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The logic of the nation: Nationalism, formal logic, and interwar Poland

Abstract

Between the World Wars, a robust research community emerged in the nascent discipline of mathematical logic in Warsaw. Logic in Warsaw grew out of overlapping imperial legacies, launched mainly by Polish-speaking scholars who had trained in Habsburg universities and had come during the First World War to the University of Warsaw, an institution controlled until recently by Russia and reconstructed as Polish under the auspices of German occupation. The intellectuals who formed the Warsaw School of Logic embraced a patriotic Polish identity. Competitive nationalist attitudes were common among interwar scientists – a stance historians have called "Olympic internationalism," in which nationalism and internationalism interacted as complementary rather than conflicting impulses.

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One of the School's leaders, Jan Łukasiewicz, developed a system of notation that he promoted as a universal tool for logical research and communication. A number of his compatriots embraced it, but few logicians outside Poland did; Łukasiewicz's notation thus inadvertently served as a distinctively national vehicle for his and his colleagues' output. What he had intended as his most universally applicable invention became instead a respected but provincialized way of writing. Łukasiewicz's system later spread in an unanticipated form, when postwar computer scientists found aspects of its design practical for working under the specific constraints of machinery; they developed a modified version for programming called "Reverse Polish Notation" (RPN). RPN attained a measure of international currency that Polish notation in logic never had, enjoying a global career in a different discipline outside its namesake country. The ways in which versions of the notation spread, and remained or did not remain "Polish" as they traveled, depended on how readers (whether in mathematical logic or computer science) chose to read it; the production of a nationalized science was inseparable from its international reception.

Keywords: *mathematical logic*, *Polish logic*, *Jan Łukasiewicz*, *Warsaw School of Logic*, *Polish notation*, *reverse Polish notation*, *olympic internationalism*, *nationalism*, *interwar science*

Logika narodu: Nacjonalizm, logika formalna i międzywojenna Polska

Abstrakt

W okresie międzywojennym w rodzącej się dyscyplinie logiki matematycznej w Warszawie wyłoniła się silna społeczność badawcza. Logika w Warszawie wyrosła w wyniku nakładających się na siebie imperialnych spuścizn, dzięki działaniom głównie polskojęzycznych uczonych, którzy kształcili się na uniwersytetach habsburskich i przybyli w czasie I wojny światowej na Uniwersytet Warszawski, instytucję kontrolowaną do niedawna przez Rosję i zrekonstruowaną jako polską pod auspicjami niemieckiego okupanta. Intelektualiści, którzy tworzyli Warszawską Szkołę Logiki, przyjęli patriotyczną polską tożsamość.

Konkurencyjne postawy nacjonalistyczne były powszechne wśród naukowców międzywojennych – stanowisko, które historycy nazwali „internacjonalizmem olimpijskim", w którym nacjonalizm i internacjonalizm oddziaływały jako impulsy raczej wzajemnie się uzupełniające niż sprzeczne.

Jeden z liderów Szkoły, Jan Łukasiewicz, opracował system notacji, który promował jako uniwersalne narzędzie do badań i komunikacji w logice. Wielu jego rodaków przyjęło ten system notacji, ale niewielu logików poza Polską. W ten sposób notacja Łukasiewicza nieumyślnie posłużyła jemu i jego współpracownikom jako narzędzie specyficznie polskie. Wynalazek, który w zamyśle miał być najbardziej uniwersalną formą zapisu, stał się szanowanym, lecz zrozumiałym tylko w kraju narzędziem. System notacji Łukasiewicza później rozprzestrzenił się w nieprzewidzianej formie, gdy powojenni informatycy zdali sobie sprawę z praktycznej użyteczności jego aspektów do pracy w specyficznych uwarunkowaniach maszynowych i opracowali zmodyfikowaną wersję tej notacji do programowania o nazwie „Reverse Polish Notation" (RPN). RPN osiągnął miarę waluty międzynarodowej, której nigdy nie miała polska notacja w logice, ciesząc się globalną karierą w innej dyscyplinie poza krajem jej imiennika. Drogi, w jakich wersje tej notacji rozprzestrzeniły się i pozostały lub nie pozostały „polskie" podczas tej podróży, zależały od tego, jak czytelnicy (zajmujący się logiką matematyczną albo informatyką) postanowili czytać tę notację; tworzenie znacjonalizowanej nauki było nierozerwalnie związane z jej międzynarodową recepcją.

Słowa kluczowe: *logika matematyczna*, *polska logika*, *Jan Łukasiewicz*, *Warszawska Szkoła Logiki*, *notacja polska*, *odwrotna notacja polska*, *internacjonalizm olimpijski*, *nacjonalizm*, *nauka międzywojenna*

1. Introduction

Between the world wars, what it meant to study logic in European learned culture was in the midst of a profound transformation. In place of the figures and moods of Aristotelian syllogism, still widely taught at nineteenth-century universities and *Gymnasien*, philosophers came to see axioms, theorems, and proofs as the building blocks of a logic now understood in fundamentally mathematical terms, and written in accordingly technical symbolism. This approach to logic would shape

postwar European intellectual history through its decisive influence on the so-called analytic tradition in philosophy. Mathematical logic's practical consequences were even more far-reaching as it eventually came to undergird the technology of digital computing.[1] Such ramifications were as yet little imagined in mathematical logic's heyday, however; its formative works concerned the abstract methodological foundations of science and mathematics. No single institution or nation could claim uncontroversial preeminence in the nascent discipline; its progenitors were dispersed across western Europe and the northeastern United States, and local disciplinary centers coalesced only gradually.

In its first two decades as the capital of an independent modern state, Warsaw emerged as the home to what was arguably mathematical logic's most robust research community. Similarly to the Second Polish Republic (1918–1939), the "Warsaw School of Logic" was born of the First World War. The School was composed of academic talent that the German occupiers had gathered in formerly Russian Warsaw from across the Polish-speaking lands held at that moment by the Central Powers, uniting at one site researchers trained in several different (and soon defunct) empires. These scholars made an intellectual home at Warsaw University, an institution consolidated by a Polish state eager to stabilize higher educational infrastructure and assert scientific prowess.[2] The study of logic in Warsaw was the fruit of overlapping

[1] Classic accounts of the rise of mathematical logic can be found in Kneale, Kneale 1962; Bocheński 1961; Grattan-Guinness 2000. An extensive recent overview can be found in Gabbay, Woods (eds.) 2004, especially volumes 3–5. The history of analytic philosophy has recently become an active field of research; for orientation, see Michael Beaney (ed.) 2013. Michael Mahoney influentially characterized the history of computing as a pair of separate histories that only united in the mid twentieth century: a history of hardware for calculation on one hand and an intellectual history of mathematical logic on the other; Mahoney 1988. For an account that emphasizes the role of mathematical logic over engineering developments, see Davis 2000 and for a more skeptical view of logic's role, Priestley 2011, especially chapter 6. Matthew Jones has recently challenged the sharpness of Mahoney's bifurcation, arguing that histories of hardware and logic "intersected time and again – not of necessity, but contingently." Jones 2016, p. 11.

[2] Robert Fox has recently argued that the interwar saw a rapid increase in the cultural importance of scientific achievement for national governments, part of what he calls "a 'national turn' in science." Fox 2016, p. 75; see also Fox 2017; Fox and Kokowski 2017.

imperial legacies, launched mainly by Polish-speaking scholars trained in Habsburg universities operating under German occupation in a space controlled, until recently, by Russia. Steeped as they were in multiple imperial traditions, the intellectuals who formed the Warsaw School of Logic fashioned for themselves a unabashedly Polish identity. Like many institutions in independent Poland, the School was enthusiastically patriotic.

The historiography of Central and Eastern Europe has recently made a welcome departure from its traditional preoccupation with nationalism; far from wishing to arrest that trajectory, my aim here is to contribute to the growing literature that complicates our picture of how concepts of nation are deployed in practice. We have learned that places and people in the supposed age of nationalism were far less nationalized than once assumed: borderlands were everywhere, as were citizens (especially peasants) who responded to the idea of nation with utter indifference.[3] Among the Warsaw logicians – patriotic elites working in a national capital – we find national ambiguity not of place or personal identification but of scientific practice. The Polish intelligentsia were convinced they urgently needed to promote Polish science; but, to put the question somewhat naively: how Polish was their research? Such a query recalls an older historiographic tradition that analyzed "national styles" of science.[4] Whereas that literature applies nationality as an analytic category for studying historical scientific work, I aim here to interrogate the process by which a given work or practice takes on (or fails to take on) a perceived national character in its own time. Bracketing the question of whether there *is* such a thing as Polish logic, I examine how people came to *speak* of "Polish logic" and to what effect.

In the wake of the First World War, patriotic scientists across Europe eagerly sought nationally inflected international recognition. Though the competitive nationalist character of interwar science – what has

[3] See in particular Brown 2004; Zahra 2010; Judson 2013; Ciancia 2017.

[4] A classic example is the French physicist, philosopher and historian of science Pierre Duhem (1861–1916), who cast the development of early modern science and philosophy in terms of an "opposition of the French genius and English genius [that] is observed in every work of the mind." Duhem 1954, p. 67. For a less dated application of the "national styles" analytic, well grounded in a comparative study of institutions, see Harwood 1987.

been called "Olympic internationalism" – is well documented, logicians rarely figure in such narratives, with some of logic's most visible figures being outspoken pacifists whose internationalism rejected rather than complemented nationalism.[5] Not so in Warsaw, where the leading logicians explicitly connected their abstract research to the prestige and even material power of their young state. They succeeded in gaining international recognition for a distinctly Polish logic, but their success took a form quite outside their control, revealing a central tension in the Olympic internationalist project: how could a scientific practice inspire international emulation and retain a national identity?

As the Warsaw School's researches expanded, one of its leading figures, Jan Łukasiewicz (1878–1956), began to promote a new system of notation for mathematical logic. With several such systems already competing for use in logical publications, Łukasiewicz argued that none of them achieved the simplicity, clarity, and brevity of his "parentheses-free symbolism." His notation – like its competitors – aspired to universality; if only logicians everywhere could agree to write the same way, the resulting convenience would accelerate the practice of research and the communication of results. At a time when the hegemony of a single national language in scientific publication remained unlikely and, to most scientists, undesirable, standardizing technical symbolism represented an urgently needed kind of universal language.[6] Łukasiewicz presented his notation as precisely such a vehicle for the international progress of logic. A number of his compatriots embraced it readily, but few logicians outside Poland ever adopted the system, even as they increasingly acknowledged the vibrant work coming out of Warsaw. Instead, Łukasiewicz's notation became a distinctively national vehicle for his and his colleagues' output. The system he had intended as his most universally applicable invention became instead a respected but provincialized way of writing. In contrast to an implicitly critical provincializing that scientists have sometimes adopted as a rhetorical strategy to

[5] The analogy to the modern Olympic games is due to Forman 1973, especially pp. 153–56. For a more extensive development of "Olympic internationalism" in science, see Somsen 2008, pp. 365–367. The most prominent pacifist logician was Bertrand Russell; see Vellacott 1980.

[6] On the quest for a universal auxiliary language for science, see Gordin 2015, chapter 4.

minimize their rivals, Łukasiewicz's foreign readers seemed genuinely to respect his notation; they simply did not use it.[7] In his notation's failure as an export, his nationalism found its greatest victory: even when the Warsaw School published in languages more widely read than their native Polish, their notation retained its foreignness for readers to the west, presenting through its typography an immediately legible national provenance, eventually known simply as "the Polish notation."

In this process of reception there existed a tension that was absent for Polish logicians themselves. To pursue national achievement in a science, while construing the content of that science as universal, was hardly contradictory. But when scientists understand achievement as consisting in winning not just readers but followers, foreign reception takes on decisive significance. Having sought mere acknowledgment of the Polish origins of a practice available for wide emulation, Łukasiewicz instead won for his notation international admiration of a practice seen as distinctly and essentially Polish. The production of a nationalized science was inseparable from its international reception. Polish logicians were comfortably committed both to universal science and to national particularity. In the transnational process of reception, these commitments became conflicting impulses. Whether a universal or nationalized interpretation of Warsaw's researches prevailed depended as much on readers of Polish science abroad as on Polish logicians' own loyalties and ambitions.

2. A university rebuilt

The Warsaw School of Logic had its origins in the nationalist aspirations of Polish intellectuals during World War I. Various Polish elites had longed for restored independence ever since the Partitions of

[7] In one of the history of science's classic controversies, for example, when the French chemist Antoine-Laurent Lavoisier (1743–1794) claimed to be performing the universal work of "reforming and completing the Nomenclature of Chemistry," his English opponent Joseph Priestley (1733–1804) referred to Lavoisier's system rather disdainfully as "that of the *French*." Lavoisier 1965, p. xiii; Priestley 1796, p. 35. However, Lavoisier's nomenclature ultimately achieved a far more successful diffusion than did the logical notation considered in the present paper. See Bensaude-Vincent, Abbri (eds.) 1995.

1772, 1793, and 1795 divvied up the Polish–Lithuanian Commonwealth among Russia, Prussia, and Austria. (Less often translated as the Polish–Lithuanian Republic, that dismembered state was the predecessor after which the interwar Polish Republic styled itself "Second.") Originally an aristocratic cause, by the turn of the twentieth century Polish patriotism found its most fervent supporters among the intelligentsia. The Polish *inteligencja* is a more capacious concept than its English cognate, encompassing not only poets and philosophers, but also educated professionals such as engineers and doctors. This class exerted immense influence on Polish cultural life in the decades leading up to the Great War and in the Second Republic.[8] With the onset of war in 1914, many members of the Polish intelligentsia saw an opportunity to realize their dreams of reunification and independence. As the armies of the partitioning powers battled for control of central and eastern Europe in the opening years of the war, local elites – not least philosophers and mathematicians – sought opportunities for state-building under the auspices of various occupying regimes.

Polish-language philosophy had already begun to flourish in the decades leading up to the First World War at the University of Lemberg (soon to become Polish Lwów, today Ukrainian L'viv) in Austrian Galicia.[9] In 1895 Kazimierz Twardowski (1866–1938), a Vienna-born Pole who had been a student of the influential philosopher Franz Brentano (1838–1917) and received his doctorate in Vienna in 1891, was appointed extraordinary professor at Lemberg. The approach to philosophy Twardowski had imbibed in Vienna is well encapsulated by Brentano's oft-quoted fourth Habilitation thesis: "The true method of philosophy is none other than that of the natural sciences."[10] When Twardowski set off for Polish-speaking Habsburg lands, he went with a feeling of being "called to bring the style of philosophizing I had been

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[8] Żarnowski 2003; Polonsky 1972, pp. 28–32. On the intelligentsia's ascendance as the voice of fin-de-siècle Polish nationalism, see Porter-Szűcs 2014, pp. 45–46.

[9] As this city lacks a standard English name, I refer here to Lemberg when discussing the city under Habsburg rule, and Lwów in the context of the Second Polish Republic, opting to convey the experience of inconstancy that changing linguistic sovereignty entailed.

[10] Brentano 1968, pp. 136–37. On Brentano's influence in Poland through Twardowski, see Dąmbska 1978. For an introduction to Brentano, see Jacquette (ed.) 2004.

taught by Brentano to my countrymen, especially to induct the academic youth into the spirit and method of this philosophy."[11] In comparison with Russian and German authorities in their respective parts of the former Polish–Lithuanian Commonwealth, the Austro-Hungarian Empire granted its Polish population considerable autonomy, including Polish-language universities operating in Lemberg and Cracow. Indeed Twardowski found fertile ground for his ambitions to found Polish philosophy anew on scientific grounds. His arrival in Lemberg marks the beginning of what is known as the Lwów–Warsaw School of philosophy, a constellation embracing philosophers of all kinds, encompassing the Warsaw School of Logic and adjacent to the Warsaw and Lwów Schools of mathematics.[12] The taxonomic intricacies of these overlapping schools need not detain us here; it is worth noting simply that historical actors' interest in these labels is itself evidence of their commitment to branding their intellectual work as the product of specific places, and an example of the heightened local and regional identities that often accompany nationalism.[13]

The Warsaw School of Logic's principal founders were Jan Łukasiewicz and Stanisław Leśniewski (1886–1939). The philosopher Tadeusz Kotarbiński (1886–1981) focused less on formal logic, but he served as another pillar of the School's community. All three had been Twardowski's students in Lemberg. Though Twardowski never specialized in mathematical logic himself, for years he offered lectures that introduced the subject to a generation of Polish philosophy students – among them Łukasiewicz, who in 1910 published a monograph on the principle of contradiction in Aristotle that included, as an appendix, the first Polish-language primer on mathematical logic.[14] By the 1930s,

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[11] Twardowski 1991, p. 14.

[12] The standard history is Woleński 1989; see especially chapter 4. Largely thanks to Woleński's impetus, the literature has begun to grow rapidly. See, among others, Brożek, Stadler, Woleński (eds.) 2017; Jadacki 2015; Murawski 2014. For a historical study focused on Łukasiewicz in particular, see Rickey 2011.

[13] E.g. on the affinity between German nationalism and the more localized concept of *Heimat*, see Applegate 1990.

[14] Woleński 1989, pp. 82–83; Łukasiewicz 1910. On the connections between Łukasiewicz's philosophical commitments and the logical research that came to dominate his academic career, see Surma 2012.

Leśniewski and Łukasiewicz's student in Warsaw Alfred Tarski (1901––1983) would become the School's most famous member internationally. When combat ignited along the Eastern Front in August 1914, Tarski was still a year away from entering *gimnazjum*. Kotarbiński had recently returned to his hometown of Warsaw, still part of the Russian Empire, where he taught Latin at a secondary school. Leśniewski had just finished a one-year stint teaching mathematics at a girls' boarding school in Warsaw; upon the outbreak of war he departed for Moscow where he again taught mathematics. Łukasiewicz, extraordinary professor in Lemberg since 1911, lived in the Austrian empire with which his former and future colleagues' native Romanov empire was suddenly at war.[15] That the logicians ascendant in Warsaw after the war were mainly trained in Habsburg Lemberg can be seen in part as a triumph of one imperial heritage over another, without denying that the logicians themselves identified with Poland over any of the fallen empires.

The Russian army entered Lemberg on 3 September 1914. Despite the relative autonomy Austrian Galicia had long enjoyed, many of the city's Polish residents welcomed Russian occupation in hopes that it was a step toward restored independence. Looking back in 1949, Łukasiewicz had "the best recollections" from this stage of the war. "The peace was total" as the Russians took control, he reminisced, and they allowed local leaders to continue running the city. That year Ukraine enjoyed a bumper crop that the war prevented the Russians from shipping farther afield, "so large sacks of the whitest flour, plenty of fruit, vegetables, and in particular dried fish were brought to Lemberg. Cafes and tea shops sprang up like mushrooms after the rain. Lemberg was probably never so copiously supplied with food as in the winter of 1914–1915."[16] He nostalgically painted a one-sided picture of an occupation that also involved arrests, surveillance, and particularly violence against Jews, along with efforts at Russification and shortages of various goods other than food. But if the sincere popularity of the occupation eludes reliable measurement, at least the relative stability, ample food supply, and vibrant café scene Łukasiewicz recalled are

[15] Feferman, Feferman 2004, p. 17; Kotarbiński 1990, pp. 1–6; Leśniewski 2015; Łukasiewicz 2013, p. 11.

[16] Łukasiewicz 2013, pp. 17–18.

well corroborated.[17] More importantly, his nostalgia shows the sense of possibility that accompanied the clash of empires for the city's inhabitants, whose diverse loyalties often eclipsed identification with any of the belligerent powers. Thus, peace and abundance under the Russians notwithstanding, Łukasiewicz recalled a "population frenzied with joy" when the Austrians retook the city on 22 June 1915, only to enter a period of "harsh military rule."[18]

In contrast to the thriving Polish intellectual scene at the University of Lemberg, the Imperial University in Tsarist Warsaw had been a Russian-language institution since 1869. After the Revolution of 1905 a boycott effectively ended Polish involvement. This boycott persisted during the war, as witnessed by a circular dated June 1915 asserting that "the school question … can only be settled after the final reckoning with the partitioners" and vowing that the "national youth of the secondary schools" would spurn the city's university until it became "completely Polish."[19] Polish academic life took place not in the university but in two newly formed organizations, the Society for Scientific Courses and the Warsaw Scientific Society. Kazimierz Kuratowski, one of interwar Warsaw's leading mathematicians, credited the vitality of academic life in independent Poland to the nationalist spirit of the scholars who had lived under this final, harshest phase of Partition. The Russian failure to stifle Polish scientific activity, he claimed in 1973, was "due to the deep patriotism of our society which saw clearly that the cultivation of learning – especially during a time of foreign rule – was of immense importance for the preservation of national identity."[20]

If the "national youth" demanded "completely Polish" schools, that label did not necessarily entail immediate political independence. The activists of the Society for Scientific Courses that had been scheming to rebuild Polish education since 1905 were perfectly willing to cooperate with non-Polish authorities. In early 1915 some of these scholars formed a committee to plan more concrete steps; their organization

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[17] Mick 2016, pp. 23–62.

[18] Łukasiewicz 2013, p. 18.

[19] Manuscripts Department, Library of the University of Warsaw, Historical-Political Materials from the Period of the First World War, manuscript 1749, item 13: Młodzież Narodowa Szkół Średnich, call to boycott the Russian schools and universities.

[20] Kuratowski 1980, p. 15.

soon morphed into the Higher Education Section of the Warsaw Civic Committee, one of a network of patriotic (but officially loyalist) administrative groups that mobilized in Russian Poland at the outbreak of war. The Russians, however, were on the defensive. They evacuated Warsaw in the summer of 1915, taking with them the Imperial University personnel who had never constituted a legitimate University of Warsaw in the eyes of the Polish elites who took control of the vacated campus. Hence when the Kaiser's forces entered the city on 5 August 1915, the Poles already had physical possession of the university and well developed plans for its reopening.[21]

The German occupation regime, known as the Government General of Warsaw and run by governor-general Hans Hartwig von Beseler, happily supported their efforts. Beseler believed it was in Germany's best interest to encourage expressions of Polish culture and even partial autonomy, first simply to achieve wartime stability and, as the occupation wore on, with an eye toward fashioning a postwar Polish state that would remain securely within the German sphere of influence.[22]

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[21] Kauffman 2015, pp. 165–166. On the Civic Committees in general, see *ibid.*, 27.

[22] The standard history is still Conze 1958. After remaining understudied for decades, Beseler's Government General has recently captured scholarly attention. Whether this German regime in Warsaw should be interpreted as a comparatively benign occupation or seen in substantial continuity with the National Socialist occupation a quarter century later has become a topic of ongoing debate. In an influential study of Ober Ost (the contemporaneous German occupation regime in the Baltic and Belarusian lands east of the Government General), Vejas Gabriel Liulevicius has argued that experiences on the eastern front provided German soldiers with "an indispensable cultural and psychological background for what came later in the violent twentieth century, a preexisting mentality" that informed the National Socialist attitude toward the east; Liulevicius 2000, p. 1. As Liulevicius acknowledges, however, military-run Ober Ost was quite unlike the Government General. Jesse Kauffman, grouping Liulevicious with the *Sonderweg* tradition of reading a pathological continuity in German history from *Kaiserreich* to Third Reich, has objected that Beseler's regime was rather a genuine state-building project that bears little meaningful connection to the nightmare of the Nazi occupation of Poland; Kauffman 2015, pp. 4–8. Robert Blobaum, aiming to sidestep a debate he sees as neglecting the perspective of the occupied for that of the occupiers, nonetheless counters Kauffman by insisting that the two German occupations of Warsaw – as experienced by non-Jewish Poles and excluding the Uprising of 1944 – were indeed comparable and in some ways the first was even harsher; Blobaum 2017, pp. 62–64. From the specific perspective of the Warsaw School of Logic, the

To this end Beseler's representatives and the Polish Higher Education Section collaborated on concrete plans for the university, negotiating thorny issues such as faculty composition. Presumably wary of undue Austrian influence in his territory, Beseler limited the number of hires from the Habsburg Polish universities, but did not block them entirely.[23] Ultimately the Polish and German sides agreed on an inaugural faculty. They assembled a cohort of promising young Polish scholars that spanned the lands currently held by one of the Central Powers to fill the posts of the new – or rather newly Polish, under German auspices – university.

Łukasiewicz had just given his first lecture of the fall 1915 semester in Lemberg when he was offered a lectureship in Warsaw. Twardowski, serving as the University of Lemberg's rector at the time, informed him "in the name of the Austrian government" of the offer. Łukasiewicz would later insist upon the agency of the Polish Civic Committee whose Higher Education Section had hired him as a lecturer, his pride apparently untroubled by the committee's collaboration with an occupation regime. In his memoirs he pointedly noted, "It was not the Austrian government, as Twardowski had said, but only the Polish Committee formed in Warsaw that called me up to the lectureship at the university."[24] Beseler would likely have been pleased to see the Austrians thus dismissed, and the German occupiers conveniently overlooked. Łukasiewicz arrived in Warsaw on 15 November, the day of the university's opening ceremony. He began lecturing in philosophy at the end of that November, alongside Władysław Tatarkiewicz, another philosopher associated with the Lwów–Warsaw School.[25] Their wartime activity would, in retrospect, appear to lay foundations for a school of formal logic in Warsaw. When the German army mutinied in November 1918 and Polish paramilitary forces rose to meet them for a remarkably

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two occupations carried precisely opposite meanings: the first meant birth, the second death. There is no question of continuity. But that perspective should not be taken as weighing seriously on the larger debate: an occupation's effect on the intellectual output of a group of professors is obviously not a morally adequate gauge of its historical significance.

[23] Kauffman 2015, pp. 168–169.

[24] Łukasiewicz 2013, pp. 18–19.

[25] *Ibid.*, p. 20.

peaceful transfer of power, numerous Polish governmental and in particular academic bodies had already been operating in some form for several years.[26]

By the time he arrived in Warsaw, Łukasiewicz had come to connect his logical research quite explicitly to a nationalist project. Writing in May 1915, still in Lemberg, he waxed patriotic in the conclusion of a lengthy review essay. He emphasized the need for "scholars thoroughly acquainted with contemporary formal logic" in every branch of science, and proclaimed:

> I desire above all that such scholars would be found in *our* nation. Science in the hands of man is not only a weapon against the elements of nature, but also against man. Nations struggle for existence against other nations. The nation best armed with the power of science has the greatest chance of victory. To try to improve and organize science, and thereby to facilitate accessible acquisition of its knowledge, is to work not only for the progress of human learning but also for the good of the nation.[27]

These are lofty stakes for a book review. (The book was Stanisław Zaremba's *Theoretical Arithmetic*.[28]) We might be tempted to read this rhetoric as a performance of national loyalty that was connected only loosely to any serious belief in some material efficacy of logic. More broadly, however, Łukasiewicz's writings seem to reflect a conviction that logic would provide practical service to society and to the state. Still in 1936 he defended his discipline by invoking the intractability of "social and economic phenomena" and asserting that "when knowledge of [mathematical logic], and the capacity for precise thought that is its result, spreads to all scientific workers, we will overcome the

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[26] On the final collapse of the German occupation regime, see Kauffman 2015, pp. 210–213. This transfer of power is usually narrated as a moment of triumph in Polish history; for a contrasting account that underscores the hunger, disease, and heightened social tension afflicting Warsaw in November 1918, see Blobaum 2017, pp. 231–244.

[27] Łukasiewicz 1916, p. 70; emphasis in the original.

[28] Zaremba 1912.

methodological deficiencies of these most difficult sciences concerning man and human society."[29]

Meanwhile, during the war, it was pure mathematics rather than mathematical logic that enjoyed the earliest institutionalization in occupied Warsaw. The young mathematicians Stefan Mazurkiewicz and Zygmunt Janiszewski were among the university's inaugural faculty. By 1917 they were leading a seminar on the nascent branch of mathematics known as topology; Kazimierz Kuratowski, their student at the time, claimed it was probably "the first [seminar] in the history of mathematics in that new, exuberantly developing field."[30] That exuberant novelty played a strategic role. As the war drew to a close, a scientific–philanthropic organization called the Mianowski Foundation launched a journal titled *Polish Science, its Needs, Organization, and Development* (*Nauka polska, jej potrzeby, organizacja i rozwój*), which continued through 1938.[31] In the first volume, Janiszewski laid out a precise programme for Polish mathematics. His plan consisted in concentrating Polish mathematical efforts in a narrow branch of mathematics, one in which other nations did not yet have a clear advantage over Poland, in order to foster a world-class research atmosphere in a specialized domain. He called for a new journal that would publish papers only in that sub-discipline, arguing that such a degree of specialization, uncommon in journals at the time, would allow mathematicians to keep up with the most relevant articles more efficiently. That such narrow focus was unprecedented created an opportunity for Polish mathematicians: "here opens for us a field of operations, and the project takes on an entirely different significance: we have in mind *the securing of a self-reliant position for Polish mathematics*."[32] Moreover, the journal would court international readers and contributors by publishing only in the international languages of mathematics (defined by Januszewski as English, French, German, and Italian). The journal *Fundamenta Mathematicae* launched in 1920 and realized Janiszewski's vision to a remarkable

[29] Łukasiewicz 1961, p. 208.

[30] Kuratowski 1980, p. 22.

[31] On the trajectory of the journal's content over the course of its publication, see Wrona 2004.

[32] Janiszewski 1918, p. 15.

degree: it became one of the world's leading journals for topology and set theory, and quickly earned Polish mathematicians international fame. Sadly the visionary himself did not live to see his project come to fruition, having succumbed to the Spanish flu at the beginning of that same year.[33]

The flourishing mathematical community fostered interest in mathematical logic and provided a natural context for its institutional growth. Leśniewski and Kotarbiński obtained professorships in philosophy in 1919. Philosophers and mathematicians worked together closely, with Łukasiewicz and Leśniewski both serving on the editorial board of *Fundamenta Mathematicae*, and their mathematical logic was increasingly seen as a discipline in its own right.[34] Jan Woleński, the School's leading historian, has argued convincingly that the extraordinary fertility of logical research in interwar Warsaw was due above all to logic's fruitful positioning as an autonomous discipline in constant collaboration with mathematics and philosophy but subordinate to neither.[35] Already in 1929, in a manifesto of sorts for mathematical logic, Łukasiewicz expressed a similar opinion: "Crucially, in Poland, and especially in Warsaw, mathematical logic is treated today as an independent science, having its own goals and tasks."[36] Happily independence did not mean isolation. Logic lectures attracted not only students specializing in logic but mathematicians and philosophers too; presentations of logic papers drew an audience of 30 or 40 people with a range of disciplinary training.[37] Łukasiewicz launched a seminar for mathematical logic in 1926, a site where participants found and discussed original results – cutting-edge research not yet available in print.[38]

Logical, mathematical, and philosophical circles overlapped considerably with each other and also with the organs of the precarious fledging government. Leśniewski, who quit Moscow for Warsaw after the Bolshevik revolution, spent a year as assistant clerk in the Ministry of Religious Denominations and Public Enlightenment (in practice,

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[33] Kuratowski 1980, pp. 29–39. See also Kuzawa 1970.
[34] Kuratowski 1980, p. 33.
[35] Woleński 1989, pp. 9–13 and 88–96.
[36] Łukasiewicz 1929, p. 606.
[37] Woleński 1989, p. 93.
[38] Łukasiewicz, Tarski 1930, p. 30.

a ministry of education) upon his return.[39] He, Mazurkiewicz, and the mathematician Wacław Sierpiński also collaborated with the Cipher Bureau decrypting enemy codes during the Polish–Bolshevik War (1919––1921).[40] Twardowski was offered posts in the same ministry, but always turned them down in favor of remaining in Lwów.[41] Of all the logicians, Łukasiewicz took on the greatest political responsibility, becoming a cabinet-level minister in the Second Republic's first year of sovereignty. In March 1918 he had become head of the Department of Higher Education in the Ministry of Religious Denominations and Public Enlightenment, operating at the time under Government General oversight. In January the following year – in a now sovereign Poland – Łukasiewicz was appointed head of his ministry in the cabinet of Prime Minister Ignacy Paderewski, a composer and pianist who had been instrumental in winning American President Wilson's support for Polish independence. "We were up to our ears in work at the ministry in that first year of Polish independence," Łukasiewicz recalled. He formally polonized the German Gymnasium he had attended (his father, an Austrian cavalry captain, had insisted he learn German well). He presided over the opening of new universities in Poznań and Wilno (today Vilnius, Lithuania), despite the fact that amidst the ongoing Polish–Soviet War Wilno was not yet securely Polish territory, and Poznań, until recently Prussian Posen, still lay on the other side of a customs border from Warsaw.[42]

Governments formed and fell rapidly in early interwar Poland; Paderewski's lasted only one year. In the end Łukasiewicz spoke rather resentfully of his time in government. He was frustrated by the frequent need to "make decisions about matters with which I was not acquainted and could not become acquainted for lack of time," and by the clientelism of others in government. He recalled with distaste an occasion when Wincenty Witos, leader of the Piast (the largest of several peasant parties), angled for his own people to hold more posts in Łukasiewicz's ministry. "Mr. Minister, you aren't nice to us," Witos

[39] Leśniewski 2015, p. 779.
[40] Nowik 2004, pp. 231–232.
[41] Twardowski 1991, p. 12.
[42] Łukasiewicz 2013, pp. 24–25.

allegedly complained; the two men shared a mutual dislike from that meeting on, to which Łukasiewicz attributed his own exclusion from the next cabinet.[43] He returned to Warsaw, apparently eager to immerse himself in scholarly work, only to find the city threatened by approaching Bolsheviks. As across much of Europe, the 1918 armistice had in fact failed to bring warfare to an end in a Poland whose boundaries were still far from certain.[44] Along with a number of colleagues, he volunteered for the army and was given a desk job as a library clerk for the Ministry of Military Affairs.[45]

Finally, in late autumn 1920, political and military interruptions seemed to subside; the heyday of the reborn university began. Łukasiewicz, Leśniewski, and Kotarbiński were all actively teaching. Łukasiewicz considered the ensuing semesters "one of his best periods of scientific creativity." He began to think about the three- and many--valued logics, the development of which would prove one of his most celebrated achievements. Leśniewski too was in "top form," and Tarski, still a student, would soon begin to publish: "It was the beginning of the Warsaw School of Mathematical Logic."[46]

3. A Polish School

During the 1920s the Warsaw School of Logic thrived both in the official structures of academia and informally in the bustling social spaces of a growing capital city. The Warsaw logicians published infrequently during these years; their research activities and findings outpaced their print output during the heady first decade of independence. In romanticized postwar reminiscences, participants would recall a milieu of

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[43] *Ibid*., p. 27.

[44] Robert Gerwarth has recently emphasized the persistence of chaotic inter-state, civil, and revolutionary warfare in the half-decade following the formal First World War as a crucial factor in understanding the emergence of fascism and the horrific violence of the Second World War; Gerwarth 2016.

[45] Łukasiewicz 2013, p. 28.

[46] Łukasiewicz 2013, pp. 28–29. Łukasiewicz first discussed his interest in three-valued logic in Łukasiewicz 1918 and publicized the first technical results in Łukasiewicz 1920a and 1920b. For a historical overview of Łukasiewicz's three- and many-valued logics, see Woleński 2001.

endlessly stimulating lectures, seminars, and café conversations.[47] Contemporary accounts were already depicting a similar scene. In a volume of introductory lecture notes published in 1929, Łukasiewicz remarked at the outset:

> I owe most […] to the scientific atmosphere which has developed in Warsaw University in the field of mathematical logic. In discussions with my colleagues, especially Professor S. Leśniewski and Dr. A. Tarski, and often in discussions with their and my own students, I have made clear to myself many a concept, I have assimilated many a way of formulating ideas, and I have learned about many a new result, about which I am today not in a position to say to whom the credit of authorship goes.[48]

Patterns of citation seem to corroborate such portrayals. While the Warsaw logicians did publish results in French and German as well as in Polish, their papers referred constantly to results obtained years earlier and not yet committed to print. Authors would frequently present other researchers' results, with their "kind permission," in print for the first time.[49] Their habitual citation of unpublished results evoked – perhaps with rhetorical intent – a continual outpouring of technical findings that apparently exceeded the logicians' opportunities or inclinations to present them in journals.

Thus the published record of the Warsaw School's researchers played catch-up with a local conversation – but that delay did not evince any indifference to credit and attribution, which this community took very seriously. Łukasiewicz's bewilderment aside, evidently they did usually keep track of who discovered what (and when) despite not always seeing their results through the press. Leśniewski eventually came to bemoan this "awkward situation" of possessing "a great deal of unpublished

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[47] On café culture in interwar Polish mathematics, see Kuratowski 1980, pp. 43–45. On the periodization of the solidification of research programmes in the 1920s and the multiplication of publications only later, in the 1930s, see Woleński 1989, p. 87.

[48] Łukasiewicz 1963, pp. x–xi.

[49] E.g. Sobociński 1932, p. 171. That article included several extensive lists of previously unpublished results discovered by Sobociński and by others. A number of results also appeared in Łukasiewicz, Tarski 1930.

scientific results from various branches of the foundations of mathematics." As discoveries piled up, they became increasingly "intermeshed with each other and with those of other researchers working in this field," creating "ever greater technical-editorial difficulties related to their preparation for print."[50] Tarski believed this scrupulousness concerning "technical-editorial difficulties" was a Polish attribute. Reflecting years later on the "strong national habits" that shape attitudes toward citation, he elaborated:

> The Germans are conscientious and dependable; the Poles too, and undoubtedly I absorbed some of that tradition in my youth. Saying the Germans are conscientious about keeping the record straight isn't necessarily praise, of course: I remember a saying, 'The Germans may put you in a concentration camp and eventually in a gas chamber, but the documentation will be perfect.' The Italians and the French are terrible about this. We see it in students who come to us now: the Italians and the French can quote theorems left and right, but it doesn't seem to occur to them to attribute them to their discoverers.[51]

Thus did Tarski embed the question of intellectual credit and attribution in national stereotypes. Morbid joking notwithstanding, he nonetheless readily assimilated Polish attitudes to the German "conscientiousness" in question. The Poles, Tarski maintained, were diligent in their documentation.

Publication did gradually accelerate, and accordingly mathematical logicians in more traditional centers of western science increasingly noted Warsaw's emerging importance to their discipline. In a 1928 supplement to the 1925 volume of the major mathematical abstract journal *Jahrbuch über die Fortschritte der Mathematik*, covering literature published 1921–22, the section on philosophy of mathematics included a number of early logical works from the Polish-language philosophical journal

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[50] Leśniewski 1991, p. 174; translation modified.

[51] Bancroft Library, University of California, Berkeley, Alfred Tarski Papers, BANC MSS 84/69 c (hereafter Tarski Papers), carton 1, folder 17: Theodora Hodges, write-up of Alfred Tarski's responses in an interview for a library science research project, 1972.

Przegląd Filozoficzny, one of the Warsaw School's major venues for publication.[52] Thus logic found a channel to readers abroad in the more highly developed transnational disciplinary infrastructure of mathematics. Similarly, Polish logicians began to attend international academic congresses, especially mathematical congresses. In 1928 Łukasiewicz could marvel to find himself conversing in Polish around a table of compatriot mathematicians in a café in Bologna.[53] Philosophers outside Poland visited Warsaw to experience the logical efflorescence firsthand. Viennese mathematician and Vienna Circle member Karl Menger came to Warsaw in 1929 and, impressed by Warsaw's "marvelous scientific atmosphere," invited Tarski to visit Vienna; Tarski accepted and made the trip in February 1930. Rudolf Carnap spent a week in Warsaw that November and appreciated the "thoroughgoing and fruitful work" of the philosophers there. American logician Willard Van Orman Quine considered several weeks he spent in Warsaw in 1933 critical to his development.[54] The Lwów logician Kazimierz Ajdukiewicz published a German primer on Polish logic in the influential Berlin and Vienna-based journal *Erkenntnis* in 1935.[55] Alonzo Church's "Bibliography of Symbolic Logic," which appeared as part of the inaugural volume of the *Journal of Symbolic Logic* in 1936, was quite thorough in its inclusion of Polish work: Polish eminence in logic was by this time well known.[56] Reporting to an American audience on the state of analytic philosophy in Europe the same year, Ernest Nagel named Warsaw and Lwów key sites along with Cambridge, Vienna, and Prague. He attributed the rise of Polish philosophy to Polish independence, lamented how much of it was published in Polish, and judged Poland "an interesting and remarkable country philosophically … there is less romantic *Schwärmerei* among [Polish philosophers] than in any other country with whose philosophic activity I am familiar."[57] The Warsaw School was gaining renown, and

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[52] [N.N.$_1$] 1925/28, pp. 1125–1127.

[53] Łukasiewicz 2013, p. 34. The group also included Tarski and the mathematician, philosopher, and modernist painter Leon Chwistek (1884–1944), among others.

[54] Menger 1994, p. 143; Carnap 1963, p. 31; Quine 1985, p. 104. On Quine's role in American intellectual history, see Isaac 2005.

[55] Ajdukiewicz 1935.

[56] Church 1936.

[57] Nagel 1936a and 1936b; quotation at 1936b, pp. 49–50.

mathematicians and philosophers outside Poland increasingly perceived a specifically Polish culture of mathematical logic.

Łukasiewicz had already embraced the idea that there was something unique about the study of logic in Poland. In the 1929 disciplinary manifesto cited above, Łukasiewicz contrasted Polish logic's disciplinary independence (*samodzielność*) – itself a patriotically loaded term – with the tendency of German mathematicians to "treat [logic] rather as an auxiliary science to mathematics." Nor did their excessively mathematical orientation save German researchers, in Łukasiewicz's assessment, from the equal and opposite sin of "philosophical speculation," for "in Germany the influence of philosophy, even among mathematicians, has thus far been so great that even Frege did not manage to free himself from it." It was thanks to Twardowski's training that Polish logicians had "learned to think clearly, conscientiously, and methodically" and therefore "Polish mathematical logic attained a great degree of scientific precision compared with mathematical logic abroad."[58] Łukasiewicz thus asserted a specifically Polish set of logical virtues and traced them to Twardowski's institutional influence. This causal connection to his teacher confirms that his notion of a distinctly Polish approach was not racial or ethnic; its explanation lay in concrete pedagogical activity – indeed activity at what was an Austrian institution at the time. Whatever contingency Twardowski's role implied, however, in Łukasiewicz's eyes the distinction worth making remained the national contrast between muddled, speculative Germany and clear, methodical Poland.

As the Second Polish Republic entered its second decade, the Warsaw logicians worked to advance their collective international standing while holding incompatible conceptions of the Poland they represented. Their conflicts displayed well-known dynamics of interwar Polish political culture: disagreements about Polishness mapped onto axes of language, religion, and ethnicity, with anti-Semitism and the place of Polish Jews provoking the bitterest disagreement. These conflicts in Polish politics were largely organized by the fiery antagonism between

[58] Łukasiewicz 1929, p. 607. German mathematician Gottlob Frege (1848–1925), now a pillar of analytic philosophy, was in 1929 a respected but not yet revered figure in the recent history of logic, though in Poland especially his work increasingly found an admiring audience.

two men, Roman Dmowski (1864–1939) and Józef Piłsudski (1867–1935). Dmowski led the conservative National Democrats (*Endecja*), the largest political party at the dawn of the Second Republic; he espoused Polish-Catholic chauvinism and rancorous anti-Semitism. Piłsudski had begun his political career in the Polish Socialist Party (PPS), but his dedication to a romantic nationalism (which rejected ethnic and religious criteria for inclusion) outweighed his socialism. He formed and led the Polish Legions during World War I and from the first days of independence he was a major charismatic force in political life even without the support of a definite party of his own. In 1926 he led a military coup, after which he governed without personally holding office, overseeing a hybrid regime until 1930 when he embraced authoritarianism more fully.[59] Anti-Semitism was widespread throughout the interwar period, and generally increased over time. Piłsudski worked to mitigate it during his lifetime; when he died in May 1935, several weeks after the ratification of a new constitution that radically strengthened the executive, he left this heightened power in the hands of his supporters who, faced with an emboldened *Endecja*, were more willing to embrace a degree of popular anti-Semitism.[60]

The academic apparatus of the new state was embroiled in its larger ideological conflicts and the universities eventually became a major flashpoint in the struggle over the 'Jewish question.' A crucial element of the University of Warsaw's Polish identity depended, in the eyes of some students and faculty, on marginalizing Jewish students and scholars. Warsaw's population was about one third Jewish between the world wars, and Jewish students reportedly made up nearly 40% of the university's student body in academic year 1920/21. This figure would fall to around 25% by 1932/33 and, coinciding with growing far-right nationalism among faculty and especially students, decline yet further to 13.4% by 1937/38.[61] Łukasiewicz recalled being "forced into" excluding Jews from an important administrative commission he formed in 1918;

[59] Piłsudski's rule eludes easy definition; I do not intend here to endorse a specific classification for either the pre- or post-1930 period. I am grateful to Kaspar Pucek for suggesting "hybrid regime" as a label that conveys the relevant ambiguity. For an overview of the period's politics, see Polonsky 1972; Porter 2000; Plach 2006.

[60] Melzer 1997, especially chapter 2.

[61] Porter-Szűcs 2014, p. 130; Garlicki 1982, pp. 134–135, 257.

when a National Democracy supporter assassinated Gabriel Narutowicz (1865–1922), the state's first elected president, Łukasiewicz – then rector of the university – cautioned against lawlessness, intolerance, and bitterness.[62] But such scourges would only multiply, and Polish university students came to form a particularly aggressive anti-Semitic segment of society, calling in the 1930s for segregated "ghetto benches" in the lecture halls and physically attacking Jewish students who resisted separate seating. By the late 1930s anti-Jewish violence was a daily occurrence at the University of Warsaw, and in September 1937 the government capitulated to the demands of the rightwing students, officially instituting ghetto benches. This appeasement failed to defuse tensions. Jewish students continued to protest and refuse ghetto benches; violence against them escalated, as did nationalist demands which now called not for segregation but total exclusion.[63]

In the face of this fierce anti-Semitism, Tarski – an assimilated Jew born Alfred Tajtelbaum – continued to gain international recognition even surpassing that of his teachers. He had changed his name and converted to Catholicism in 1924; nonetheless, his heritage may explain his failure ever to attain a professorship in Poland, and it strained his relationship with Łukasiewicz and Leśniewski as their anti-Semitism intensified during the 1930s.[64] By 1935, Leśniewski was writing to his own teacher Kazimierz Twardowski that, while he hoped for the sake of science that Tarski received a professorial chair in Warsaw, he nonetheless felt "a sincere antipathy towards Tarski" and would prefer to see him "offered a full professorship, for example in Jerusalem, from where he could send us offprints." He then revealed that he increasingly sought to keep his own research secret "so that certain Jew-boys or their foreign friends do not play some filthy trick on me again, as they have already done."[65] Here anti-Semitism merged with a more general xenophobia to militate against the informal dialogue and sharing of results that had flourished in the 1920s. The School's quest for international recognition notwith-

[62] Łukasiewicz 2013, p. 22; Garlicki 1982, pp. 181–182.

[63] Melzer 1997, chapter 5.

[64] Feferman, Feferman 2004, pp. 36–39, 98–104.

[65] Leśniewski to Twardowski, September 8, 1935 (sh. 101–102v), digitized and translated by A. O. V. Le Blanc at the Polish Philosophy Page, *Documentation on Twardowski* (1.10.2017).

standing, Leśniewski seemed by this time to desire primarily an ethno--nationally delimited scholarly conversation.

But a narrow concept of Polish identity did not undergird real unity for those members of the School that embraced it. Ethnic Polish identity was for many Poles inseparable from Catholicism, and the appropriate relationship between Catholic thought and formal logic was another source of controversy. Over time Łukasiewicz identified increasingly closely with the Church. In 1929 he married Regina Barwińska, a devout Catholic, whose devotion seems to have heightened his own – he also accepted her anti-Semitism as a natural extension of her piety.[66] In the 1930s Łukasiewicz took a strong interest in medieval Scholastic logic, through which he would form close intellectual friendships with several priests. In 1936 a Polish priest living in Paris, Augustyn Jakubisiak, attacked the "latest philosophical trends" of logical empiricism and mathematical logic for their "relentless battle against the philosophical doctrines of the past," and included prominently among the militants in question "the Polish logicians of the renowned 'Warsaw School.'"[67] Łukasiewicz issued a vigorous (and quite sarcastic) response, arguing that mathematical logic is merely a continuation of ancient logic, an expansion and refinement of methods for reasoning available to all philosophers regardless of their doctrines.[68] Around the same time there arose a small group calling itself the Cracow Circle, which attempted to reform Thomist philosophy in light of mathematical logic, though they were disappointed to find that most Catholic philosophers – in Poland and abroad – were uninterested in deviations from the Aristotelian logical tradition.[69] Nor did any commitment to Catholicism unite the Warsaw School. Already in adolescence Kotarbiński had "parted … with the illusion of religious substantiations of morality" and in his work he sought to ground an "independent ethics,

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[66] Łukasiewicz 2013, p. 42. The relationship between Catholic anti-Judaism and modern (secular and racialized) anti-Semitism is complex; Brian Porter has described it in terms of real differences of content that, from the 1920s on, actors comfortably ignored in favor of a broad anti-Semitic alliance. See Porter 2005.

[67] Jakubisiak 1936, p. 11.

[68] Łukasiewicz 1961, pp. 195–198.

[69] Woleński 2013; Murawski 2015. The members of the Cracow Circle were Dominican Father Józef M. Bocheński, Rev. Jan Salamucha, Jan Franciszek Drewnowski, and Bolesław Sobociński.

the ethics of practical realism" solely in "emotional evaluation developed through human interrelations."[70] Łukasiewicz later bitterly summarized Kotarbiński as a "doctrinaire leftist" who "not only wrote articles of dubious value against religion and the Church, but even officially left the Roman Catholic Church, and appeared to love Jews much more than Poles."[71] But if Łukasiewicz explained his dislike of leftwing colleagues in the language of rightwing nationalism, he was equally quick to attribute their growing antipathy towards him to their own Polish patriotism. The year before Germany invaded Poland, Łukasiewicz received an honorary doctorate from the University of Münster, giving rise during the war to what he called "a dislike with a nationalist background," as "it seemed to everyone, that for this reason I must be sympathetic to Germany."[72]

In sum, the Warsaw logicians were not bound together by shared political commitments beyond loyalty to a Poland they defined in different ways. Fruitful collaboration and camaraderie coexisted with conflict and sometimes intense xenophobia. My goal is not to adjudicate on matters of praise and blame, but rather to emphasize that all these social dynamics coexisted and together comprised the milieu in which the Warsaw School logicians lived, worked, and taught. A lack of political cohesion as a school does not indicate that logic in Poland was an alternative to politics.[73] Rather logic was yet another cultural arena – a particularly attractive one precisely for its claims to pure rationality – in which to stake out politicized and nationalized eminence.

4. A national notation

As the Warsaw School's publications multiplied, they soon took on a distinctive appearance thanks to what Łukasiewicz considered "one of [his] greatest inventions."[74] After his term as university rector, longing

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[70] Kotarbiński 1990, p. 2.

[71] Łukasiewicz 2013, p. 42.

[72] *Ibid.*, p. 72.

[73] The situation thus stands in contrast to that in the postwar United States, where George Reisch has argued that formerly leftwing logical empiricist philosophers turned to the "icy slopes" of formal logic as an allegedly "apolitical, technical, and professional" retreat from public engagement during the dangerous years of anticommunist hysteria. Reisch 2005, p. 21.

[74] Łukasiewicz 2013, p. 29.

to immerse himself entirely in research, Łukasiewicz resigned his chair and began 1924 intent on living frugally off his savings for several years. Hyperinflation followed by currency reform sapped those savings in less than a year, but that time sufficed for him to develop his so-called "parentheses-free notation."[75] Eschewing the notations replete with mathematical symbols, repurposed punctuation, and newly invented markings that were already competing for users, Łukasiewicz designed a system composed entirely of letters – capital and small, Latin, Greek, and in at least one late version Fraktur – never interrupted by punctuation or spacing.[76] Capital letters denoted "functors," or statements about propositions. Each capital-letter functor was followed by its "arguments," the propositions to which it referred. Together a functor and its arguments formed another proposition. Arguments could be lowercase letters signifying elementary propositions, or else compound propositions consisting of other functors with their own arguments. For example, the functor *C* represented the conditional, a statement of the form "if–then." In Łukasiewicz's notation, "*Cpq*" is a proposition meaning "If *p*, then *q*," where *p* and *q* also symbolize propositions. Similarly, "*p* or *q*" (or more precisely: "at least one of the statements *p* and *q* is true") is written "*Apq*." More complicated logical expressions were represented by longer strings of compounded functors and arguments. One such example suffices to convey the visual style of Łukasiewicz's symbolism (without diving into its technical content). In Bertrand Russell and Alfred North Whitehead's epochal three-volume *Principia Mathematica* (1910–1913), they express a rule they call "the principle of summation" in their notation as follows: "$\vdash :. q \supset r .\supset : p \vee q .\supset . p \vee r$."[77] In Łukasiewicz's parentheses-free

[75] *Ibid.* On the economic crisis and resulting reform, see Polonsky 1972, pp. 116–122.

[76] Łukasiewicz publically claimed 1924 as the date of invention in Łukasiewicz 1931. He first presented the system in print in Łukasiewicz 1929, pp. 610–612 n. The Fraktur letters appear in the Archive of the University of Warsaw, Jan Łukasiewicz papers, folder 22: unfinished and untitled introductory monograph (in English) on the propositional calculus (hereafter Łukasiewicz, unfinished monograph), for example at p. 9. For an overview of Łukasiewicz's system, see Simons 2017.

[77] Whitehead, Russell 1910, p. 101. (The ultimate period inside the quotation marks is my own punctuation, not part of Whitehead and Russell's notation.) The principle of summation might be rendered in prose as "If *q* implies *r*, then '*p* or *q*' implies '*p* or *r*.'"

symbolism, the same principle reads: "*CCqrCApqApr*."[78] We need not parse these strings of characters here; for our purposes it suffices to appreciate that, whereas other notations sprinkled dots or parentheses between letters to indicate the order in which functors should be applied, Łukasiewicz's notation encoded the order of operation in the literal order symbols were written on the page. The placement of the letters alone made the expression unambiguous.

Łukasiewicz promoted his system as a universal improvement for logical writing. To the end of his life he believed his was "the simplest and the most reasonable" notation for logic, consisting only of characters "available in every printer's office" and always resulting in a "formula [that] contains no brackets, is shorter than the usual formula … and can be read only in one way."[79] It was a notation particularly well suited to carrying out deductions in accordance with formalized rules of inference, as the typographic simplicity facilitated the specification and use of such rules. Thus a reader could easily, in Łukasiewicz's words, "treat arrangements of letters … as for the time being figures in a kind of game, having no significance."[80] Some Polish logicians began to employ Łukasiewicz's trademark unpunctuated notation in print, but although Łukasiewicz insisted its attractions applied quite generally, it did not catch on elsewhere during the interwar years: "Later I adapted this symbolism to other areas of logic, and even to arithmetic, and I am convinced that it is possible to apply it with benefit everywhere. It was not universally accepted, but I think that sooner or later it will be."[81] Here he optimistically embraced a straightforward universalism with respect to notation: his system, incidentally originating in Poland, would transform the writing of logic everywhere.

Łukasiewicz's optimism was misplaced: instead of catching on internationally, the parentheses-free symbolism had the opposite effect of rendering Warsaw's local specificity literally legible in the idiosyncratic visual appearance of its published research (this despite the fact the notation never achieved hegemony even in Warsaw). The School's most widely-circulating articles in the 1930s tended to appear in German,

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[78] Łukasiewicz, unfinished monograph, p. 103.
[79] *Ibid.*, pp. 9–10.
[80] Łukasiewicz 1929, p. 610 n. 1.
[81] Łukasiewicz 2013, p. 29.

but sometimes used Łukasiewicz's notation despite its rarity outside Poland.[82] By adopting an unconventional symbolism, Łukasiewicz and others effectively reproduced in logical notation the foreignness of the Polish language in international eyes: notation became a second layer of unfamiliarity. No impediment to international recognition, this twice foreign quality of Polish logical research shaped the nature of the recognition it received, bestowing on it a durable nationalized quality. As Łukasiewicz's fame in the Anglophone world grew, so too did familiarity with his notation, which soon would be widely identified as Polish.

International familiarity with the Warsaw School's work only increased when the School itself fell victim to the devastation of World War II. Łukasiewicz weathered most of the war in Warsaw. As the Red Army approached Warsaw in 1944, he and Regina hoped to escape to Switzerland; they settled for Münster, home of their friend Heinrich Scholz, who was able to arrange for their relocation.[83] After the war they ended up in Dublin, where Łukasiewicz would lecture until his death in 1956, after which Regina returned to Poland. Tarski had the good fortune to be in Cambridge, Massachusetts for a Unity of Science conference in September 1939 – good fortune but also anguish, as he was separated from his wife Maria and their two children for the duration of the war. They survived in Warsaw, fled to Cracow during the Warsaw Uprising in 1944, and after some bureaucratic tribulations were able to join Alfred in Berkeley, where he had obtained a professorship.[84] Leśniewski had died of lung cancer a few months before the war. Many other members of the Warsaw School were killed by the Nazis – Adolf Lindenbaum and Janina Hosiasson-Lindenbaum, Mojżesz Presburger,

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[82] Perhaps the most prominent example was Łukasiewicz and Tarski 1930, which Woleński has deemed "one of the most important texts on logic produced in the Warsaw School"; Woleński 1989, p. 115. Other examples of prewar publications in German employing parentheses-free notation include Tarski 1934–1935 and Łukasiewicz 1935. Sobociński 1932 (in Polish) was another particularly important example of Łukasiewicz's notation, as it consolidated results concerning the shortest axioms of various systems, a line of inquiry that flourished specifically in that system. It is necessary to clarify however that not all prominent Polish logicians used Łukasiwicz's system. Leśniewski generally favored his own notation, for example, and Tarski too usually used more conventional systems (see e.g. most of the essays in Tarski 1983).

[83] Schmidt am Busch, Wehmeier 2007.

[84] Feferman, Feferman 2004, pp. 124–170.

Jan Salamucha, and Mordchaj Wajsberg, to name only a few.[85] It was in the context of enormous loss that the forced dispersion of those who survived brought many of them into close contact with logicians in new locales.[86]

From this scattering of Polish logicians followed publications in the Polish tradition outside Poland. Working in Dublin, Łukasiewicz published what became one of his best known works in the Anglophone world, an influential study of Aristotle's logic using mathematical methods and parentheses-free notation.[87] Meanwhile he evidently inspired his Irish colleague Carew Meredith not only to pursue inquiries akin to his own, but even to use his notation – a rare instance of use by a non-Polish logician.[88] In 1948 Józef Bocheński, a Dominican friar (and a central figure in the aforementioned Cracow Circle of mathematically inclined Thomists) who had ended up in Fribourg after the war, published a French-language logic textbook intended to "serve as a basis for elementary oral teaching" and "summarize the laws most useful to non-mathematical applications of logic." He adopted the unusual convention of "[giving] alongside the Peano-Russellian symbolism that of Łukasiewicz."[89] In the booklet's earlier sections he literally gave both notations side by side (figure 1); in later chapters he tended to pick one or the other, leaning more often toward Łukasiewicz's system. (One reader of the library copy I consulted objected to this expedient and

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[85] Leśniewski's final days are described in Kotarbiński 1966. This incomplete list of logicians killed during the war is selected from that given in Woleński 1989, p. 19.

[86] Not all the survivors went into exile; notably Kotarbiński remained in Poland and attempted to maintain academic life under Communist rule. The received view of Polish intellectual culture during this period is well captured by the title of Czesław Miłosz's classic polemic *The Captive Mind* (1953); John Connelly has argued, however, that compared with Czech and East German academia the Polish professorate remained a force of substantive resistance to the regime under Communism; Connelly 2000. The Polish mathematical community suffered perhaps even greater losses (according to one estimate, 62 of the 100 most prominent were killed during the war), but they also managed to rebuild a school in postwar Poland in a way the logicians never did (Kuzawa 1970, pp. 490–492).

[87] Łukasiewicz 1951.

[88] Meredith 1953. Łukasiewicz's notation was apparently unknown in Ireland before his arrival; see Faris 2013.

[89] Bocheński 1948, p. 5.

obligingly penciled in some Peano-Russellian translations.[90]) Bocheński's introductory text found enthusiastic readers quite literally around the world. Arthur Prior, a young logician teaching at Canterbury University College in Christchurch, began using it as a textbook. "Despite the language difficulty," he wrote in 1952, "I have found this a first-class textbook to accompany lectures to New Zealand students."[91] His preference for the notation he considered most perspicuous, in other words, overrode his preference for assigning texts in the language of instruction. He still spoke of the notation in terms more individual than national: "Professor Lukasiewicz's [*sic*] symbolic technique."[92]

5.3. Lois de l'implication.

5.311.	$p \supset q \cdot \equiv \cdot \sim p \vee q$	$ECpqANpq$	
5.312.	$p \supset q \cdot \equiv \cdot p \mid \sim q$	$ECpqDpNq$	
5.313.	$p \supset q \cdot \equiv \cdot \sim \cdot p \sim q$	$ECpqNKpNq$	
5.314.	$p \supset q \cdot \equiv \cdot p \equiv pq$	$ECpqEpKpq$	
5.315.	$p \supset q : \equiv : q \cdot \equiv \cdot p \vee q$	$ECpqEqApq$	
5.32.	$p \supset q \cdot \equiv \cdot \sim q \supset \sim p$	$ECpqCNqNp$	Loi de la contraposition simple.
5.321.	$p \supset \sim q \cdot \equiv \cdot q \supset \sim p$	$ECpNqCqNp$	2ème loi de la contraposition simple.
5.322.	$\sim p \supset q \cdot \equiv \cdot \sim q \supset p$	$ECNpqCNqp$	3ème loi de la contraposition simple.
5.33.	$p \cdot \supset \cdot q \supset r : \equiv : q \cdot \supset \cdot p \supset r$	$ECpCqrCqCpr$	Loi de la commutation simple.
5.34.	$pq \supset r : \equiv : p \cdot \supset \cdot q \supset r$	$ECKpqrCpCqr$	1ère loi de l'exportation.
5.35.	$pq \supset r : \equiv : q \cdot \supset \cdot p \supset r$	$ECKpqrCqCpr$	2ème loi de l'exportation.
5.36.	$p \cdot \supset \cdot p \supset q : \equiv : p \supset q$	$ECpCpqCpq$	
5.37.	$pq \supset r \cdot \equiv \cdot \sim rq \supset \sim p$	$ECKpqrCKNrqNp$	1ère loi de la contraposition syllogistique.
5.38.	$pq \supset r \cdot \equiv \cdot p \sim r \supset \sim q$	$ECKpqrCKpNrNq$	2ème loi de la contraposition syllogistique.
5.39.	$\sim \cdot p \supset q \cdot \equiv \cdot p \sim q$	$ENCpqKpNq$	

Fig. 1. Bocheński's presentation of the laws of implication in two notations (with labels in French). *Source*: Bocheński 1948, p. 23.

[90] Marginalia at *ibid.*, p. 31 in the copy held at Princeton University's Firestone Library.

[91] Prior 1952a, p. 35 n. 3.

[92] *Ibid.*, p. 37.

Soon, however, and without much comment, the phrase "Polish notation" became the common label. In a review of Quine's *Methods of Logic* published later in 1952, the same year as his praise of Bocheński's text, Prior employed the nationalizing name. Paraphrasing one of Quine's techniques, Prior proposed to "vary it a little by using the Polish notation."[93] The phrase also appeared that same year in the discipline where Łukasiewicz's symbolism would ultimately find a wider community than it ever did among logicians: the burgeoning postwar field of computer science. The idea of using the parentheses-free symbolism to construct a machine language occurred to several researchers independently in the 1950s. In 1952 three computer scientists affiliated with the University of Michigan and the Burroughs Adding Machine Company in Detroit proposed a physical machine based on that technique. They described "a new method for the evaluation of truth-functions … which does seem to be practical for formulas of great length and many variables and which has other features of interest. This new method is based on the Polish notation."[94] Theirs and Prior's uses in 1952 are the earliest appearances of the phrase "Polish notation" in print that I have found, though both invocations are too casual to suggest that the authors considered it a novelty. In the absence of evidence regarding a definite first appearance, what is germane is precisely the casual way in which a nationalizing label came to replace descriptors referring to Łukasiewicz or to the lack of parentheses. It simply struck writers as natural to invoke the notation's Polish origin.[95] At a 1957 conference on "data processing and automatic computing machines" held at the Weapons Research Establishment in Salisbury, South Australia, a computer scientist named Charles Hamblin invoked the "minor complication of algebraic symbolism" that arises in relation to parentheses, then noted, "For many years now, however, logicians have used a system of writing logical formulae which eliminates brackets entirely – the so-called 'Polish' notation."[96] Though he used scare quotes and a qualifying "so-called" to maintain ironic distance from the phrase, Hamblin also believed it named

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[93] Prior 1952b, p. 201.

[94] Burks, Warren, Wright 1952, p. 2.

[95] An anonymous referee offered the interesting speculation that perhaps non-Poles preferred to avoid spelling and typing the name "Łukasiewicz."

[96] Hamblin 1957, p. 121.2.

something used "for many years now." Despite apparent reservations, he considered "Polish notation" now the relevant name.

Polish notation continued to garner attention among computer scientists, albeit in an inverted form. A few years after the Burroughs Company group in Michigan described their Truth Function Evaluator, colleagues of theirs in Paoli, Pennsylvania built a device according to the scheme. William Miehle reported on that machine to the Association for Computing Machinery in 1955, explaining its notation: "a formula is written and scanned from right to left, and instead of writing an operator *between* the variables such as (*p* dot *q*), it is written to the *left* (*Kpq*). Its advantages are that no parentheses are needed and that it can be mechanized as will be shown."[97] Łukasiewicz had never prescribed that his reader scan right to left, which would in any case be an inefficient way to apprehend the overall structure of a complicated expression. But his system does tend to push operations that should be evaluated earlier toward the right, with the result that if a machine is to process an expression mechanically, it can do so most efficiently by reading it backwards.

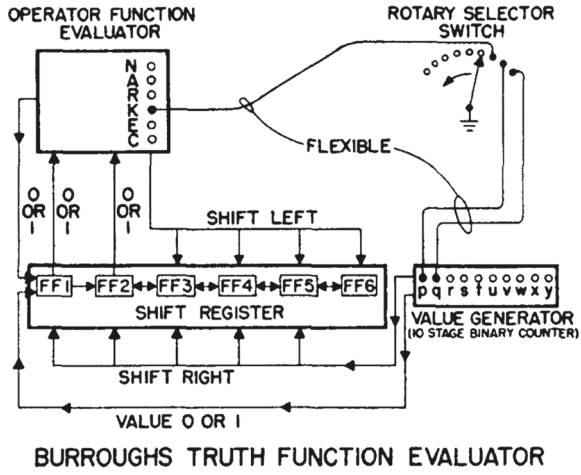

Fig. 2. Design of the Burroughs Truth Function Evaluator. The letters "NARKEC" in the "operator function evaluator" are the capital-letter "functors" of Łukasiewicz's notation. *Source*: Miehle 1957, p. 190.

[97] Miehle 1957, p. 189.

One alternative to requiring the machine to read backwards was for human beings to write backwards. This was Hamblin's innovation at the 1957 Weapons Research Establishment conference. (He seems not to have been aware of the Burroughs Truth Function Evaluator.) By flipping the order of the 'Polish' formulae, Hamblin proposed a notation optimized for mechanical scanning:

> For machine use this system [i.e. Polish notation] has the disadvantage that the order in which the operator-symbols occur in the formula is the reverse of the order in which the operations are supposed to be performed. It is perfectly feasible, however, to use a 'reverse Polish' notation in which the operators follow the operands: i.e. in place if "a + b" we can write "ab+", and in place of "(a + b) × c" we can write "ab+c×". It is now not very difficult to demonstrate that each symbol of a formula can be regarded as a machine instruction. […] This system of having what might be called a 'running accumulator' has the advantage, implicit in the mathematical symbolism, of permitting intermediate results to be 'held' pending the calculation of additional terms.[98]

It turned out that the material spatial relationship of letters and symbols in the "Polish" system provided a solution to a physical challenge inherent in the construction of computing machines, namely the retention of relevant terms over the course of a complex computation.[99] By embedding information about the order in which operations should be performed in the literal order they were written, rather than in the usual nesting parentheses, Łukasiewicz had unintentionally indicated a way to encode such operations more efficiently for execution by a machine.

Hamblin's Reverse Polish notation (often abbreviated RPN) enjoyed greater mainstream standing among computer scientists than

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[98] Hamblin 1957, pp. 121.2–121.3.

[99] The entanglement of notational and mechanical concerns here echoes the issue of carrying ones in addition that Matthew Jones has identified as central to the struggle to develop mechanical calculators – further support for his argument that logical and technological histories of computing are less separable than often imagined. Jones 2016, pp. 3–5.

Łukasiewicz's original ever did among mathematical logicians. In 1960 the English Electric Company announced their KDF-9 computer system, the first commercial machine built on RPN architecture, likely inspired by Hamblin's work.[100] Perhaps most famously, for years Hewlett-Packard designed their calculators to use RPN. Though many users found RPN entry confusingly different from conventional mathematical writing, others became devoted advocates, forming around H-P calculators a kind of cult following.[101] Fans of RPN insisted it invited a more natural way of thinking about calculations. For Hamblin, however, the claim had never been framed in terms of what is ideal for human beings; he advocated Reverse Polish Notation as a method of representation that was inherently better suited to the material constraints of machine programming than its competitors.[102]

5. Conclusion

The nationalizing modifier in its name notwithstanding, RPN first appeared in South Australia, was first implemented in Britain, and generally enjoyed a global career never particularly attached to its namesake country. But names matter: users (and detractors) of RPN to this day refer each time they name it, often unknowingly, to a history grounded in the coexistence of nationalist and universalist ambitions in interwar Poland. Though invented over a decade after the end of the Second World War, RPN is in this sense a product of interwar scientific internationalism and its "Olympic" impulse to associate achievements with their nation of origin.

The roles of nationalism, internationalism, and universalism in science are typically construed as orientations toward science on the part of the scientist. The case of Polish logic shows nationalism to be in part something contemporary international *readers* attach to a scientific

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[100] Davis 1960. On the English Electric team's probable contact with Hamblin, see Lavington 1980, p. 76.

[101] Goth 2002.

[102] The story of RPN thus supports Stephanie Dick's insistence that implementation, located at "the interface between models and machines – between abstraction and materiality," is crucial to understanding the histories of mathematics and computing alike; Dick 2015, p. 629.

practice, a way of categorizing it and locating it in a growing discipline, admiring without fully imitating it. In 1967 the Clarendon Press published a volume titled *Polish Logic 1920–1939*, collecting and translating important interwar papers by a number of mathematical logicians who had worked in Warsaw and elsewhere in the Second Republic. The editor Storrs McCall, a Canadian philosopher teaching in Kampala, Uganda, praised "an extraordinary flowering of logical thought in Poland – a fecundity so extensive as to have left its mark in every branch of contemporary logical development" despite the difficulty of accessing many of these papers outside Poland and, more specifically, the lack in many cases of English translations.[103] Of this volume, Woleński has remarked, "'The title is striking because we do not find usually expressions such as 'American logic,' 'British logic,' etc. I think that the title, which basically does not make much sense, was due to the specific attitude of Polish logicians. Logic is universal, and neither Polish, nor British, etc. However, I do not avoid the expression 'Polish logic.'"[104] Indeed the Polish logicians shared a specific attitude toward the importance of promoting logical research in their own nation, even while diverging widely on their attitudes toward other elements of national culture, politics, and identity.

If their patriotic stance informed the nationalizing reception of their work, so too did its idiosyncratic appearance. The translations in McCall's volume mostly retained their original symbolism, many of them using Łukasiewicz's notation. In a rare acknowledgment of the immense and often feminized labor that turns an author's logical manuscript into a printed publication, McCall lauded "Esther Barfield, Betty Laubach, and Janet Hutchison […] the best typists of Polish symbolism in the world."[105] He thus also highlighted the enduring foreignness of his authors' notation. The volume named a nationalized subject and emphasized at the outset the national idiosyncrasy of its typography. We might read this episode of nationalizing reception as a continuation of the process Larry Wolff has called "inventing Eastern Europe," persisting centuries after the Enlightenment discourse that was

[103] McCall (ed.) 1967, p. v.
[104] Woleński 1989, p. 314 n. 9.
[105] McCall (ed.) 1967, p. vi.

Wolff's focus.[106] The ongoing practice of situating the logical research of Poland as somehow nationally Polish reinforced a sense of distance and difference for Anglophone readers. Thus was Polish logic provincialized, orientalized – and, in the computing applications that would become widespread, ultimately 'reversed' – but its international recognition as a product of Poland was secure. The durability of the label "Polish notation" has memorialized Polish contributions to formal logic in the field's vernacular in a manner connected more closely to Polish logicians' universalism than to their efforts to assert national logical prowess. In the distinctness of Łukasiewicz's notation, the contribution he considered his most universal, he inadvertently created the opportunity for readers to attach a lasting national particularity to Polish logic. Nationalization took place abroad.

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Bibliography

ARCHIVAL SOURCES

Archive of The University of Warsaw. *Jan Łukasiewicz Papers.*

Bancroft Library, University of California. *Alfred Tarski Papers.* BANC MSS 84/69 c.

Manuscripts Department, Library of The University of Warsaw. *Historical-Political Materials from the Period of the First World War.* Manuscripts 1744–1778.

STUDIES

Ajdukiewicz, Kazimierz 1935: Der logistische Antiirrationalismus in Polen. *Erkenntnis* 5, pp. 151–161.

Applegate, Celia 1990: *A Nation of Provincials: The German Idea of Heimat*. Berkeley: University of California Press.

[106] Wolff 1994.

Beaney, Michael (ed.) 2013: *The Oxford Handbook of the History of Analytic Philosophy*. Oxford: Oxford University Press.

Bensaude-Vincent, Bernadette; Abbri, Ferdinando (eds.) 1995: *Lavoisier in European Context: Negotiating a New Language for Chemistry*. Canton, MA: Science History Publications.

Blobaum, Robert 2017: *A Minor Apocalypse: Warsaw during the First World War*. Ithaca: Cornell University Press.

Bocheński, I. M. 1948: *Précis de logique mathématique*. Bussum: F. G. Kroonder.

Bocheński, I. M. 1961: *A History of Formal Logic*. Trans. Ivo Thomas. Notre Dame, Indiana: University of Notre Dame Press.

Brentano, Franz 1968: Die Habilitationsthesen. [In:] *Über die Zukunft der Philosophie*. By Franz Brentano, edited by Oskar Kraus. 2nd edition. Hamburg: Felix Meiner. pp. 133–141.

Brown, Kate 2004: *A Biography of No Place: From Ethnic Borderland to Soviet Heartland*. Cambridge, MA: Harvard University Press.

Brożek, Anna; Stadler, Friedrich; Woleński, Jan (eds.) 2017: *The Significance of the Lvov-Warsaw School in the European Culture*. Cham, Switzerland: Springer.

Burks, Arthur W.; Warren, Don W.; Wright, Jesse 1952: Truth-function Evaluation Using the Polish Notation. Engineering Research Institute, University of Michigan, Burroughs Adding Machine Co. Project M828.

Conze, Werner 1958: *Polnische Nation und deutsche Politik im ersten Weltkrieg*. Köln: Böhlau Verlag.

Church, Alonzo 1936: A Bibliography of Symbolic Logic. *The Journal of Symbolic Logic* 1(4), pp. 121–218.

Carnap, Rudolf, 1963: Intellectual Autobiography. [In:] *The Philosophy of Rudolf Carnap*. Edited by Paul Arthur Schilpp. La Salle, IL: Open Court. pp. 1–84.

Ciancia, Kathryn 2017: Borderland Modernity: Poles, Jews, and Urban Spaces in Interwar Eastern Poland. *The Journal of Modern History* 89(3), pp. 531–61.

Connelly, John 2000: *Captive University: The Sovietization of East German, Czech, and Polish Higher Education, 1945–1956*. Chapel Hill: The University of North Carolina Press.

Davis, G. M. 1960: The English Electric KDF 9 Computer System. *The Computer Bulletin* 4(3), pp. 119–120.

Davis, Martin 2000: *The Universal Computer: The Road from Leibniz to Turing*. New York: W. W. Norton & Company.

Dąmbska, Izydora 1978: François Brentano et la Pensée philosophique en Pologne: Casimir Twardowski et son École. *Grazer philosophische Studien* 5, pp. 117–129.

Dick, Stephanie 2015: Of Models and Machines: Implementing Bounded Rationality. *Isis* 106(3), pp. 623–634.

Duhem, Pierre 1954: *The Aim and Structure of Physical Theory*. Trans. Philip P. Wiener. Princeton: Princeton University Press.

Faris, John Acheson 2013: Jan Łukasiewicz w Irlandii – kilka wspomnień (marzec 1996) [Jan Łukasiewicz in Ireland – A Few Recollections (March 1996)]. [In:] Łukasiewicz 2013, pp. 100–102.

Feferman, Anita Burdman; Feferman, Solomon 2004: *Alfred Tarski: Life and Logic*. Cambridge: Cambridge University Press.

Forman, Paul 1973: Scientific Internationalism and the Weimar Physicists: The Ideology and Its Manipulation in Germany after World War I. *Isis* 64(2), pp. 151–180.

Fox, Robert 2016: *Science without Frontiers: Cosmopolitanism and National Interests in the World of Learning, 1870–1940*. Corvallis: Oregon State University Press.

Fox, Robert 2017: The dream that never dies: the ideals and realities of cosmopolitanism in science, 1870–1940. *Studia Historiae Scientiarum* 16, pp. 29–47. DOI: 10.4467/2543702XSHS.17.004.7705. Available online: http://www.ejournals.eu/sj/index.php/SHS/article/view/SHS.17.004.7705/6769.

Fox, Robert; Kokowski, Michał 2017: Historiography of Science and Technology in Focus. A Discussion with Professor Robert Fox. *Studia Historiae Scientiarum* 16, pp. 69–119. DOI: 10.4467/2543702XSHS.17.006.7707. Available online: http://www.ejournals.eu/sj/index.php/SHS/article/download/6836/6771.

Gordin, Michael D. 2015: *Scientific Babel: How Science Was Done Before and After Global English*. Chicago: Chicago University Press.

Gabbay, Dov M.; Woods, John (eds.) 2002: *Handbook of the History of Logic*. 11 volumes. Amsterdam: Elsevier, 2004.

Goth, Greg 2002: Fans of Hewlett-Packard Calculators Say 'It All Adds Up.' *Computing in Science & Engineering* 4(2), pp. 5–8.

Grattan-Guinness, I. 2000: *The Search for Mathematical Roots, 1870–1940: Logics, Set Theories and the Foundations of Mathematics from Cantor through Russell to Gödel*. Princeton: Princeton University Press.

Garlicki, Andrzej (ed.) 1982: *Dzieje uniwersytetu warszawskiego 1915–1939* [*The History of the University of Warsaw 1915–1939*]. Warsaw: Państwowe Wydawnictwo Naukowe.

Gerwarth, Robert 2016: *The Vanquished: Why the First World War Failed to End*. New York: Farrar, Straus and Giroux.

Hamblin, C. L. 1957: An Addressless Coding Scheme Based on Mathematical Notation. [In:] *Data Processing and Automatic Computing Machines: Proceedings of a Conference (on Data Processing and Automatic Computing Machines) Held at Weapons Research Establishment, Salisbury, S.A., June 3rd–8th, 1957*. Salisbury, South Australia: Weapons Research Establishment, pp. 121.1–121.12. Available online: http://www.massey.ac.nz/~rmclachl/DPACM/121%20-%20addressless%20coding%20scheme.pdf.

Harwood, Jonathan 1987: National Styles in Science: Genetics in Germany and the United States between the World Wars. *Isis* 78(3), pp. 390–414.

Isaac, Joel 2005: W. V. Quine and the Origins of Analytic Philosophy in the United States. *Modern Intellectual History* 2(2), pp. 205–234.

Jacquette, Dale (ed.) 2004: *The Cambridge Companion to Brentano*. Cambridge: Cambridge University Press.

Jadacki, Jacek 2015: *Polish Philosophy of the 19th and 20th Centuries*. Warsaw: Wydawnictwo Naukowe Semper.

Jakubisiak, Augustyn 1936: *Od zakresu do treści* [*From Extension to Substance*]. Warsaw: Droga.

Janiszewski, Zygmunt 1918: O potrzebach matematyki w Polsce [On the Needs of Mathematics in Poland]. *Nauka polska, jej potrzeby, organizacja i rozwój* 1, pp. 11–18.

Jones, Matthew L. 2016: *Reckoning with Matter: Calculating Machines, Innovation, and Thinking about Thinking from Pascal to Babbage*. Chicago: Chicago University Press.

Judson, Pieter M. 2013: Marking National Space on the Habsburg Austrian Borderlands, 1880–1918. [In:] *Shatterzone of Empires: Coexistence and Violence in the German, Habsburg, Russian, and Ottoman Borderlands*. Edited by Omer Bartov and Eric D. Weitz. Bloomington: Indiana University Press, pp. 122–135.

Kauffman, Jesse 2015: *Elusive Alliance: The German Occupation of Poland in World War I*. Cambridge, MA, USA: Harvard University Press.

Kneale, William; Kneale, Martha 1962: *The Development of Logic*. Oxford: Clarendon Press.

Kotarbiński, Tadeusz 1966: Garstka wspomnień o Stanisławie Leśniewskim [A Handful of Memories of Stanisław Leśniewski]. *Ruch Filozoficzny* 24(3–4), pp. 155–163.

Kotarbiński, Tadeusz 1990: Philosophical Self-Portrait. [In:] *Kotarbiński: Logic, Semantics and Ontology*. Edited by Jan Woleński. Dordrecht: Kluwer Academic Publishers, pp. 1–6.

Kuratowski, Kazimierz 1980: *A Half Century of Polish Mathematics: Remembrances and Reflections*. Oxford and New York: Pergamon Press.

Kuzawa, Mary Grace 1970: Fundamenta Mathematicae: An Examination of Its Founding and Significance. *The American Mathematical Monthly* 77(5), pp. 485–492.

Lavington, Simon 1980: *Early British Computers: The Story of Vintage Computers and the People Who Built Them*. Manchester: Manchester University Press.

Lavoisier, Antoine-Laurent 1965: *Elements of Chemistry in a New Systematic Order, Containing All the Modern Discoveries*. Trans. Robert Kerr. New York: Dover.

Leśniewski, Stanisław 1991: On the Foundations of Mathematics. Trans. D. I. Barnett. [In:] Stanisław Leśniewski, *Collected Works*. Edited by S. J. Surma, J. T. Srzednicki, D. I. Barnett, and V. F. Rickey. 2 volumes. Dordrecht: Kluwer Academic Publishers, vol. 1, pp. 174–382.

Leśniewski, Stanisław 2015: Autobiografia [Autobiography]. [In:] Stanisław Leśniewski, *Pisma Zebrane* [Collected Works]. Edited by Jacek Jadacki. 2 volumes. Warsaw: Wydawnictwo Naukowe Semper, vol. 2, pp. 779–780.

Liulevicius, Vejas Gabriel 2000: *War Land on the Eastern Front: Culture, National Identity, and German Occupation in World War I*. Cambridge: Cambridge University Press.

Łukasiewicz, Jan 1910: *O zasadzie sprzeczności u Arystotelesa* [*On the principle of contradiction in Aristotle*]. Cracow: Polska Akademia Umiejętności.

Łukasiewicz, Jan 1916: O pojęciu wielkości [On the Concept of Magnitude]. *Przegląd Filozoficzny* 19, pp. 1–70. [Abridged and trans. in:] Łukasiewicz 1970, trans. O. Wojtasiewicz, pp. 64–83.

Łukasiewicz, Jan 1918: *Treść wykładu pożegnalnego wygłoszonego w auli Uniwersytetu Warszawskiego 7 marca 1918* [A Lecture Delivered in the Auditorium of the University of Warsaw on 7 March 1918]. Warszawa. [Trans in:] Łukasiewicz 1970, trans. O. Wojtasiewicz, pp. 84–86.

Łukasiewicz, Jan 1920a: O pojęciu możliwości [On the Concept of Possibility]. *Ruch Filozoficzny* 5, pp. 169–170. [Trans in:] McCall (ed.) 1967, trans. H. Hiż, pp. 15–16.

Łukasiewicz, Jan 1920b: O logice trójwartościowej [On Three-Valued Logic]. *Ruch Filozoficzny* 5, pp. 170–171. [Trans in:] McCall (ed.) 1967, trans. H. Hiż, pp. 16–18.

Łukasiewicz, Jan 1929: O znaczeniu i potrzebach logiki matematycznej [On the Significance and Needs of Mathematical Logic]. *Nauka Polska* 10, pp. 604–620.

Łukasiewicz, Jan 1931: Uwagi o aksyomacie Nicod'a i o 'dedukcyi uogólniającej' [Comments on Nicod's Axiom and on 'Generalizing Deduction']. *Księda pamiątkowa Polskiego Towarzystwa Filozoficznego*. Lwów. [Reprinted in:] Łukasiewicz 1961, pp. 164–177. [Trans. in:] Łukasiewicz 1970, trans. O. Wojtasiewicz, pp. 179–196.

Lukasiewicz, Jan 1935: Zur Geschichte Der Aussagenlogik. *Erkenntnis* 5, pp. 111––131. [Trans in:] Łukasiewicz 1970, trans. S. McCall, pp. 197–217.

Łukasiewicz, Jan 1936: Logistyka i filozofia [Logistic and Philosophy]. *Przegląd Filozoficzny* 39, pp. 115–131. [Reprinted in:] Łukasiewicz 1961, pp. 195–209. [Trans. in:] Łukasiewicz 1970, trans. O. Wojtasiewicz, pp. 218–235.

Łukasiewicz, Jan 1951: *Aristotle's Syllogistic: From the Standpoint of Modern Formal Logic*. Oxford: Clarendon Press.

Łukasiewicz, Jan 1961: *Z zagadnień logiki i filozofii: Pisma wybrane* [*From the Problems of Logic and Philosophy: Selected Works*]. Edited by Jerzy Słupecki. Warsaw: Państwowe Wydawnictwo Naukowe.

Łukasiewicz, Jan 1963: *Elements of Mathematical Logic*. Trans. Olgierd Wojtasiewicz. New York: MacMillan.

Łukasiewicz, Jan 1970: *Selected Works*. Edited by L. Borkowski. Amsterdam and London: North-Holland Publishing Company and Warsaw: PWN – Polish Scientific Publishers.

Łukasiewicz, Jan 2013: *Pamiętnik* [*Memoirs*]. Edited by Jacek Jadacki and Piotr Surma. Warsaw: Wydawnictwo Naukowe Semper.

Łukasiewicz, Jan; Tarski, Alfred 1930: Untersuchungen über den Aussagenkalkül. *Sprawozdania z Posiedzeń Towarzystwa Naukowego Warszawskiego, Wydział III Nauk Matematyczno-fizycznych (Comptes Rendus des séances de la Société des Sciences et des lettres de Varsovie, Classe III, Sciences Mathématiques et Physiques)* 23, pp. 30–50. [Trans. in :] Tarski 1983, pp. 38–59.

Mahoney, Michael S. 1988: The History of Computing in the History of Technology. *Annals of the History of Computing* 10(2), pp. 113–25.

McCall, Storrs (ed.) 1967: *Polish Logic 1920–1939*. Oxford, Clarendon Press.

Melzer, Emanuel 1997: *No Way Out: The Politics of Polish Jewry, 1935-1939*. Cincinnati: Hebrew Union College Press.

Menger, Karl 1994: *Reminiscences of the Vienna Circle and the Mathematical Colloquium*. Edited by Louise Golland, Brian McGuinness, and Abe Sklar. Dordrecht: Kluwer Academic Publishers.

Meredith, Carew A. 1953: Single Axioms for the Systems (C, N), (C, 0) and (A, N) of the Two-Valued Propositional Calculus. *Journal of Computing Systems* 1(3), pp. 155–170.

Mick, Christoph 2016: *Lemberg, Lwów, L'viv, 1914–1947: Violence and Ethnicity in a Contested City*. West Lafayette: Purdue University Press.

Miehle, William 1957: Burroughs Truth Function Evaluator. *Journal of the ACM* 4(2), pp. 189–192.

Murawski, Roman 2014: *The Philosophy of Mathematics and Logic in the 1920s and 1930s in Poland*. Trans. Maria Kantor. Basel: Birkhäuser.

Murawski, Roman 2015: Cracow Circle and Its Philosophy of Logic and Mathematics. *Axiomathes* 25(3), pp. 359–76.

[N.N.$_1$] 1925/28: *Jahrbuch über die Fortschritte der Mathematik* 48 Jahrgang 1921–22.

Nagel, Ernest 1936a: Impressions and Appraisals of Analytic Philosophy in Europe I. *The Journal of Philosophy* 33(1), pp. 5–24.

Nagel, Ernest 1936b: Impressions and Appraisals of Analytic Philosophy in Europe II. *The Journal of Philosophy* 33(2) pp. 29–53.

Nowik, Grzegorz 2004: *Zanim złamano "Enigmę": Polski radiowywiad podczas wojny z bolszewicką Rosją 1918–1920* [*Before Breaking "Enigma": Polish Radio Intelligence during the War with Soviet Russia 1918–1920*]. Warsaw: Rytm.

Plach, Eva 2006: *The Clash of Moral Nations: Cultural Politics in Piłsudski's Poland, 1926–1935*. Athens, Ohio: Ohio University Press.

Polish Philosophy Page 2017: *Documentation on Twardowski*. Available online (1.10.2017): http://segr-did2.fmag.unict.it/~polphil/PolPhil/Tward/Tward-Doc.html.

Polonsky, Antony 1972: *Politics in Independent Poland 1921–1939: The Crisis of Constitutional Government*. Oxford: Clarendon Press.

Porter, Brian 2000: *When Nationalism Began to Hate: Imagining Modern Politics in Nineteenth-Century Poland*. Oxford: Oxford University Press.

Porter, Brian 2005: Antisemitism and the Search for a Catholic Identity. [In:] *Antisemitism and Its Opponents in Modern Poland*. Edited by Robert Blobaum. Ithaca: Cornell University Press, pp. 103–123.

Porter-Szűcs, Brian 2014: *Beyond Martyrdom: Poland in the Modern World*. West Sussex: Wiley-Blackwell.

Priestley, Joseph 1796: *Considerations on the Doctrine of Phlogiston, and the Decomposition of Water*. Philadelphia: Thomas Dobson.

Priestley, Mark 2011: *A Science of Operations: Machines, Logic and the Invention of Programming*. London: Springer.

Prior, A. N. 1952a: Lukasiewicz's Symbolic Logic. *Australasian Journal of Philosophy* 30(1), pp. 33–46.

Prior, A. N. 1952b: Methods of Logic by W. V. Quine. *Australasian Journal of Philosophy* 30(3), pp. 200–202.

Quine, W. V. 1985: *The Time of My Life: An Autobiography*. Cambridge and London: The MIT Press.

Reisch, George A. 2005: *How the Cold War Transformed Philosophy of Science: To the Icy Slopes of Logic*. Cambridge: Cambridge University Press.

Rickey, V. Frederick 2011: Polish Logic from Warsaw to Dublin: The Life and Work of Jan Łukasiewicz. *Canadian Society for History and Philosophy of Mathematics Proceedings* 24, pp. 93–109.

Schmidt Am Busch, Hans-Christoph; Wehmeier, Kai F. 2007: On the Relations between Heinrich Scholz and Jan Łukasiewicz. *History and Philosophy of Logic* 28(1), pp. 67–81.

Simons, Peter 2017: Łukasiewicz's Parenthesis-Free or Polish Notation. [In:] *The Stanford Encyclopedia of Philosophy* (Spring 2017 Edition). Edited by Edward N. Zalta. Available online (1.10.2017): https://plato.stanford.edu/archives/spr2017/entries/lukasiewicz/polish-notation.html.

Sobociński, Bolesław 1932: Z badań nad teorią dedukcji [From the Investigation of the Theory of Deduction]. *Przegląd Filozoficzny* 35, pp. 171–193.

Somsen, Geert J. 2008: A History of Universalism: Conceptions of the Internationality of Science from the Enlightenment to the Cold War. *Minerva* 46(3), pp. 361–79.

Surma , Piotr 2012: *Poglądy Filozoficzne Jana Łukasiewicza a logiki wielowartościowe* [*Jan Łukasiewicz's Philosophical Views and Many-Valued Logics*]. Warsaw: Wydawnictwo Naukowe Semper.

Tarski, Alfred 1934–5: Über die Erweiterungen der unvollständigen Systeme des Aussagenkalküls. *Ergebnisse eines mathematischen Kolloquiums* fascicule 7, pp. 51–57. [Trans. in:] Tarski 1983, pp. 393–400.

Tarski, Alfred 1983: Logic, Semantics, Metamathematics. 2nd edition. Trans. J. H. Woodger. Edited by John Corcoran. Indianapolis, Indiana: Hackett Publishing Company, Inc.

Twardowski, Kazimierz 1991: Selbstdarstellung. Edited by Jan Woleński and Thomas Binder. *Grazer philosophische Studien* 39(1), pp. 1–26.

Vellacott, Jo 1980: *Bertrand Russell and the Pacifists in the First World War*. Brighton: Harvester Press.

Whitehead, Alfred North; Russell, Bertrand 1910: *Principia Mathematica*. Volume 1. Cambridge: at the University Press.

Woleński, Jan 1989: *Logic and Philosophy in the Lvov–Warsaw School*. Dordrecht: Kluwer Academic Publishers.

Woleński, Jan 2001: The Rise of Many-Valued Logic in Poland. [In:] *Zwischen traditioneller und moderner Logik*. Edited by Werner Stelzner and Manfred Stöckler. Paderborn: Mentis, pp. 193–204.

Woleński, Jan 2013: Józef M. Bocheński and the Cracow Circle. *Studies in East European Thought* 65(1–2), pp. 5–15.

Wolff, Larry 1994: *Inventing Eastern Europe: The Map of Civilization on the Mind of the Enlightenment*. Stanford: Stanford University Press.

Wrona, Grażyna 2004: 'Nauka polska, jej potrzeby, organizacja i rozwój' (1918––1939), pierwsze polskie czasopismo naukoznawcze ['Polish Science, its Needs, Organization, and Development' (1918–1939), the First Polish Journal of Science Studies]. *Rocznik historii prasy polskiej* 7, pp. 19–47.

Zahra, Tara 2010: Imagined Noncommunities: National Indifference as a Category of Analysis. *Slavic Review* 69(1), pp. 93–119.

Zaremba, Stanisław 1912: *Arytmetyka teoretyczna* [*Theoretical Arithmetic*]. Cracow: Polska Akademia Umiejętności.

Żarnowski, Janusz 2003: The Polish Intelligentsia between the Intellectual Elite and the Middle Class: Typicality and the Peculiarity of the Polish Social Stratum. [In:] Janusz Żarnowski, *State, Society and Intelligentsia: Modern Poland and its Regional Context*. Aldershot: Ashgate. Unpaginated.