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Logica Universalis

Adolf Lindenbaum: Notes on his Life, with Bibliography and Selected References

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Abstract. Notes on the life of Adolf Lindenbaum, a complete bibliography of his published works, and selected references to his unpublished results.

Mathematics Subject Classification. 01A60, 01A70, 01A73, 03-03.

Keywords. Adolf Lindenbaum, biography, bibliography, unpublished works.

This paper is dedicated to Adolf Lindenbaum (1904–1941)—Polish-Jewish mathematician and logician; a member of the Warsaw school of mathematics under Wacław Sierpiński and Stefan Mazurkiewicz and school of mathematical logic under Jan Łukasiewicz and Stanisław Leśniewski;[1] and Alfred Tarski's closest collaborator of the inter-war period.

Our paper is divided into three main parts. The first part is biographical and narrative in character. It gathers together what little is known of Lindenbaum's short life. The second part is a bibliography of Lindenbaum's published output, including his public lectures. Our aim there is to be complete and definitive. The third part is a list of selected references in the literature attesting to his unpublished results[2] and delineating their extent.

Just to confuse things, we name the second and third parts of our paper, respectively, "Bibliography Part One" and "Bibliography Part Two". Why, we no longer remember. If it will help, the reader is welcome to think of them as "published results" and "the unpublished ones that everybody agrees on and gives him credit for".

As this way of organizing things deprives us of our own bibliographical appendix, we begin by quickly enumerating...

[1] The Łukasiewicz-Leśniewski school of mathematical logic was a group of logicians working within the broader context of the Lwów-Warsaw school. See J. Woleński, ***Logic and Philosophy in the Lvov-Warsaw School***, Kluwer, Dordrecht 1989.

[2] We use the word "results" in a broad sense, including suggestions and avenues of inquiry that bore fruit primarily for others but originated with Lindenbaum.

Our Sources

[1] B. Armatys, L. Armatys, W. Stradomski, ***Historia filmu polskiego. Tom II: 1930-1939***, Wydawnictwa Artystyczne i Filmowe, Warsaw 1988, p. 207.

[2] Documents and letters from the Tarski archives in Bancroft Library, U.C. Berkeley.

[3] Documents and photographs from the archives of Warsaw University: *Akta studenckie*—RP 11 947 (A. Lindenbaum). Photograph of Lindenbaum © University of Warsaw Archives, by kind permission. We are grateful to Anna Dziedzic for her help with obtaining the scan.

[4] A.B. Feferman and S. Feferman, ***Alfred Tarski: Life and Logic***, Cambridge University Press: Cambridge 2004, pp. 37, 93, 97, 101, 108, 155, 169, 191, 386.

[5] D. Gromska, '*Philosophes polonais morts entre 1938 et 1945* [Adolf Lindenbaum]', ***Studia Philosophica***, vol. 4 (1948), p. 59.

[6] J.J. Jadacki, 'Adolf Lindenbaum', in ***. . . A mądrości zło nie przemoże*** <. . . But against Wisdom evil does not prevail>, ed. by J.J. Jadacki & B. Markiewicz, Polskie Towarzystwo Filozoficzne, Warsaw 1993, pp. 168–169. (The words '*a mądrości zło nie przemoże*' are from Wisdom of Solomon 7:30—a book in the Eastern Orthodox and Catholic Old Testaments).

[7] P. Mancosu, 'Tarski's Engagement with Philosophy', in S. Lapointe *et al.* (eds.), ***The Golden Age of Polish Philosophy***. Logic, Epistemology, and the Unity of Science, vol. 16, Springer: Dordrecht 2009, chapter 9, p. 132.

[8] T. Manteuffel, ***Uniwersytet Warszawski w latach 1915/16–1934/35***. ***Kronika***. Nakładem Uniwersytetu Józefa Piłsudskiego, Warsaw 1936, pp. 215 & 233 (on Adolf Lindenbaum), p. 181 (on the Philosophical Seminar in the faculties of philosophy and the humanities), and p. 216 (on the Philosophical Seminar in the faculty of mathematics and natural sciences).

[9] E. Marczewski, 'Kirszbraun Mojżesz D(awid?) (1903 lub 1904–1942)', ***Polski słownik biograficzny*** <Polish Biographical Dictionary>, vol. 12, Kraków 1966–67, p. 486b. We shall sometimes use the abbreviation ***PSB***.

[10] E. Marczewski and A. Mostowski, 'Lindenbaum Adolf (1904–1941)', ***Polski słownik biograficzny*** <Polish Biographical Dictionary>, vol. 17, Kraków 1971, pp. 364b–365b.

[11] A. McFarland, J. McFarland and J.T. Smith (eds.), ***Alfred Tarski: Early Work in Poland—Geometry and Teaching***, Birkhäuser: Basel 2014.

[12] ***Powszechna Encyklopedia Filozofii***, vols. 4 and 6, Lublin 2003 and 2005.

[13] M. Przeniosło, ***Matematycy polscy w dwudziestoleciu międzywojennym: Studium historyczne***, Wydawnictwo Uniwersytetu Humanistyczno-Przyrodniczego Jana Kochanowskiego, Kielce 2011, p. 160.

[14] Records of the Senate of Poznań University for 1937–1939 (*Protokoły posiedzeń senatu Uniwersytetu im. Adama Mickiewicza w Poznaniu w latach* 1937–1939)

[15] 'Reminiscences of logicians', in ***Algebra and Logic***, ed. by J. Crossley, Lecture Notes in Mathematics 450, Springer, Berlin 1975, pp. 26–27, 44. (These are transcripts of audio recordings of two informal discussions that took place in Crossley's office on the 15th and 29th of January, 1974. Reminiscences concerning Adolf Lindenbaum are those of Andrzej Mostowski, who was present at both days' discussions).

[16] Surma 1982—as per our: **3. Bibliography Part Two**.[3]

[17] Warsaw telephone directories of 1930–1940 from *Mazowiecka Biblioteka Cyfrowa* (www.mbc.cyfrowemazowsze.pl).

[18] ***Wielka Encyklopedia Powszechna PWN***, vol. 6, Warsaw 1965, p. 527.

[19] J. Woleński, ***Logic and Philosophy in the Lvov-Warsaw School***, Kluwer, Dordrecht 1989.

[20] J. Woleński, ***Essays in the History of Logic and Logical Philosophy***. Dialogikon, vol. 8, Jagiellonian University Press: Kraków 1999.

[21] '*Wykaz imienny docentów według stanu z dnia 31 grudnia 1937 r.*<State Register of Docents as of 31 December 1937>', Ministry of Religious Affairs and Public Education, Warsaw 1938 (www.sbc.org.pl/dlibra/doccontent?id=11721&from=FBC).

The foregoing list is scanter than we would like. Unfortunately, not much is known today of Lindenbaum's childhood, the family he grew up in, or his "*persona*" beyond school and work. Whatever records once existed are now mostly lost, so our biography of him must regrettably concentrate on his academic and professional life.

In a follow-up paper, currently in preparation, we shall review the works themselves, and examine Lindenbaum's influence onthe work of those around

[3] Surma does not explicitly refer to Marczewski and Mostowski's ***PSB*** entry on Lindenbaum, and it seems he was unacquainted with its contents at the time he wrote his 1982 article, because he appears to be unaware that some of his assertions disagree with it. As both Marczewski and Mostowski knew Lindenbaum personally, and as their ***PSB*** entry is based partly on their own recollections of him (see the list of sources they cite at the bottom of their entry), we are inclined to favor their account over Surma's where disagreements arise. Also, it seems, Surma did not fully avail himself of some of the other archival materials that were at his disposal.

him and of others who followed. But that is a story for another day. For now ...

1. A Short Life

Adolf Lindenbaum in 1927

The photo is from Lindenbaum's second student book when he enrolled in the Faculty of Humanities, academic year 1927/28.

Adolf Lindenbaum was born in Warsaw on June 12, 1904, the son of Mowsza Henoch Lindenbaum and Emilja Lindenbaum, née Krykus. It is not known if he had siblings; there is speculation that he might have had a sister. Nothing is known about his parents' backgrounds, or about the family's financial circumstances, save that his father Mowsza was the owner-of-record of a number of companies, and that in 1931 he produced a movie[4] that was a financial success.

There is no record of which elementary school Lindenbaum attended. In September, 1914, at the age of ten, he entered gimnazjum Rocha Kowalskiego.[5]

[4] Titled ***Krwawy Wschód*** <Bloody East>, released October 8, 1931, starring Mieczysław Cybulski, directed by Jan Nowina-Przybylski, screen play by Anatol Stern, music by Tadeusz Górzyński, production design by Stefan Norris, filmed at Zoro-Film studios. It is the only movie that Mowsza Lindenbaum is known to have produced. Critics panned it, but it was apparently a modest box-office success, staying in premiere cinemas for 30 days, according to film historian Dr. Rafał Syska. No copies are known to have survived to the present day.
[5] The meaning of the Polish word "*gimnazjum*" has changed several times over the last 200 years. In the inter-war period it was an eight-year secondary school embracing the equivalents of grades 5 through 12 in today's American terms.

The following year, age eleven, he transferred to gimnazjum filologiczne Michała Kreczmara,[6] where he completed his secondary schooling—passing his matriculation exam (*egzamin dojrzałości*, also known as *matura*) on May 27th, 1922, 2 weeks before his eighteenth birthday. This exam normally comprised two parts, oral and written. Lindenbaum was granted an exemption from the oral part "as a student showing good progress" (*jako uczeń, wykazujący dobre postępy*).[7]

Two things stand out from this period. In the summer of 1920, as advancing Soviet forces threatened Warsaw, the young Adolf, who had just turned sixteen in June, was obliged to do community service in support of Poland's war effort. He was enlisted into the *Koło Pomocy Żołnierzowi ,,Spójnia"*, an organization set up by the Polish White Cross, where he worked as an errand-boy (*goniec*) for 4 months, up until the ceasefire of October, 1920. These duties overlapped the first month-or-so of his penultimate year of gimnazjum (11th grade, in today's American terms).

Second, and more notably, the mathematician Mojżesz Dawid Kirszbraun was a classmate of Lindenbaum's at gimnazjum Kreczmara. They were in the same graduating class of 1922,[8] and entered Warsaw University together. The two worked together at university, and their joint results are cited in [26a]. Kirszbraun's 1930 master's thesis (*praca magisterska*) was later expanded and published in ***Fund. Math.*** (see Kirschbraun 1934) and continues to garner citations to this day.

On September 14th, 1922, Lindenbaum applied for admission to the mathematics section of the faculty of philosophy at Warsaw University. Up to that point we have no record of exactly where in Warsaw he or his parents lived. On his university application papers he gave his address as: Apt. 4 – 45 Złota Street (*ul. Złota 45 m.4*). Warsaw telephone books spanning the (much later) time period 1930 through 1939 give the same address for M.H. Lindenbaum (M.H. presumably being Mowsza Henoch). This suggests, not entirely surprisingly, that Adolf was still living with his parents when he applied for admission to university.[9]

The application process required him to submit a résumé (*życiorys*). In his résumé he wrote, among other things, that he is "of the Jewish faith" (*Jestem wyznania mojżeszowego*), and he concluded with touching openness:

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[6] The reason for the move remains unexplained. Possible reasons are legion, of course, but one clue may be, that one (or both) of the schools might have moved. Gimnazjum M. Kreczmara is known to have had three addresses: first on Miodowa Street, then on Śniadeckich, then Wilcza. It is suggestive that two other people with the surname Lindenbaum, ages 5 and 8 years younger than Adolf, were recorded to have been living on Śniadeckich in 1939—a street which was only one block long.

[7] Quoted from a handwritten résumé (*życiorys*) accompanying Lindenbaum's application to Warsaw University, dated the 14th of September, 1922.

[8] Kirszbraun passed his matriculation exam on May 22nd, 1922, 5 days ahead of Lindenbaum.

[9] What is somewhat surprising is that, according to a list of registered members of the Polish Mathematical Society, this was still Adolf's address in 1931, when he would have been 26 or 27 years old. See: ***Annales de la Société Polonaise de Mathématique***, vol. 10, 1931, p. 154.

"Always loving mathematics, I did not hesitate for a moment what to choose among the different advanced studies, having decided to apply for admission to that faculty where I will be able to study this science". (*Zawsze miłując matematykę, nie wahałem się ani chwili co do wyboru wśród różnych rodzajów studjów wyższych, postanowiwszy prosić o przyjęcie mnie na ten wydział, na którym będę w możności tę naukę studjować.*)[10]

Lindenbaum's application was accepted on September 19th, 1922, and on October 2nd he commenced his studies in the mathematics section of the faculty of philosophy. It took him until the end of the spring trimester (third trimester) of the 1926/27 academic year to complete his course work. On September 15th, 1927, he writes, "I completed my mathematics studies in 5 years, i.e., I am [now] in the process of taking my doctoral exams". (*W ciągu 5-ciu lat studja w zakresie matematyki ukończyłem, t.j. jestem w trakcie składania egzaminów doktorskich.*)

Lindenbaum's teachers during this period were (in alphabetical order): Czesław Białobrzeski, Samuel Dickstein, Michał Kamieński, Tadeusz Kotarbiński, Kazimierz Kuratowski, Stefan Kwietniewski, Franciszek Leja, Stanisław Leśniewski, Jan Łukasiewicz, Stefan Mazurkiewicz, Stefan Pieńkowski, Antoni Przeborski, Aleksander Rajchman, Wacław Sierpiński, Stefan Straszewicz, Alfred Tarski, Władysław Witwicki, Antoni Zygmund and Kazimierz Żórawski.[11]

Tarski writes (see Tarski 1949, p. xii) that Lindenbaum was his "student"—a claim that is cited verbatim, and apparently accepted without scrutiny, in Feferman and Feferman 2004, p. 93. It is not clear how Tarski intended these words to be understood. A reader not well versed in the details of the situation might infer too much. Tarski was scarcely three-and-a-half years older than Lindenbaum, and was himself a student at Warsaw University throughout most of Lindenbaum's time there. The two of them first met as students in Leśniewski's seminar. Tarski only secured a teaching job in the closing months of 1925.

Lindenbaum attended two of Tarski's courses: the theory of cardinal numbers (*teorja liczb kardynalnych*) in the winter and spring trimesters of the 1925/26 academic year, and elementary mathematics—plane geometry (*matematyka elementarna—planimetrja*) in the 1926/27 academic year. These were, in all likelihood, the first two courses Tarski ever taught in his brand-new rôle as a freshly minted *docent*. It is hard to believe that Lindenbaum did not already know the material as well as Tarski.[12]

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[10] On some of these documents—which he wrote as a very young man, even in some cases as a teenager—his writing style can best be described as "conversational" rather than formally correct: incomplete sentences, run-on sentences, words hastily chosen and ill fitting. As some of this "flavor" gets lost in translation, we show his original words in parentheses. His penmanship, in contrast, was impeccably legible.

[11] In alphabetical order, Zy comes before Ż6.

[12] In 'Reminiscences of Logicians', C-C. Chang asks Andrzej Mostowski (p. 26), "So Lindenbaum was not technically a Tarski student?"... and Mostowski answers, "That is right".

While still just a fourth-year student, in the spring trimester of the 1925/26 academic year, Lindenbaum published papers in two journals ([26] and [26a]). He was also considering preparing for his doctoral exams. On October 27th, 1926, he asked to be given leave from his course requirements for the 1926/27 academic year to allow him time to prepare: "*Posiadając już zaliczone 4 lata studiów na Uniwersytecie Warszawskim* (*wizy dziekańskie*)*, a pragnąc obecnie przystąpić do składania egzaminów doktorskich, co ponadto mam utrudnione przez postronne przyczyny,—mam zaszczyt prosić o udzielenie mi urlopu na rok akademicki 1926/27*". His request was turned down, and his fifth year of course work proceeded to its bitter end, with eleven courses undertaken (*pocz. pośw.*) and three completed (*kończ. pośw.*). Tarski's plane geometry was not one of those completed. Nor had Tarski's cardinal numbers been completed the year before.

Lindenbaum needed time off to prepare for his doctoral exams. Simply letting his university enrolment run out would not have provided it. Military service threatened the moment he ceased being a student.[13] He cited his two published papers in support of a second application to the university, dated September 15th, 1927, for admission to the faculty of humanities (*wydział humanistyczny*), claiming he wanted to study psychology and pedagogy. On his application he added, squeezing it in like an afterthought, that he had secured a student postponement of military service (*wojskowe świadectwo prolongacyjne posiadam*).

His application was immediately accepted, and as the fall trimester of the 1927/28 academic year got underway, Lindenbaum became a freshman once again. He signed up for eleven courses in an eclectic range of subjects, with teachers Karol Appel, Henryk Mościcki, Bogdan Nawroczyński, Mojżesz Schorr, Władysław Tatarkiewicz, Józef Ujejski and Wiktor Wąsik. Of these, he attended only two: Józef Ujejski's course on the Polish romantic poet Adam Mickiewicz (*twórczość Adama Mickiewicza na tle literatury współczesnej*), and Nawroczyński's psychology course on character and its training (*charakter i jego wychowanie*). This gave him the time he needed.

Sierpiński supervised Lindenbaum's Ph.D. dissertation, titled '*O własnościach metrycznych mnogości punktowych*' ('On metric properties of point sets').[14] As its title suggested, it was on point set topology. Lindenbaum's first publication [26] formed part of it. The thesis was finished and submitted in the autumn of 1927[15] and successfully defended on June 22nd, 1928, and its author received the title of Doctor of Philosophy:

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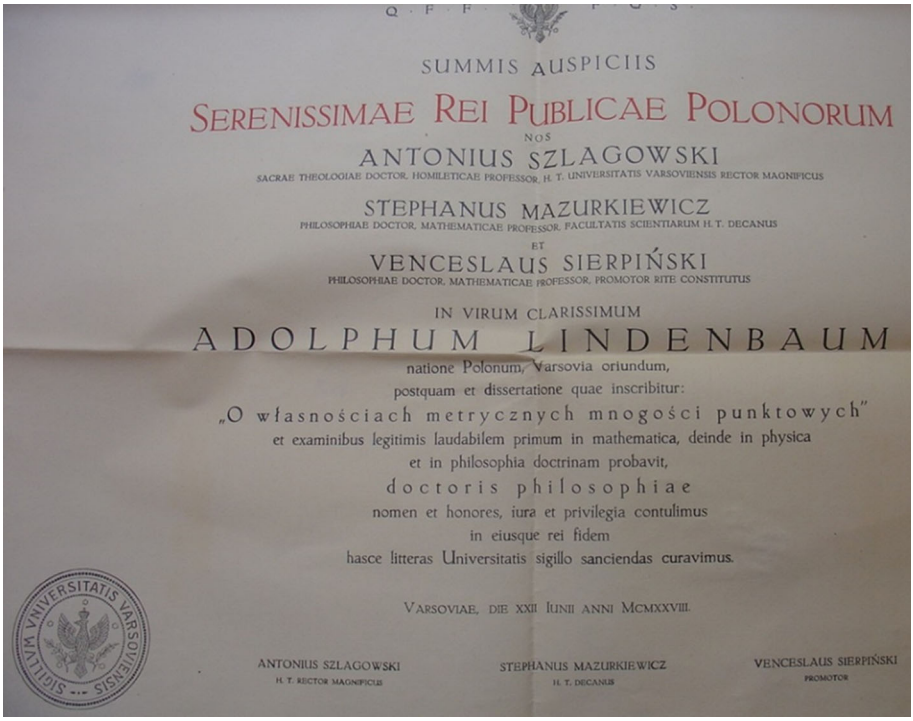
[13] His aforementioned "external circumstances" (*postronne przyczyny*)—at that time a well understood euphemism within the university's walls.

[14] Marczewski and Mostowski's ***PSB*** entry on Lindenbaum, and Jadacki's entry in ***... A mądrości zło nie przemoże***, have both omitted the word "*metrycznych*" (metric) from the dissertation's title, thereby obscuring the fact that the work was primarily about topology. And in the same paragraph (on p. 168) Jadacki goes on to give an excessively narrow and selective summary of Lindenbaum's ideas, depicting them as limited exclusively to propositional calculus and its algebraization... which they certainly weren't.

[15] The year 1927 is mentioned by Lindenbaum himself in [33a], p. 106, footnote 18; by Kirszbraun 1934, p. 78, footnote 4; and by Sierpiński 1936a, p. 32.



SUMMIS AUSPICIIS

SERENISSIMAE REI PUBLICAE POLONORUM

NOS

ANTONIUS SZLAGOWSKI

SACRAE THEOLOGIAE DOCTOR, HOMILETICAE PROFESSOR, H. T. UNIVERSITATIS VARSOVIENSIS RECTOR MAGNIFICUS

STEPHANUS MAZURKIEWICZ

PHILOSOPHIAE DOCTOR, MATHEMATICAE PROFESSOR, FACULTATIS SCIENTIARUM H. T. DECANUS

ET

VENCESLAUS SIERPIŃSKI

PHILOSOPHIAE DOCTOR, MATHEMATICAE PROFESSOR, PROMOTOR RITE CONSTITUTUS

IN VIRUM CLARISSIMUM

ADOLPHUM LINDENBAUM

natione Polonum, Varsovia oriundum,

postquam et dissertatione quae inscribitur:

„O własnościach metrycznych mnogości punktowych"

et examinibus legitimis laudabilem primum in mathematica, deinde in physica

et in philosophia doctrinam probavit,

doctoris philosophiae

nomen et honores, iura et privilegia contulimus

in eiusque rei fidem

hasce litteras Universitatis sigillo sanciendas curavimus.

VARSOVIAE, DIE XXII IUNII ANNI MCMXXVIII.

SIGILLUM UNIVERSITATIS VARSOVIENSIS

ANTONIUS SZLAGOWSKI
H. T. RECTOR MAGNIFICUS

STEPHANUS MAZURKIEWICZ
H. T. DECANUS

VENCESLAUS SIERPIŃSKI
PROMOTOR

More or less at the same time, Lindenbaum stopped signing up for new courses, and started gathering affidavits from student societies he had been involved with, testifying that he had no outstanding obligations to them. Records show these included...

- *Koło Matematyczno-Fizyczne Słuchaczów Uniwersytetu Warszawskiego* (Student Mathematics and Physics Circle)
- *Towarzystwo ,,Bratnia Pomoc" Studentów Uniwersytetu Warszawskiego* ("Fraternal Assistance" Student Society)
- *Wzajemna Pomoc Studentów-Żydów Uniwersytetu Warszawskiego* (Jewish Student Mutual Assistance Association)
- *Składnica Centrali Akademickich Bratnich Pomocy w Warszawie* (Central Registry of Academic Fraternities)
- *Samopomoc Związku Akademickiej Młodzieży Zjednoczeniowej* (Student Union Mutual Aid Association)
- *Koło Filozoficzne Studentów Uniwersytetu Warszawskiego* (Student Philosophy Circle)

An entry (*świadectwo wystąpienia z uniwersytetu*) in the university's archives dated June 15th, 1929, records that Lindenbaum officially ceased being a student in the faculty of humanities on that date.

Lindenbaum's doctoral dissertation was never published as a whole. Some 8 years after its defense, Sierpiński in one of his papers cites a theorem from the dissertation, noting that, "*La démonstration de cette proposition se trouve*

dans la Thèse de M. Lindenbaum (*Varsovie 1927, non publiée*) *et sera publiée prochainement*". (Sierpiński 1936a, p. 32)

In 1934 Lindenbaum presented a habilitation thesis to the University's faculty of mathematics and natural sciences[16] and after successfully defending it was awarded the title of *Docent*.[17] This qualified him to be commissioned by the University (or more precisely, by the faculty of mathematics and natural sciences) to give lectures in its name. And commission him it eventually did, on February 1st, 1935, for the winter and spring trimesters of that academic year. Then at the beginning of the next academic year, on October 1st, 1935, he took up the position of *adiunkt* (assistant professor) in the Philosophical Seminar, an administratively and academically autonomous unit within the faculty of mathematics and natural sciences that was at that time under the direction of Jan Łukasiewicz.[18]

The origins of the Philosophical Seminar went back to the autumn of 1915, and up until September 30th, 1927, it existed within the framework of the erstwhile faculty of philosophy. Over that period it had been directed by (variously) Jan Łukasiewicz, Władysław Tatarkiewicz, Tadeusz Kotarbiński and Kazimierz Ajdukiewicz. Occasionally it had been under dual (joint) directorship; for a certain period its work was carried out in two parallel sections.

One month after reorganization of the University's structure (refer again to footnote 16), starting from October 1st, 1927, each of the two newly-created faculties was given its own Philosophical Seminar. The one in the faculty of humanities was placed under the joint direction of Tadeusz Kotarbiński and Władysław Tatarkiewicz, while the one in the faculty of mathematics and natural sciences was put under the sole direction of Jan Łukasiewicz. It was Łukasiewicz's Philosophical Seminar that hired Lindenbaum.

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[16] Note: not the "faculty of philosophy, mathematics section," in which he was enrolled as an undergraduate. By the time he submitted his PhD dissertation, in the late autumn of 1927, that faculty and that section no longer existed. The university had undergone a reorganization in the interim. Both the faculty of humanities and the faculty of mathematics and natural sciences had been created on September 1st, 1927, replacing the erstwhile faculty of philosophy (see: T. Manteuffel, ***Uniwersytet Warszawski w latach 1915/16–1934/35: Kronika***, pp. 181 & 216.)

[17] According to Manteuffel, *op. cit.*, p. 233, the title was conferred on July 3, 1934. It was recognized by the Ministry of Religious Affairs and Public Education on September 30, 1934 (see: '*Wykaz imienny docentów według stanu z dnia 31 grudnia 1937 r.*') The meaning of the word "*docent*" has changed subtly over the years. At that time, a docenture associated its bearer quite closely with the university, and the specific faculty, that awarded it: it was a license to teach there. This was not as close an association as outright faculty membership: employment was not automatic, and the designation retained an element of portability in the wider world. But nor was it merely an academic qualification. It was an intermingling of five notions: (a) avowed intent, (b) certified ability, (c) presumed entitlement, (d) conditional rank, and (e) targeted employer: *vocatus sum docere, veniam docendi*.

[18] Manteuffel, *op. cit.*, gives two different dates in connection with Lindenbaum's appointment to the position of *adiunkt* in the Philosophical Seminar: July 3rd, 1935 (see p. 233), and October 1st, 1935 (see p. 216). Probably the former is the date when the faculty adopted a resolution to offer him a permanent position, and the latter is when he took up his duties. We do not know if he was employed by the Philosophical Seminar somewhat earlier with the job title of *asystent*.

Then in academic year 1934/35 the faculty of mathematics and natural sciences set up a Seminar of Philosophy of Mathematics in addition to, and administratively separate from, its Philosophical Seminar, and placed it under the direction of Stanisław Leśniewski.[19]

There is no record of Lindenbaum's having held gainful employment prior to this appointment, which would imply that he was 30 years old before he had any visible means of support. Anecdotal evidence suggests his parents were affluent,[20] and that he led somewhat the life of a *bon vivant*, spending money freely in restaurants.[21] This is hearsay, and sits oddly with his known political sympathies (see below), but if true it would not be the first such case in history, or the last.

Lindenbaum's habilitation thesis *qua* physical document seems not to have survived the ravages of war: it disappeared without a trace. For the last 70 years it has been widely presumed that its contents, its subject, its title, were no longer known. We have reason believe, however, that its subject and contents, if not its exact title, might (possibly) be staring us in the face.

In ***Matematycy polscy w dwudziestoleciu międzywojennym : Studium historyczne***, Małgorzata Przeniosło observes that in the 1930's ***Wiadomości Matematyczne*** was known to publish longer works, including habilitation and doctoral dissertations. In 1935, for instance, it published Karol Borsuk's habilitation thesis and Józef Marcinkiewicz's doctoral thesis, and in 1937, Władysław Hepter's doctoral thesis. We speculate that [34] could be Lindenbaum's habilitation thesis. The timing of its appearance in print is strongly suggestive. Moreover, it has the "look and feel" of a thesis; it has a thesis-writer's fingerprints all over it. It is a longer work (on Cantor's notion of a multiply-ordered set—*mehrfach geordnete Menge*); its first part is historical, expository and critical; and the remainder is completely original.

[19] Upon its creation Tarski was transferred to the Seminar of Philosophy of Mathematics and given the position of *adiunkt*. Until then he had been in Łukasiewicz's Philosophical Seminar, to which he had been appointed *asystent* on October 1st, 1929. Tarski's habilitation in 1925 was in philosophy of mathematics, in the erstwhile "faculty of philosophy, mathematics section" (see: *Wykaz imienny docentów...*), but he went without permanent employment at the University for four years after becoming a *docent*.

[20] Jan Zygmunt recalls that sometime around 1973 Roman Suszko told him Lindenbaum's family "was rich". On page 68 of his ***Essays in the History of Logic and Logical Philosophy*** Woleński writes of the Warsaw Logical School that "some of its members, like Lindenbaum, were rich, but others, like Tarski, rather poor". McFarland, McFarland & Smith (eds) echo this assessment in their ***Alfred Tarski: Early Work in Poland—Geometry and Teaching***, stating that Lindenbaum was "independently wealthy" (see the box on p. 335). However the cumulative weight of evidence may be less than it appears. The McFarland passage is based solely on Woleński's authority, and Woleński in turn recalls only having heard someone venture the opinion in conversation.

[21] Among logicians in Poland in the 1960's and early 70's it was rumored, wistfully and not without envy, that Lindenbaum liked having a good time, being among people, frequenting cafés, partying; and hence didn't have time to edit his own work. [JZ, RP].

In any event, whatever his habilitation thesis was about, we know that as a *docent* he taught courses in a variety of subject areas, mainly in mathematics but also in logic. The titles of some of his courses were:

- Seminar on set theory and measure theory for advanced students.
- Introduction to actuarial mathematics.
- Modern algebra.
- On new investigations into the foundations of mathematics and the mathematical foundations of other sciences.
- On the superposition of functions.
- Selected topics from measure theory and the theory of functions.

From 1926 on, Lindenbaum was a member of the Polish Mathematical Society (*Polskie Towarzystwo Matematyczne* ... which we sometimes abbreviate here as *PTM*). He frequently delivered lectures at its meetings (see, e.g., [26^{a}], [26^{a}a], [27^{a}], etc.), and he published some shorter works in its official record of proceedings, ***Annales de la Société Polonaise de Mathématique***. In 1938 he was elected treasurer of the Warsaw Section of *PTM*.

From his earliest student days he had taken part in the Warsaw Scientific Society (*Warszawskie Towarzystwo Naukowe*, or *WTN*). Its record of proceedings, ***Comptes-rendus des séances de la Société des Sciences et des Lettres de Varsovie***, contains one of his first ever published papers ([26a], written jointly with Tarski), and, 12 years later, his last ([38], with Mostowski). Also in 1938, he delivered a lecture [38^{l}] at one of *WTN*'s meetings.

Lindenbaum was one of the co-founders of the Polish Logical Society (*Polskie Towarzystwo Logiczne*, or *PTL*). At its inaugural meeting on April 22nd, 1936, he was elected to sit on its interim board to help steer it through the legal proceedings of getting registered—a tortuous process that was to take more than a year. On completion of registration, on May 5th, 1937, Lindenbaum was re-elected to *PTL*'s board of governors as its secretary. At the same meeting, Jan Łukasiewicz was elected its chairman, and Alfred Tarski its vice-chairman.[22] Lindenbaum delivered lectures at two *PTL* meetings: one before it became a legally registered entity [36^{l}], and one after [37^{l}a].

He took part in three Polish Mathematical Congresses...

1. Lwów, 1927, where he presented two lectures: [29^{a}] and [29^{a}a];
2. Wilno, 1931, where he gave three lectures: [31^{l}], [31^{l}a] and [31^{l}b];
3. Warsaw, 1937, where he delivered two lectures: [37^{a}] and [37^{a}a];

and also in two international conferences...

4. The First Congress of Mathematicians from Slavic Countries, Warsaw, 23–27 September 1929 (see [29^{l}]);
5. Le Congrès International de Philosophie Scientifique, Sorbonne, Paris 1935 (see [36]).

Lindenbaum presented lectures at meetings of the Warsaw Philosophical Society (see for example [33^{l}] and [35^{l}]), but it is not known if he was ever a member

[22] A brief description of the creation of *PTL* is given in a note in *Ruch Filozoficzny*, vol. 13 (1937), p. 160b.

of that Society. It is known that he did not take part in any of the Society's national congresses. The first Polish Philosophical Congress was held in Lwów, May 10th–13th, 1923, and Lindenbaum was just finishing his first-year courses in Warsaw at the time. The second Congress was held in Warsaw, 23–27 September 1927, but he was not listed among its registered participants.[23] The third Congress took place in Kraków, 24–29 September 1936, and again he was not listed.[24]

Lindenbaum quickly made a name for himself in mathematics communities beyond Poland's borders, particularly in France, Germany, Austria and the Soviet Union. He was turning out attention-getting stuff. He benefited from the high visibility of the two schools of logic and mathematics that he belonged to, and the prestige of their imprimaturs. He wrote almost all his published works in either French or German (only two, [34] and [35], were in Polish), and the journals where his work appeared enjoyed a wide international circulation... not least ***Fundamenta Mathematicae***, whose star was rising fast. Soon everything with his name on it was being reviewed in ***Jahrbuch über die Fortschritte der Mathematik*** or in ***Zentralblatt für Mathematik*** by internationally renowned mathematicians and logicians like W. Ackermann, F. Bachmann, R. Baer, E. Čech, A. Fraenkel, S.C. Kleene, A. Kolmogoroff and A. Schmidt—not to mention Polish reviewers such as Stanisław Ulam and Bronisław Knaster.

As the thirties wore on, Lindenbaum himself was invited to become a contributing reviewer for ***Zentralblatt***. He accepted, and altogether contributed seven reviews to that publication (see Bibliography Part One, Sect. 2.3).

On February 1st, 1936, Tarski wrote to Karl Popper that he [Tarski] was collaborating with Lindenbaum on a book on set theory. In a subsequent letter to Otto Neurath dated April 28th, 1936, Tarski goes into more detail, claiming to be very busy since a very large mathematical book that he is co-authoring with Lindenbaum should soon appear.[25] Its title was to have been ***Theorie der eineinendeutigen Abbildungen*** <Theory of one-to-one correspondences>[26] and Lindenbaum refers to it in his abstract [36[a]], saying it is to appear ("*à paraître*") in the series '*Monografie Matematyczne*' <Mathematical Monographs>. An announcement by the series editors of '*Monografie Matematyczne*' duly appeared, on the back cover of volume 7,

[23] A full list of participants of the second Congress was published in *Przegląd Filozoficzny*, vol. 31 (1928), pp. 222–225. Łukasiewicz, Tarski and Lindenbaum's future wife Janina Hosiasson (=Hosiassonówna) actively participated in the 1927 Congress.

[24] A full list of participants of the third Congress was published in *Przegląd Filozoficzny*, vol. 39 (1936), pp. 542–548. Again Łukasiewicz, Tarski and Lindenbaum's wife Janina, now Hosiasson-Lindenbaumowa, actively participated.

[25] This is a direct quote from Paolo Mancosu's paper, 'Tarski's Engagement with Philosophy', in S. Lapointe *et al.* (eds.), ***The Golden Age of Polish Philosophy***, Logic, Epistemology, and the Unity of Science, vol. 16, Springer: Dordrecht 2009, chapter 9, p. 132.

[26] '*Abbildung*' can also be translated as 'function' or 'mapping'.

confirming their intention to publish the book in 1938 as volume 8 of the series.[27] In the event, this book never saw the light of day.

Due to a convergence of forces that could almost be called a "perfect storm"—the anti-Semitic policies that were gaining ground in Polish universities after 1935, Lindenbaum's known activities in the communist movement (see below), a growing shortage of vacant posts and of money to pay salaries—he had no great chances of being promoted to an academic position higher than that of *docent*.

Nevertheless, in 1937, when Zygmunt Zawirski's move to Jagiellonian University in Kraków opened up the post of Chair Professor of the Theory and Methodology of Sciences (*Katedra Teorii i Metodologii Nauk*)[28] at Adam Mickiewicz University in Poznań, he applied for the position. And so did Mordechaj Wajsberg. And so did Alfred Tarski. For reasons unknown to this day, nobody got the job. The Chair was left vacant for 8 years. It was only in 1945, after the end of WW2, that it was finally filled by Kazimierz Ajdukiewicz.[29]

Lindenbaum's political sympathies were left-leaning, and some of his political activities illegal for the time. He belonged to the Polish Communist Party from at least 1935 up until it was disbanded in 1938 by Stalin, and campaigned for it in intelligentsia circles.[30] In 1936 he signed a petition to Professor Halvdan Koht (a member of the Nobel Committee in Oslo) urging that Karl von Ossietzky, a German political journalist imprisoned by the Nazis, be awarded the Nobel Peace Prize.[31] Together with many writers and social activists of the day Lindenbaum added his name to an open letter "to the workers of Lwów" expressing solidarity with "the proletariat's protest against the bloody massacre [of April, 1936] of workers fighting for jobs, bread and freedom".[32]

It should be added, that none of Lindenbaum's published writings on mathematics or logic betrayed the slightest hint of his political sympathies.

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[27] Readers can view the back cover of vol. 7 on the Internet at The Polish Digital Mathematics Library.

[28] Later renamed Chair Professor of Logic and the Methodology of Sciences (*Katedra Logiki i Metodologii Nauk*).

[29] See pp. 128 & 156–157 in J.J. Jadacki, editor, ***Alfred Tarski: dedukcja i semantyka (déduction et sémantique)***, Wydawnictwo Naukowe Semper, Warsaw 2003. There is no trace in its record of proceedings, from 1937 until after the end of the war, that the Senate of Poznań University ever took up the business of replacing Zawirski. The Ministry of Education assumed it would, and helpfully put out soundings around the country on the University's behalf. But it seems that, in doing so, the Ministry jumped the gun. Though names were put forward, no competition was held at that time.

[30] From Marczewski and Mostowski's ***PSB*** entry, Kraków 1971, *loc. cit.*

[31] The petition was issued in the name of the editorial staff, co-workers and "friends" of the monthly ***Głos Współczesny*** <Contemporary Voice> and appeared in March, 1936, no. 3, p. 1. It was a left-leaning newspaper with national circulation.

[32] Published in ***Lewar***, 15th May, 1936, no. 4, p. 10. This was a biweekly literary magazine sponsored and influenced by the Polish Communist Party from 1933 through 1936. Its name was a play on words, combining "leverage" and "leftist".

It is also known that he loved mountain climbing in the Tatras, sharing this passion with Tarski and Maria Kokoszyńska-Lutman, and that he took an interest in literature and art.[33]

Either sometime in late 1935, or (more likely) sometime in the first 7 or 8 months of 1936, Lindenbaum married Janina Hosiasson.[34] Janina had been a student of Tadeusz Kotarbiński and Jan Łukasiewicz during Lindenbaum's first few years at Warsaw University. She had successfully worked on induction and confirmation, and had received her doctorate under Kotarbiński in 1926.

Born December 6th, 1899, Janina was four-and-a-half years older than Adolf. It is not clear exactly when, where, or under what circumstances they first met. It is entirely possible they became aware of each other as early as Lindenbaum's first semester at university, in the autumn of 1922. Gimnazjum Michała Kreczmara was an all-boys school, so he would have been keenly aware of this principal difference in his new surroundings. And photographs attached to his two applications for admission to Warsaw University show he had dark and intense good looks.

By the late 1920's Janina was a respected philosopher of logic and a fellow member alongside Lindenbaum of the Lwów-Warsaw school. They both delivered papers at the First Congress of Mathematicians from Slavic Countries (Warsaw, 23–27 September 1929), and Janina went on to spend the 1929/30 academic year studying philosophy in Cambridge on a scholarship from the Polish Ministry of Religious Affairs and Public Education. Overall she published some twenty research papers and, among other things, translations into Polish of three pedagogical and philosophical books by Bertrand Russell.[35]

The couple took up residence in Żoliborz—then, as today, a Warsaw neighborhood of intelligentsia and old money—at16 Krasińskiego Street, apartment 34 (*ul. Krasińskiego 16 m. 34*) according to the *PTM*'s list of registered members (see: ***Annales de la Société Polonaise de Mathématique***, vol. 15, 1936, p. 195). As it happened, the apartment right next door was the Ossowski's, Maria and Stanisław. On one door, a nameplate announced "*Adolf i Janina Lindenbaumowie*". On the next, "*Maria i Stanisław Ossowscy*". Leśniewski, who was a frequent visitor to both households, maintained that a patriarchy reigned in one, a matriarchy in the other. In fact the first names were in alphabetical order.[36]

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[33] Again this comes from Marczewski and Mostowski, ***PSB***, Kraków 1971, *loc. cit.*: "*Interesował się literaturą i sztuką; z pasją uprawiał taternictwo*".

[34] The exact date of their wedding is not known. There is no record of it in the Archives of the Civil Registry Office in Warsaw. Janina published two notes in ***Erkenntnis***, vol. 5 (1935/1936), pp. 44 & 176, under her maiden name, Hosiassonówna, and participated in a meeting of the Warsaw Philosophical Society on November 4, 1935 under her maiden name (see [35[1]]), but by mid-September of 1936 she was using her new surname, Hosiasson-Lindenbaumowa at conferences.

[35] See Bulińska 1998 for a calendar (*kalendarium*) of Hosiasson's life and a complete list of her publications.

[36] Retold from Henryk Hiż, '*Garstka wspomnień kibica matematyków*' <Memoirs of a Mathematician Junkie>, Roczniki Polskiego Towarzystwa Matematycznego, seria ii: ***Wiadomości matematyczne***, vol. 26 (2000), pp. 53–59, see p. 57.

The Lindenbaums had no children. On September 6th, 1939 (at the outbreak of war), they moved to Vilnius, at that time a Polish city. And there, it seems, they separated.[37] Janina settled in Vilnius, while Adolf continued on to Białystok. It is not known if they visited each other after that, or if they remained on amicable terms.

Lindenbaum had an opportunity to escape to the West but chose not to take advantage of it, preferring to stay in Poland.[38] On September 17th, 1939, Białystok came under Soviet rule, and the Soviets set up a Pedagogical Institute in the city. Lindenbaum was appointed a *docent* at the Institute, where he taught mathematics throughout 1940 and a large part of 1941. He was offered a position in Moscow at this time but again chose not to take advantage of it, for the same reason.[39]

On June 22nd, 1941, Germany declared war on the Soviet Union. On the same day, the Vilnius Uprising began. Within days, German troops were in Białystok, and not much later Vilnius. In September, 1941, Janina was arrested by the gestapo and in April, 1942, after 7 months of imprisonment in Vilnius, she was transported to a small community on the outskirts of the city (Paneriai) and shot.

Sometime around September, 1941, Adolf was arrested in Białystok. Details of his ensuing fate are less clear. It is generally believed he was killed in 1941, shortly after his arrest, but it is not known if he was first transported to Paneriai, or if he was executed in Białystok.[40]

2. Bibliography Part One

Part One draws in large measure on an earlier compilation of Lindenbaum's works that appeared in an article by S.J. Surma titled 'On the

[37] Janina informed Tarski of her separation from Adolf in a letter dated the beginning of 1941. The letter is now held in the Tarski Archives in Bancroft Library at U.C. Berkeley. [We owe this information to Jan Woleński. We have not seen the letter's content ourselves. –JZ, RP].

[38] Marczewski and Mostowski, ***PSB***, Kraków 1971, *loc. cit.*

[39] Marczewski and Mostowski, ***PSB***, Kraków 1971, *loc. cit.*: "*Pragnąc pozostać w kraju nie skorzystał ani z możliwości wyjazdu na Zachód, ani później z propozycji objęcia stanowiska w Moskwie*".

[40] See for example Jadacki, ***...A mądrości zło nie przemoże***, Warsaw 1993, *loc cit.*: "*został zamordowany przez Niemców ... w Ponarach pod Wilnem lub według innej wersji w Białymstoku [?]*". The entry in ***Wielka Encyklopedia Powszechna PWN***, vol. 6, Warsaw 1965, p. 527, says that Lindenbaum was imprisoned in the Vilnius ghetto in September, 1941, then disappeared without a trace: "*we wrześniu 1941 zamknięty w getcie wileńskim, zginął bez wieści*". Curiously, the Archives of the Civil Registry Office in Warsaw hold death certificates for both Adolf and Janina, issued by court ruling (Sąd Grodzki w Warszawie) no. I Zg 1124/1947, of June 21, 1947, finding that both of them died in Warsaw. But too many details conflict with other more credible sources: date of birth, mother's given name, mother's maiden name, father's given name, date of death, and (obviously) place of death. The court's findings appear to have been a summary "tying up of loose ends"—drawing a line under millions of missing persons at one go.

origin and subsequent applications of the concept of the Lindenbaum algebra' (***Logic***, ***Methodology and Philosophy of Science***, ***VI*** (***Hannover, 1979***), in the Series *Studies in Logic and the Foundations of Mathematics,* vol. 104, North-Holland, Amsterdam-New York, 1982, pp. 719–734). While Surma's was the first (and until now only) reasonably comprehensive bibliography of Lindenbaum's works, it nevertheless left some gaps which we attempt to fill. In particular the present bibliography includes fourteen works not cited by Surma, and provides information, lacking in Surma's compilation, about translations and reviews of many of the cited works. As well, we feel that our method of indexing, patterned after the system Givant adopted in his seminal bibliography of Tarski, is easier to navigate (see next paragraph).

Part One of the Bibliography has four sections: 2.1–Papers, 2.2–Abstracts and Short Notes, 2.3–Reviews, and 2.4–Public Lectures. Within each section entries are arranged in chronological order and are indexed by a bibliographical sign consisting of two digits and optionally one or two letters, all in square brackets. The two digits refer to the year of publication or, in the case of ***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la Société Polonaise de Mathématique***), to the volume's nominal or titular year, since ***Rocznik***'s actual publication dates usually follow the years to which the volumes pertain. Superscripts "a", "r" and "l" immediately following the two-digit year refer respectively to abstracts, reviews, and lectures. References to papers have no superscripts. Where two or more publications of the same type (i.e., within the same section of Part One) share the same two-digit year, the precise order of their publication dates is conveyed by appending suffixes "a", "b", "c", and so on, not superscripted. These suffixes, if present, are always in last place, following any superscripts.

When applicable, in Sects. 2.1 and 2.2 a reference has been added in square brackets at the end of a citation to indicate any review of the cited work, its reviewer, and where the review appeared: i.e., whether in JFM (=***Jahrbuch über die Fortschritte der Mathematik***), Zbl (=***Zentralblatt für Mathematik***), or JSL (=***The Journal of Symbolic Logic***).

Several of the Polish titles—for instance [34], [35], [29^{a}] and some of the lectures in Sect. 2.4—use old spellings which were current in Lindenbaum's day. In the interests of historical accuracy we have kept Lindenbaum's original spellings.

It may strike the reader as odd that we include Sect. 2.4, Public Lectures, in a bibliography of Lindenbaum's published works. No transcripts or abstracts of these lectures are known to exist. They count as published works solely in a legal sense of having been delivered to a public audience. We believe, however, that this approach serves a useful purpose. In most cases the titles of his lectures are sufficiently indicative that one may surmise broadly what those lectures were about. By adding where, when and to what audience he gave each lecture, where its title was announced or recorded, and (sometimes) who he

co-presented it with, this raises the possibility of matching some of his lectures with various unpublished ideas, techniques and results anecdotally ascribed to him by others in the field, and of getting a better idea as to when some of these things might have entered the general consciousness.

2.1. Papers

[26] Contributions à l'étude de l'espace métrique. Partie I. ***Fundamenta Mathematicae***, vol. 8 (1926), pp. 209–222. (See [26a], p. 327, note 1, for a correction. A part II was never published.) [JFM 52.0585.01 (E. Pannwitz)].

[26a] Communication sur les recherches de la théorie des ensembles (with A. Tarski). ***Sprawozdania z posiedzeń Towarzystwa Naukowego Warszawskiego, Wydział III Nauk Matematycznych i Przyrodniczych*** (=***Comptes-rendus des séances de la Société des Sciences et des Lettres de Varsovie***, ***Classe III***), vol. 19 (1926), pp. 299–330. [JFM 57.1330.02 (S. Ruziewicz)]
(1) Reprinted in: ***Alfred Tarski***, ***Collected Papers***. ***Volume 1***, *1921-1934*, ed. by S. R. Givant and R. N. McKenzie, Birkhäuser Verlag, Basel 1986, pp. 173–204.

[30] Remarques sur une question de la méthode axiomatique. ***Fundamenta Mathematicae***, vol. 15 (1930), pp. 313–321. [JFM 56.0488.03 (A. Rosenthal)]

[30a] Sur les opérations d'addition et de multiplication dans les classes d'ensembles (with A. Koźniewski). ***Fundamenta Mathematicae***, vol.15 (1930), pp. 342–355. [JFM 56.0084.02 (R. Baer)]

[31] Sur les ensembles ordonnés. ***Comptes-rendus hebdomadaires des séances de l'Académie des Sciences***, Paris, vol. 192 (1931), pp. 1511–1514. [JFM 57.0091.03 (A. Fraenkel); Zbl 0002.18405 (A. Kolmogoroff)]

[31a] Bemerkung zu den vorhergehenden »Bemerkungen . . . « des Herrn J. v. Neumann. ***Fundamenta Mathematicae***, vol. 17 (1931), pp. 335–336. [JFM 57.0055.03 (T. Skolem); Zbl 0003.0502 (A. Schmidt)]

[33] Sur les ensembles dans lesquels toutes les équations d'une famille donnée ont un nombre de solutions fixé d'avance. ***Fundamenta Mathematicae***, vol. 20 (1933), pp. 1–29, Errata, p. 287. [JFM 59.0095.02 (W. Hurewicz); Zbl 0006.34001 (B. Knaster)]

[33a] Sur les ensembles localement dénombrables dans l'espace métrique. ***Fundamenta Mathematicae***, vol. 21 (1933), pp. 99–106; Errata p. 295. [JFM 59.0567.04 (G. Aumann); Zbl 0008.08806 (E. Čech)]

[33b] Sur les superpositions des fonctions représentables analytiquement. ***Comptes-rendus hebdomadaires des séances de l'Académie des Sciences***, Paris, vol. 196 (1933), pp. 1455–1457. [JFM 59.0267.03 (A. Rosenthal); Zbl 0007.06005 (S. Saks)] (For errata see [34a], p. 15, note 1.)

[34] Z teorji uporządkowania wielokrotnego <Sur la théorie de l'ordre multiple> (Polish with French summary). ***Wiadomości Matema-***

tyczne, vol. 37 (1934), pp. 1–35. [JFM 60.0867.01 (S. Ruziewicz); Zbl 0009.30304 (Th. Motzkin)]

[34a] Sur les superpositions des fonctions représentables analytiquement. ***Fundamenta Mathematicae***, vol. 23 (1934), pp. 15–37. [JFM 60.0195. 02 (A. Rosenthal); Zbl 0009.30502 (S. Saks)]

[34b] Corrections au mémoire »Sur les superpositions des fonctions représentables analytiquement«. (Ce volume, pp. 15–37). ***Fundamenta Mathematicae***, vol. 23 (1934), p. 304. [JFM 60.0195. 03 (A. Rosenthal); Zbl 0010.01403 (S. Saks)]

[35] Miara w geometrji (with E. Szpilrajn) <Measure in geometry> (In Polish). ***Świat i życie***. ***Zarys encyklopedyczny współczesnej wiedzy i kultury***, vol. 3, Lwów–Warszawa 1935, pp. 586–595.

[36] Sur la simplicité formelle des notions. ***Actes du Congrès International de Philosophie Scientifique***, ***Sorbonne***, ***Paris 1935***, ***VII Logique***, Actualités scientifiques et industrielles, vol. 394, Hermann & C^{ie}, Paris 1936, pp. 29–38 (1936). [JFM 62.1050.01 (W. Ackermann); JSL 2 (1937), pp. 55–56 (S. C. Kleene)]

[36a] Über die Beschränktheit der Ausdrucksmittel deduktiver Theorien (with A. Tarski). ***Ergebnisse eines mathematischen Kolloquiums***, vol. 7 (1936), pp. 15–22. [JFM 62.0039.02 (F. Bachmann); Zbl 0014.38602 (A. Schmidt); JSL 1, pp. 115–116 (B. Rosser)][41,42]

(1) On the limitations of the means of expression of deductive theories, in: A. Tarski, ***Logic***, ***Semantics***, ***Metamathematics***. ***Papers from***; ***1923–1938***. Translated by J. H. Woodger, Clarendon Press, Oxford 1956, pp. 384–392. Second edition, *ibid.*, edited by J. Corcoran, Hackett, 1983. (Revised English translation of [36a])

[41] Tarski in footnote 12 of his 'Calculus of relations' (see The Journal of Symbolic Logic, vol. 6 (1941), p. 89) remarks: "There are several misprints in that [i.e. [36a]] paper. In particular, read 'metamathematisch' and 'Metamathematik' instead of 'mathematisch' and 'Mathematik"'.

[42] In a footnote 1 on page 15 of [36a] the authors state that their Theorem 9 had earlier been presented by Tarski to the Second Polish Philosophical Congress, Warsaw, 1927 "in a lecture on the concepts of consistency and completeness," and that "[other results] of the present communication were first presented at sessions of the Logic Section of the Warsaw Philosophical Society on 15 June 1932 (Lindenbaum: *On some methodological questions connected with the foundations of Geometry, Part I*) and 1 February 1933 (Lindenbaum and Tarski: *On some metalogical theorems*)".

Notice that Lindenbaum's 15 June 1932 lecture is our item [32^{l}] hereinbelow, and that in their footnote the authors do not mention Part 2 of that lecture, which is our item [32^{l}a]. As regards the lecture which the authors allege they gave jointly on 1 February 1933, we cannot find any corroborating evidence of Lindenbaum's having been a co-presenter of it. On the contrary, ***Ruch Filozoficzny***, vol. 13 (1935), p. 149b, records that Tarski delivered a lecture with this title on this date, presumably alone as no co-presenter is recorded, and that on 8 February 1933, exactly 1 week later, Lindenbaum delivered a lecture on a different topic, also presumably alone, as again no co-presenter is recorded. The latter (i.e., Lindenbaum's 8 February 1933 lecture) is our item [33^{l}] hereinbelow. It may be that by 1936 the authors are starting to misremember a few of the quotidian details of 3 and 4 years earlier (who gave which lecture on what date) but remember that they collaborated on the substance.

(2) Sur la limitation des moyens d'expression des théories déductives, in: A. Tarski, ***Logique, sémantique, métamathématique. 1923–1944***, vol. 2, **Philosophie pour l'Age de la Science**, Librairie Armand Colin, Paris 1974, pp. 109–120. (Revised French translation of [36a])
(3) Reprinted in ***Alfred Tarski***, ***Collected Papers***. ***Volume 2***, ***1935–1944***, ed. by S. R. Givant and R. N. McKenzie, Birkhäuser Verlag, Basel 1986, pp. 205–212.
(4) O ograniczeniach środków wyrazu teorii dedukcyjnych, in: A. Tarski, ***Pisma logiczno-filozoficzne***, Volume 2, ***Metalogika***, Translated and annotated, with introduction, by Jan Zygmunt, Wydawnictwo Naukowe PWN, Warsaw 2001, pp. 147–157 [Polish translation of [36a](1)].

[38] Über die Unabhängigkeit des Auswahlaxioms und einiger seiner Folgerungen (with A. Mostowski), ***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***), vol. 31 (1938), pp. 27–32. [JFM 64.0932.01 (Th. Skolem); Zbl 0019.29502, p. 295 (A. Schmidt); JSL 4, pp. 30–31 (A. A. Fraenkel)]
(1) *On the independence of the axiom of choice and some of its consequences*, in: A. Mostowski, ***Foundational Studies***. ***Selected Works***, vol. 1, edited by K. Kuratowski, W. Marek, L. Pacholski, H. Rasiowa, C. Ryll-Nardzewski, and P. Zbierski. Studies in Logic and the Foundations of Mathematics, vol. 93, North-Holland Publishing Company, Amsterdam and PWN—Polish Scientific Publishers, Warszawa, 1979, pp. 70–74. (English translation of [38a] by M. J. Mączyński) [Zbl 0425.01021 (E. Mendelson)]

2.2. Abstracts and Short Notes

[26ª] Sur l'arithmétique des types ordinaux. ***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la Société Polonaise de Mathématique***), vol. 5 (année 1926, publ. 1927), pp. 103–104. (Summary of §3 of [26a], presented at the meeting of the Polish Mathematical Society, Warsaw Section, on 23 April 1926.)

[26ªa] Sur l'indépendence des notions primitives dans les systèmes mathématiques (with A. Tarski). ***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la Société Polonaise de Mathématique***), vol. 5 (année 1926, publ. 1927), pp. 111–113. (Presented at the meeting of the Polish Mathematical Society, Warsaw Section, on 17 December 1926).
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[27ª] Sur quelques propriétés des fonctions de variable réelle. ***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la Société Polonaise de Mathématique***), vol. 6 (année 1927, publ. 1928),

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[29ª] Méthodes mathématiques dans les recherches sur le système de la théorie de déduction. ***Księga Pamiątkowa Pierwszego Polskiego Zjazdu Matematycznego***, ***Lwów***, ***7–10. IX.1927*** (Supplement to ***Annales de la Société Polonaise de Mathématique***), Kraków 1929, p. 36. (See also ***Ruch Filozoficzny***, vol. 10 (1926/27), p. 205b, where only the Polish title of the lecture is given: O matematycznych metodach badania nad teoryą dedukcyi <On mathematical methods of investigation into the theory of deduction>).

[29ªa] O pewnych własnościach metrycznych mnogości punktowych.— Sur certaines propriétés métriques des ensembles de points. ***Księga Pamiątkowa Pierwszego Polskiego Zjazdu Matematycznego***, ***Lwów***, ***7–10.IX.1927*** (Supplement to ***Annales de la Société Polonaise de Mathématique***), Kraków 1929, p. 96.

[31ª] Sur un ensemble linéaire extrêmement non homogène par rapport aux transformations continues et sur le nombre des invariants de ces transformations. ***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la Société Polonaise de Mathématique***), vol. 10 (année 1931, publ. 1932), pp. 113–114. [JFM 58.0648.12] (Presented at the meeting of the Polish Mathematical Society, Warsaw Section, on 16 January 1931).

[31ªa] La projection comme transformation continue la plus générale. ***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales* de la Société Polonaise de Mathématique**), vol. 10 (année 1931, publ. 1932), pp. 116–117. [JFM 58.0648.13] (Presented at the meeting of the Polish Mathematical Society, Warsaw Section, on 8 May 1931).

[31ªb] Sur les figures convexes. ***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la Société Polonaise de Mathématique***), vol. 10 (année 1931, publ. 1932), pp. 117–118. [JFM 58. 0805.05] (Presented at the meeting of the Polish Mathematical Society, Warsaw Section, on 8 May 1931.)

[31ªc] Sur les constructions non-effectives dans l'Arithmétique élémentaire. ***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la Société Polonaise de Mathématique***), vol. 10 (année 1931, publ. 1932), pp. 118–119. [JFM 58. 1001.14] (Presented at the meeting of the Polish Mathematical Society, Warsaw Section, on 8 May 1931.)

[34ª] Sur le ,,problème fondamental" du jeu d'échecs. ***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la Société Polonaise de Mathématique***), vol. 13 (année 1934, publ. 1935), pp. 124–125. (Presented at the meeting of the Polish Mathematical Society, Warsaw Section, on 24 February 1933.)

[34ªa] Sur le nombre des invariants des familles de transformations arbitraires. ***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la Société Polonaise de Mathématique***), vol. 13 (année 1934,

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[34^{a}b] Remarques sur le groupe des permutations de l'ensemble des nombres entiers. ***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la Société Polonaise de Mathématique***), vol. 13 (année 1934, publ. 1935), p. 131. (Presented at the meeting of the Polish Mathematical Society, Warsaw Section, on 19 January 1934.)

[34^{a}c] Sur les relations contenues dans les relations ordinales. ***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la Société Polonaise de Mathématique***), vol. 13 (année 1934, publ. 1935), p. 132. (Presented at the meeting of the Polish Mathematical Society, Warsaw Section, on 19 January 1934.)

[36^{a}] Sur le nombre des invariants des familles de transformations arbitraires, II. ***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la Société Polonaise de Mathématique***), vol. 15 (année 1936, publ. 1937), p. 185. (Presented at the meeting of the Polish Mathematical Society, Warsaw Section, on 31 January 1936.)

[37^{a}] Numérotage des types logiques. ***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la Société Polonaise de Mathématique***), vol. 16 (année 1937, publ. 1938), p. 191. [Summary of a lecture given by Lindenbaum on 30 September 1937 to the Third Polish Mathematical Congress in Warsaw.]

[37^{a}a] Sur l'équivalence de deux figures par décomposition en nombre fini de parties respectivement congruentes. ***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la Société Polonaise de Mathématique***), vol. 16 (année 1937, publ. 1938), p. 197. (Summary of a lecture given by Lindenbaum on 30 September 1937 to the Third Polish Mathematical Congress in Warsaw.)

[38^{a}] Sur les bases des familles de fonctions. ***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la Société Polonaise de Mathématique***), vol. 17, année 1938, publ. 1939), p. 124–126.

2.3. Reviews[43]

[38^{r}] L. P. Gokieli, Über den Funktionsbegriff. Trav. Inst. Math. Tbilissi 2 (1937), 1–35. ***Zentralblatt für Mathematik***, vol. 18 (1938), p. 1.

[38^{r}a] L. Couffignal, Sur un problème d'analyse mécanique abstraite: la théorie de la réduction résulte de fonctions mécaniques. C. R. Acad. Sci., Paris 206 (1938), 1336–1338. ***Zentralblatt für Mathematik***, vol. 18 (1938), pp. 338–339.

[38^{r}b] W. Hetper, Le rôle des schémas indépendants dans le système de la sémantique élémentaire. Arch. Towarz. nauk. Lwów 9 (1938), 253–263. ***Zentralblatt für Mathematik***, vol. 19 (1938), p. 145.

[43] Though the following seven reviews were all published in ***Zentralblatt***, it should be noted that the journal's own search engine, ZbMATH, returns only four of them when asked to find Lindenbaum as a reviewer: http://zbmath.org/.

[38^{r}c] W. Hetper, Relations ancestrales dans le système de la sémantique. Arch. Towarz. Nauk. Lwów 9 (1938), 265–280. ***Zentralblatt für Mathematik***, vol. 19 (1938), p. 145.

[38^{r}d] L. Chwistek, Remarques critiques concernant la notion de la variable dans le système de la sémantique rationnelle. Arch. Towarz. nauk. Lwów 9 (1939), 283–333. ***Zentralblatt für Mathematik***, vol. 19 (1938), p. 145.

[38^{r}e] L. Couffignal, Solution générale, par des moyens mécaniques, des problèmes fondamentaux de la logique déductive. C. R. Acad. Sci., Paris 206 (1938), 1529–1531. ***Zentralblatt für Mathematik***, vol. 19 (1938), p. 145.

[38^{r}f] L. Couffignal, Les opérations des mathématiques pures sont toutes des fonctions mécaniques. C. R. Acad. Sci., Paris 207 (1938), 20–22. ***Zentralblatt für Mathematik***, vol. 19 (1938), p. 146.

2.4. Public Lectures

[25^{l}] O podstawach matematyki <On the foundations of mathematics>. Meeting of the Warsaw University Student Philosophy Circle, academic year 1924/25. (***Ruch Filozoficzny***, vol. 9 (1925), p. 117b.)

[25^{l}a] O równoważności układów aksyomatycznych logistyki B. Russella i D. Hilberta <On the equivalence of the axiom sets for the logics of B. Russell and D. Hilbert>. Meeting of the philosophy of mathematics sections of the Warsaw University student philosophy circle and student mathematics and physics circle, academic year 1924/25. (***Ruch Filozoficzny***, vol. 9 (1925), p. 117b.)

[27^{l}] O pojęciu nieskończoności <On the concept of infinity>. Pierwszy Zjazd Kół filozoficznych Studentów Uniwersytetów Polskich <First Congress of Polish University Student Philosophy Circles>, Warsaw, 20 September 1927. (***Ruch Filozoficzny***, vol. 10 (1926/27), p. 209ab.)

[29^{l}] Z podstaw teoryi grup <On the foundations of group theory>. I Kongres Matematyków Krajów Słowiańskich <First Congress of Mathematicians from the Slavic Countries>, Warsaw, 23–27 September 1929. (***Ruch Filozoficzny***, vol. 11 (1928/29, p. 201a. And ***Comptes-Rendus du I Congrès des Mathématiciens des Pays Slaves***, ***Warszawa 1929***, edited by F. Leja, Książnica Atlas T.N.S.W., Warszawa 1930, p. 24.)

[31^{l}] Formalizacja elementarnego rachunku—Formalisation du calcul élémentaire. The Second Polish Mathematical Congress, Wilno, 23–26 September 1931. (***Ruch Filozoficzny***, vol. 13 (1932–1935), p. 53b. And ***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la Société Polonaise de Mathématique***), vol. 10 (année 1931, publ. 1932), p. 140.)

[31^{l}a] Badania nad własnościami metrycznymi mnogości punktowych—Etudes des propriétés métriques des ensembles de points. The Second Polish Mathematical Congress, Wilno, 23–26 September 1931. (***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la So-***

ciété Polonaise de Mathématique), vol. 10 (année 1931, publ. 1932), p. 141.

[31[l]b] Sur les problèmes concernant un critère de simplicité des notions. The Second Polish Mathematical Congress, Wilno, 23–26 September 1931. (See [33], p. 26, footnote 22. Notice that there is no information on this lecture in the article 'Deuxième Congrès des Mathématiciens Polonais, Wilno 1931' in ***Annales de la Société Polonaise de Mathématique***), vol. 10 (année 1931, publ. 1932), pp. 132–151.)

[32[l]] O pewnych kwestyach metodologicznych w związku z podstawami geometryi. Cz. I. <On some methodological questions concerning the foundations of geometry. Part 1.>, The meeting of the Warsaw Philosophical Society, Section of Logic, Warsaw, 15 June 1932. (***Ruch Filozoficzny***, vol. 13 (1932–1935/6), p. 47b.)

[32[l]a] O pewnych kwestyach metodologicznych w związku z podstawami geometryi. Cz. II <On some methodological questions concerning the foundations of geometry. Part 2.>, The meeting of the Warsaw Philosophical Society, Section of Logic, Warsaw, 22 June 1932. (***Ruch Filozoficzny***, vol. 13 (1932–1935/6), p. 47b.)

[33[l]] O zagadnieniach, związanych z pewnem kryteryum prostoty pojęć <On problems connected with a certain criterion for the simplicity of concepts>. The meeting of the Warsaw Philosophical Society, Section of Logic, Warsaw, 8 February 1933. (***Ruch Filozoficzny***, vol. 13 (1932–1935/6), p. 149b.)

[33[l]a] Lecture previewing the forthcoming paper [34a]. The meeting of the Polish Mathematical Society, Warsaw, 10 March 1933. (***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la Société Polonaise de Mathématique***), vol. 13 (année 1934, publ. 1935), p. 125, and [33b], p. 1455, footnote 1, and [34a], p. 15, footnote 1.)

[35[l]] Wrażenia z Kongresu Filozofii Naukowej w Paryżu (wrzesień 1935) <Reflections on the Congress of Scientific Philosophy in Paris (September 1935)> (with J. Hosiasson and A. Tarski). The meeting of the Warsaw Philosophical Society, Warsaw, 4 November 1935. (***Ruch Filozoficzny***, vol. 13 (1932–1935/6), p. 149b.)

[36[l]] O prostocie formalnej <On formal simplicity>. The meeting of the Polish Logical Society, Warsaw, 6 May 1936. (***Ruch Filozoficzny***, vol. 14 (1936–1938), p. 151b.)

[37[l]] Sur l'indépendence de l'axiome du choix. The meeting of the Polish Mathematical Society, Warsaw Section, 12 February 1937. (***Rocznik Polskiego Towarzystwa Matematycznego*** (=***Annales de la Société Polonaise de Mathématique***), vol. 16 (année 1937, publ. 1938), p. 217.)

[37[l]a] O pracach i projektach Międzynarodowej Komisji Ujednostajnienia Symboliki Logicznej <On the work and projects of the International Committee for the Standardization of Logical Symbolism>.

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[38^{l}] O niezależności pewnika wyboru i niektórych jego konsekwencjach <On the independence of the axiom of choice and some of its consequences> (with A. Mostowski). The meeting of the Warsaw Scientific Society, Warsaw, 16 March 1938. (***Ruch Filozoficzny***, vol. 15 (1939), p. 66a. Lecture based on [38a].)

3. Bibliography Part Two

In the works listed in the following survey of the literature, one can find acknowledgments of unpublished results or ideas ascribed to Lindenbaum, proofs of his theorems that he left unproved or communicated only orally, and extensions of his work to further domains. The variety of these attributions is broad: from logic, metalogic, set theory (cardinal and ordinal arithmetic, the rôle of the Axiom of Choice and the Continuum Hypothesis) and topology (metric spaces and congruence of sets by decompositions), to real analysis and number theory. As this selection of references demonstrates, the range and impact of his acknowledged contributions extends considerably beyond his published works.

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