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Mathematical logic in Poland 1918–1939

Abstract. Poland in the years 1918–1939 became one of the main centres of mathematical logic in the entire Word. This paper describes the rise of this field in Poland, Polish logical circles, organizations, journals and the main achievements of Polish logicians[1].

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1. If one were to speculate, say around 1900, how the development of mathematical logic would have been predicted around 1920, hardly any mention of Poland would be expected. Yet twenty years later Warszawa was called ([11], p. 73) one of the capitals of mathematical logic, and 60 years later one can read ([4, p. 200]): There is probably no country which has contributed, relative to the size of its population, so much to mathematical logic and the foundations of mathematics. Even if one is skeptical (as I am) about such rankings or about the importance of logical investigations relatively to the number of inhabitants in particular countries, the development of logic in Poland is a remarkable historical circumstance. Below, I describe basic facts from the history of the phenomenon called "Polish logic".

2. Roughly speaking, Polish logic had two parents, namely philosophy and mathematics. Kazimierz Twardowski (1866-1938), Brentano's

[1]This paper is based on my earlier related writings, particularly [15, 16, 17, 19]. It should be noted that I mention mostly logicians specialized in mathematical logic. Logic sensu largo includes semantics, logic sensu strict (formal, mathematical) and methodology of science. Since the borderline between particular branches of logic sensu largo is vague to some extent, my choice of names is somehow arbitrary; see [5, 10, 14] for a wider presentation of logic (sensu largo) in Poland, particularly in the Lwów-Warsaw

student and the founder of the Lwów-Warsaw philosophical school, attracted some of his students to logic. His role in the development of logic in Poland is well described in the following words ([13, 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.

Jan Łukasiewicz (1878-1956), Kazimierz Ajdukiewicz (1890-1963), Tadeusz Czeżowski (1889-1981), Tadeusz Kotarbiński (1886-1981), Stanisław Leśniewski (1886-1939) belonged to Twardowski's students working in various fields of logic. However, their writings were more philosophical than mathematical until the period 1914-1918.

3. In fact, Kraków, not Lwów (Lviv in Ukrainian), became the first serious centre of mathematical logic. Stanisław Zaremba (1863-1942), a distinguished Polish mathematician, had strong interests in logic and the foundations of mathematics. However, influenced by the French style of doing mathematics, he considered logic to be a peripheral branch of mathematics, having only a secondary importance, mainly in teaching mathematicians. The Jagiellonian University in Kraków had a special position in mathematical logic (officially it was one of professorships in mathematics) occupied by Jan Sleszyński (1854-1931). He was the most competent Polish scholar in mathematical logic until 1920s. Sleszyński's lectures in Kraków were quite advanced and referred to Frege, Peano and Principia Mathematica (by Whitehead and Russell; this book is the landmark of mathematical logic until now). Leon Chwistek (1884-1944), another important "logical" figure in Kraków. He tried to continue ideas of Russell, particularly the idea of logical types.

4. Warszawa (Warsaw), the most brilliant place of Polish logic, appeared on the stage in 1915, when the University of Warsaw was reopened after being closed in 1831). Poland recovered its independence in 1918. This also resulted in a great debate about the tasks and prospects of Polish science and academic life, including the development of mathematics. Zygmunt Janiszewski (1888–1920) formulated the famous program of Polish Mathematical School (the Janiszewski program). Roughly speaking, according to Janiszewski, Polish mathematicians should concentrate set theory, topology and their applications to other branches of mathematics. This project (see [6] for more details) was accepted by several leading Polish mathematicians, such as Wacław

Sierpiński (1882-1969), Stefan Mazurkiewicz (1888-1945) and Kazimierz Kuratowski (1896-1980) (all three working in Warszawa) as well as Stefan Banach (1892-1945) and Hugo Steinhaus (1887-1972) in Lwów (see [3][3]. Janiszewski's program attributed a great role to mathematical logic and the foundations of mathematics considered as autonomous branches of mathematics, having its own problems and not dependent on its applications in mathematics or on other practical functions.

5. Janiszewski also postulated that Poland should have a special mathematical journal publishing in main international languages. This idea found its realization in Fundamenta Mathematicae (the first volume appeared in 1920). The significance of mathematical logic in 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, two mathematicians (Mazurkiewicz, Sierpiński) and two philosophers (Leśniewski and Łukasiewicz). This board illustrates well the mentioned fact that Polish logic (or more precisely, the Warsaw School of Logic) had two parents: philosophy and mathematics. In other words, this group could be (and is) regarded as a part of Polish Mathematical School and the Lwów-Warsaw School).

6. The placement of logic and the foundations at the heart of mathematics required definite organizational steps . The University of Warsaw had the Faculty of Mathematical and Natural Sciences. The Department of the Philosophy of Mathematics was very soon organized and Leśniewski became its head. Łukasiewicz left the University in 1918 in order to act as the Minister of Religious Denominations and Public Education in the government under Ignacy Paderewski. He returned as a faculty member in 1919 and the University established for him a special position in philosophy at the Faculty of Mathematics and Natural Sciences. Both professors began intensive teaching of mathematical logic, mostly to mathematicians but also to philosophers (Kotarbiński was another professor who popularized logic among philosophers; also Ajdukiewicz lectured on logic in Warsaw in 1926-1928). Teaching of logic was very intensive in the University of Warsaw; students could attend several general and special courses. The level was very high. For instance, the first volume of Principia Mathematica was recommended as a textbook for advanced students. According to a legend, the entire Principia was read by 6 persons, including 3 Poles. Logic was also intensively taught in secondary school. [11] was written for students at

this level; its translation into English ([12] became an advanced university textbook. [1] and [7] are general textbooks of logic published for students of mathematics of the University of Warsaw.

7. Departments of logic were organized in other Polish universities. New were established in Poznań (1919, Zawirski became the professor in 1924) and Lwów (Chwistek became the professor). Sleszyński's position was cancelled after his retirement in 1924 – a new department (of logic) was founded in the Jagiellonian University in 1937 (Zawirski became the professor). The University of Vilna (Vilnius in Lithuanian) was the only which had no department of logic, although this field was taught by Czeżowski as the professor of philosophy. To compare, Poland had 4-5 departments of (mathematical) logic whereas the only one existed outside this country (Münster – Heinrich Scholz was the professor). Of course, this does not mean that logicians were not present in mathematical or philosophical departments over the world, but Poland was the exceptional country as far as the matter concerns the number of professorships in logic. This circumstance testifies a great prestige of logic in Poland. According to Łukasiewicz, logic is a separate scientific field independent and autonomous of mathematics and philosophy. Although some mathematicians considered this view as exaggerated (in fact, Leśniewski and Łukasiewicz left the editorial board of Fundamenta Mathemathica, probably because their mathematical fellows had a different opinion about the status of logic) it was accepted by most philosophers and logicians in Poland; Kraków was the exception due to Zaremba's view. Anyway, Łukasiewicz organized (in 1936) the Polish Society of Logic, the second after the Association of Symbolic Logic professional organization grouping logicians; the latter – international, but the former – the first national. Łukasiewicz also claimed that Polish logicians should have own journal publishing papers in international languages. The two first volumes of this journal called Collectanea Logica (the second professional logical journal after the Journal of Symbolic Logic) was ready in the autumn of 1939, but the outbreak of the Second World War prevented the final realization of this enterprise – all copies were destroyed and only some off-prints survived (they were earlier distributed). Polish logicians published their works in various journals, mathematical (Fundamenta Mathematicae, Annales de la Société Polonaise de Mathématique, Comptes Rendus des Séances de la Société Scientifique de Varsovie) and philosophical (Przegląd Filozoficzny (Philosophical Review), Kwartalnik Filozoficzny (Philosophical

Quarterly) and Ruch Filozoficzny (Philosophical Movement)).

8. Alfred Tarski (1901-1983) opened the list of young mathematicians and philosophers attracted by logic in Warszawa. The logical community in this city included (in alphabetical order and covering the whole interwar period: Stanisław Jaśkowski (1906-1965), Adolf Lindenbaum (1904-1941?), Andrzej Mostowski (1913-1975), Moses Presburger (1904?-1943), Jerzy Słupecki (1904-1984), Bolesław Sobociński (1904-1980; a philosopher by training)) and Mordechaj Wajsberg (1902-1942?). The names of three other of logicians who graduat-ed shortly before 1939 or studied during War World II and began their academic work after 1945 should be added to this list, namely Jan Kalicki (1922-1953; a mathematician), Czesław Lejewski (1913-2001; a classicist and philosopher) and Henryk Hiż (1917; a philosopher). The development of logic in Warszawa had two sub-periods in 1918-1939, namely 1918-1929 and 1929-1939. The first decade consisted in intensive teaching and scientific work at the seminars of Leśniewski and Łukasiewicz, but the second period brought important publications period and international recognition; Polish logicians, mostly from Warszawa, took part in many philosophical and mathematical conferences, notably in events organized by the Vienna Circle in the 1930s. The fruitful co-operation (independently of some mentioned misunderstandings) of mathematicians and philosophers in Warszawa had the utmost significance for the shape of logic in this place. The founders of the Polish mathematical school made a brave experiment consisting in inviting two philosophers with a modest mathematical background as professors at the Faculty of Mathematics and Natural Sciences; this did not happen in any other country.

9. Mathematicians in Lwów tolerated mathematical logic in a friendly way but did not consider it to be something central in mathematics. At first, Ajdukiewicz, as an associate professor and then professor of philosophy conducted courses in mathematical logic, but Chwistek took over this role after his appointment as the professor of logic. Chwistek brought some people from Kraków; in particular, Władysław Hetper (190?-1941?) should be mentioned. The group of Lwów logicians included also Józef Pepis (190?-1942?, a mathematician), Zygmunt Schmierer (1910-1943; a philosopher) and Eustachy Żyliński (1880-1954, a mathematician).

The position of logic in Kraków gradually decreased, which is illustrated by cancelling Sleszyński's position. The story of logic in this

academic community was related to the already mentioned attitude of Zaremba, who did not accept the Janiszewski program and considered logic as located at the peripheries of mathematics. On the other hand, Witold Wilkosz (1891-1941), a mathematician, worked in logic and the foundations of mathematics, especially in set theory. Zbigniew Jordan (1911-1977) was trained by Zawirski in Poznań; the acitivities of the latter in Kraków were too short to give educational results. Zawirski moved to the Jagiellonian University in 1937, but as a professor of philosophy, not logic. Logic at the University of Wilno (now Vilnius in Lituania) was popularized by Czeżowski as a professor of philosophy (mathematicians in Wilno were not particularly interested in logic). Although logic had no significance in the Catholic University in Lublin (established in 1919), two Thomists, namely Father Józef M. Bocheński (1902-1995) and Father Jan Salamucha (1904-1944) were logicians. The former lived in Italy and Switzerland, while Salamucha taught in Kraków at the Theological Faculty. This brief survey shows that Polish logical community was numerous: mathematical logicians were present in all Polish academic centres, philosophical as well as mathematical ones.

10. Łukasiewicz considered logic as "morality of thought and speech". In general Polish logicians maintained that although logic gives no recipe for various tensions in the world , it may contribute to its improvement by helping people to understand each other. Thus, according to this view, doing logic and teaching it resulted in an important social service. Perhaps this explains to some extent the passion which was a characteristic feature of the logical research done in Poland. This passionate attitude to logic eliminated to some extent various political and social differences and tensions among logicians in Warszawa. In fact, the Warsaw School of Logic, although unified by the common scientific enterprise, was quite differentiated from the sociological point of view. Some of its members, Lindenbaum, for instance, came from rich families, others, such as Tarski or Presburger, had serious financial difficulties. Lindenbaum shared communist views, but Leśniewski, Sobociński and Łukasiewicz supported conservatism. Łukasiewicz, twice elected as Rector Magnificus, belonged to the top academic VIPs, but Wajsberg worked as a modest teacher in a Jewish secondary school. Tarski, Lindenbaum, Presburger and Wajsberg were Jews, but Leśniewski and Sobociński (later also Łukasiewicz) were radical anti-Semites. "Religion divides people, logic unifies them" (it can be generalized to other worldviews, political, etc.)– as Tarski nicely expressed Polish attitude to the

social function of logic.

11. The years 1939-1945 were tragic for Poland. As far as logicians are concerned, Leśniewski died in 1939, a few months before the outbreak of the war, Wilkosz in 1941, Zaremba in 1942, Chwistek in 1944, a few months before its end. Herzberg, Lindenbaum, Pepis, Presburger, Skarżeński, Salamucha, Schmierer and Wajsberg were killed by the Nazis (some dates are uncertain, hence the question marks somewhere), Hetper perished in the Soviet Union. The outcome was even more tragic, because many young and promising scholars and students lost their lives. Tarski left Poland in August 1939, Łukasiewicz in 1944, and the same happened during the war or shortly after its end to Hiż, Jordan, Kalicki, Lejewski and Sobociński. Bocheński remained abroad. Zawirski died in 1948. Poland restored its academic life very soon after 1945 and logic returned as a very respectable subject of research and teaching in the country. Polish logicians working abroad after 1945, particularly Tarski, essentially contributed to the development of logic in many countries. Ajdukiewicz, Czeżowski, Jaśkowski, Kotarbiński, Mostowski and Słupecki remained in Poland and continued the golden pre-war period of Polish logic.

12. The brief summary of Polish achievements of logic in the period 1918–1939 includes:

(a) many-valued logic (Łukasiewicz, Tarski, Lindenbaum, Sobociński, Słupecki, Wajsberg);

(b) works in classical propositional logic (Łukasiewicz, Tarski, Sobociński,Wajsberg);

(c) natural deduction (Jaśkowski);

(d) intutionistic logic (Jaśkowski, Tarski, Wajsberg);

(e) the semantic theory of truth (Tarski, perhaps the most celebrated achievement of Polish logic);

(f) general metamathematics (Tarski, Lindenbaum, Wajsberg);

(g) special metamathematics and the foundations of arithmetic, geometry and algebra (Tarski, Lindenbaum, Presburger, Wilkosz, Pepis);

(h) set theory and its foundations (Tarski, Lindenbaum, also with collaboration of Sierpiński and Kuratowski);

(i) Leśniewski's system (Leśniewski, Tarski, Sobociński);

(j) Chwistek's systems (theory of constructive types, rational semantics – Chwistek, Hetper, Herzberg, Skarżeński);

(k) theory of syntactic categories (Leśniewski, Ajdukiewicz);

(l) the history of formal logic (Łukasiewicz, Bocheński, Jordan, Salamucha, Sleszyński; in particular, Łukasiewicz completely changed the approach to the history of logic by his claim that old logic should be investigated through the lenses of contemporary logic).

In general, Polish logicians insisted that logic should be done without presupposing any particular philosophical standpoint, in particular, logicism, formalism or intutionism, that is, the main currents in the philosophy of logic and mathematics at that time. Only Leśniewski and Chwistek based their systems on definite philosophical positions, roughly speaking close to logicism but supplemented by nominalism. The general view mentioned was characteristic for Polish Mathematical School. The attitude toward the axiom of choice is perhaps a good illustration in this respect. This axiom was controversial among mathematicians – some accepted it, other rejected due to its non-constructive character. According to Poles (Sierpiński was the main exponent of this attitude), the axiom of choice is a normal mathematical assertion and its role in mathematics should be investigated independently of philosophical quarrels around it. Consequently, all mathematical methods, finitary or not, are admissible in logical investigations, particularly in metamathematics. Hence, Polish logicians contributed to logicism (works in set theory), formalism (works in general metamathematics) or intuitionism (works in intuitionism) without feeling obliged to accepting philosophical backgrounds of these currents. On the other hand, some important Polish logical discoveries were motivated by philosophy, for example, Łukasiewicz's many-valued logic by the problem of determinism or Tarski's theory of truth – by the classical truth-definition going back to Aristotle. According to most Polish logicians, logic as a specialized field, does not force any concrete philosophical view. Consequently, they had various, so to speak "private" philosophies, for instance, Łukasiewicz was a Platonist, but Tarski was a nominalist. Philosophical freedom in Polish logic can be regarded as having a great significance for successful logical investigations. On the other hand, Polish logicians had great hopes that logic could improve philosophy by introducing to it rigour and scientific method.

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Logika matematyczna w Polsce (1918–1939)

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Streszczenie. W latach 1918-1939 Polska stała się jednym z głównych światowych ośrodków logiki mtematycznej. Artykuł przedstawia powstanie logiki w Polsce, polskie centra, organizacje i czasopisma logiczne oraz osiągnięcia polskich logików.

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