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ROMAN MURAWSKI

THE CONCEPTION OF LOGIC IN THE CRACOW CIRCLE: SALAMUCHA, DREWNOWSKI, BOCHEŃSKI

Abstract. The aim of this paper is to present and analyse the views on logic of the members of the so-called Cracow Circle, namely the Dominican Father Józef (Innocenty) M. Bocheński, Rev. Jan Salamucha, and Jan Franciszek Drewnowski. They tried to apply the methods of modern formal/mathematical logic to philosophical and theological problems. In particular, they attempted to modernise contemporary Thomism (the trend which was then prevailing) by employing logical tools. The influence of Jan Łukasiewicz, the co-founder of the Warsaw School of Logic will be also discussed.

Keywords: formal logic; philosophy; theology; Thomism; Cracow Circle

1. INTRODUCTION

Let us begin by explaining briefly what was the Cracow Circle? The term 'Cracow Circle' is used to describe a group of scholars who tried to apply the methods of modern formal/mathematical logic to philosophical and theological problems. In particular, they attempted to modernize contemporary Thomism (the trend which was then prevailing) by employing logical tools. The group included the Dominican Father Józef (Innocenty) M. Bocheński, Rev. Jan Salamucha, and Jan Franciszek Drewnowski. The logician Bolesław Sobociński collaborated with them.

According to Bocheński the Circle lasted for seven years – from the beginning of his friendship with Salamucha till the outbreak of World War II. Its official beginning and public appearance coincide with the special meeting held during the Third Philosophical

Congress in Cracow on 26 August 1936. However, contacts and collaboration between members of the Circle began earlier (Bocheński 1989, 9-18). They shared interests in mathematical logic as well as philosophical and theological issues and were convinced that modern mathematical logic could be used in philosophical and theological investigations. They were dissatisfied with the prevailing methods and results of philosophical and theological research and reflections of their times, which they wanted to establish as a scientific theory, aimed at a complete axiomatization and formalization of the Catholic doctrine, especially Thomism.

The Cracow Circle was influenced by Jan Łukasiewicz, the key representative of the Lviv-Warsaw Philosophical School and one of the founders of the Warsaw School of Logic.[1] Members of the Cracow Circle shared the views of the Lviv-Warsaw School and opposed the Vienna Circle.

All members of the Circle but Bocheński studied under Łukasiewicz. Sobociński was even an assistant to Łukasiewicz. Though Bocheński was never reading under any of the Warsaw logicians, he was a close acquaintance of Łukasiewicz and Leśniewski. Drewnowski wrote his doctoral dissertation on Bolzano's logic under Kotarbiński, but found himself close to Leśniewski – the second founder of the Warsaw School of Logic (Drewnowski developed some of Leśniewski's systems). Salamucha attended Leśniewski's lectures on logic at Warsaw University, where he met Drewnowski. One could say that the aim of the Cracow Circle was to extend the program of the Lviv-Warsaw School to Catholic philosophy and theology. Łukasiewicz himself formulated a program of radical reform in philosophy based on the methods of modern logic.[2]

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1 On the Lviv-Warsaw Philosophical School and the Warsaw School of Logic, see: Woleński 1989.

2 Łukasiewicz formulated this programme in his paper *O metodę w filozofii* [*On method in philosophy*], (Łukasiewicz 1927, 3-5).

Since modern formal/mathematical logic played an important role in the Cracow Circle, it is worth asking how the members of the Circle understood logic and what conception of logic they endorsed.

2. JAN SALAMUCHA'S CONCEPTION OF LOGIC

Let us start with the conception of logic of Jan Salamucha. The logical tools he used in his works were first of all the classical two-valued propositional calculus and the set-theoretical concepts of membership, relation, and set. He referred often to Whitehead and Russell's *Principia Mathematica* and used symbols proposed by them. He was convinced that those tools suffice. He used for instance neither semantic concepts nor the concept of truth. In particular, he never referred to Tarski's fundamental work *Pojęcie prawdy w językach nauk dedukcyjnych* [The concept of truth in the language of deductive sciences] (Tarski 1933).[3] One should also add that he cut himself off from nominalism,[4] preserving neutrality towards the philosophical problems related to this idea.

Salamucha understood logic as an objective science – its theses are formulated in an objective language and not in a metalanguage. However, he treated logic as a formal science – as such, it could not be located on any level of abstraction. Following Aristotle and Aquinas, he saw logic not as the science of reality but of the operational concepts concerning reality. Logic is the science *de entibus secundae intentionis*. Note that this clearly runs against an objective concept of logic. Salamucha was aware of this difficulty but did not consider this issue further.

Some problems of this type also appear in the context of the applicability of mathematical logic to metaphysical issues, which was the main issue addressed by Salamucha and the members of the

3 English translation: Tarski 1983, 152-278.

4 On Tarski's tendency towards nominalism, see: Murawski 2014.

Cracow Circle. From the point of view of the scholastic tradition, mathematical logic is located at the second level of abstraction whereas philosophy (metaphysics in particular) at the third level. Salamucha did not reject this Medieval classification and saw the solution to the apparent contradiction in the fact that Medieval mathematics and logic differed from modern mathematics and logic. He stressed that Medieval mathematics analyzed the quantitative characteristics of objects, whereas modern mathematics broke away with this approach. He wrote that: "for the majority of modern mathematicians, mathematics is simply a deductive theory, in which theorems are derived from some axioms and definitions with the help of logical theses. Mathematics can contain no empirical elements" (Salamucha 1937, 132).[5] And he summarized: "Thus, it appears that the fears that the application of logistics to metaphysics constitutes a violation of the differences between the traditional degrees of abstraction are a result of some misunderstandings. Too great an emphasis has been laid upon the origin of logistics and modern mathematics has been confused with medieval mathematics" (Salamucha 1937, 137).[6]

Salamucha stressed that logic is a theory of deductive argumentation. Unfortunately, he did not develop this idea. Hence it is not clear whether logic should be treated as a theory of consequence or a collection of meta-theses stating which objective theses should be accepted. Logic provides a tool for controlling reasoning. Although the latter, understood as a mental activity, is not intersubjectively verifiable, the correct application of the rules of inference can be verified by assigning (linguistic) expressions to particular elements of reasoning and examining the operations conducted on those expressions. In this context, Salamucha discusses methodological

5 English translation: Salamucha 2003, 79.
6 English translation: Salamucha 2003, 83.

nominalism.[7] According to him, logic does exclude meanings but only temporarily – it abstracts from meanings while analyzing arguments. This is required for methodological reasons only. He stressed that such a conception of logic does not necessarily force nominalism in philosophy.

Salamucha's conception of logic implies that logic is not creative. It aims to check the conducted activities (for instance, reasoning). It helps to check and order deductions. However it is to some extent a universal science – this means that its theses can be used in all disciplines, "the normative consequences of logic embrace all fields of science and even ordinary life if we want it to be at least a little logical" (Salamucha 1936, 620).

Being convinced that the tools developed in Whitehead and Russell's *Principia Mathematica* (which were sufficient to construct the whole of mathematics) will suffice in his investigations, Salamucha did not exclude that in the future it could be necessary to extend logic to make it more suitable for an adequate analysis of philosophical problems. This could be the case – according to Salamucha – in attempts to solve the problem of analogy. It was argued that in metaphysics analogous concepts are used whereas logic is aimed at providing precise concepts and making them unambiguous. Having no solution to this he stressed that the concept of analogy, employed in Scholastic philosophy, is vague and pointed to some ideas in Drewnowski's *Zarys programu filozoficznego* [*Outline of a philosophical program*] (Drewnowski 1934).

7 This should be distinguished, for example, from Chwistek's nominalism, which understands reasoning just as an operation on expressions (devoid of meaning) – cf. Murawski 2011, 121-130.

3. JAN DREWNOWSKI AND HIS PHILOSOPHICAL PROGRAM

Drewnowski's *Zarys programu filozoficznego* became the manifesto of the Cracow Circle, although some members referred to it rather loosely. Drewnowski was an expert in natural sciences and his philosophical program was based on the interdependence of various fields of science, especially logic, natural sciences, mathematics, and theology. He aimed to propose a new philosophical language that could be used to express the views of many different philosophers, in particular the theses of modern scientific philosophical theories and the theses of classical philosophy, including Thomism.

One of the important components of Drewnowski's program was his theory of signs. He claimed that signs play a substitutive role. In fact, they enable us know the real world by going beyond direct sensations and by creating systems. However, he observed that the identification of signs with reality can lead to the reduction of the latter to what signs define and to the understanding of what signs signify as some new domain of reality. This resembles what Twardowski and Łukasiewicz said about signs and their role. Recall that they both appreciated the role and importance of a good symbolism in logic but simultaneously warned against its overestimation. Twardowski talked about symbolic mania and pragmatic phobia (Twardowski 1927, 394-406). According to him a symbol represents an object but cannot replace it, that is a symbol is always only a tool. If one forgets these two things we have to do with the attitude called by Twardowski symbolic mania. It is connected with a pragmatic phobia which consists of bias against objects denoted by symbols. His views were fully accepted in Lviv-Warsaw School – its representatives proclaimed the thesis that a symbol represents an object and the thesis on semantic intension and semantic transparency of a symbol. In particular, Łukasiewicz recommended constant contact with reality while using developed philosophical systems.

Drewnowski stressed that while constructing a new theory one should refer to the appropriate domain of reality. Theory is never an "isomorphic" image of a fragment of the reality it describes. This is a consequence of a certain freedom in the choice of language and axioms. Here one has to do with irrational factors and reasons, hence the relation between theory and reality is in a certain sense irrational. However, it should be stressed that Drewnowski was never a relativist, he was convinced of the existence of the objective truth. His relativism was connected with the conviction that no system of signs and symbols can have an absolute value.

Drewnowski appreciated the scientific value and significance of logic, in particular of mathematical logic. He treated logic as a tool and claimed that it is neutral in cognition. Although logic plays an auxiliary role, it is an important role nonetheless.

Drewnowski stressed the necessity of distinguishing between language and metalanguage – in particular he wrote that one should distinguish the mechanism of signs and executive instructions describing such a system. However, he did not distinguish between implication and entailment and identified them both!

His description of the process for constructing and developing a formalized theory is principally correct. According to him, axioms express either established laws of the domain or some suppositions. In both cases, they do not express anything absolute. Hence they should be considered as premises in formulated theorems. This indicates that he knew about the deduction theorem! Recall that this theorem states the following: if a sentence A can be proved by using a non-logical axiom B, then the implication $B \to A$ can be proved on the basis of logic alone.

Similarly, he treated definitions – they enable us to introduce appropriate abbreviations or express some suppositions as axioms do. However, this second remark seems to be wrong (in fact, it can be proved that definitions are non-creative).

In connection with the role of logic, it is interesting to see how Drewnowski treated mathematical theories. Although they are similar to theories in natural sciences, according to him they are the most developed systems of signs. He distinguished between mathematics and mathematical theories. This is in fact unclear! One can compare this with Gödel's distinction between objective and subjective mathematics (Gödel 1995, 304-323). Recall that Gödel understood under objective mathematics as a system of all *true* mathematical propositions, while by subjective mathematics he meant a system of all *provable* mathematical sentences. This distinction is a consequence of his first incompleteness theorem. Gödel also claimed that no axiomatic system (hence no mathematical theory) can embrace the whole of objective mathematics. This thesis, however, presupposes Platonism in the philosophy of mathematics (in fact, Gödel was a Platonist). On the other hand, one finds by Drewnowski no such philosophical declaration. Even if one assumes his claim that some parts of mathematics belong to the natural sciences (for example, the arithmetic of natural numbers), this does not explain the problem in the case of more advanced theories.

Drewnowski also considered the problem of applying symbolic logic, in particular to philosophy. He addressed this issue in the paper *Stosowanie logiki symbolicznej w filozofii* [*Applying symbolic logic in philosophy*] (Drewnowski 1965, 53-65) as well as in the unpublished manuscript *Uwagi o stosowaniu logiki symbolicznej* [*Remarks on applying symbolic logic*] (Drewnowski 1967). He refers there to the book *Grundzüge der mathematischen Logik* by D. Hilbert and W. Ackermann (Hilbert, Ackermann 1928) where – according to him – they characterized the method for applying logic to other domains of inquiry. This method consists in augmenting the language of classical predicate calculus by new constant symbols for the specific concepts of a theory and by formulating the basic presuppositions of the domain in this extended language. The latter are added to axioms of the predicate calculus as non-logical axioms. Using now inference

rules of the predicate calculus one deduces new theorems concerning the considered domain. Drewnowski stresses that symbols of the predicate calculus do not obtain a new interpretation by this procedure – they are used in their general and universal logical meaning.

Drewnowski stood in opposition to the view that symbolic logic cannot be applied outside mathematics, especially in philosophy. On this issue, he criticized the arguments of the so-called existential Thomism. This problem was also considered by Kazimierz Ajdukiewicz in the paper *O stosowalności czystej logiki do zagadnień filozoficznych* [*On the applicability of pure logic to philosophical problems*] (Ajdukiewicz 1934, 323-327). The key issue is whether modern logic, which is extensional, can be applied to philosophical questions formulated in an intentional natural language. Drewnowski claimed that the extensionality of classical logic does not stand in the way of applying logic in philosophy. He explained in *Zarys programu filozoficznego*: "All our [i.e., by members of the Cracow Circle] attempts were neither interpretation of logical symbols nor a translation of metaphysics into the language of symbolic logic. The method we are using consists… in applying only the classical logical calculus to the language of which new constant symbols have been added" (Drewnowski 1934, 203-204).

Drewnowski stressed the extensionality of the classical predicated calculus. It should be added that he distinguished three senses of extensionality. Here he had in mind extensionality in the sense of equivalence, which means that replacing an expression by an equivalent one does not change the truth value. Other types of extensionality are: extensionality in the sense of identity (= replacement by identical objects) or domain extensionality (= replacement by expressions of the same domain of meaning). Observe that in predicate calculus there are neither identity axioms (they must be added) nor extensionality axioms (as in set theory).

Drewnowski claimed that the source and reason of the opinion that classical logic cannot be applied outside mathematics come from

the fact that it has been so far applied mainly just to mathematics. Any correct application of symbolic logic to domains other than mathematics must avoid any extensional improvements which can be convenient in an analysis of the foundations of mathematics. The pure application of classical predicate calculus suffices.

4. BOCHEŃSKI'S CONCEPTION OF LOGIC

In this way, we come to the third member of Cracow Circle – Father Józef (Innocenty) M. Bocheński. Let us begin by stressing that he did not develop a comprehensive and consistent conception of logic. Nevertheless one can reconstruct his views on logic on the basis of his remarks made in various works. Note also that his views (not only those connected with logic) are evaluative – he was a follower of Kant, then of neo-Thomism, and finally moved towards analytic philosophy.

Bocheński distinguished logic and the philosophy of logic. The former is placed on the objective level whereas the latter on the meta-objective level, together with the history of logic. According to Bocheński, proper logic consists of pure logic and applied logic. Pure logic is formal and its most important form is mathematical logic. Applied logic consists of semiotics and methodology.

It is worth mentioning that Bocheński did not speak about metalogic in the sense of an investigation of formal systems and their properties such as consistency, completeness, and decidability.

From a historical and developmental perspective, Bocheński distinguished traditional and modern logic. Modern logic can be characterized as being mathematical, symbolic, formal, and objective. It is mathematical because, on the one hand, it was developed to meet the requirements of mathematics, and it grew out of mathematics: on the other hand, it has been developed through mathematical methods. However, this does not mean that logic can be applied only to mathematics. In fact, it can and should be applied wherever

deduction is used. In addition, modern logic is symbolic because it uses a symbolic notation and it is formal because logical rules and arguments refer only to the form of expressions and not to their meaning or sense. Lastly, it is objective because it does not take into accout subjective features and elements such as thinking, understanding, imagination, emotions, etc.

Bocheński was convinced that the best available logic is mathematical logic (formal logic) (Bocheński 1936, 445-454) but later he thought that certain philosophical problems required richer logical tools. Formal logic gives first of all precision so important in scientific considerations – he wrote: "»Precise« is called our way of speaking, which observes the following rules: As far as words are concerned, they must be unequivocal signs of simple things, features, experiences, etc.; they are to be clearly defined in relation to these simple signs, in accordance with precisely stated rules. Furthermore, these words should always be used in such a way that each one of them constitutes a part of a proposition, i.e. an expression that is true or false. Where propositions are concerned, they cannot be accepted until we know exactly what they mean and why we assent to them. Sometimes we accept them as evident, sometimes on the basis of faith or proof – in the latter case it should be conducted on the basis of clearly formulated and efficient logical directives" (Bocheński 1937, 28-29).

In formal logic, it is the classical two-valued logic that plays a fundamental role. At the same time, formal logic does not focus so much on the truth of the conclusions deduced by applying logical tools – this is the task of other sciences – but on the truth of its theses. Despite the fundamental role of classical logic, Bocheński was of the opinion that in some philosophical or theological considerations it can be not sufficient. He admitted the possibility of using for example many-valued logics in theology. These logics could be treated as the logics of probability and utilized to evaluate the degrees of falsity – this may allow us to realize the idea of St. Thomas Aquinas.

In his investigations Bocheński applied and used not only classical logic but also logic broadly understood, embracing formal logic as well as semiotics, which was based on the former, and the general methodology of sciences. This is especially true after he embraced analytic philosophy. In his opinion, logic is a fundament and an ideal pattern of rationality, it establishes norms of rationality.[8] Since according to him reality is rational and the world has a rational structure, hence outside logic there is only nonsense.

Logic provides the notional tools to analyze complex arguments and notions. It provides the *organon* of philosophy and more generally of every discipline. It enables to analyze the structure of reasoning applied in various disciplines. In this way, the correctness of such reasoning can be checked. Just this was one of the aims of Cracow Circle with respect to philosophy and theology, in particular to Thomism. Compare the analysis of St. Thomas' proof *ex motu* of the existence of God due to Salamucha (Cf. Salamucha 1934, 53-92).

In addition to being a tool, logic plays other roles. In particular, it plays an educational role (*paidagogos*) and an informative role (*meros*). Its pedagogical role means that logic indicates the proper scientific methods in the sense of Łukasiewicz's adage: "Logic is the morality of speech and thought". By the last role, *meros* Bocheński means the fact that some theorems and results of logic can lead to new formulations or even solutions to philosophical problems. In fact, modern logic has solved many traditional philosophical problems. Consider for instance Russell's conception of logical paradoxes and his theory of systematic ambiguity (this was the solution to the traditional problem of the 'univocity of being'). His theory of types, which he developed

8 In Bocheński 1988, 65 we find the following exchange between Jan Parys and Bocheński: "P[arys]: Can it be said that logic is a norm of rationality in science, does it really play such a role? B[ocheński]: Secondarily, secondarily yes. In principle logic is a description of objects and if one feels offended by logic, he proceeds against the general structure of the world and he thinks irrationally. Logic as a description of objects is a description of the world."

to solve the paradoxes in Frege's system, indicated that there are many levels of reality and contributed to the development of the theory of analogy. Another example is Tarski's definition of truth, which was a contribution to the problem of truth. Gödel's first incompleteness theorem showed that provability is not the same as truth, and that there are no philosophical systems that could embrace the whole of reality (like Hegel's system, even more, there is no formal systems embracing all truths about natural numbers.

In this way, we come to the problem of the relations between logic and other scientific disciplines. Bocheński stressed – like other members of the Warsaw School of Logic – that logic is an autonomous discipline. This means that it has its specific objects of investigation and methods. This is true not only of modern formal logic. Every highly developed logic has the right to be characterized as autonomous (Bocheński 1980, 3-14).

Logic is not just a tool of philosophy. Since philosophy investigates the foundations and most general properties of objects, modern logic, as any logic, becomes also in this sense a part of philosophy. However, refuting the accusations that were made during the discussion at the meeting of the Cracow Circle in Cracow in August 1936, Bocheński made it clear that he also paid attention to the necessity of distinguishing between formal logic and philosophy.

What are the connections between logic, in particular mathematical logic, and ontology? Bocheński did not identify them and stressed their differences. Among the latter, he indicated the symbolic nature and axiomatization typical of mathematical logic but not of ontology. Hence their differences depend on their methods rather than objects of study. However, the latter are also not the same. According to Bocheński, ontology is the study of real objects whereas mathematical logic is the ontology of real and ideal objects. He wrote that ontology is a prolegomenon to the axiomatic treatment of the same objects in logic, and that logic is "ontology developed in an axiomatic way" (Bocheński 1988, 54). Hence the first aim of logic is

not the investigation of language (as nominalists claim) and logic is not the technology of thinking. The main object of study of logic are relations in the world, both real and ideal. Logic aims to discover the logical structure of reality. Being a kind of ontology, it constitutes a branch of philosophy.

As for the connections between modern mathematical logic and mathematics itself, does formal logic belong to mathematical sciences? Bocheński claimed that the answer to this question depends on the definition of mathematics. If mathematics is defined through its method, then logic, which uses the same method and has the same characteristics as the mathematical sciences (it is symbolic, formalistic, deductive, objective, etc.) should be regarded as a mathematical discipline. As a matter of fact, the boundaries between modern logic and mathematics are blurred. However, logic is distinguished from mathematics by the maximal generality of its fundamental branches and by a higher degree of exactness.

Bocheński claimed that there is one logic, he stressed the unity of logic, however, this does not exclude the possibility that various logical systems do exist.

5. CONCLUSION

The above considerations show that all members of the Cracow Circle were well educated and well acquainted with contemporary mathematical logic. They treated classical logic, especially classical propositional calculus augmented by some set-theoretical means, as the main tool in their project of modernizing theological investigations and in particular Thomism. However, they were aware of the possible necessity of extending those tools by richer methods (such as the theory of analogy, non-classical logics, etc.). Being agreed on, say, the technical level, they might differ with respect to some meta--theoretical questions concerning logic. However, one thing should be stressed here. All considered members of the Cracow Circle firmly

defended the *neutrality* of logic with respect to philosophy. In particular Bocheński explicitly claimed that the process of constructing logical systems does not assume any philosophical presumptions – logic is and should be neutral. According to Bocheński, the thesis of the neutrality of logic was originally formulated and presented by Jan Łukasiewicz at the meeting in 1936. His influence in particular and the influence of Warsaw School of Logic in general on the ideology of Cracow Circle – as indicated above – was decisive. Bocheński wrote: "This is not surprising as all the members of the Circle, with the exception of myself, had been his pupils. His were the methodological postulates, the criticism of modern philosophy, and the doctrine of the neutrality of logic stated explicitly for the first time at a meeting of the Circle in 1934. And again, the inquiries by some members of the Circle into the ancient and medieval logic were in fact the continuation of the pioneering work done by Łukasiewicz" (Bocheński 1989, 12).

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ROMAN MURAWSKI
Uniwersytet im. Adam Mickiewicza w Poznaniu, Wydział Matematyki i Informatyki
(Adam Mickiewicz University in Poznan, Faculty of Mathematics and Computer Sciences, Poland)
ORCID: https://orcid.org/0000-0002-2392-4869
rmur@amu.edu.pl

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