

# Stanisław Piątkiewicz and the Beginnings of Mathematical Logic in Poland

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This paper presents information on the life and work of Stanisław Piątkiewicz (1849–?). His *Algebra w logice (Algebra in Logic)* of 1888 contains an exposition of the algebra of logic and its use in representing syllogisms. This was the first original Polish publication on symbolic logic. It appeared 20 years before analogous works by Łukasiewicz and Stamm. © 1996 Academic Press, Inc.

In dem Aufsatz werden Informationen zu Leben und Werk von Stanisław Piątkiewicz (1849–?) gegeben. Sein *Algebra w logice (Algebra in der Logik)* von 1888 enthält eine Darstellung der Algebra der Logik und ihre Anwendung auf die Syllogistik. Piątkiewicz' Schrift war die erste polnische Publikation über symbolische Logik. Sie erschien 20 Jahre vor ähnlichen Arbeiten von Łukasiewicz und Stamm. © 1996 Academic Press, Inc.

W pracy przedstawiono osobę i dzieło Stanisława Piątkiewicza (1849–?). W szczególności analizuje się jego rozprawę *Algebra w logice* z roku 1888, w której zajmował się on nowymi wówczas ideami algebry logiki oraz ich zastosowaniami do sylogistyki. Praca ta jest pierwszą oryginalną polską publikacją z zakresu logiki symbolicznej. Ukazała się 20 lat przed analogicznymi pracami Łukasiewicza i Stamma. © 1996 Academic Press, Inc.

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## 1. TRADITIONAL VIEWS ON THE ORIGINS OF MATHEMATICAL LOGIC IN POLAND

The successes of Polish logic after the First World War stimulated several authors to investigate its origins. All of them credited the beginnings of logic in Poland to Kazimierz Twardowski (1866–1938), who founded the Lvov–Warsaw school of philosophy while a professor at Lvov University, and to Jan Łukasiewicz (1878–1956), a logician who was a professor of philosophy at Warsaw University. Thus Ajdukiewicz, for example, wrote in 1934: “Łukasiewicz, well-educated not only in philosophy but also in mathematics, became a discoverer of logic for Poland. Perhaps this resulted from the influence of Twardowski, who was the first in Poland to speak about the algebra of logic, doing so in his university lectures in . . . 1899–1900” [1, 401]. Likewise, Ingarden remarked in 1938: “Twardowski was the first in Poland . . . to lecture about new attempts to reform logic” [9, 28].

Other authors writing on this subject have generally accepted the claims of Ajdukiewicz and Ingarden. Such was the case, for example, with Jordan [12, 9] and Skolimowski [20, 54]. Kotarbiński presented Łukasiewicz as the first representative

of mathematical logic in Poland and Twardowski as his distinguished teacher [13; 14]. Recent publications, such as that of Woleński [23, 82], essentially repeat these views.

What is wrong with the claims of Ajdukiewicz, Ingarden, and their followers is this: they insinuate that, before Twardowski and Łukasiewicz, there was no response at all in Poland to mathematical logic. In fact, mathematical logic was known in Poland and was discussed there in print long before Łukasiewicz's book on the subject appeared in 1910. Clearly, the first publications to inform Polish readers of the algebra of logic were translations of works by foreign authors. One of those translations stimulated the first original Polish contribution to this subject. This was not by Łukasiewicz, but by the mathematician Stanisław Piątkiewicz.

## 2. THE LIFE AND WORK OF S. PIĄTKIEWICZ

Works dealing with the algebra of logic have not generally been translated into Polish. Thus, for example, those of George Boole and Augustus De Morgan do not exist in Polish even today. Nevertheless, three books treating the algebra of logic, at least in part, were translated into Polish during the 1870s and 1880s.

The first of these was *Logic*, a textbook by the Scottish philosopher Alexander Bain, published in Polish translation in 1878. This book devoted a chapter to Boole and De Morgan. The second was *Logique*, an elementary handbook by Louis Liard, translated in 1886, which mentioned Boole's algebra of logic. The third, *Elementary Lessons in Logic* by William Stanley Jevons, appeared in translation the same year. Results in the algebra of logic were mentioned there only in passing.

The first translation, that of Bain's book, is historically the most important, since it directly influenced Piątkiewicz. This Polish mathematician, who also had philosophical interests, was born on September 21, 1849 in the village of Dębowiec (Dembowiec) within the Austro-Hungarian Empire. Although he was from a poor family, he graduated from Lvov University in 1871 with a degree in mathematics and physics. The following year he began teaching in a grammar school in Przemyśl, and in 1879 he was assigned to one in Lvov, where he remained until 1890. Then he returned to Przemyśl as director of the local grammar school, where he taught logic and psychology. He remained there until his retirement in 1906.<sup>1</sup>

While he taught in Lvov, Piątkiewicz took an interest in mathematical logic. His teaching duties may have been what led him to study logic more thoroughly and to read the translation of Bain. The result was Piątkiewicz's 50-page paper, *Algebra w logice* (*Algebra in Logic*), published in 1888 in the reports of the Royal Imperial

<sup>1</sup> Most of the biographical data were taken from the printed reports of the directors of the First Grammar School in Przemyśl and of the Fourth Grammar School in Lvov. The place and the year of birth of Piątkiewicz are given by Goliński in [8, 100]. The exact date of birth was determined based on the book of baptisms of the parish of Dębowiec. Dates of the beginning and the end of the university studies are given according to the information obtained from the District State Archive in Lvov. Some of the biographical details as well as some sources were made accessible to use by the courtesy of Dr. S. Kostrzewska-Kratochwilowa, Rev. J. Wójtowicz, and two former pupils of Piątkiewicz as well as then grammar school professors, S. Jurek and J. Kolankowski.

Grammar School No. IV in Lvov. These reports were very similar to what in Germany are called *Programmschriften*.

### 3. THE CONTENTS OF *ALGEBRA W LOGICE*

In *Algebra w logice*, Piątkiewicz referred to a wide range of authors on mathematical logic, from Leibniz and Boole to Gottfried Ploucquet and William Hamilton, De Morgan and Jevons, Robert Grassmann and Ernst Schröder. Piątkiewicz was also aware of an extensive secondary literature, and referred explicitly to Bain's book as the source of his own contribution [18, 5]. The only work of consequence that Piątkiewicz did not mention was Gottlob Frege's *Begriffsschrift*, which had not yet attracted wide interest in any country, although it would do so later.

The first section of Piątkiewicz's work defended the algebra of logic against various objections to it, for example, that natural language can adequately express the formal laws of thought without the use of symbols. He emphasized the vagueness of natural language and wished to show "that the presentation of logic in an algebraic way is possible, that it is not superfluous and that it will contribute to broadening the scope of formal logic" [18, 6].

In his second section, entitled "Identity Law. Association (Addition) of Concepts," Piątkiewicz revealed his psychologistic approach to logic, which had been influenced by Herbart. This psychologism did not reduce the value of Piątkiewicz's formal theory, since, as a mathematician, he presented the theory independently of any psychological interpretation.

Piątkiewicz's psychologism was the traditional view. He was similarly traditional in not distinguishing between unproved propositions and derived theorems—in contrast with Schröder's *Operationskreis* of 1877. Thus, Piątkiewicz was guided by traditional logic in his choice of elementary laws. Among the laws governing identity, for example, he mentioned only the so-called law of identity ( $a = a$ ), which was much valued by earlier logicians and philosophers. He did not mention the important law stating that identity is transitive, and mistakenly treated the symmetry of identity as contained in the law of identity. Symmetry and transitivity were used tacitly.

The main subject of this second section was the addition (union) of classes. Here, he followed Jevons, instead of Boole, in defining addition for all classes rather than for merely disjoint ones. Piątkiewicz discussed some relations between classes, such as subordination, overlapping, exclusion, and being different. His definitions of these relations were not completely precise, resulting in some errors of reasoning. (As an aside, we note that Piątkiewicz, like Bolzano, argued that the intension and extension of a concept are not reciprocal.)

The third section of Piątkiewicz's report was called "Specification (Multiplication) of Concepts," i.e., intersection of classes. To guarantee that multiplication of classes is defined in every case, he accepted the empty class 0. Some formal proofs were presented, e.g., for the theorem that if  $ac = bc$  and  $a + c = b + c$ , then  $a = b$ . Yet he did not grasp the difference between the formal proof of a law and its geometric interpretation, as when he considered the distributive law.

Section four, entitled "Negation of Concepts, Negative Concepts. The Law of

Contradiction and the Law of the Excluded Middle,” treated those two laws, which, together with the law of identity, were the traditional laws of logic before Boole. The two laws were stated as  $aa_1 = 0$  and  $a + a_1 = 1$ , where  $a_1$  denoted (as in Schröder’s *Operationskreis*) the complement of a class  $a$ . Piątkiewicz stated De Morgan’s laws and proved the uniqueness of negation. The proofs given in this section were fairly precise.

“Logical Equations,” the fifth section, is the heart of Piątkiewicz’s work. It contained a detailed presentation of Schröder’s method of solving logical equations. In this section, Piątkiewicz showed his competence in using the logical calculus.

The sixth and final section (“Applications of Previous Sections”) was the longest one. Most of it dealt with the deduction of particular syllogistic moods by means of the theory of logical equations and with the formulation of rules of a generalized syllogistic in which sentences may contain negated subjects and predicates. Here, there were various imprecise statements, but they merely continued the imprecisions already present in Boole.

#### 4. CONCLUSION

As this synopsis of *Algebra w logice* shows, Piątkiewicz informed his readers about Boolean logic in a competent way. Although his work contained no new results, it showed more knowledge of symbolic logic than was then possessed by any Polish university teacher of logic. At the time, he was the only person in Poland who was fully conscious of the progress being made in logic.

Unfortunately, Piątkiewicz did not succeed in awakening in Poland an interest in the new logic. The reasons are clear. He did not hold an academic position. After completing *Algebra w logice*, he moved to Przemyśl, far from any center of research. Moreover, during those years mathematicians, whether in Poland or elsewhere, seldom paid attention to logic. Logicians, who were philosophers, were not capable of reading papers in mathematical logic. Hence, Piątkiewicz’s work remained unknown for a long time.

Only 20 years later did there again arise in Poland a level of logical knowledge comparable to that of Piątkiewicz—thanks to the work of Łukasiewicz and to the 1911 article [21] by the Polish mathematician Edward Stamm (1886–1940), who went on to write numerous works on the algebra of logic. But at first Łukasiewicz and Stamm had no original results either. The well-known appendix to Łukasiewicz’s work on Aristotle’s logic (1910), which Jordan [12, 11] called the first presentation of modern logic in Poland, was, in fact, only a summary of Louis Couturat’s elementary exposition, *L’algèbre de la logique* (1905). It is true that, methodologically, this appendix was at a higher level than Piątkiewicz’s work. But Łukasiewicz’s appendix already belonged to another epoch in the development of logic. In 1910, the first volume of *Principia mathematica* by Whitehead and Russell had appeared, which was first discussed in Poland by Chwistek [4].

In any case, mathematical logic did not begin in Poland in 1910 or in 1899. Piątkiewicz’s *Algebra w logice* of 1888 marks the real beginning of mathematical logic there. Between 1888 and 1899 one can note another significant date. In 1891, the

logic of Giuseppe Peano was briefly mentioned by Samuel Dickstein (1851–1939), a Polish mathematician at Warsaw University who was also a historian of mathematics [6, 39]. Thus, knowledge of mathematical logic came to Poland several years earlier than is usually claimed.

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