Zuzana Rybaříková*

THE VALUE OF REALITY TO LOGIC
AND THE VALUE OF LOGIC TO REALITY
A COMPARISON OF ŁUKASIEWICZ'S AND LEŚNIEWSKI'S VIEWS

Abstract

Since Kazimierz Twardowski introduced the notions of "symbolomania" and "pragmatophobia," the relationship between logic and reality was the focus of the philosophers from the Lvov-Warsaw School — *inter alia* two prominent logicians of the group, Stanisław Leśniewski and Jan Łukasiewicz. Bolesław Sobociński has pointed out, however, that there was a contrast between their approach to logic and reality. Despite being members of the same philosophical group and even colleagues from the same department, their philosophical views on the position of logic in reality differed considerably. Yet they both agreed that reality has a certain importance for logic and that logic could be valuable for reality. The aim of this paper is to introduce their divergent positions and describe in more detail how Leśniewski and Łukasiewicz understood the relationship between logic and the real world.

Keywords: Stanisław Leśniewski, Jan Łukasiewicz, philosophy of logic, metaphysics of logic

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> Philosophy, including logic, is not primarily about language, but it's about the real world.
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> (Prior 1996: 45)

In the history of analytic philosophy, the relationship between logic and reality has often been complicated. On the one hand, logic tends to be listed among *a priori* disciplines that are based on rules and not on experiences; hence, it is a discipline independent of reality. On the other hand, there were and still are philosophers that intend to apply logic to the issues of reality, or who do not hold such a clear distinction between *a priori* and empirical dis-

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* University of Ostrava, Department of Philosophy, Reální 5, 701 03 Ostrava, Czech Republic, e-mail: zuzana.rybarikova@osu.cz, ORCID: http://orcid.org/0000-0002-6128-1868.

ciplines (see, e.g., Łukasiewicz 1970e: 391-393, 395; Quine 1951: 39-43). On this view, logic is related to reality. It could bring certain valuable results to it, or reality could be considered in formulating systems of logic.

This issue of determining the relationship between logic and reality was well known among the members of the Lvov-Warsaw School due to Kazimierz Twardowski's paper "Symbolomania and Pragmatophobia." As the title suggests, Twardowski (1979: 4) warned in his paper against "symbolomania," which is the situation when symbols are not only means of philosophical investigation but also its aim, and "pragmatophobia," which is an aversion targeted towards objects that are represented by those symbols. Twardowski also claimed that these two philosophical defects are connected and that mathematical logic, in which deductive rules are applied regardless of reality, is fallible due to these defects. Twardowski argued:

> Algebraic, or symbolic, logic likewise exposes its exponents to the risk of developing symbolomania and pragmatophobia, for in that discipline every theorem "must be proved in a strictly deductive manner by means of formal rules of calculus, without reference to the meaning of the symbols with which we work." (Twardowski 1979: 4)

Nevertheless, he admitted that formalization could be a useful tool (Twardowski 1979: 3, 6).

Twardowski did not mention any philosopher who could be susceptible to sustain "symbolomania" or "pragmatophobia." Therefore, it is not certain whether and to what extent the paper targeted Jan Łukasiewicz or Stanisław Leśniewski. Arianna Betti (2006: 67) argues that the main target at the time might have been Łukasiewicz. Nonetheless, if this was the case, Jan Woleński (1989: 45-46) claims the attack was not entirely justified, as both Łukasiewicz and Leśniewski took reality into account; and despite the fact that logic was sometimes not only the means but also the aim of investigation, an accusation of "symbolomania" would be misguided.

However, there was a distinction between their views on logic and reality, with Bolesław Sobociński sketching out the distinction in Łukasiewicz's necrology:

> There is an interesting contrast on this score between the two great figures of the Warsaw School of Logic, Łukasiewicz and Leśniewski. The latter also was a philosopher by training; he too moved away from philosophy and avoided even philosophical "asides" in his published work. But, unlike Łukasiewicz, he held that one could find a "true" system in logic and in mathematics. His systematization of the foundations of mathematics was not meant to be merely postulational; he wished to give, in deductive form, the most general laws according to which reality is built. For this reason, he had little use for any mathematical or logical theory which, even though consistent, he did not consider to be in accord with the fundamental structural laws of reality. (Sobociński 1956: 42-43)

> Although he [Łukasiewicz] was by training a philosopher and always remained inter-
> ested to some extent in philosophical problems, his mind seems to me to have had a
> predominantly mathematical bent, while almost all his work was purely formal in
> character. He was interested first and foremost in questions of deduction, validity,
> axiomatization. . . . Like most other symbolic logicians and mathematicians of the present
> day, he had no fixed philosophical views about the necessity or otherwise of some
> conformity between his deductive systems and reality. (Sobociński 1956: 42)

My aim is to focus on this distinction and provide a more elaborate de-
scription of how valuable reality was for their systems of logic and, vice versa,
how valuable logic was for reality in their views. Firstly, the paper introduces
Leśniewski's views. Secondly, it discusses Łukasiewicz's views on the value of
reality to logic and the value of logic to reality. This structure might seem
ahistorical, as Leśniewski was younger than Łukasiewicz, and some of his
views on logic were affected by his older colleague. However, Leśniewski's
views presented in this paper were formulated prior to Łukasiewicz.

1. LEŚNIEWSKI ON LOGIC AND REALITY

As Sobociński's quote suggests, logic and reality were closely connected in
Leśniewski's work. Although Leśniewski's views on logic underwent devel-
opment, Rafał Urbaniak (2014: 7) claims that Leśniewski was interested in
logic and its philosophy from the beginning of his career. Nonetheless,
Leśniewski (1992b: 181-195) was hostile towards symbolic logic at first. He
was inclined to Mill's understanding of logic and to the work of Edmund
Husserl and other representatives of Brentano's school. He pointed out that
this hostility was caused mainly by the ambiguities that appeared in the
writings of then prominent logisticians, primarily in Russell and Whitehead's
Principia Mathematica. Leśniewski required an interpretation of the formu-
las of their system.

Leśniewski (1992b: 364-365) argued that it was Leon Chwistek, a Polish
logician who was not a member of the Lvov-Warsaw School, who finally made
him appreciate symbolic logic. This caused Leśniewski's system, which was
initially formulated in natural language, to become formalized. He developed
two systems of logic: Protothetic and Ontology. He also introduced his theory
of parts and wholes, Mereology, but only in natural language (see Lejewski
2016: 134-139).

When Leśniewski began to develop symbolic logic, he labeled his ap-
proach "intuitive formalism," as he used the precise language of symbolic
logic to formalize his philosophical intuitions (see Woleński 1989: 145-146).

This does not mean, however, that Leśniewski was a proponent of Hilbert's formalism. Czesław Lejewski (2016: 143) stressed that Leśniewski opposed Hilbert's view that logic is just a formal game with symbols. According to Leśniewski, logic should serve reality and provide precise rules for it. His critique of symbolic logic from the previous period did not disappear. He still required an interpretation of the formulas of the systems of logic, despite the fact that he did not hold his own earlier works in high esteem (see Kotarbiński 2016: 113-114).

While working on his systems of logic, Leśniewski always considered reality. Lejewski (1984: 126) argued that Leśniewski understood the theses of his systems to be true in a similar manner as true statements of empirical science. Moreover, Sobociński (1956: 43) claims that Leśniewski sought to postulate such laws of logic and the foundations of mathematics that could become general laws of reality. Thus, Leśniewski argued for "a robust sense of reality" in logic, similarly to Bertrand Russell (Luschei 1962: 51). Russell (1920: 169-170) once wrote that logic concerns the real world in a similar way to zoology. This understanding of logic caused Leśniewski to have little sympathy for developing various systems of logic and for any formalistic view that saw logic as a mere game with symbols (see Lejewski 2016: 143-144, Leśniewski 1992c: 487, Woleński 1995: 390).

This understanding of logic had its drawbacks. As Leśniewski's mathematician colleagues informed him, describing reality is not the aim of the axiomatic system in mathematics (Lejewski 2016: 155). Thus, although Leśniewski aimed to postulate systems that could be the foundation of mathematics, his aims were more philosophical than mathematical.

The connection between logic and reality also meant that Leśniewski's philosophical position played an important role in the formulation of his systems of logic and foundations of mathematics. Specifically, he required his systems to contain three main features. The systems should be extensional, two-valued, and should not violate nominalism.

Firstly, Leśniewski (1992b: 187) argued against intensional systems of logic and intensional functions. He claimed that intensional functions introduce into a system of logic the positions of its author, and thus it enters the psychological realm (see Woleński 1989: 143-145). Leśniewski, in accordance with other members of the Lvov-Warsaw School, was a proponent of anti-psychologism in logic, and so he aimed to exclude all psychology from logic. Piotr Surma (2012: 146-147) claims that it might have been Leśniewski who pointed out the connection between psychologism and intensional logic in the Lvov-Warsaw School. His position in the school might have helped to spread this notion among its members.

Secondly, Leśniewski insisted that any system of logic has to be two-valued. He criticized many-valued systems of logic openly in discussions with their author Łukasiewicz, as well as in his personal communication with other members of the Lvov-Warsaw School (see Łukasiewicz 1998b: 244-245, Leśniewski 2016: 214). His most renowned denial of more than two values, however, might be his discussion with Tadeusz Kotarbiński. In the discussion, Kotarbiński (1913: 79, 86-88) claimed *inter alia* that future contingent propositions could have a third truth-value. They were, according to him, neither true nor false but *indefinite*. Kotarbiński was inspired by Łukasiewicz's work but argued against the rule of bivalence several years before it was denied by Łukasiewicz (see Betti 2002: 31-33). However, Leśniewski succeeded in convincing Kotarbiński that a third value is untenable (see Simons 2021). Leśniewski (1992a: 84-85) also demonstrated in the discussion that this view was affected by his notion of logic and reality. He was convinced that there are just two values — truth and falsehood — in reality.[1]

Thirdly, Leśniewski was a nominalist and required his systems of logic to comply with his ontology. There are several meanings of the word "nominalism" in philosophy. In Leśniewski's work, "nominalism" means that abstract entities are not part of his ontology (Simons 2020). From the logical point of view, the most troublesome abstract entities that Leśniewski considered were classes. Leśniewski expressed his disagreement with classes as abstract entities, directly listing them among mythical entities:

> Scenting in the "classes" of Whitehead and Russell and in the "extensions of concepts" of Frege the aroma of mythical specimens from a rich gallery of "invented" objects, I am unable to rid myself of an inclination to sympathize "on credit" with the authors' doubts as to whether objects which are such "classes" do exist in the world. (Leśniewski 1992b: 224)

Since Leśniewski denied the existence of classes as abstract entities and proposed instead classes understood as collections of objects, he had to postulate his own set theory, which he called Mereology, which concerns the relation between parts and wholes. Mereology is based on two logical theories, Protothetic, which is Leśniewski's counterpart of propositional calculus, and Ontology, Leśniewski's calculus of names. Leśniewski formulated all these systems to be acceptable from a nominalist point of view (Urbaniak 2014: 189).

Although Leśniewski's systems of logic are in accordance with his ontological views, he aimed to postulate systems of logic that would be ontologically neutral — that is, systems of logic should not require any specific onto-

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[1] Hiż (2016: 180) pointed out that besides this aversion towards many-valued logics, Leśniewski regretted that he did not invent them.

logical position; they should not give clues about reality (see Simons 1998: 8). This is not the case with Russell's system of logic that contains the theorem *24.52, which requires the existence of at least one individual. Even Russell (1920: 203) found this theorem problematic and argued:

> The primitive propositions in *Principia Mathematica* are such as to allow the inference that at least one individual exists. But I now view this as a defect in logical purity.

No such requirement is contained in Leśniewski's system of logic. Therefore, V. F. Rickey (1998: 31) points out that Leśniewski's system of logic could also be used with a Platonistic ontology, even though it does not correspond to Leśniewski's own philosophical convictions.

To conclude, Leśniewski aimed to introduce his systems of logic and foundations of mathematics as general laws of reality. Therefore, he postulated several requirements that his systems had to follow, in order to comply with his ontological views. At the same time, this practice and several rather philosophical convictions caused Leśniewski's work to be philosophical rather than mathematical.

2. ŁUKASIEWICZ'S VIEWS ON LOGIC AND REALITY

In the quote above, Sobociński argues that the connection between logic and reality is much looser in Łukasiewicz's work than in Leśniewski's case. Sobociński described Łukasiewicz as a logician who was interested in several systems of logic without claiming that they could provide the only rules for reality. While this reflected Łukasiewicz's late period opinion about logic and reality, he held a different view during the development of his ideas.

Łukasiewicz started as a proponent of anti-psychologism. Following Husserl and Frege, he claimed that logic is an *a priori* discipline at that time, and thus he thought that it diverged from any empirical research. Nonetheless, when he developed his systems of many-valued logic, the interplay between logic and reality came to play a much more important role. Firstly, his system of three-valued logic was introduced among others as a tool to refute determinism — that is to say, he applied logic to solve a philosophical issue that also has an impact on the understanding of reality. Łukasiewicz (1970a: 228-229) even offered a list of philosophical issues that could benefit from their formulation in mathematical logic.

Secondly, Łukasiewicz discussed the position of logic with respect to ontology and the ontological commitments of systems. On the one hand, he was

opposed to the postulation of abstract entities in logic and philosophy (he mentions explicitly Platonic ideas and Kantian things-in-themselves) (Łukasiewicz 1998a: 41). Later, Łukasiewicz (1998c: 426) also rejected the Fregean concepts of truth and falsity that he had employed in his previous works. On the other hand, he claimed that he was not a nominalist, as this position would limit the scope of logic, causing logic to be finite, and making it dependent on empirical facts (Łukasiewicz 1970a: 223-224).

Thirdly, Łukasiewicz was aware of the fact that there are several competing systems of logic. At the same time, he was convinced that only one system is valid in reality. He argued that the results of empirical sciences could prove which one it was (Łukasiewicz 1970a: 233).[2] Nonetheless, there was a difference between Łukasiewicz's views and practice in this period. Łukasiewicz was interested in several systems of logic, such as the classical propositional calculus, three-valued systems of logic, or intuitionistic logic, and he developed them (Simons 2021).

Despite these views about logic and reality, Łukasiewicz was aware that an excessive connection between logic and reality could have a negative impact on logic. He and his colleagues (primarily from the Cracow Circle) faced accusations of nominalism, conventionalism, or relativism (see Łukasiewicz 1970b: 239). He also dealt with the claim that mathematical logic denies metaphysics and implies godlessness (see Łukasiewicz 1970a: 225, 234). Thus, he insisted on the metaphysical neutrality of logic.

The accusations stemmed from the fact that the proponents of mathematical logic were recruited at that time primarily from analytic philosophy, and some of them were renowned for some of these views. Łukasiewicz challenged this linking, as although analytic philosophers held mathematical logic in high esteem, and often used it in their argumentations, the method itself should not be blamed for the convictions of its users (see Łukasiewicz 1970a: 225, 234). He also pointed out that the previously mentioned convictions belong to philosophy, but logic is a discipline that is independent of philosophy. Nominalism, conventionalism, relativism, as well as the question of metaphysics and the existence of God are philosophical questions and, as such, beyond the scope of logic. Łukasiewicz (1970a: 234; 1970b: 241-244) argued that mathematical logic does not contain in itself any philosophical doctrine.

The connection between systems of logic and reality loosened in his final period, which was addressed above in the quote by Sobociński. In 1952, Łukasiewicz published his second paper on intuitionistic logic. Unlike in his

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[2] Łukasiewicz (1970b: 249) even confesses in the concluding part of his article "In Defence of Logistic" that he saw logic as a firm and concrete structure placed in God's mind.

first paper on the topic, he had a more favorable attitude towards this system of logic. Łukasiewicz (1970c: 333) described his views on the system as follows:

> It seems to me that among the hitherto known many-valued systems of logic the intuitionistic theory is the most intuitive and elegant.

This change in his views on the intuitionistic logic also represents a change in his views on the relationship between logic and reality in general. In the same paper, he also argues:

> We have no means to decide which of the n-valued systems of logic, n ≥ 2, is true. Logic is not a science of the laws of thought or of any other real object; it is, in my opinion, only an instrument which enables us to draw asserted conclusions from asserted premises. (Łukasiewicz 1970c: 333)

Łukasiewicz (1970d: 378-379) repeated his view on systems of logic as instruments again when he developed his system of four-valued modal logic:

> I am fully aware that other systems of modal logic are possible based on different concepts of necessity and possibility. I firmly believe that we shall never be able to decide which of them is true. Systems of logic are instruments of thought, and the more useful a logical system is, the more valuable it is. I hope that the Ł-modal system expounded above will be a useful instrument and deserves a further investigation and development.

Łukasiewicz's concept of multiple systems of logic used as instruments of thought might suggest that there could be more realms, with each system of logic valid in its own realm. Piotr Surma (2012: 86-87) vindicates such an understanding of Łukasiewicz's later position, which he, following Woleński (1989: 197), called "local pluralism." Surma points out that the final part of Łukasiewicz's book *Aristotle's Syllogistic from the Standpoint of Modern Formal Logic* proposes such a reading. Łukasiewicz (1957: 207) argues in it:

> While Aristotle's treatment of necessity is in my opinion a failure, his concept of ambivalent possibility or contingency is an important and fruitful idea. I think that it may be successfully applied to refute determinism.

Thus, Surma concludes that despite the fact that Łukasiewicz criticized Aristotle's system of modal logic in previous sections of his book, he might have found it applicable in the refutation of determinism.

Łukasiewicz's approach to determinism is another example of the fact that the relationship between logic and reality apparently became detached in the late period of his development. Łukasiewicz postulated a four-valued system of logic in that period. While the three-valued system of logic was formulated as Łukasiewicz's support for free will and denial of logical determinism, it was not the case in this system. Kijania-Placek (2000: 142-145) pointed out that

the four-valued system of logic contains theorems that imply determinism, such as $\vdash (\Delta p \wedge \Delta q) \rightarrow \Delta(p \wedge q)$ or $\vdash \Delta(p \wedge q) \rightarrow \Delta p$.[3]

From Łukasiewicz's argumentation in this period, it seems that he prioritizes the logical consequences of his system of modal logic over the ontological consequences it could have. Specifically, Łukasiewicz (1970d: 376-377) postulates a system (a) that does not contain the rule of necessitation,[4] (b) that is extensional and contains the rule of extensionality, and (c) in which there are no apodictic (necessarily true) propositions. Łukasiewicz (1970e: 395-396) is convinced that apodictic propositions are dispensable, as there is no need to have stronger propositions than true ones, and that apodictic propositions could lead to paradoxes.

To sum up, in his philosophy of logic, Łukasiewicz moved away from reforming the system of logic for the sake of metaphysics to considering systems of logic as instruments and focusing mainly on the logical features of the system. Consequently, in his final period, Łukasiewicz distanced logic from reality in the sense that logic was no longer expected to reflect certain firm structures of reality. Still, as Surma (2012: 88) points out, Łukasiewicz never relinquished the view that logic could be a useful instrument for dealing with reality. In fact, reality began to play a crucial role in an evaluation of systems of logic. Only a system of logic that proves to be useful in solving problems of the empirical world or metaphysics is a valuable instrument.

CONCLUSION

Despite Twardowski's criticism, both prominent logicians of the Lvov-Warsaw School, Leśniewski and Łukasiewicz, considered reality when they developed their systems of logic. Yet their views on the relationship between logic and reality differed. In Leśniewski's work, reality is valued: logic is strongly embedded in reality. The systems should be in accordance with reality and have general laws built into it. Although reality has such an important place in the development of the systems of logic, this position distanced

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[3] The first formula means: "If p is possible and q is possible, then it is possible that p and q." The second formula means: "If it is possible that p and q, then it is possible that p." The violation of indeterminism lies in the fact that if p stands for "There will be a sea battle tomorrow" and q for "There will not be a sea battle tomorrow," the first formula could be interpreted as: "If it is possible that there will be a sea battle tomorrow and it is possible there will not be a sea battle tomorrow, then it is possible that there will be a sea battle tomorrow and there will not be a sea battle tomorrow."

[4] Łukasiewicz referred to this rule as the "rule of tautology" (see Łukasiewicz 1970d: 376).

Leśniewski from his mathematician colleagues, who viewed this approach as philosophical.

By contrast, in his late period, Łukasiewicz detached logic from reality in the sense that logic no longer was expected to mirror a firm structure of reality. At the same time, reality began to play a crucial role in the evaluation of systems of logic. Only systems of logic that prove to be useful are valuable.

Finally, both logicians vindicated the ontological neutrality of logic. This was one of the philosophical requirements Leśniewski postulated for his system. Łukasiewicz was also against the view that logic has any ontological commitments. It helped him to liberate mathematical logic from the accusations of its opponents.

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