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THE RECEPTION OF LOGIC IN POLAND: 1870–1920

RECEPCJA LOGIKI W POLSCE: 1870–1920

A b s t r a c t

This paper presents the reception of mathematical logic (semantics and methodology of science are entirely omitted, but the foundations of mathematics are included) in Poland in the years 1870–1920. Roughly speaking, Polish logicians, philosophers and mathematicians mainly followed Boole's algebraic ideas in this period. Logic as shaped by works of Gottlob Frege and Bertrand Russell became known in Poland not earlier than about 1905. The foundations for the subsequent rapid development of logic in Poland in the interwar period were laid in the years 1915–1920. The rise of Polish Mathematical School and its program (the Janiszewski program) played the crucial role in this context. Further details can be found in [8]. This paper uses the material published in [20–24].

Keywords: *traditional logic*, *algebraic logic*, *mathematical logic*, *mathematics*, *philosophy*, *the Lvov-Warsaw School*, *Polish Mathematical School*, *logic in Cracow*

S t r e s z c z e n i e

W artykule przedstawiono recepcję logiki matematycznej w Polsce w latach 1870–1920. Polscy logicy, zarówno filozofowie jak i matematycy, kontynuowali algebraiczne idee Boole'a w tym okresie. Logika w stylu Gottloba Fregego i Bertranda Russella stała się znana w Polsce około 1905 r. Podwaliny pod dalszy szybki rozwój logiki w okresie międzywojennym zostały położone w latach 1915–1920. Powstanie Polskiej Szkoły Matematycznej i jej program (program Janiszewskiego) odegrały kluczową rolę w tym kontekście. Dalsze szczegóły można znaleźć w [8, 12]. Niniejszy artykuł korzysta z materiału zawartego w [20–24].

Słowa kluczowe: *logika tradycyjna*, *logika algebraiczna*, *logika matematyczna*, *matematyka*, *filozofia*, *Szkoła Lwowsko-Warszawska*, *Polska Szkoła matematyczna*, *logika w Krakowie*

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1. General remarks about logic in Poland before the second half of the 19th century

Poland had no major tradition in logic until the interwar period (1918–1939). Jan of Głogów (c. 1445–1507) was perhaps the most interesting Polish logician in the Middle Ages. He, like other Polish logicians of that time, was strongly influenced by the terminist *logica nova* in the Prague style. *Logica* (published in Ingolsdadt in 1618) of Jan Śmiglecki (c. 1562–c. 1619) became a popular textbook in Oxford in the 17th century (it was republished in Oxford in 1634, 1638, 1968). Yet works of both mentioned logicians as well as other Poles working in logic were not particularly original and presented well-known topics elaborated from a typical scholastic point of view (see [5, 9, 17, 19] for further information). Perhaps this link between scholasticism and the style of doing logic decided that the Committee of National Education, acting in Poland in the second half of the 18th century, had serious reservations concerning the place of logic in the general curriculum. Consequently, the Committee asked Étienne Bonnot de Condillac to write a textbook of logic for Polish high schools and universities. His *Logique* (Polish translation 1802) was used in Poland in the first of the 19th century. However, Condillac's textbook presented not formal logic, but rather principles of sensualist epistemology popular among *les philosophes* of the French Enlightenment. In fact, Poland had no reliable textbook of formal logic in the period directly preceding the rise of mathematical (algebraic) logic.

Poland lost its independence at the end of the 18th century (in 1795). The country was partitioned among Russia, Prussia and Austria. The political deterioration caused a crisis in science and education. Polish universities were closed (Warsaw, Vilna) or their academic level essentially decreased (Cracow, Lvov; in fact, the latter was German-speaking). Romanticism considerably dominated Polish philosophy between 1800 and 1850. Although this style of thinking protected national consciousness to some extent, it did not create a sympathetic intellectual atmosphere for logic and related fields. The situation changed in the 1860s and 1870s, mostly in the Russian and Austrian-Hungarian sectors; Polish culture was extremely restricted in the German (Prussian until 1871) sector. Russian authorities allowed the opening the Main School in Warsaw (it was closed in 1869 and replaced by the Imperial (Russian) University). This school, acting as a kind of university, cultivated positivistic philosophy (the Warsaw or Polish positivism). Although scientific achievements of Polish positivists were rather moderate, their activities essentially contributed to the popularization of science. In particular, several important scientific works, popular as well as highly professional, were translated and published in Polish. As far as logic and the foundations of mathematics are concerned, the following books and papers (published as booklets) deserve to be mentioned (the date of Polish edition in brackets; titles are abbreviated in some cases; I also mention some books published after 1900): A. Bain, *Logic* (1878), J.S. Mill, *Logic* (1989), W.S. Jevons, *Logic* (1886), L. Liard, *Logic* (1886), B. Riemann, *On Fundamental Hypotheses in Geometry* (1877), F. Klein, *Lectures on Geometry* (1899), H. Helmholtz, *On Measuring and Counting in Mathematics* (1901), H. Poincaré, *Science and Hypothesis* (1908), *The Value of Science* (1908), *Science and Method* (1911), R. Dedekind, *Continuity and Natural Numbers* (1914), F. Enriques (ed.), *Problems Concerning Geometry* (1914), M. Pieri, *Elementary Geometry* (1915), A.N. Whitehead, *Introduction to Mathematics* (1916) or J.W. Young, *Twelve Lectures on Fundamental Concepts of Algebra and Geometry*

(1917). The importance of this translation enterprise, initiated by mathematicians, particularly by Samuel Dickstein (1851–1939) consisted mainly in the fact that the works mentioned (and other ones) competently informed Polish scientists about the scientific progress obtained in logic, mathematics and philosophical problems of these fields. An important informative role was played by the journal *Wiadomości Matematyczne* (Mathematical News). Let me also mention that the first volume of *Przegląd Filozoficzny* (Philosophical Review) started its life in 1897 and achieved the status of the main Polish philosophical journal very soon. It was open for all directions and problems, including logic and the philosophy of mathematics.

The Danubian Empire became a fairly liberal country after 1870. The authorities gave national provinces wide autonomy. As far as the academic life in Galicia (the Austro--Hungarian part of Poland) is concerned, the universities in Cracow and Lvov became fully Polish. This fact had far-reaching consequences for the development of science in Poland (not only in Galicia, because many Poles coming from other occupied sectors of the country entered these universities). The Jagiellonian University in Cracow was an old (established in 1364) and very respected academic center and, in spite of a temporary regress in the first half of the 19th century, could continue normal academic activities. On the other hand, the University of Lvov (which had the beginnings in 1652, but was finally established in 1818) was practically completely reorganized after 1870, when the last German-speaking professors left its departments. New professors and scholars had to introduce Polish teaching and do science from scratch. Since they were not especially bound by traditional standards and rules, they could freely recommend several novelties for their students. Kazimierz Twardowski (1966–1938), a student of Brentano, became one of the most important university teachers in the entire history of Poland. His idea of doing philosophy in a clear and methodologically responsible way created a very favorable environment for logical investigations. Although Twardowski was not a mathematician or even a formal logician in the customary sense, his role in the development of logic in Poland cannot be overestimated. This is documented by the following words of Alfred Tarski ([18], p. 20):

Almost all researchers, who pursue the philosophy of exact sciences in Poland, are indirectly or directly the disciples of Twardowski, although his own works could be hardly be counted within this domain.

The difference between “all” and “almost” in this quotation refers to logicians in Cracow.

Stanisław Piątkiewicz (1848–?) and Dickstein (see above) can be considered as the very precursors of mathematical logic in Poland. The former, a professor of mathematics in a college (high school, secondary school) in Lvov, published a short report (see [14]) about the algebra of logic. Although this work did not have even a moderate scientific influence, it was (and is) perceived as the first Polish publication in the field of mathematical logic. Dickstein, mentioned earlier as having great merits for the translation program of foreign works into Polish, wrote an extensive treatise (see [4]) on concepts and methods of mathematics. He quoted Bolzano, Cantor, Dedekind, Frege, Grassmann, Hankel, Helmholtz, Peano, Weierstrass and Wundt, that is, leading mathematicians and philosophers involved in investigations of mathematics from the methodological point of view. This list of names indicates that Dickstein was quite well acquainted with the current state of the art in logic and the foundations of mathematics. From a general point of view, Dickstein’s book considers mathematics formally on the basis of the theory of mathematical operations. There

are several data that this book had some influence in Poland. In particular, it can be viewed of an anticipation of the later style of investigating mathematics which became dominant in the Polish school. According to this perspective, mathematics should be analyzed via its characteristic methods, not from a general philosophical standpoint. In other words, mathematics requires more mathematical foundations, free from strong philosophical assumptions.

2. Cracow

Krakow became the first serious centre of investigations in the field of mathematical logic. Stanisław Zaremba (1863–1942), a distinguished Polish mathematician, had strong interests in logic and the foundations of mathematics (see [25–27]). However, following the attitude of French mathematicians and their style of doing mathematics, he considered logic as a peripheral branch of mathematics, having only a secondary importance, mainly in teaching mathematicians. In particular, he maintained that mathematical logic had no interesting problems, and he rejected set theory as the conceptual basis of the entire mathematics. These views prevailed among mathematicians in Cracow and blocked progress in research. On the other hand, the Jagiellonian University established a professorship in mathematical logic, which was held by Jan Sleszyński (1854–1931). He was the most competent Polish scholar in mathematical logic until the 1920s. Śleszyński's lectures in Krakow were quite advanced and used the ideas of Frege, Peano and *Principia Mathematica* of Whitehead and Russell (see [16]; although they were published in a book form in 1925–1929, the book's content reproduces earlier courses given by Sleszyński). Edward Stamm (1886–1940), more a philosopher than a mathematician, worked on the algebra of logic and various foundational problems in the spirit of Boole. Leon Chwistek (1884-1944), another important figure in Krakow, also came to logic from philosophy, not from mathematics (perhaps it explains why Chwistek considered logic more seriously than did Zaremba and his followers). Very soon he began to work in the style of Russell. A comparison of [11] and [2], two works devoted to a very similar topic, namely the principle of contradiction, gives a good impression of the distance between Krakow and Lvov in doing logic. The latter book uses the framework of the algebra of logic, while Chwistek appealed to Russell's theory of types. Generally speaking, Chwistek tried to combine Russell's logicism and Poincaré's constructivism (he completed his project after 1920). More specifically, Chwistek rejected Platonism and favoured nominalism. His work can be regarded as the first original Polish contribution to mathematical logic. All works of Cracow logicians in the first two decades of the 20th century indicate that their acquaintance with the current (relatively to 1900–1920) state of mathematical logic was fairly high.

3. Lvov

Roughly speaking, Polish logic had two parents, namely philosophy and mathematics. This double pedigree was particularly evident in Lvov. In philosophy (see section 1), practically everything goes to Kazimierz Twardowski. He gave the first course in Poland in which

elements of mathematical logic were included. These lectures took place in the academic year 1899/1900, were mostly devoted to Brentano's reform of traditional logic, but also informed about the algebra of logic. Jan Łukasiewicz (1878–1956) participated in this class. He began to study Frege and Russell about 1904; in particular, he was impressed by the latter. Łukasiewicz began systematic courses in advanced algebra of logic. Twardowski was a charismatic teacher. He trained many philosophers with explicit interests in logic, also strongly influenced by Łukasiewicz's teaching of logic, including Kazimierz Ajdukiewicz (1890–1963), Tadeusz Czeżowski (1889–1981), Tadeusz Kotarbiński (1886–1981) and Zygmunt Zawirski (1882–1948); Stanisław Leśniewski (1886–1939) joined this circle in 1910. All Lvov logicians coming from philosophy also studied mathematics, mostly under Wacław Sierpiński (1882–1969), who acquainted his students with set theory (see [15], one of the first textbook in the set theory in the world) and the problems of the foundations of mathematics. Sierpiński's textbook informs about basic mathematical facts concerning sets, but also about difficulties in the foundations of mathematics, for example, it analyses the antinomy of Richard (but does not mention the Russell antinomy). Zygmunt Janiszewski (1988–1920) came to Lvov in 1915 and obtained his habilitation there. He wrote a few popular papers in logic and the foundations of mathematics (see the next section).

Łukasiewicz's book [11] played an important role in Lvov. Although, as I noted earlier, this treatise is very elementary on the purely mathematical level, it successfully popularized formal logic among philosophers in Lvov, due to its Appendix summarizing Couturat's algebra of logic (see [1]). The book was basically devoted to an elaborate analysis of the principle of contradiction in Aristotle and in later philosophy. Łukasiewicz also informed about antinomies of set theory. This problem was discussed by several other authors, for instance, Leśniewski (see [9]) and Czeżowski (see [3]). The former, inspired by various, more or less complicated, attempts to solve set-theoretical paradoxes, offered a completely new solution via mereology considered as a kind of set theory (see [10]). Doubtless'y, Sierpiński's mentioned textbook also essentially contributed to increasing interest in antinomies in Lvov. Yet logical works in Lvov in the period 1900–1920, although based on a relatively solid knowledge of the state of art in logic, could be hardly regarded as systematic or governed by a commonly accepted research project. In fact, logical papers published by logicians from Lvov in 1900–1920 were devoted to various topics and frequently combined formal topics with general philosophical investigations. In many respects, logic in Lvov was similar to that done in Cracow, although the latter centre appears as more advanced from the mathematical point of view.

4. Warsaw and the Polish Mathematical School

Warszawa entered the stage exactly in 1915. The German army very soon took the city in World War I. The German authorities agreed to reopen the (Polish) University of Warsaw in 1915. The academic staff was mainly imported from Lvov. Łukasiewicz was appointed a professor of philosophy. He began lectures in logic (elementary and advanced), and attracted many young mathematicians very soon. Kazimierz Kuratowski (1896–1980) reported ([8], p. 23/24) Łukasiewicz teaching activities in the following way:

"Jan Łukasiewicz was another professor who greatly influenced the interests of young mathematicians. Besides lectures on logic and the history of philosophy, Professor Łukasiewicz conducted more specialized lectures which shed new light on the methodology of the deductive sciences and the foundations of mathematical logic. Although Łukasiewicz was not a mathematician, he had an exceptionally good sense of mathematics and therefore his lectures found a particularly strong response among mathematicians. (...) I remember a lecture of his on the methodology of the deductive sciences in which he analyzed, among other things, the principles which any system of axioms should satisfy (such as consistency and independence of axioms). The independence of axioms in particular was not always observed by writers and even in those days was not always exactly formulated. Łukasiewicz submitted to detailed analysis Stanisław Zaremba's *Theoretical Arithmetic* (1912) which was well known at that time, questioning a very complicated principle formulated in that work, which was supposed to replace the rule of independence of axioms. The criticism was crushing. Nevertheless, it brought about a polemical debate in which a number of mathematicians and logicians took part in the pages of the *Philosophical Review* (1916–1918). I mention this because a byproduct of Łukasiewicz's ideas in our country was the exact formulations of such notions as those of quantity, the ordered set, and the ordered pair (the definition of the ordered pair which I proposed during the discussion was to find a place in world literature on the subject). This illustrates the influence brought by Jan Łukasiewicz, philosopher and logician, on the development of mathematical concepts".

Thus, logic began to play an important role at the inception of the Polish Mathematical School.

Poland recovered its independence in 1918. This also resulted in a great debate about the objectives and prospects of Polish science and culture. Scholars in every field discussed how to develop their disciplines and what to do in order to keep up with the world science. Particularly important was the discussion among mathematicians. In fact, it already started in Lvov, but it was rather personal, involving Sierpiński and Janiszewski. They were strongly disappointed by a lack of a common language and common research interests among Polish mathematicians. Sierpiński and Janiszewski believed that set theory and topology could play a fundamental role in mathematics. The national discussion about science, its needs and perspectives, was a good occasion for manifesting views about the future of mathematics in Poland. Janiszewski became the main exponent of the project, later known as the Janiszewski program (see [8]). Roughly speaking, Polish mathematicians, according to Janiszewski, should concentrate on chosen mathematical fields and work as one strong group. The second point was very soon abandoned, but the first was adopted. Although Janiszewski did not mention any concrete topic to be cultivated in Poland, most Polish mathematicians understood his program as favouring set theory, topology and their applications to other branches of mathematics. Two significant centres of the Polish mathematical school arose in Poland, namely in Warszawa and in Lvov. Krakow remained more traditional, in the spirit of Zaremba (see section 2). Sierpiński, Janiszewski and Stefan Mazurkiewicz (1888–1945) played the main role in Warszawa, while Stefan Banach (1892–1945) and Hugo Steinhaus (1887–1972) became the leaders in the Lvov mathematical community. Yet one important difference between the two centres of modern mathematics in Poland should be noted. Although mathematicians in Lvov worked mainly on applications of set theory and topology,

the circle in Warszawa focused more on abstract matters. Janiszewski also postulated that Poland should have a special mathematical journal published in international languages. This idea found its materialization in *Fundamenta Mathematicae* (the first volume appeared in 1920).

Janiszewski's program attributed a great role to mathematical logic and the foundations of mathematics. Janiszewski himself wrote a few general papers on logical and foundational matters in 1915–1916. Perhaps the most interesting is [7]), in which he considered mathematical logic as an autonomous branch of mathematics, having its own problems and not dependent on its applications in mathematics or on other practical roles. This was in very deep contrast with the views of Zaremba. The placement of logic and the foundations at the heart of mathematics required certain organizational steps. The University of Warsaw had the Faculty of Mathematical and Natural Sciences. The Department of the Philosophy of Mathematics was organized very soon and Leśniewski became its head. Łukasiewicz left the University in 1918 in order to act as the Minister of Religious Confessions and Education in the government under Ignacy Paderewski, the first Polish Prime Minister. He (Łukasiewicz) returned to the academic staff in 1919 and the University established for him a special position in philosophy at the Faculty of Mathematics and Natural Sciences. Both professors of logic (Łukasiewicz acted more as a logician than a philosopher) began intensive teaching of mathematical logic, mostly to mathematicians but also to philosophers. The first project of *Fundamenta Mathematicae* divided the journal into two series, one devoted to set theory, topology and their applications, and the other to logic and the foundations. This project was finally abandoned, but the significance of mathematical logic in the eyes of the founders of the Polish mathematical school found its impressive manifestation in the composition of the Editorial Board of *Fundamenta*: Mazurkiewicz, Sierpiński, Leśniewski and Łukasiewicz. Polish translation of the mentioned Couturat on the algebra of logic (see [1]) became the first Polish textbook of mathematical logic. However, this book was very soon viewed as too obsolete to be a source of information about modern logic. As Bronisław Knaster (1883–1980), the translator of Couturat's book, remarked (see [1], p. III) in his Preface:

As a deductive theory Couturat's work – when seen in the light of recent requirements of logic and methodology – is not free from certain defects of composition, incorrect formulations, and inexact arrangement.

Clearly, these "recent requirements" were related to works of Frege, Russell and Hilbert and were reported by Łukasiewicz in his lectures mentioned by Kuratowski (see above); Knaster himself attended Łukasiewicz's courses. In particular, Couturat's understanding of the algebra of logic as being interpreted either as propositional calculus or as the algebra of sets became replaced by the arrangement of logical theories in which the former functions as the most basic ingredient of logic. One can say that this step completed the reception of mathematical logic in Poland. The golden period of logic in Poland began just after 1920. Ten years later Heinrich Scholz (see [13], p. 73) called Warsaw one of the world capitals of mathematical logic.

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