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ON THE PHILOSOPHICAL-LOGICAL VIEWS OF LUDWIK BORKOWSKI

The scientific achievements of Ludwik Borkowski in the field of formal logic justify treating him as a notable representative of that branch of knowledge in 20th-century Poland. However, a characteristic feature of his work throughout many years was the close connection between its formal and philosophical aspects.[1] While assessing his writings, one feels inclined to call him an excellent logician among philosophers and philosopher among logicians.[2]

Ludwik Borkowski was born on August 7, 1914, in Obroszyn near Lvov, and died on October 22, 1993, in Wrocław. Throughout the years 1933 to 1938 he studied at Jan Kazimierz University in Lvov. Having been forced to make a break in his studies because of an illness, he graduated from the Jagiellonian University, acquiring the master's degree in philosophy on the basis of his thesis in mathematical logic *Analiza rozwiązania antynomii podanego przez Behmanna* [An analysis of the solution of the antinomy proposed by Behmann]. He worked for two years as a teacher in the State Gymnasium and Lyceum for adults in Wrocław. On September 1, 1948, he began work at the University of Wrocław — first as a senior assistant, then as an adjunct (from 1951), as a docent (from 1961) and, from 1973, as an associate professor. In 1950 he earned his PhD at the University of Wrocław's Faculty of Mathematics, Physics and Chemistry on the basis of his

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[1] A bibliography of Ludwik Borkowski's works was created by Anna Buczek and Stanislaw Kiczuk (BUCZEK and KICZUK 1984; until 1984) as well as Kordula Świętorzecka (ŚWIĘTORZECKA 1994).

[2] Such an opinion was expressed by Witold A. Pogorzelski in his *Ocena dorobku naukowego prof. dr hab. Ludwika Borkowskiego* [An assessment of Prof. Dr. Ludwik Borkowski's scientific output] (= POGORZELSKI 1979].

thesis *O definicjach analitycznych i syntetycznych* [On analytic and synthetic definitions], with Jerzy Słupecki as his advisor. His Habilitation, acquired in 1960, was conferred on the basis of his three-part thesis: (1) "O kwantyfikatorach właściwych" [On proper quantifiers], (2) "Systemy rachunku zdań i rachunku funkcyjnego o jednym terminie pierwotnym" [The systems of propositional calculus and functional calculus with one primary term], (3) "Sprowadzenie arytmetyki do typikalnej logiki bez aksjomatu nieskończoności i typikalnej logiki bez aksjomatu nieskończoności i typikalnej wieloznaczności stałych arytmetycznych" [Reducing arithmetic to a typical logic without the axiom of infinity and the typical ambiguity of arithmetical constants]. The State Council's decree from October 25, 1973, made him an associate professor of mathematical sciences. (BORKOWSKI 1984, 78–82). In the years 1975–1985 he worked at the Faculty of Christian Philosophy of the Catholic University of Lublin, directing the Department of Logic. In 1980 he acquired the title of a full professor in logic. Even though he retired in 1984, he taught private classes for six more years.

His achievements include, among other things: (a) constructing logical calculi with the presuppositional method: the system of Aristotle's syllogistic, a fragment of Leśniewski's ontology (under the name of the presuppositional quantifier-less nominal calculus), systems of modal logic equivalent to Lewis' systems S4 and S5, and (along with Jerzy Słupecki) an intuitionistic propositional and predicate calculus; (b) an analysis of the basic notions associated with non-classical logics (e.g. the notion of possibility and necessity); (c) metalogical research, both syntactic and semantic: formulating a precise definition of analytic proposition, work on the theory of consequences and the notion of logical implication; (d) developing a new account of the classical notion of truth. His logical writings as well as his formal systems are characterized by elegance, simplicity and clarity. His philosophical background allowed him to see formal problems in a broader context. He also worked in the history of logic, with the intention of popularizing the tradition of the Lvov-Warsaw school. Considerably less known are his philosophical views, stemming from his logical research and from his reflections on the results of applying logical analysis to philosophy. Even though Borkowski did not write directly on these topics, his remarks concerning them are dispersed among his numerous works concerning formal logic and the history of logic. The aim of this paper is to extract those remarks and make a consistent whole out of them.

1. SCIENTIFIC INSPIRATIONS: THE LVOV-WARSAW SCHOOL

The influence exerted on Ludwik Borkowski's scientific interests, and thus also on the subject matter of the works he published and on his general research attitude, by his philosophical studies at the Faculty of Humanities of Jan Kazimierz University in Lvov in the years 1933–1938, is unquestionable. Even though he did not meet the creator of the Lvov philosophical school and head of the Chair of Philosophy, Kazimierz Twardowski (who had already retired three years earlier), he studied under the supervision of his direct students: Mieczysław Kreutz, Roman Ingarden and especially Kazimierz Ajdukiewicz, who gave the philosophy in Lvov a distinctly logicizing character. (WOLEŃSKI 1985, 22).[3] The Chair of Logic, at that time directed by Leon Chwistek, belonged to the Mathematical-Scientific Faculty and did not cooperate with the Chair of Philosophy.

In the last academic year spent in Lvov, Borkowski was a junior assistant and a president of the Students' Philosophical Research Group. Though a long-lasting illness, followed by the war, prevented him from completing his studies in Lvov, it was Lvov that shaped his main interests, philosophical views and general intellectual attitude. He absorbed the spirit of the Lvov school and internalized what it considered especially valuable: the method and general approach to one's area of research.

Borkowski's studies took place during the period of flourishing of the Lvov-Warsaw school. It was in the 30s that the most important results were achieved and the school took on international significance. After the logical activity had been transferred to Warsaw, the Lvov school became the Lvov-Warsaw school. The University of Warsaw was the worksite of two notable logicians and philosophers belonging to the first generation of the Lvov school,[4] Jan Łukasiewicz and Stanisław Leśniewski, later joined by their student, Alfred Tarski. The merits of these three scholars in the field of mathematical logic are difficult to overrate. One thing which deserves attention is the broadness of their research interests, encompassing formal as well as philosophical problems.

[3] According to Bogusław Wolniewicz, the school's uniqueness resulted from the so-called clarificational tendency, grounded in contemporary formal logic. See WOLNIEWICZ 2016, 14.

[4] The first generation is considered to include the thinkers who finished their studies in Lvov before 1914.

Ludwik Borkowski's scientific work can undoubtedly be treated as a part of the continuation of the logical-methodological tradition of the Lvov-Warsaw school. He not only retained the reverence and respect to his mentors, but also found the inspiration for his own scientific interests in the problems which were the subject of the school's research. He worked on issues connected to both classical and non-classical logical calculi, in this way referring back to the works of J. Łukasiewicz, S. Leśniewski and A. Tarski. Especially innovative was his interest in non-classical logic, since they were not yet the subject of animated debate, or at any rate did not belong to the chief problems discussed by logicians, in the middle of the 20th century. When L. Borkowski directed his attention to non-classical logics, his philosophical attitude was made clear — as was the fact that he treated logic instrumentally, in the tradition of Aristotle's *Organon*. From the philosophical viewpoint, his insightful research on the intuitional interpretation of J. Łukasiewicz three-valued logic and of a four-valued matrix for modal functors turned out to be especially important. The creative results he achieved contributed to a better understanding of the cognitive status of many-valued and modal logics.

In his scientific work L. Borkowski paid much attention to analyzing and determining the basic logical notions important for the theory of knowledge and the methodology of the sciences. He made a significant contribution especially to the development of the theory of definitions and the theory of inference. With his works touching on those topics he continued the thought of K. Ajdukiewicz, the founder (in 1953) of the serial publication *Studia Logica* and its long-standing editor. The editorial note opening the first volume says: "Apart from works in the field of formal logic proper, which includes also mathematical logic, *Studia Logica* is going to publish writings in other branches of logic, e.g. inductive logic, the science of definitions and classifications, the science of notions and judgments etc. The journal opens its pages to works concerning the history of logic, especially Polish logic, whose estimable achievements have not been duly recognized yet." Beginning with the end of the 50s, Borkowski belonged to the circle of logicians cooperating with the journal and published in it the majority of his writings whose subject matter corresponded to its program, outlined above. From 1965 to 1978 he was one of the series' editors, participating in the editorial work on 21 issues.

One of the goals of the scholars gathered around *Studia Logica* was maintaining the tradition of the logical school which had been active in Lvov and Warsaw in the pre-war period. This called for a synthetic outline of the outcomes of the research done at the latest stage of the history of Polish logic. L. Borkowski (along with Jerzy Słupecki) described the work and achievements of J. Łukasiewicz in the fields of formal logic and the theory of deduction as well as K. Ajdukiewicz's work in logic, methodology of sciences, and logic's applications to philosophical problems. He translated from English a couple of important papers by J. Łukasiewicz so that they could be published in the Polish edition of J. Łukasiewicz's selected writings prepared by J. Słupecki, and himself edited the selected writings of J. Łukasiewicz in English. In addition, he presented the history of the newer research on the propositional calculus and Aristotle's syllogistic — the branches of logic on which the attention of Polish logicians constantly focused. L. Borkowski's works contributed to the current universal recognition given to the great scientific merits of these authors.

2. PRESUPPOSITIONAL SYSTEMS: GETTING CLOSER TO THE PRACTICE OF PROOF

An important aspect of Ludwik Borkowski's work refers back to the research initiated in Poland by Jan Łukasiewicz in 1926 as a part of the current connected to Hilbert's program. At that time, J. Łukasiewicz stated the following problem: since mathematical proofs do not refer to logical theses but to the presuppositions and rules of reasoning, is it possible to make a system of structural rules out of those rules and investigate their relation to the theorems of the axiomatic propositional calculus? The first positive solutions of this problem were proposed by Stanisław Jaśkowski (1934) and Gerhard Gentzen (1935). Their goal was to make the logical theory of proof as close as possible to the actual practice of proof in mathematics and other sciences. However, in general, the method of natural deduction proposed by them was accepted in logic quite slowly (NIEZNAŃSKI 1972, 251).

L. Borkowski began his scientific career at the University of Wrocław under the supervision of J. Łukasiewicz's student, Jerzy Słupecki, who quickly noticed the significant intellectual potential of the young doctoral student and invited him to cooperate. Together they worked out a theory of presuppositional deduction which was in many ways original, universally known today as the Słupecki-Borkowski method. It was published for the first time in the co-authored paper "A Logical System Based on Rules and its Application in Teaching Mathematical Logic" (*Studia Logica* 7, 1958).[5] The first logic handbook in Polish literature employing the principles of the theory of natural deduction was *Elementy logiki matematycznej i teorii mnogości* [Elements of mathematical logic and set theory] (Warszawa, 1963). It was assessed in a positive way even by S. Jaśkowski, who stated in his review that "the rules in the formulation of the authors are clear and give a reason to believe that popularizing the presuppositional method will be possible at last" (JAŚKOWSKI 1965, 117–118). What is more, Jaśkowski assessed the application of the new method to the whole of the material explained in the handbook as a "very fortunate" (ibidem) solution. The subsequent handbooks by L. Borkowski, *Logika formalna. Systemy logiczne. Wstęp do metalogiki* [Formal logic: Logical systems. Introduction to metalogic] (= BORKOWSKI 1970) and *Wprowadzenie do logiki i teorii mnogości* [Introduction to logic and set theory] (= BORKOWSKI 1991) the preferred and the most often employed method was natural deduction.

L. Borkowski based his presuppositional propositional calculus on two kinds of rules. The first one were metalogical rules of producing presuppositional proofs — both direct and indirect — while the second one is constituted by the rules of adding new lines to the proof, usually formulated as the schemes of reasoning which concern adding or omitting particular logical constants. For the predicate calculus, apart from the suitably extended directives of the propositional calculus, the rules of omitting and adding quantifiers and the directive of introducing nominal presuppositions are added.

When L. Borkowski explains the presuppositional method itself, he also makes some general philosophical-logical remarks concerning different methods of constructing a logical system. In particular, he explains why the axiomatic systems of propositional calculus came into being earlier than the presuppositional systems, in spite of the latter ones being more intuitive and possessing an indubitable didactic advantage. According to him, such state of things is caused by the fact that the axiomatic method has been known and used in mathematics for a very long time. The first axiomatic system in the history of human thought was, as J. Łukasiewicz has shown, Aristotle's syllogistic, while Euclid's geometry (4th century B.C.) followed in its foot-

[5] Before that, J. Słupecki presented this method at the session of the Polish Mathematical Society in Wrocław in 1953. In 1957, L. Borkowski published the work on the construction of presuppositional propositional calculi based on matrix rules. The calculi include one primary term (binary truth-functional functor) or two primary terms (the functor of negation and binary truth-functional functor). See BORKOWSKI 1990b, 303–312.

steps. Nowadays all mathematical disciplines that have reached the appropriate stage of development are constructed in the form of axiomatic systems. At the same time, when mathematicians prove their theorems, they employ a much simpler method — that of natural deduction. Thus, even though the presuppositional proof theory did not come into being before the 20^{th} century, deduction as a practice is a universal and common investigative procedure, used in mathematics for centuries. The form of presuppositional proofs is simple and clear, though the methodological structure of presuppositional systems is in principle more complex than that of an axiomatic system (SŁUPECKI and BORKOWSKI 1984, 75). Another meaningful achievement of Borkowski was proving the theorem of the equivalence of axiomatic and presuppositional systems of the classical propositional calculus.

In his work dedicated to the memory of Ajdukiewicz, *Deductive Foundation and Analytic Propositions* (= BORKOWSKI 1966, 59–74; a Polish translation: BORKOWSKI 1990e, 346–362), Borkowski explained why he ascribed such significance to the method of proof based solely on rules, where the notion of axiom is dispensable — namely because he used those calculi in his new attempt to delineate analytic propositions. Borkowski was not satisfied with the common delineation stating that analytic propositions are propositions which can be justified deductively, since in such a case the axioms of logic would not be analytic. In addition to that, such a solution causes the problem of the analyticity of propositions containing defined terms. For example, it is not clear why the proposition in the form $p \to p$, where p contains a term from the field of the empirical sciences, should be analytic, because introducing a definition requires providing a proof of the propositions about the only object fulfilling the definition's conditions, and such a proof may require an empirical premise. Borkowski shows that all these difficulties disappear if deductive reasoning is understood as a reasoning taking place in a system based solely on rules.

Referring to the analyses performed by K. Ajdukiewicz in his paper "Le problème du fondement des propositions analytiques" (= AJDUKIEWICZ 1958, 259–272), L. Borkowski differentiates between three senses of analyticity: (1) A is analytic in the syntactic sense if and only if (iff) A is provable only on the basis of the laws of logic; (2) A is analytic in the semantic sense iff A is true in every non-empty domain; (3) A is analytic in the pragmatic sense iff it is possible to state it on the basis of axiomatic and deductive rules of the language (BORKOWSKI 1966, 60–61). He treats the first definition as a precisification of

Bolzano's idea and the second one as a modification of Frege's definition, while the third concerns the analyticity due to the way expressions are understood (MOSTOWSKI 1969). The set of analytic propositions in the syntactic sense is the narrowest set, while the set of analytic propositions in the pragmatic sense is the broadest one. Due to Gödel's theorem, there are analytic propositions in the semantic sense which are not analytic in the syntactic sense. That distinction by L. Borkowski is developed in the writings of Jan Woleński, including those written in foreign languages. J. Woleński considers it an important voice in the discussion concerning the problem of analytic sentences, but also notes that the incompleteness of arithmetic does not justify the existence of propositions which are analytic in the semantic sense (i.e. true in every non-empty domain) but not in the syntactic sense, since undecidable propositions cannot be true in all models (WOLEŃSKI 2007, 423–431).

The problem of analyticity has a connection to L. Borkowski's research on definitions. The work "Kilka uwag o pojęciu definicji" [Some remarks on the notion of definition] brings an important deepening of the theory of nominal definition. The method of constructing logical calculi solely on the basis of rules is employed again — this time in order to formulate a non-relative notion of deductive justification. L. Borkowski includes among the analytic propositions (in the syntactic sense) only the theses of a certain logical system based solely on rules and the consequences of the definitions for which the condition of existence and uniqueness can be proven in such a logical system. Within this account, the theses of arithmetic turn out to be analytic propositions — contrary to what Kant and Russell say.

The importance of L. Borkowski's research on the presuppositional method is manifested not only by the new way of constructing logical systems or by the applications outlined above, but also by the fact that the research contributes to the development of one of the branches of logic: the theory of deductive systems. L. Borkowski shows in a systematic way, mainly in his handbooks, the applications of the codified presuppositional method to all the areas and varieties of classical and non-classical logic as well as metalogic. In his minor writings he presents the implementations of this method in particular systems. A work which stands out among such writings is the paper "O pewnym systemie logicznym opartym na regułach i jego zastosowaniu przy nauczaniu logiki matematycznej" [On a certain logical system based on rules and its application for learning mathematical logic] (= BORKOWSKI 1990c, 174–183), in which he formulates a certain arrangement of presuppositional rules for Lewis' modal systems S4 and S5 and for the intuitionistic propositional calculus, presenting the proof of the equivalence of those presuppositional systems with appropriate axiomatic systems.[6] L. Borkowski demonstrates in it that the only essential feature distinguishing presuppositional systems of classical and intuitionistic logic is that in the latter the rule of creating direct proofs is not secondary with reference to the rule of creating indirect proofs, and that the rule of creating indirect proofs is applicable only to those expressions whose antecedent begins with the sign of negation. In his other works Borkowski gave a set of presuppositional rules for Aristotle's syllogistic and for a certain fragment of Leśniewski's ontology. He also proved by means of the presuppositional method important metalogical theorems, both syntactic and semantic, such as the theorems on the smallest sets, the theorem on deduction or Gödel's theorem.[7] One can repeat with Stanisław Kamiński that the presuppositional method is the instrument or keystone of numerous achievements of L. Borkowski (KAMIŃSKI 1984, 16).

3. THE PHILOSOPHICAL CONTEXT OF NON-CLASSICAL LOGICS

Though L. Borkowski's scientific interests were remarkably broad throughout his whole career, after his Habilitation he became visibly more concerned with the philosophical grounding of his research on logical calculi and with providing an intuitive interpretation to the results of that research. At that time, and especially after 1975, when he joined the circle of the Lublin school philosophers,[8] he became more interested in the philosophical context associated with non-classical logics. L. Borkowski's best-known achievements in the area of non-classical logics, which at some point were also called philosophical logics, concern many-valued, modal and intuitionistic logics. His contribution consists not only in acquiring important formal results but also in pointing out their profound philosophical context.

[6] Borkowski formulated presuppositional systems S4 and S5, some of the strongest modal systems. Similar results for weaker normal modal logics have been achieved by M. Tkaczyk. See TKACZYK 2007, 219–228.

[7] And many other theorems proven in the handbook *Wprowadzenie do logiki i teorii mnogości* (= BORKOWSKI 1991).

[8] In 1975, when L. Borkowski, as an associate professor of mathematical sciences, took over the Chair of Logic at the Faculty of Christian Philosophy, began the period of his scientific and didactic work at KUL.

Philosophically valuable analyses can be found in the paper "W sprawie intuicyjnej interpretacji logiki trójwartościowej Łukasiewicza" [In connection to an intuitive interpretation of Łukasiewicz's three-valued logic] (1977; = BORKOWSKI 1990f.). Its starting point was the work of J. Słupecki (1964, 185–191)[9] and the latter's attempt to systematize the presuppositions of J. Łukasiewicz's interpretation of the problem of the logical value of propositions concerning future events. L. Borkowski points out the errors in the formalization proposed by J. Słupecki, namely that presupposition 8, which is supposed to express the necessity of the causal relation and takes the following form:

$$(f_1 \Rightarrow f) \rightarrow (f_1 \times f_2 \Rightarrow f),$$

where the variables f, f_1 and f_2 range over the set of all events, the expression $f_1 \Rightarrow f$ states that event f_1 is the cause of event f, while the sign $\times$ is the intersection of events,

leads to the conclusion that an impossible event is the cause of any event having some cause (if f_2 is the complement of f_1). The theorem, stating that the cause necessarily proceeds the effect , is written down by Borkowski as:

$$(p_1 * f_1) \wedge (p * f) \rightarrow ((f_1 \Rightarrow f) \rightarrow (p_1 \rightarrow p)),$$

where the expression '$p * f$' states that the proposition p describes the event f,

which he reads as: if f_1 is the cause of f, then, if f_1 exists, f_2 exists.[10]

Presupposition 8 is needed for the proof of expression 11, which has the form:

$$\exists g\ (g \Rightarrow f \times f_1) \equiv \exists g\ (g \Rightarrow f) \wedge \exists g\ (g \Rightarrow f_1),$$

where the variable g range over the set of all past or present events, and '$\equiv$' is the sign of the functor of equivalence.

This does not raise any intuitive objections — which is why Borkowski proposes to accept that statement as one of the presuppositions. Out of the accepted presuppositions and the definition of the determined event of the form $D(f) \equiv \exists g\ (g \Rightarrow f)$[11] Słupecki deduced the formulas for the value of three-valued conjunction, alternative and negation. However, in order to

[9] See also the extension of that work: SŁUPECKI, BRYLL and PRUCNAL 1967, 45–66.

[10] As shown by M. Lechniak, this implies $(p_1 * f_1) \wedge (p_2 * f_2) \wedge (p * f) \rightarrow ((f_1 \Rightarrow f) \rightarrow (p_1 \wedge p_2 \rightarrow p))$, which seems inconsistent with Borkowski's intentions, since if we replace p_2 with the negation of p_1, we will acquire $p_1 \wedge \neg p_1 \rightarrow p$, a thesis, which means that the value of the expression $f_1 \Rightarrow f$ is meaningless. See LECHNIAK 1996, 161–176.

[11] An event f is determined if there is a past or present fact which is its reason.

define the functor of implication, he needed to extend the intuitive basis of the system by adding to it the presuppositions concerning the modal functors of necessity and possibility.[12]

According to L. Borkowski, some consequences of the accepted presuppositions are unacceptable — e.g. that the conjunction of two propositions both of which have the third logical value has the third value also in the case when one of them is the negation of the other. If the proposition “There will be a sea battle tomorrow” has the third logical value, its negation also has that value, which means that the same value would be associated with their conjunction. This seems to be at odds with the intuition that the conjunction “There will be a sea battle tomorrow and there will be no sea battle tomorrow” is simply false. In a similar way, the alternative of two propositions of the third value, one of which is the negation of the other, should be true and not of the third value (BORKOWSKI 1990f, 428-429).

Because of that, Borkowski proposed to re-formalize the intuitions lying at the root of the three-valued logic. In order to reach the conclusion that the conjunction $p \wedge \neg p$ has the value 0, while the alternative $p \vee \neg p$ has the value 1, also in the cases when their elements have a value which is neither 1 nor 0, one needs to modify the definition of the determined event, so that it takes the following form:

$$\mathrm{D}(f) \equiv \exists f\,(f = f_1 + f_1') \vee \exists g\,(g \Rightarrow f),$$

i.e. an event is determined when it is a certain event or has a cause.

As a result, propositions describing non-determined events (the latter having a value which is neither 1 nor 0) can be divided into two disjunctive classes of events. Because of that, it needs to be accepted that there are at least two values different from 1 and 0. The resulting four-valued matrix for the functor of implication and negation would be identical with the matrix of Łukasiewicz’s Ł-modal system if not for the tables for modal functors. In addition to that, it turns out that the same matrix for the functors $\neg$, $\wedge$, $\vee$ and $\rightarrow$ can be acquired by multiplying two two-valued matrices. This implies that this matrix validates all (and only such) theses of the classical propositional calculus that are written down by means of those functors. Thus, the system in question is significantly different from the three-valued system of Łukasiewicz.

[12] $(p * f) \rightarrow [1(Lp) \equiv \mathrm{D}(f)]$, where L is the functor of necessity; $(p * f) \rightarrow [0(Lp) \equiv \neg\mathrm{D}(f)]$; $(p * f) \rightarrow [1(Mp) \equiv \neg\mathrm{D}(f')]$, where M is the functor of possibility and f' is the event contrary to the event f; $(p * f) \rightarrow [0(Mp) \equiv \mathrm{D}(f')]$.

J. Łukasiewicz is known to have attached great hopes to many-valued logics. He believed that they could influence the history of logic in the same way as the coming into being of non-Euclidean geometries influenced the history of mathematics, and postulated constructing anew the logical system, arithmetic and set theory on the basis of a logic which does not respect the principle of bivalence. Afterwards he came to doubt that view under the influence of the research results he achieved, namely the thesis that it is possible to introduce the definitions of classical functors within some many-valued systems and the fact that the modal systems whose characteristic matrices are also many-valued contain the classical logical calculus as a proper part.

It is to this problem that Borkowski refers in his article "Kilka uwag o zasadzie dwuwartościowości i logikach wielowartościowych" [Some remarks on the principle of bivalence and many-valued logics] (1981; = BORKOWSKI 1990a, 469–475).[13] He is especially concerned with the question whether the principle of bivalence is rejected in the many-valued logic, i.e. whether many-valued logics replace the classical logic. He states that "Łukasiewicz, while constructing the three-valued propositional calculus by means of the matrix method, assumed that there is a third logical value different from truth and falsehood, declaring his stance to be a rejection of the principle of bivalence, and generalized the notion of the truth-functional functor to the functors characterized by three-valued tables in which logical values are interpreted semantically" (ibidem, 470). Afterwards, however, he no longer interpreted logical values semantically in finitely and infinitely many-valued systems. Borkowski explains that the matrix characteristics of the system are an algebraic, where the values of the matrix do not have to be interpreted semantically. In other words, he believes that the notions of matrix satisfying the expressions in the matrix and the tautology of the matrix are syntactical. The matrix characteristics can be treated purely formally, i.e. syntactically, and the values of the matrix do not necessarily have an interpretation — especially a semantic one (ibidem, 471–472).

In this way L. Borkowski shows that constructing a system whose adequate matrix has more than two values does not have to be accompanied by rejecting bivalence and assuming that the division of propositions into true and false is not complete. At the same time, he shows us what was really

[13] This short paper became the universally accepted interpretation of the logical values of multi-valued logics. See LECHNIAK 1999.

Łukasiewicz's approach when he constructed his three-valued propositional calculus — namely, Łukasiewicz did not show that there is a third logical value different from truth and falsehood (in the logical sense) but introduced a new division of propositions into determined (true today, false today) and non-determined (neither true nor false today) alongside the division of propositions into true and false. As a result of a cross-division made out of the two binary divisions (true/false and determined/non-determined), L. Borkowski acquires a four-valued system, which, according to him, meets certain intuitions concerning the truth and the possibility of getting to know it in a better way than the three-valued system does.

As far as the abovementioned works by L. Borkowski are concerned, S. Kamiński writes that they constitute "a revelational result, since they undermine the philosophical foundations of the great formal monument of Łukasiewicz's many-valued logics. The intuitions lying at the root of those logics probably do not lead to the systems which enrich the inventory of philosophical cognition" (KAMIŃSKI 1984, 14). Borkowski showed that logical values which differ from the classical ones do not require accepting any intuitions which differ from the two-valued ones—which means that the assumption that many-valued logics have a competitive character should be rejected. By the same token he proved that Łukasiewicz's expectations towards those logics cannot be fulfilled. In fact, many-valued logics do not find application in mathematics done in the spirit of classical logic. Their significance comes down to enriching the inventory of the research on logical systems — e.g. many-valued matrices are used in the proofs of the independence of the set of axioms.

In addition to all that, L. Borkowski was interested in modalities. He published his first work on that subject, "O terminach modalnych" (On modal terms), in 1958 (= BORKOWSKI 1990d.). The work extended the language of the propositional calculus with Łukasiewicz-Tarski quantifiers by adding to it so called propositional variables with pointers. At the root of the system lies the notion of a proposition's logical form — a propositional form which comes into existence when the extra-logical constants within the proposition are replaced with variables (different constants need to be replaced by different variables). In order to make it possible to express in the propositional calculus not only the connections between propositions but also those between propositions and their logical forms and those between propositions with reference to the connections between their logical forms, Borkowski introduces propositional variables with changeable pointers (e.g. p_v, q_v). The pointers have the following sense: if p represents a particular proposition and p_v represents that proposition's logical form, then v represents the sequence of variables associated (on the grounds of a particular principle) to the sequence of extra-logical constants of that proposition. (If in some expression a pointer v appears along with the variables p_1, p_2, ..., p_n, then in that expression v represents the sequence of variables associated with the sequence of extra-logical constants of propositions represented by the variables p_1, p_2, ..., p_n.) The pointers can be quantified by applying the laws of a narrower unary predicate calculus. These conclusions allow Borkowski to define modal functors in the following way:

a) $Lp \equiv (\forall v)\ p_v$, or, verbally: a state of affairs is necessary if and only if the logical form of the proposition stating that state of affairs is true for all the values of the variables (the generalization of the logical form of that proposition is a true proposition), i.e. if that proposition is analytic.
b) $Mp \equiv (\exists v)\ p_v$, or, verbally: a state of affairs is possible if and only if the logical form of the proposition stating that the state of affairs is valid for certain values of the variables, i.e. if that proposition is non-contradictory (BORKOWSKI 1990d, 143–144).

On the grounds of these definitions of modal terms Borkowski introduced the axioms and rules of Lewis' modal system S5. In addition to that, he constructed a truth-table method of validating propositional formulas with modal functions, relying also on the analogies between quantifiers and modal functions. The same analogy was used by Saul Kripke in the 1960s of the 20th century, to construct a relational semantics of modal logics, which may be the reason why Kazimierz Pasenkiewicz defined L. Borkowski's work as among the more important which have been published after the war in the area of modal logic (PASENKIEWICZ 1969).

Borkowski returned to the subject of modality in his work "Uwagi o okresie warunkowym oraz implikacji materialnej i ścisłej" [Remarks on the conditional and on the material and strict implication] (= BORKOWSKI 1964), in which he speculated on the usefulness of the system of strict implication for the formalization of deductive inferences and gave an intuitive interpretation of the method of validating the expressions of the system S5 by means of infinite binary sequences. Borkowski analyzed the meaning of the colloquial conditional and speculated on the problem of how to formalize the infallible inferences made in science. He believed that material implication should not be treated as an equivalent of the colloquial conditional in contemporary logic. Borkowski assigned to logicians with philosophical leanings the task of researching different systems of strict implication from the viewpoint of their usefulness for the formalization of different types of deductive inference. He believed that that could bring significant profits with respect to applying logic to the empirical sciences.

At a later stage of his work Borkowski became more interested in philosophical-logical problems, which was noticeable especially after 1975, when he became a member of KUL's scholarly circle. The logical literature from that period was imbued with enthusiasm and hope for constructing a system of logic more perfect than the classical logical calculus which would be applicable to all the sciences and all possible areas of discourse. This hope was connected to the discovery of non-classical logics. At that time different non-classical logics were already known, and new calculi pretending to the name of logical calculi were constantly being created. Such a situation posed many problems such as: What is the cognitive value of the known systems of logic? What is the scope of logic? In what sense can we talk about the validity of logic? Are there many valid logics? Those and other fundamental questions from the area of formal logic, the philosophy of logic and science, and the history of logic were discussed by the first and second generations of the philosophers educated at KUL. The latter included, among others, the methodologist Stanisław Kamiński, the metaphysician Mieczysław Albert Krąpiec, the epistemologist Antoni B. Stępień, the historians of philosophy Stefan Swieżawski and Marian Kurdziałek, the ethicists Karol Wojtyła and Tadeusz Styczeń, the philosopher of religion Zofia J. Zdybicka and the philosopher of nature Włodzimierz Sedlak. The addition to the group of a thoroughbred logician brought mutual advantages. L. Borkowski's contribution was his rich and multisided scientific output, immense pedagogical experience and the tradition of his school, which made him pay sensitive attention to high logical culture. The philosophers of the Lublin circle, in turn, influenced him by means of an atmosphere of philosophical discussion displaying vast historical erudition as well as a methodological consciousness accompanying their proceedings.

L. Borkowski's undoubted merit was enriching the logical culture at the KUL. He did this not only by raising the standards of debate, which was supposed to respect the principles of logic broadly conceived, but also by working out some particular substantive theses. Within the Lublin school there had been a decades-long debate—sometimes a very animated one—

over the form of the philosophy done in the school and especially over the possibility of logicizing it. Such a postulate, referring back to the ideals of the Cracow Circle, accompanied the work of the creator of the modern logic of norms, Jerzy Kalinowski, who chaired the meetings called Metaphilosophical Conversatories at KUL.[14] Kalinowski along with his students headed in the direction of "a logistic defense of metaphysics", i.e. making it more precise and at least partially formalized by means of the tools provided by contemporary logic (JANECZEK 2008, 89-106; KICZUK 1996, 5–18). Afterwards, mainly due to the influence of S. Kamiński, who was striving to connect the approach of the Lvov-Warsaw school with that of existential Thomism — and due to his fruitful cooperation with M.A. Krąpiec[15] — this ambitious program was abandoned. It was L. Borkowski who on the one hand made others conscious of the limits of formal methods, resulting e.g. from Gödel's theorem,[16] and on the other saw in non-classical logic a powerful tool; the latter led him to analyze the presuppositions lying at the root of non-classical logic so as to discover their possible areas of application. The research in that field was continued by one of L. Borkowski's and S. Kamiński's students, Stanisław Kiczuk, which resulted in constructing a logic of change and a causal logic for the physical sciences.

4. TOWARDS A NEW CLASSICAL DEFINITION OF TRUTH

Among the philosophically important topics the discussion of which was continued by L. Borkowski was the theory of truth. The latter was the main subject of his works from the Lublin period: "Pewna wersja definicji klasycznego pojęcia prawdy" [A certain version of the definition of the classical notion of truth] (1980), "Dowód równoważności dwóch sformułowań klasycznej definicji prawdy [A proof of the equivalence of two formulations of the classical definition of truth] (1987), "Uzupełniające uwagi do mego artykułu "Dowód równoważności sformułowań klasycznej definicji prawdy" [Supplementary remarks to my paper "A proof of the equivalence of two formulations of the classical definition of truth"] (1989–90) and "O definicji prawdy za pomocą pojęcia stanu rzeczy opisywanego przez zdanie" [On the

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[14] Their participants included, among others, Antoni B. Stępień, Stanisław Majdański, Leon Koj, Tadeusz Kwiatkowski, Witold Marciszewski.

[15] The cooperation resulted in the book *Z teorii i metodologii metafizyki* (= KRĄPIEC 1962, 1994^3).

[16] The paper "O twierdzeniu Gödla" (= BORKOWSKI 1981).

definition of truth by means of the notion of the state of affairs described by a sentence] (1993).[17] The theory of truth — an especially significant case of the interaction between philosophy and logic — was a subject of interest to the philosophers of the Lublin school.

L. Borkowski referred back to Tarski's semantic theory of truth from 1933. A. Tarski is known to have overcome a then-popular trend to reduce the truth of theorems in deductive systems to the feature of provability by means of his breakthrough study on the notion of truth in the languages of deductive sciences. All later additions to Tarski's theory were only its secondary transformations, referring also to the notion of satisfaction. Making use of A. Tarski's results, L. Borkowski proposed an original version of the modern account of the classical definition of truth, according to which from the definition of truth should follow all the equivalences of the form:

$$x \text{ is true if and only if } p,$$

where 'p' is the translation of a particular proposition into the metalanguage and 'x' is a metalinguistic name of the same proposition in the object language.

Using an appropriate metalanguage, L. Borkowski created the definition of truth in this version: a proposition is true if and only if the state of affairs described (stated) by that proposition occurs (BORKOWSKI 1980, 119). His delineation has not so far been formulated by means of the notions of contemporary logic because of the conviction that states of affairs are *sui generis* objects about which logic is silent.[18]

L. Borkowski's definition is based on two surprising ideas. First, it reduces the notion of a state of affairs to the set-theoretical notion of a relation, while replacing the ambiguous "occurrence of a state of affairs" with the clear-cut "non-emptiness of a relation". A state of affairs is a relation limited to a sequence of objects which "participate" in the state of affairs in question. For instance, the state of affairs described by the proposition "3 > 2" is the number 3's being larger than the number 2; it can be reduced to the relation $>|3, 2$, i.e. the relation of being larger limited in its domain to the set $\{3\}$ and in its codomain to the set $\{2\}$. In such an account, the occurrence of a state of affairs is understood as the non-emptiness of the corresponding

[17] All the papers have been published in Roczniki Filozoficzne, in the following respective issues: 28 (1980), No. 1: 119–131; 35 (1987), No. 1: 87-99; 37–38 (1989–90), No. 1: 325–336; 41 (1992), No. 1: 23-25. All of them were included in the book published after Borkowski's death: *Pisma o prawdzie i stanach rzeczy* (= BORKOWSKI 1995).

[18] This is stated in the remark made by Borkowski in his letter to A. Białat (BORKOWSKI 1995, 3).

relation limited to the sequence (BIŁAT and ŻEGLEŃ 1994, 116). One of the students, Andrzej Biłat, remarked that on the proposed interpretation states of affairs described by two false propositions are identical, since each of them is equal to the empty set. As a result, Borkowski modified his theory. In the new version, a state of affairs was not the relation limited to the sequence but a couple consisting of the relation and the sequence, of the form $<R^{(n)}, <u_1, \ldots, u_n>>$. The latter arrangement represents the occurring state of affairs if and only if n in $<u_1, \ldots, u_n>$ is an element of the relation $R^{(n)}$ which has n elements. For example, the state of affairs described by the proposition "3≥2" is an ordered couple $<\geq, <3, 2>$, i.e. a couple whose first element is the relation of not being smaller and the second element is the couple of numbers <3, 2>. Such a state of affairs occurs, because the couple <3, 2> is an element of the relation ≥.

L. Borkowski's logical semantics, like that of A. Tarski, solves in a positive way the problem of the definition of the classical notion of truth for formalized languages only. However, it was afterwards extended to the languages of other theories.

CONCLUSION

L. Borkowski's scientific work concerns many branches of knowledge and is characterized by the versatility of its results. This short review encompasses only some of those results — the philosophical-logical ones. Many of his creative achievements belonging to the areas of semiotics, the methodology of the sciences, metalogic and formal logic have been omitted here. The most important omissions include his original coverage of e.g. Leśniewski's system of ontology, consequence theory, the theory of justification, the theory of definition (including the definition of analytic sentence) and the notion of the two-place quantifier. All those works connect the formal, semiotic and philosophical approaches in an excellent way.

L. Borkowski's role in forming the logical culture of the Polish scholarly environment and of Polish youth is difficult to overestimate. He cared about a comprehensive educational program in logic, which he wanted to achieve by means of handbooks, republished numerous times, which discussed logical problems with an eye to detail.[19] It is through these handbooks that many

[19] The handbooks in question are: *Elementy logiki matematycznej i teorii mnogości* (= BORKOWSKI and SŁUPECKI 1963); *Logika formalna* (= BORKOWSKI 1970), *Elementy logiki formalnej*

important results entered the canon of logical knowledge in the form of theories and theorems discovered by both foreign and Polish scholars, such as the Turing machine, the method of sequents, the method of semantic tables, Gödel's theorem, the deduction theorem and non-classical logics. All of this was gathered, placed in a broader context and, as far as possible, presented by means of the method of natural deduction. Borkowski's handbooks contained a comprehensive overview of what was known about logic at his time.

However, the role of Borkowski was not limited to the authorship of handbooks. Quantifiable data about his pedagogical work are provided by the more than 50 master's and 5 doctoral dissertations written under his supervision,[20] which encompassed the following subjects: the formalization of the proofs of theorems in mereology, temporal functors in Leśniewski's ontology, proofs of the equivalence of the axiomatic systems of Leśniewski's mereology, a system of so-called quantum logic, contemporary systems of epistemic logic, Leonard and Goodman's calculus of individuals, systems of the logic of questions, Belnap's system of propositional calculus, the axiomatization and axiomatizability of certain propositional calculi and Beth's semantic tables vs. the method of natural deduction. All those topics reflected issues discussed during the seminars as well as in L. Borkowski's own work.

In his logical work L. Borkowski continued the great tradition of J. Łukasiewicz, S. Leśniewski, J. Słupecki and K. Ajdukiewicz. His mentors taught him clarity in posing problems and precision in solving them. He did not pick fashionable topics but, not unlike the logicians of the Lvov-Warsaw school, dealt with subjects which were basic for logic broadly conceived and had important philosophical implications. A good example is provided by his philosophical remarks on the notion of set, in which he explains that set theory is based on a distributive understanding of set while Leśniewski's mereology is based on a collective understanding of it. L. Borkowski made his philosophical views clear also when he assessed the presuppositions and the role of non-classical logic. He displayed great care in the intuitive interpretation of his logical results and presented formal problems in a remarkably clear way. To him, logic was not just a sort of mathematical game.

L. Borkowski understood logic as a tool — an organon — applied in the

(= BORKOWSKI 1972) and *Wprowadzenie do logiki i teorii mnogości* (= BORKOWSKI 1991). Some of them have been republished many times and translated to foreign languages.

[20] 8 master's and 2 doctoral dissertations have been prepared at KUL.

other sciences, but at the same time he believed it to be an autonomous discipline, subordinated neither to philosophy nor to mathematics. The main feature of logic was its precision — to an even greater degree than it was the case with mathematics.

Alongside his formal results, L. Borkowski's unquestionable scientific-constructive achievement lay in drawing attention to the philosophical aspects of logic. Comprehensive philosophical knowledge acquired during his studies in Lvov and Cracow and by means of his own philosophical reading helped him to see formal problems in a broad way. Another meaningful influence was provided by his debates with the philosophers from the Wrocław and Lublin circles, which found concrete expression in his preference for philosophically significant subjects. Investigating philosophical sources, inspirations and implications of logical results was something he did throughout the whole period of his creative activity. His analyses are gaining in popularity especially now, in the second decade of the 21st century — a time of increasing proliferation of different calculi, often unaccompanied by considerations aimed at justifying them. That is because L. Borkowski showed what the role of the system of logic is and how it should be constructed, but also because concrete results achieved by him contributed to working out a definite position in the debate about pluralism in logic.

REFERENCES

AJDUKIEWICZ, Kazimierz. 1958. "Le problème du fondement des propositions analytiques." *Studia Logica* 8: 259–272 (Polish translation: "Problem uzasadniania zdań analitycznych." In Kazimierz AJDUKIEWICZ. *Język i poznanie.* Vol. 2. Warszawa: PWN, 308–321).

BIŁAT, Andrzej, and Urszula ŻEGLEŃ. 1994. "Ludwik Stefan Borkowski: w poszukiwaniu prawdy w logice." *Ruch Filozoficzny* 51: 111–124.

BORKOWSKI, Ludwik, and Jerzy Słupecki. 1963. *Elementy logiki matematycznej i teorii mnogości.* Warszawa: PWN.

BORKOWSKI, Ludwik. 1964. "Uwagi o okresie warunkowym oraz implikacji materialnej i ścisłej." In Tadeusz KOTARBIŃSKI, ed. *Rozprawy logiczne, Księga pamiątkowa ku czci Profesora Kazimierza Ajdukiewicza*, 11–12. Warszawa: PWN.

BORKOWSKI, Ludwik. 1966. "Deductive Foundation and Analytic Propositions." *Studia Logica* 19: 59-74 (Polish translation — see BORKOWSKI 1990e).

BORKOWSKI, Ludwik. 1968. "Kilka uwag o pojęciu definicji." *Studia Logica* 23 (1968): 59–70.

BORKOWSKI, Ludwik. 1970. *Logika formalna*. Warszawa: PWN.

BORKOWSKI, Ludwik. 1972. *Elementy logiki formalnej*. Warszawa: PWN.

BORKOWSKI, Ludwik. 1980. "Pewna wersja definicji klasycznego pojęcia prawdy." *Roczniki Filozoficzne* 28 (1980), No. 1: 119–131.

BORKOWSKI, Ludwik. 1981. "O twierdzeniu Gödla." *Filozofia* [a journal of the Circle of Philosophy Students at the Catholic University of Lublin] 7: 5–10.

BORKOWSKI, Ludwik. 1984. "Autobiogram: Ludwik Stefan Borkowski." *Ruch Filozoficzny* 41: 78–82.

BORKOWSKI, Ludwik. 1987. "Dowód równoważności dwóch sformułowań klasycznej definicji prawdy." *Roczniki Filozoficzne*, 35, fasc. 1: 87–99.

BORKOWSKI, Ludwik. 1990a. "Kilka uwag o zasadzie dwuwartościowości i logikach wielowartościowych." In Ludwik BORKOWSKI. *Studia logiczne. Wybór*, 469–475. Lublin: TN KUL.

BORKOWSKI, Ludwik. 1990b. "O matrycowych regułach rachunku zdań." In Ludwik BORKOWSKI. *Studia logiczne. Wybór*, 303–312. Lublin: TN KUL.

BORKOWSKI, Ludwik. 1990c. "O pewnym systemie logicznym opartym na regułach i jego zastosowaniu przy nauczaniu logiki matematycznej." In Ludwik BORKOWSKI. *Studia logiczne. Wybór*, 174–183. Lublin: TN KUL.

BORKOWSKI, Ludwik. 1990d. "O terminach modalnych." In Ludwik BORKOWSKI. *Studia logiczne. Wybór*, 138–173. Lublin: TN KUL.

BORKOWSKI, Ludwik. 1990e. "Uzasadnianie dedukcyjne a zdania analityczne." In Ludwik BORKOWSKI. *Studia logiczne. Wybór*, 346–362. TN KUL, Lublin 1990.

BORKOWSKI, Ludwik. 1990f. "W sprawie intuicyjnej interpretacji logiki trójwartościowej Łukasiewicza." In Ludwik BORKOWSKI. *Studia logiczne. Wybór*, 426–433. Lublin: TN KUL.

BORKOWSKI, Ludwik. 1991. *Wprowadzenie do logiki i teorii mnogości*. Lublin: TN KUL.

BORKOWSKI, Ludwik. 1993. "O definicji prawdy za pomocą pojęcia stanu rzeczy opisywanego przez zdanie." *Roczniki Filozoficzne* 41, fasc. 1: 23–25.

BORKOWSKI, Ludwik. 1995. *Pisma o prawdzie i stanach rzeczy.* Lublin: Wydawnictwo UMCS.

BUCZEK, Anna, i Stanisław KICZUK. 1984. "Bibliografia prac Ludwika Borkowskiego 1951-1985." *Roczniki Filozoficzne* 32, fasc. 1: 19–29.

JANECZEK, Stanisław. 2008. "Wydział Filozofii." In Grzegorz KRAMAREK and Eugeniusz ZIEMANN. *Katolicki Uniwersytet Lubelski Jana Pawła II. 90 lat istnienia*, 89–106. Lublin: Towarzystwo Naukowe KUL.

JAŚKOWSKI, Stanisław. 1965. Rev.: *Elementy logiki matematycznej i teorii mnogości* by J. Słupecki, L. Borkowski. *Studia Logica* 16: 117–118.

KAMIŃSKI, Stanisław. 1984. "Ludwik Borkowski jako kontynuator logiczno-metodologicznych prac szkoły lwowsko-warszawskiej." *Roczniki Filozoficzne* 32, fasc. 1: 7–17.

KICZUK, Stanisław. 1996. "Spór o stosowalność logiki formalnej do filozofii w szkole lubelskiej." *Roczniki Filozoficzne* 44, fasc. 1: 5–18.

KRĄPIEC, Mieczysław Albert. 1962 [1994^3]. *Z teorii i metodologii metafizyki.* Lublin: TN KUL [RW KUL].

LECHNIAK, Marek. 1996. "O próbach intuicyjnej interpretacji logiki trójwartościowej J. Łukasiewicza." *Roczniki Filozoficzne* 44, fasc. 1: 161–176.

LECHNIAK, Marek. 1999. *Interpretacje wartości matryc logik wielowartościowych.* Lublin: Redakcja Wydawnictw KUL.

MOSTOWSKI, Andrzej. 1969. "Ocena całokształtu dorobku naukowego doc. dr Ludwika Borkowskiego." Archive of the John Paul II Catholic University of Lublin.

NIEZNAŃSKI, Edward. 1972. (Review:) *Logika formalna* by Ludwik Borkowski. Warszawa 1970. *Studia Philosophiae Christianae* 8, No. 1: 246–253.

PASENKIEWICZ, Kazimierz. 1969. "Ocena dorobku naukowego doc. dr Ludwika Borkowskiego." Archive of the John Paul II Catholic University of Lublin.

POGORZELSKI, Witold. 1979. "Ocena dorobku naukowego prof. dr hab. Ludwika Borkowskiego." Archive of the John Paul II Catholic University of Lublin.

SŁUPECKI, Jerzy, and Ludwik BORKOWSKI. 1984. *Elementy logiki matematycznej i teorii mnogości.* Warszawa: PWN.

SŁUPECKI, Jerzy, Grzegorz BRYLL, and Tadeusz PRUCNAL. 1967. "Some Remarks on Three-valued Logic." *Studia Logica* 21: 45–66.
SŁUPECKI, Jerzy. 1964. "Próba intuicyjnej interpretacji logiki trójwartościowej Łukasiewicza." In Tadeusz KOTARBIŃSKI, ed. *Rozprawy logiczne. Księga pamiątkowa ku czci Kazimierza Ajdukiewicza*, 185–191. Warszawa: PWN.
ŚWIĘTORZECKA, Kordula. 1994. "Wspomnienie o Profesorze Ludwiku Borkowskim (1914-1993)." *Studia Philosophiae Christianae* 30, No. 1: 183–191.
TKACZYK, Marcin. 2007. "Założeniowe systemy normalnych logik modalnych." *Roczniki Filozoficzne* 55, No. 1: 219–228.
WOLEŃSKI, Jan. 1985. *Filozoficzna szkoła lwowsko-warszawska.* Warszawa: PWN.
WOLEŃSKI, Jan. 2007. *Epistemologia.* Warszawa: PWN.
WOLNIEWICZ, Bogusław. 2016. "Mój obraz szkoły lwowsko-warszawskiej." In Anna BROŻEK i Anna CHYBIŃSKA, eds. *Fenomen szkoły lwowsko-warszawskiej*, 13–19. Lublin: Wydawnictwo Academicon.

O FILOZOFICZNO-LOGICZNYCH POGLĄDACH LUDWIKA BORKOWSKIEGO

Streszczenie

Dzięki zdobytej wiedzy filozoficznej Ludwik Borkowski widział problemy formalne w szerszym kontekście. Był w uprawianiu logiki kontynuatorem tradycji szkoły lwowsko-warszawskiej. Podejmował problemy podstawowe dla szeroko pojętej logiki oraz mające doniosłe konsekwencje filozoficzne, np. logiki nieklasyczne, teoria prawdy, metoda założeniowa, teoria konsekwencji, teoria definicji. Dbał o intuicyjną interpretację swych wyników logicznych, a samą logikę traktował jako naukę autonomiczną, która ma pełnić funkcję służebną wobec innych nauk. Choć nie pisał typowych dzieł filozoficzno-logicznych, dociekanie filozoficznych źródeł, inspiracji i konsekwencji wyników logiki towarzyszyło mu przez cały czas twórczej aktywności.

ON PHILOSOPHICAL-LOGICAL VIEWS OF LUDWIK BORKOWSKI

Summary

Ludwik Borkowski's vast knowledge of philosophy allowed him to put his logical studies in a philosophical context. As a logician, he continued the tradition of the Lvov-Warsaw school. He dealt with the basic issues of the widely understood logic as well as with those having strong philosophical implications (e.g. non-classical logics, the theory of truth, natural deduction, the theory of consequence). He also worked on the theory of definition and the intuitive interpretation of logical results. For Borkowski, logic was an autonomous science whose function is supposed to be ancillary towards the other sciences. Although he did not write any typical philosophical-logical works, investigating philosophical sources, inspirations and the implications of logical results was something he did throughout the whole period of his creative activity.

Słowa kluczowe: Ludwik Borkowski; systemy założeniowe; zasada dwuwartościowości; modalności; definicja prawdy.
Key words: Ludwik Borkowski; natural deduction; principle of bivalence; modalities; definition of truth.

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