occurred almost simultaneously. It seems to me that Boole’s idea for the introduction of algebraic

methods in logic, reducing logic to mere algebra could well have emerged considerably earlier. The works of Frege, however, are historically related to the development of science. They come in response to the need of logical analysis of the foundations of mathematics, and thus are the natural development of the creation of the set theory and its establishment as the basis of mathematics. But non-classical logic came to light very soon after them. The system of classical predicate logic had not been completely created yet when Łukasiewicz proposed his system of a three-valued logic, and Lewis's system emerged. It is natural to regard them as continuation of the works of Frege and Hilbert. The methods are similar: formal and mathematical. (By analogy, we could imagine that Newton's theory historically came much later and was created only in the late 19th century.) This was another obstacle to their methodological demarcation. It is rather easy to view them as the one whole or as the one natural process, as two stages of the same development. If there had been a transition from classical to non-classical logic and if the real construction of systems, alternative to classical logic, had had to happen, then classical logic itself would have been completed at least to some extent. Heyting's system of intuitionistic logic was created naturally after the creation of several axiomatic systems of propositional logic. However, it was not at all absolutely necessary for the classical logic to be constructed up to its total completion before its competing alternatives came into being, moreover that the idea of non-classical logic came much earlier.

Another general reason to view the two revolutions as the one whole is that the second is a continuation of the first: apart from being temporally near to each other, they also have similar causes that generated them. Both are a result of theory's lagging behind 'empirics' findings. The difference is that in the first case empirics were mathematical while in the other they were non-mathematical.

Logical paradoxes are the third general reason: the paradoxes in set theory, the semantic paradoxes, and the paradoxes of material implication. However, in classical logic they exert their influence at a later, intermediate stage. The paradoxes in set theory serve as catalysts and accelerators, they affect principles and postulations that are basic for the theory. The idea to form a set of sets is essential to Cantor's theory. In his approach, the set is an object like any other object and one can treat and manipulate it in the same way as other mathematical objects. Then it is natural to use the same logic. However, finite and infinite sets are different, they have qualitatively different properties and, since they are different, it is debatable whether the same logic may be applied. While in the first revolution it was Russell's pa-

adox that gave the greatest impetus, semantic paradoxes and especially the paradox of material implication that played a greater role in the second one, demonstrating the incapacity of classical logic to express logical inference adequately. In part, the synthesis of the two types of rationality coexisting in contemporary logic, the philosophical and the mathematical one, is the basis of the revolutions in contemporary logic. This is especially valid for non-classical logics. The creation of many-valued, modal, intuitionistic logics is related to philosophical postulations. Unfortunately, this synthesis is sometimes partial, inconsistent and incomplete.

There is another synthesis in the revolutions. The Stoics divided propositions into simple and complex and studied how the truth in the complex ones depended on the truth of the simple ones of which they were composed and on the form and manner of their combination. Aristotle restricted himself to the analysis of some elementary subject-predicate relations. Propositional logic regards propositions as indivisible, unstructured, with a single property of being 'true' or 'false'. In the system of classical predicate logic, a successful synthesis has been achieved of the two approaches to logic which began their development in antiquity: Aristotle's subject-predicate approach studying inferences based on the subject-predicate structure, and the Megarian and Stoic approach studying inferences based on propositional relations (well-realized in the system of classical propositional logic).

The first revolution separated logic from ontology. The second provided a possibility to restore this connection. The ideological basis of the first is Leibniz's idea to present demonstration as a calculation similar to the mathematical one, and to introduce more systematically mathematical methods into logic. Retrospectively, the essence of the idea is the view that it is precisely the methods of this type that would be efficient for the logician. The ideological basis of the second revolution is provided by Aristotle's modal syllogistic, by the works of Ramos, and unexpectedly to some by the spirit of Hegel's works.

When we speak of revolutions, two views emerge immediately: the revolutionary and the evolutionary one, namely, revolutions are gradually and continuously prepared by evolutions, but as they are well prepared, revolution is revolution. We face this question both when we speak about social development and when we discuss issues of philosophy of science. My aim here is not to consider this question in detail but I still think that a synthesis between the two views is possible: revolution is a result of evolution. In revolution, the evolutionary potential becomes realized quickly, in a relatively narrow period, leading to a considerable change in a relatively short time. For a number of specialists in social philosophy, the cause of a revolution

is the retarding or retention of the natural evolutionary way of development of society, and revolutions are the symptom of an unsound state of society, of essential errors in its development. If it had developed in the natural evolutionary way, there would have been no need for a revolution. I might accept this position concerning society, but I do not think that it could be mechanically applied for the revolutions of thought. I would not accept the emergence of a grandiose idea changing many basic postulations as a symptom for an ‘unsound state’ of the given field or for ‘essential errors’ in its development. However, I consider these words appropriate when such an idea has come too late and thus the respective field has lagged behind other fields related to it! The revolutions in contemporary logic have been conditioned by the considerable lagging behind in the development of logic compared to mathematics and other sciences related to it. At a certain moment, it became necessary for it to catch up within very short terms. There is a link between the development of ideas in different sciences. Many discoveries in physics have been related to results of mathematics, and vice versa. Achievements in chemistry have been related to results in physics. This internal correlation in the development of the separate sciences exists especially in fields that penetrate in a specific way into many areas of knowledge. A clear and well-known example of that is mathematics: one can discover mathematical regularities in many areas of knowledge, mathematical models have a wide application. Maybe less frequent than mentioned, logic is such a field with a considerable wide application. This is the reason for perceiving the lagging behind especially painfully.

The revolutions in logic raise questions in a similar perspective to the ones of the revolutions in physics: what would be justly deemed as a revolution; is there one or are there two revolutions? Philosophers of physics ask themselves “whether one can consider the discovery of *X*-rays or M \ddot{e} ssbauer’s effect as a revolution...” A question that seems to be similar is whether G \ddot{o} del’s limitative theorems are revolutionary. If the emergence of classical dynamics (Galileo and Newton) is a revolution, then the emergence of the system of classical logic is, for me, an achievement in logic, similar in spirit, and this is why it should be called a revolution, too. The question whether it is a matter of one or two revolutions is not raised only in logic. A similar question has also been asked about the development of physics. The relativist and quantum revolutions: are those two separate or a common relativist-quantum revolution? Is the theory of relativity a continuation of the revolution in electrodynamics, or it is separate as a subsequent revolution? Is it one or two revolutions, of the special or general theory?

Consider another analogy: the theory of relativity does not deny or replace classical physics. Analogically, non-classical logic does not deny or replace classical logic. As the philosophy of physics accepts the thesis that the theory of relativity is more suitable to some theories related to certain entities and ontology, similarly the philosophy of logic could accept the thesis that for some theories related to certain entities and ontology, a kind of non-classical logic is more suitable.

Another moment, characteristics of revolutions, is observed in the development of logic: reconsidering universality, the scope of certain basic principles and postulations. There is no just one, but several such moments, and in each of them the sphere of validity of some basic principles or postulations undergoes a change. This is considered to be a sufficient reason to speak of a revolutionary transition, but the word ‘revolution’ is nevertheless too strong. I accept as the most appropriate and I use the concept of ‘micro-revolution’ for the reconsideration of a basic principle of classical logic. The transition from classical to non-classical logic consists of some different micro-revolutions. Micro-revolutions do not happen in a single turn, they have a more complex nature; they consist of different steps that are sometimes so small that look like evolution. Micro-revolutions are not always historically consecutive, they do not strictly follow one another. In the historical development of logic, some micro-revolutions took place parallel to others and even some came before others. The ideas of the Russian logician N. Vasiliev, the forerunner of intensional and paraconsistent logics, came before the emergence of many-valued and modal logics. The idea of extending classical logical operators by modal ones seems to be more natural and acceptable from a classical point of view and much more important and desirable from a philosophical point of view. However, there is a greater awareness of it only after Gödel’s axiomatization of the systems of Lewis – later than the creation of intuitionistic and many-valued systems. Relevant logic, which is much more closely related to logical inference, emerged only after it became clear that modal logic was not suitable for that purpose.

The important moments of the second revolutionary transition (micro-revolutions) [6] are as follows:

a) *Denying the principle of the excluded middle* (tertium non datur). Intuitionistic logic encompasses the principles of logical reasoning which Brouwer used in developing his intuitionistic mathematics.

b) *Denying the bivalence principle*, one of the basic and most important principles of classical logic. The main idea is that two-valued logic cannot express the diversity of logical situations, e.g. in propositions of modality or probability. In most epistemological situations only ‘truth’ and ‘falsity’

are too coarse – it can be said of many statements that they are true only to a certain extent. But the indefiniteness of their truth does not exempt us of the need to perform logical operations on them. Depending on the epistemological situation to which the logical system is related, admitting a third value having a truth status different from ‘true’ and ‘false’ allows us to set a rich palette of interpretations: “neutral”, “indefinite”, “possible”, “unknown”, “predefined”, “probable”, “antinomic”, “meaningless”, “overloaded”, etc. Abandoning the principle of two values does not stop with the introduction of three values: allowing for one intermediate value leads to the requirement for others; most interpretations of the third value allow to be set for different degrees, e.g. ‘more indefinite’. The interpretations of the third value have a modal importance, and modal operations also allow to be set for degrees: “very necessary”, “more necessary”, “less necessary”, etc.

c) *Extension of classical logical terms.*

d) *Denying the principle of extensionality* (intensional logic).

e) *Denying the universality of the law of non-contradiction* (paraconsistent logic).

f) *Denying monotonicity* (non-monotonic logic).

I accept the possibility for several other micro-revolutions to take place, but my impression is that all basic ideas for taboo breaking have already been tried.

Usually, problems in knowledge come from borderline cases. The development of science involves specifying, particularizing, and giving shape to and displacement of boundaries. In the development of the 20th-century logic, such a displacement has usually lead to enlargement. Each micro-revolution involves such a displacing and enlargement. The main moment is an enlargement of the boundaries of set of logical terms. For some time, many-valued, modal, and intuitionistic logics have been at the borderline. However, after the emergence of the semantics of possible worlds, the borders have been enlarged and modal logic has steadily come into the interior and even close to the core of contemporary logic. In my view, deontic and paraconsistent logics are currently close to the border but on the inside, while the border itself contains non-monotonic logic, erotetic logic and most of the many recently emerging and not properly established logical systems. Deontic, erotetic logic, etc. are at the borderline because, by some of the criteria, there is a discrepancy with definition of logic – in the spirit of ‘Jorgenson’s dilemma’, there are doubts whether there can be any logical inference in them at all. In the terminology of Lakatos they are ‘monsters’.

Important methodological results, as a consequence of the first revolution, were Gödel’s incompleteness theorems. There is a popular thesis saying

that these theorems are in themselves a revolution. However, their condition was the creation of the system of classical logic. This is an interesting point: a new theory is built and it allows to obtain an important result. If we believe that there are reasons to call this result a revolution, then we have the question: When did it start with that result or with the creation of the new theory that was its condition? I am more inclined to call a revolution the creation of classical logic. There are quite a number of important results in physics whose condition was Newton's theory but they are not called revolutions. Although historically Gödel's theorems were not expected, something of the kind could have been expected retrospectively, since Hilbert's program allowed to be situation of self-reflection similar to some semantic paradoxes. The consistency of arithmetic is proved by arithmetization: the system contains arithmetic and must be proved by it, i.e. it contains both its own syntax's and its semantics.

Contemporary logic is closely connected to the development of the philosophy of mathematics. The crises in the foundations of mathematics are among the important factors for the development of contemporary logic, especially for the revolutions discussed here. The creation of the system of classical logic was provoked by the Third Crisis in the foundations of mathematics related to the paradoxes of set theory, and at the very moment when it was hoped to become a stable fundament for the construction of mathematics. We face here an interesting point, maybe not very standard for the philosophy of science. A standard situation is: a crisis in a certain field leads to a revolution in the same field. In the case of the revolution in logic, things are somewhat different: a crisis in mathematics leads to a revolution in another, though very close and related field, i.e. in logic! An attempt to standardize the situation would be to accept that in fact that was not a crisis in mathematics, but in the logical foundations of mathematics instead. However, set theory is a 'purely' mathematical discipline. Most philosophers of mathematics talk of a 'third crisis in the development of mathematics'. The development of logic has lead to reconsidering many questions of the philosophy of mathematics. The first revolution, for instance, imposed to practicing mathematicians a "structuralistic" conception of mathematics: "With its development, mathematics is becoming more and more abstract and, from a 'science of quantitative relations and spatial forms', it has turned into a science studying abstract mathematical structures, mathematical models of theoretical systems."

The second revolution raised many other problems prior to philosophy of logic, but the main one is widely discussed in philosophy of science problem: the *proliferation* and respectively the questions about the *monism and*

pluralism of logic. After the second revolution, logic has been subdivided into a number of logics; so which one now is a “proper logic”? And can we talk about “proper logic” at all? A number of alternatives to classical logic have been offered. Questions have been asked such as: “What is logic after all?” “Is logic two-valued or many-valued?” For some of non-classical logics, their status as “logic” is reasonably questioned. Is there, after all, a reason why all those disciplines use one and the same word “logic”? Could we say that some of them are ‘more’ logic than others? Which ones of them and what degree is the question of truth related to? Even if some of the logics are ruled out as ‘illegitimate’ logics or ‘mathematical exercises with symbols’, and then others are ruled out because they employ the word ‘logic’ only metaphorically. So, all those questions are valid nonetheless. What did then happen with Leibniz’s thesis about the ontological universality of science: “logical truths are valid in all possible worlds”? The conception of “one logic” allows us to consider it as a necessary connection of thoughts according to their truth-value, valid for all real and possible worlds of theories. However, logic becomes parcelled; many logics have appeared, but which one is the only logic? Is there anything allowing us to use the same word for all of them? Is every one of those logics a separate, independent area with no connection to the rest, or can they be grouped together in some way, and by what criteria? Which of them and to what extent are the most general laws of thought studied (namely, the connection of thoughts according to their truth, the laws and process of scientific knowledge and knowledge in general)? How are they related to the question of truth? Which of them is rather a game with symbols, mathematical experiment bearing only a distant relationship to logic, and which are logics whose “logicality” can be proved by ontological and epistemological arguments? What about the a priori nature of logical laws? The philosophy of science calls this subdivision a proliferation of the theory, and considers it to be a symptom and a reason for the methodological crisis in the field. So, is the proliferation in logic the beginning of crisis or is it a sign of crisis in the development of logic? How is this related to the conceptions of monism and pluralism of logic? The problems related to the philosophical interpretation of non-classical logical systems have assumed an ever increasing actuality in modern logic. What should the aim be in constructing such systems? What is the position of a given system among the rest of logical systems? What is their role in the theory of knowledge? In current practice methodological developments considerably lag behind the formal logical investigations.

An important question is how far and to what degree the appearance of non-classical logic has led to the crisis in logic. Does their appearance mark

the beginning of a crisis, or are they the symptom of an already existing, latent crisis? In that case studies of non-classical logic will be attempts to overcome this crisis.

My stand on this question is that the appearance of non-classical logics is rather a symptom, showing that traditional logic is becoming more and more unable to respond to the requirements conditioned by the development of science and cognition. In this respect, the appearance of non-classical logics is one way of trying to overcome the crisis. The way out of the crisis goes through the establishment of the concept of “logicality”, which embraces non-classical logics (or at least a great deal of them), and especially their confirmation as logics.

Maybe there is not only one crisis, but two. The first is related to the “limitedness” and the inadequacy of the traditional and classical logic, which led to the appearance of non-classical logics. The second is a result of the existence of these logics, which led to proliferation. The common ground in both cases is a crisis in the foundation of logic, related to fundamental questions such as “the subject and essence of logic and the logical”, “the unity of logic, its universality and its boundaries.”

There are two positions:

The first is ‘logical monism’ which insists on the uniqueness of logic: ‘There is one logic and everything else called “logic” is just an application of this unique logic in one or another field’. This thesis often leads to the thesis that this is the traditional (or classical) logic.

The other is ‘logical fundamentalism’, i.e. the desire to find a doubtless fundament to logic, to demarcate logic and make it independent, to show what unites different logics: ‘Many logics are types of logic, and, being such, they must necessarily have something in common’. The task to find and demonstrate what is ‘common’ belongs to philosophy.

A radically possible way out of the methodological situation in logic is “*logical anti-fundamentalism*”: ‘Many logics are independent disciplines, each with its own object and methodology, therefore there is no proliferation and no reason to talk of a crisis’. Then no logic can justly declare that it is the ‘real logic’. However, the proliferation of logic provokes a natural tendency toward fundamentalism, which can be observed in many papers written by philosophers of logic. That is why I propose “*logical neo-fundamentalism*” as an alternative way out. This is a conception of the character, object and nature of the logical, viewed from both the epistemological and the ontological aspect. The conception of “logical neo-fundamentalism” must lend a support to orientation in the many logics, introduce some kind of structure, order, organization in them. At the

same time, it must demonstrate their unity in their diversity, clearly state what they have in common. And it must clearly justify whether, in the presence of so many different logics, there can be universality of logic and, if it can, in what sense we are to understand it. Such a (“neo-fundamentalistic”) conception must necessarily involve the following aspects:

1. It must provide a clear and argumentative conception of logic, which should be a development of the previously existing conceptions of logic. It must include a consideration of the nature and objects of logic and also must encompass non-classical logics or at least a considerable part of them, and serve as a criterion of evaluating which logical systems can be called logic and which cannot. It also must allow systems that have not been constructed yet to be evaluated. My shortly *definition for logic* is as follows: ‘logic deals with the objectively ontologically predetermined dependence (relation) between thoughts according to their truth, as expressed in language’. This synthetic definition encompasses the relations of logic, thinking, truth and inference and as well as of language and ontology.

2. It must provide a consideration of the universality of logic as understood in the sense of item 1. My idea is replacing the conception of logic in genera (‘logic of the world’) by ‘logic of a theory, or of a group of theories (about the world)’, and thus the universality of logic is realized by the universality of logics and the universality of “logicality”. The conception of one logic allows it to be regarded as a necessary correlation between the thoughts of truth and makes it valid for all real and possible worlds. The concept of a multitude of logics renders this impossible. This narrows the universality of each separate logic. It can only be universal as far as it is logic, that is, as far as its laws are universal for a particular field or theory. It is clear that a logic should be universal with respect to the world it describes, but then a number of different worlds are possible. ‘A world’ could even mean a certain aspect of another world. The universality of logic will be realized by the universality of the separate logics, inasmuch as they will be complementing each other. The common thing between them will be “logicality”, that is, the very fact that they are logics and that they express a necessary correlation between the thoughts of truth valid for their corresponding theory. This position allows to discuss a number of controversial issues. Such is Hilary Putnam’s thesis that “some of the necessary truths of logic can sometimes happen to be false by empirical reasons” [3]. Expressed in this form, this statement is unclear to me. It comes out that ‘necessary truths’ are not necessary. I think that my position allows to explain: the truths in question are ‘the necessary truths of classical logic’ and therefore the formulation becomes as follows: ‘empirical reasons can replace classical

logic by non-classical logic'. Related to 'empirical reasons', ontology defines logic! Another unclear thesis in [3] is that "logic, in a certain sense, is a natural science" – what does precisely this mean? I perceive that logic has its 'empirics' (a somewhat specific one, to be sure) and it is in this sense that "logic is similar to natural sciences."

3. It must provide a kind of structuring of the many logical systems constructed so far; the criteria for such a structuring must be related to the points provided in 1 and 2. This idea of structuring must come from one common position and allow to be develop.

My own attempts and the analysis of many other attempts to classify logical systems (e.g. see "map" in Resher's paper [4]) have convinced that a successful orthodox classification is only possible if using internal mathematical, syntactic criteria. However, such a classification would not give much to the philosophical methodological meaning of those systems. Mathematicians classify their structures according to internal criteria, but the philosophical methodological look must evaluate them according to whether they are pure models or correspond to 'objective relations of objective things', and to which precisely. Every logical structure constructed as a mathematical system is a potential model and, depending on its interpretation, may serve for modelling in diverse areas. However, our purpose requires a classification corresponding to the philosophical interpretation and the importance of the systems rather than to their formal technical elements. This will not be a classification in the precise sense of the word, but a "*typologization*", since a system may have different interpretations and the demarcation will not be strictly exclusive.

I propose the following "typologization" of logics, corresponding to their philosophical evaluation (this is a "typologization", and perhaps even a classification of the basic, most important and crucial philosophical methodological interpretations of logical systems) [6]:

(i) *Logical systems serving as bases for a mathematical theory.* Classical logic and the intuitionistic logic are certainly here.

(ii) *Logical systems, attempts for the explication of logical inference,* e.g. Alexander Zinoviev's complex logic and naturally relevant logic.

(iii) *Logical systems expressing epistemological aspects.* Modal, many-valued, paraconsistent logics, and to some extent also temporal logic and fuzzy logic, can be viewed as logics of particular epistemological situations.

(iv) *Logical systems related to ontological aspects.* There is the conception that ontology determines logic and that entities in themselves impose the logic to the theory studying (describing) them. This argumentation is related to the idea that some properties of the objects of the micro-world re-

quire a non-classical logic for the theories studying them. I would formulate a ‘thesis of Reichenbach, Birkhoff, and von Neumann’: “The mathematical apparatus of quantum mechanics requires a logic different from classical logic” which I interpret: “The ontology of the objects of quantum mechanics imposes a non-classical logic upon the theories studying them.” The strongest version is that the problems with the quantum mechanics are first symptoms emerging in the initial approach to the genuine non-classical science. In the future, maybe there will be much more drastic situations. In the process of cognition we face again and again new entities and theories about them in which the work with classical logic meets considerable difficulties and inconveniences and this will lead to essential complications. And for theories studying these entities, we will have to reconsider the universality of some of the laws of classical logic.

(v) *Logical systems as (only) mathematical models* and systems created without philosophical justification: they are interesting at least because they allow analogies with other systems interesting in philosophy. Such logical systems can be regarded as “uninterpreted” abstract languages.

(vi) *Applied logic*, logical systems that do not claim to explicate logic in any general philosophical, epistemological or ontological sense, but aim only to express logical relations involved in a particular field of application, such as artificial intelligence, cognitive science, linguistics, computer science, etc.

A comparative analysis of the classification according to internal mathematical criteria and the typologization according to philosophical-and-methodological criteria contributes to understanding the place and the importance of each separate logical system. Logics in which the two-value principle does not hold are closest to logical systems typologized as logics related to epistemological situations, and also to the controversial but very interesting type of logics related to non-classical ontologies. For systems typologized as related to logical inference, a non-observance of the principle of combinability and of extensionality is convenient. The historically established unification concerning the question of the logic of necessity with the question of inference (related to the paradoxes of material implication) is not necessary. The two questions could also be considered separately, with different methods and instruments. Many modal logics do not observe the principle of functionality. However, if we consider modal logics as logical systems related to epistemological situations, then modal operators will transform, in a certain manner, the truth-value of the propositions into another truth-value. Then, it is reasonable to construct also modal logics in which to retain the principle of functionality in some form, probably some kinds of many-valued functionality. The systems of Lewis are actually built

on classical logic, but would the idea of logic with a different implication not be realized successfully in systems constructed differently? After the emergence of the semantics of possible worlds, this modal logic can be defined, rationalized and interpreted as logic of possible worlds. Unlike extensional interpretations, here the truth of a proposition does not depend solely on the truth of A in the particular world but also on its truth in other possible worlds. Thus possible worlds are regarded in themselves as two-valued but with a notion of truth relative to the particular possible world. This is an elegant and beautiful generalization of the classical two-valued logic: it is the logic of a universe with one only possible world. The necessity to take into account the character and degree of truth of the separate propositions of one area leads to multiple possible worlds in it, which leads to a non-classical logic for their universe!

If we analyze the possible interpretations of the third value, we will see that in most of them it is a subject to discussion whether the logical system that would corresponds to them should have precisely three values. For some interpretations, another type of many-valued logic would seem to be more appropriate. Thus, as logic for databases and computer systems, four-valued logic is more suitable. Just one additional value provides a few opportunities. This kind of analysis can lead to the conclusion that for a given interpretation there is no adequate logical system, which could lead to the construction of new systems that would take into account the specific nature of the interpretation! That is, epistemological interpretations of modal logic lead to the idea of many-valued logic, but a many-valued logic with a special interpretation of truth-values related to their modal interpretation! The main point is not to have multiple-values with truth-values defined beforehand, or multiple-values generating modality, but multiple-values generated by a modality extracted from the need for a logic considering a modal graduation of truth. I would classify many-valued logical systems having fixed matrices of truth-values, although they too have some interpretations, as mathematical models. From a philosophical-and-methodological point of view, probability and topological logics are much more interesting than the systems of Post.

The difficulties in building paraconsistent set theory are not a matter of chance. Although mathematics is said to be an ontology-free science some mathematical ontology still exist! The ontology of the micro-world determines the logic of sciences that deals with it, and so does the ontology of mathematical objects in respect to the related theories. Intuitionistic logic turns out to be compatible with mathematical ontology, but not with paraconsistent logic. The importance of paraconsistent logic for philosophy is

greater than for mathematics. The aim of paraconsistent logic is to study the logic of a theory that tolerates contradictions. But the necessity of such a logic is quite different from the necessity to construct mathematics to deal with them. The construction of systems, tolerant to contradictions, can be associated with the explication of real epistemological situations. History of science could provide instances of inconsistent theories doing their job. For some time such theories do not come out of use, though scientists use them with caution. Many contemporary mathematicians who are not so easily disconcerted with the paradoxes use naive set theory in their current work. In this perspective the role of paraconsistent logic could be considered as methodological in the following sense. Paraconsistency does not open a way out of the paradoxes, as it is not the likely candidate for an underlying logic of mathematics. It rather explicates in logical terms how mathematics (or other theory) with paradoxes do their job. "If a contradiction were now actually found in arithmetic will only prove that an arithmetic with a contradiction in it could render very good service." [7]. There is a philosophical view according to which for some fragments of reality, there can be no consistent world-picture or account. Any such account would be incomplete. This view is connected with the so-called "Hegel's thesis" that there are "true contradictions". According to that, consistency is a sufficient, but not a necessary condition for the existence of abstract objects, and concerning the existence of concrete objects it is neither necessary nor sufficient. The "real antinomy" could not be eliminated in any normal way that would come down to a replacement of subjective elements by objective ones. Real antinomies are not fallacies but are "peculiar objective truths" [2]! This makes it necessary to produce logic, adequate for the purpose of studying contradictory, inconsistent entities. By the way, it can be argued with great certainty that the logic of individuals, as well as of social groups, is inconsistent. It is practically established that any sufficiently large databases are inconsistent. Contradictory information may be acquired through different channels (or even by one and the same channel). Paraconsistent logic is a goal oriented not in the same way as classical logic, and this makes it improper to extrapolate the classical aims in the field of paraconsistency. This fact should not distract us from the merit of a paraconsistent system, on the contrary, it should be considered an asset from a philosophical point of view. They have their place among non-classical logic, which are not close to intuitionistic logic, but rather to modal or many-valued logic. Therefore, we should regard them in the way we do the above mentioned logics. There are hardly any attempts to use modal logic as an underlying logic for mathematical theory, but this is no reason to

underestimate them, to examine their proper use in this. The same holds for the paraconsistent logic. So, the purpose of paraconsistent logic is to account for a kind of epistemological situations, for the logic of a certain social or computer system and also to explicate the logic of a theory, which studies a specific sort of ontological entities. Since paraconsistent logics are not the alternative to classical logic, it is not necessary to construct them thus as systems, which serve as bases for mathematical theory they are framed [5].

The idea to construct a relevant logic as a restricted subsystem of classical logic is similar to the idea of intuitionistic logic (another restricted subsystem). However, it is an open question whether the philosophical ideas on which they are based would not be realized better in logical systems of a qualitatively different type. Classical logic is so constructed as to be a convenient basic logic for mathematical theory. But how far methods suitable for one kind of questions can be convenient in resolving quite different types of questions? The typologization helps to distinguish between logics explicating logical inference, logics of possible worlds, and logics of necessity and contingency. The modal systems of Lewis are closest to the second kind. Fuzzy logics are not only applied they are closely to questions related to epistemology and dialectics where often the terms ‘fuzzy’ and ‘rough’ are used.

The question of the philosophical and the methodological rationalization of the intuitionistic logic is still open. To what extent does intuitionistic logic correspond to the philosophy of intuitionism and are the kinds of semantics that are proposed for it in accordance with this philosophical standpoint? Is it logic of (and for) mathematics, or does it refer to other theories and fields? Does it explicate the constructive thinking only in mathematics, or does it explicate the constructive thinking in a considerably wider philosophical sense? Is it the only possible constructive logical conception, or are there other alternatives. So, what about superintuitionistic logics? If superintuitionistic logics are alternatives to intuitionistic logic as another explication of a constructive thinking, as another constructive logical conception.

Karpenko [1] claims that the presence of denumerably many superintuitionist logics is shocking and deserves philosophical and logical interpretation!

But is there a kind of logical intuition in the background of the class of superintuitionist logics or at least of some of its members? If yes, then the questions put by Karpenko: “How can we interpret the presence of denumerably many logical systems? Is each of them correct and can be

called logic on the same grounds as the others? How can we interpret the presence of a continuum of logical systems that can be qualified as logics on the same grounds as the others?” have a great significance for philosophy. On the other hand, if we treat them as pure mathematical models, I do not think that their infinite number presents to us some significant problems. In my opinion, superintuitionistic logics are pure mathematical models. So they are not PhL.

Figuratively, some of the systems of modern logic justify the expression: “*Non-classical logics are not what they are.*”

The place, where a system is located in the typologization, essentially determines the criteria and methods of evaluating. For systems, which are evaluated as basis for a mathematical theory and as pure mathematical models, the basic feature is the mathematical perfection, i.e. precision, interesting theorems. In applied logical systems, it is important that the system is a successful model related to the particular questions of the specific field to which the system is directed. However, when the system is typologized as philosophical, e.g. in logical systems aiming at a better explication of logical inference, or in logics related to certain epistemological situations, or logics related to new non-standard ontology's, the situation is different. This increases the methodological importance of the system, but also it increases the philosophical requirements to it. When the basic value of the system is mathematical, the criteria are mathematical and the judges are mathematicians. When the system is closely related to methodological questions and conceptions, when it explicates notions and categories of philosophical nature, the criteria for it should be philosophical and its judges should be philosophers! The big boom in the establishment of non-classical logics came when it was demonstrated that they also have an essentially applied character, e.g. in fields like computer science. This is an important but not a fundamental argument, since my basic thesis is the philosophical and methodological importance of non-classical logics related to issues of epistemology, dialectics, and ontology.

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