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Karl Schröter and His Interest in Polish Mathematical Logic. Based on Unpublished Archival Documents

Abstract. Karl Schröter (1905–1977) worked in the field of mathematical logic and the foundations of mathematics, first at Westphalian Wilhelm University of Münster [*Westfälische Wilhelms-Universität Münster*], then at the Berlin Humboldt University [*Humboldt-Universität zu Berlin*]. From today's perspective, he is considered the most important mathematical logician in the German Democratic Republic. He founded the Logic School in Berlin and developed mathematical logic in that country. Most academics working in East Germany in mathematical logic and the foundations of mathematics were either direct students of Schröter or studied under his intellectual influence. He referred to his Münster's supervisor, Heinrich Scholz (1884–1956), and representatives of the Polish School of Mathematical Logic as his teachers of mathematical logic.

In this article, we present the results of our research on two topics. First, we give — compared to what has been published so far — an extended scientific biography of Schröter and a complete list of his scientific works. Our second aim is to inform the logical community about unknown archival documents confirming Schröter's interest in the Polish logic (Stanisław Leśniewski, Jan Łukasiewicz, Alfred Tarski and Mordchaj Wajsberg). To accomplish these two tasks, we conducted archival research in the Münster and Berlin archives, performed a preliminary analysis of the collected documents, and compared our findings with existing publications on Schröter. The archival research made it possible to clarify his scientific curriculum vitae. The documents also indicate areas for further, more detailed research, including those concerning Schröter's connections with the Polish School of Mathematical Logic.

Keywords: Karl Schröter; mathematical logic; Lvov-Warsaw School; scientific relations and exchange

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Abbreviations.
ABBAW: Akademiearchiv, Berlin-Brandenburgische Akademie der Wissenschaften
DAW: Deutsche Akademie der Wissenschaften zu Berlin
FMI: Fachbereichsbibliothek Mathematik und Informatik (Universität Münster)
HU: Humboldt-Universität zu Berlin
HU UA: Humboldt-Universität zu Berlin, Universitätsarchiv
JDAWB: Jahrbuch der Deutschen Akademie der Wissenschaften zu Berlin
NHS: Nachlass Heinrich Scholz. Historische Bestände; Nachlässe und Sammlungen, Universitäts- und Landesbibliothek Münster
NKS: Nachlass Karl Schröter, Akademiearchiv. Berlin-Brandenburgische Akademie der Wissenschaften
PV: Personal- und Vorlesungsverzeichnis Westfälische Wilhelms-Universität Münster
ULM: Universitäts- und Landesbibliothek Münster
UM UA: Universität Münster, Universitätsarchiv

1. Introduction

Karl Schröter's main research topics were mathematical logic and the foundations of mathematics; he is claimed to be the most important mathematical logician in the German Democratic Republic (see [18], pp. 17, 86; [27], p. 301; [23]; [28]; [21], p. 123).[1] He founded the Logic School in Berlin and developed mathematical logic in that country. Most scientists working in the East Germany in mathematical logic and the foundations of mathematics are direct or indirect students of Schröter, as are mathematicians working in various fields of mathematics (see [17], p. 3; [18], p. 17; [19]).

Schröter worked in two university cities: Münster and Berlin (East). He referred to his Münster supervisor, Heinrich Scholz, and representatives of the Warsaw School of Logic, originating from the philosophical Lvov-Warsaw School, as his teachers of mathematical logic (cf. [17]).

In this article, we present the results of our research on two topics. First, we present an extended scientific biography of Schröter and a complete list of his scientific works, which go beyond what has been published so far. Our second aim is to inform the logical community

[1] Kreiser as synonims treat 'mathematical logic' and 'semantic logic' [cf. 18, p. 16].

about unknown archival documents confirming Schröter's interest in the achievements of Polish logicians, in particular Stanisław Leśniewski, Jan Łukasiewicz, Andrzej Mostowski, Alfred Tarski and Mordchaj Wajsberg. To accomplish these two tasks: 1) searches were conducted in the following archives: ABBAW, HU UA, ULM; 2) a preliminary analysis of the collected documents was performed; 3) a comparison with publications on Schröter was carried out. The archival research made it possible to clarify the scientific curriculum vitae of this logician.

To the best of our knowledge, Schröter's contributions to logic were and still remain relatively unknown in Poland.

In the first part of the work, we will present the initial period of Schröter's life: his educational path and first steps in the academic path. The following two chapters discuss his academic activity in the two scientific centres he was associated with: Munster and Berlin. In these chapters, archival documents that testify to his connections with Polish logicians will be pointed out. The work ends with a summary indicating directions for further research.

2. Karl Schröter's Life. The beginning of his academic activity

Karl Schröter was born on 7 September 1905 in Wiesbaden-Biebrich (Germany) and died on 22 August 1977 in Berlin. He came from a family of craftsmen; later, his father became a merchant. From 1915 to 1924, he attended Realgymnasium, and after a four-year break, he studied mathematics, physics, philosophy, and psychology at the universities Göttingen, Heidelberg, and Frankfurt am Main from 1928 to 1935. In 1935, in Frankfurt, he passed the exam that qualified him to teach in higher education, specializing in mathematical logic and the foundations of mathematics (HU UA, Bestand K. Schröter. PA nach 1945).

Schröter began to work on his doctoral dissertation under the supervision of Max Wertheimer (1880–1943), focusing on Gestalt Psychology, using mathematical methods. However, political circumstances in Germany complicated his doctoral plans. Unfortunately, due to the NS law, Wertheimer was displaced and forced to leave Germany because of his Jewish origin (cf. 18, p. 87). Schröter gratefully accepted the opportu-

nity to continue his studies and doctoral work under Heinrich Scholz[2] in Münster.

From 1934 to 1939, Schröter worked as a high school teacher in Münster. From 1 April 1939 to 1 May 1943, he was employed at the Westphalian Wilhelms University of Münster [*Westfälische Wilhelms-Universität Münster*][3] as a scientific assistant, collaborating with Scholz who was Schröter's teacher and mentor in mathematical logic, which was called 'Logistic' at that time (cf. 17, p. 3). From 1943 to 1948, he served as a docent in mathematical logic and the foundations of mathematics.[4]

From 26 May 1941 until the end of the Second World War, Schröter worked as a mathematician in the Foreign Office contracted as a research assistant in Department Z Encryption and Communications [*Chiffrier- und Nachrichtenwesen*]. From 12 January 1944, he worked in the Foreign Office's alternative office in Hermsdorf/Riesengebirge, transferred to this place due to the war (see 23, p. 176; 18, p. 86). Scholz made efforts to keep Schröter in Münster so that he could take an active part in developing mathematical logic. However, it was impossible to relieve Schröter of his 'Berlin' ministry duties. Nevertheless, Schröter sometimes visited Münster during the war, as Scholz mentioned in his correspondence (NHS, Scholz – Max Bense, 30.06.1943). His PhD defense and habilitation colloquium took place during these stays. Starting in April 1945, he was interned by the Allies, and from 8 May to 9 September he was in London and until 1 October 1945 in Marburg (see 23, p. 176).

While working in the Foreign Office, the 36-year-old Schröter earned his PhD on 20 December 1941 at the Westphalian Wilhelms University of

[2] Heinrich Scholz (1884–1956) — German logician, philosopher and theologian. 1928–1952 he was employed at the Westphalian Wilhelm University of Münster, where he organized a group of academics working in the area of mathematical logic, later called 'Group from Münster' or 'School from Münster'. They dealt with different topics: the logical foundation of mathematics, mathematical logic, the history of logic, algebra, topology, foundation of computer science. Scholz held the first chair for Mathematical Logic and Foundation of Mathematics in Germany; he also established the Institute for Mathematical Logic and Foundation of Mathematics, which still exists today. Scholz's extensive correspondence and his letters exchanged with Polish logicians, preserved in the archives, span the period from 1928 to 1956 (see 11, 22).

[3] The university name has been changed several times. Since 1 October 2023, the official name has been 'University Münster' [Universität Münster]. See "Die Geschichte des Names" https://www.uni-muenster.de/ZurSacheWWU/quellen/index.html.

[4] Kreiser called it 'Diäten-Dozentur' (see 18, p. 86).

Münster. The title of his dissertation was "A general concept of calculus" [S1], supervised by Heinrich Scholz. Two years later, in 1943, he finished the habilitation based on a paper titled *Axiomatisation of Frege's Propositional Calculus* [S2]. His habilitation lecture was titled *The Arithmetic of Natural Numbers in the Context of the Theory of Lattices* [S4]. It was given on 22 May 1943 in Philosophische und Naturwissenschaftliche Fakultät.

Schröter belonged to Scholz's group of helping Poles during the Second World War, as he mentioned in his post-war curriculum vitae (see (HU UA, Bestand K. Schröter. PA nach 1945); [18], p. 87; [23]). Over time, he became one of Scholz's closest co-workers.[5] Due to the destruction caused by the bombing of Münster, Scholz invited Schröter to live in his flat (NHS, Scholz – Dürr, 14.05.1946). In the post-war period, however, they were able to work closely together for only a few years until the 43-year-old Schröter agreed to take up his duties as a professor at HU in East Berlin in 1948. His three children were born while he was already there [cf. 23; HU UA, Bestand K. Schröter. PA nach 1945].

Due to Schröter's opposition and resistance activities during the Nazi regime, he became a member of the 'Observation Committee' after the war as a representative of non-professors. He advised the denazification of the Westphalian Wilhelms University of Münster. The denazification was introduced by a law of the Allies in all 4 occupation zones of Germany (cf. HU UA, Bestand K. Schröter. PA nach 1945; [18], p. 87; [28]).

Bibliography of Karl Schröter's works

[S1] *Ein allgemeiner Kalkülbegriff*, Leipzig 1941.

[S2] *Axiomatisierung der Fregeschen Aussagenkalküle*, Leipzig 1943.

[S3] "Was ist eine mathematische Theorie?", *Jahresbericht der Deutschen Mathematiker-Vereinigung*, 53 (1943): 69–82.

[S4] "Die Arithmetik der natürlichen Zahlen im Rahmen der Theorie der Verbände", *Mathematische Annalen*, 120 (1947): 197–201.

[S5] "Der Nutzen der mathematischen Logik für die Mathematik", *Archiv für Logik und Grundlagen der Mathematik*, 1 (1950): 2–16.

[5] Other Scholz's students and co-workers were: Friedrich Bachmann (1909–1982), Albrecht Becker-Freyseng (1907–1976), Gisbert Hasenjaeger (1919–2006), Hans Hermes (1912–2003), Friedrich Hirzebruch (1927–2012), Walter Kinder (1909–1998), H. Arnold Schmidt (1902–1967), Hermann Schweitzer (1909–2002) [22]. Schröter exchanged letters with some of them.

[S6] "Brouwer, L.-E.-J.: *Remarques sur la notion d'ordre*. C.r. Acad. Sci., Paris 230, 263–265 (1950)" [article review], *Zentralblatt für Mathematik*, 34 (1950): 290.

[S7] "Hilbert, D. und W. Ackermann: *Grundzüge der theoretischen Logik. 3.* Verbesserte AuflḂerlin, Göttingen, Heidelberg: Springer-Verlag, 1949" [book review], *Zentralblatt für Mathematik*, 34, 7/9 (1950): 290.

[S8] "Church, Alonzo: *Conditioned disjunction as a primitive connective fort the propositional calculus*. Portugaliae Math. 7, 87–90 (1948)" [article review], *Zentralblatt für Mathematik*, 34, 7/9 (1950): 291.

[S9] "Sobociński, B., *L'analyse de l'antinomie russeliene par Leśniewski. I*, Methodos, Milano 1, 94–107 (1949)" [article review], *Zentralblatt für Mathematik*, 34 (1950): 151–152.

[S10] "Sobociński, B., *L'analyse de l'antinomie russeliene par Leśniewski. II*, Methodos, Milano 1, 220–228 (1949)" [article review], *Zentralblatt für Mathematik*, 34 (1950): 152.

[S11] "Szmielew W.: *Decision problem in group theory*. Proc. 10 internat. Congr. Philos., Amsterdam 1948, 2, 763–766" [article review], *Zentralblatt für*
Mathematik, 34 (1950): 293.

[S12] "Lacombe, D.: *Sur la méthode extensive en métamathématique*. Rev. Sci., Paris 85, 515–518 (1947)" [article review], *Zentralblatt für Mathematik*, 34, 7/9 (1950): 292–293.

[S13] "Deduktiv abgeschlossene Mengen ohne Basis", *Mathematische Nachrichten*, 7, 5 (1952): 293–304.

[S14] "Die Grundfragen der Mathematik und Philosophie", *Deutsche Zeitschrift für Philosophie*, 1 (1953): 119–131.

[S15] "Diskussion. Über Fragen der Logik" ["Über den Gegenstand der mathematische Logik"], *Deutsche Zeitschrift für Philosophie*, 1 (1953): 619–628.

[S16] "Diskussion. Über Fragen der Logik. Über die Rolle von Syntax und Semantik in der Logik", *Deutsche Zeitschrift für Philosophie*, 2 (1954): 167–188.

[S17] "Über Fragen der Logik. Das Gödelsche Theorem von den formal unentscheidbaren Sätzen der Principia Mathematica und verwandter Systeme", *Deutsche Zeitschrift für Philosophie*, 2 (1954): 446–464.

[S18] "Viktor Kraft: *Der Wiener Kreis. Der Ursprung des Neopositivismus – Ein Kapitel der jüngsten Philosophiegeschichte*. Springer-Verlag, Wien 1950, 185 Seiten" [book review], *Deutsche Zeitschrift für Philosophie*, 2 (1954): 246-258.

[S19] "Rudolf Carnap: *Einführung in die symbolishe Logik mit besonderer Berücksichtigung ihrer Anwendungen*. Springer-verlag, Wien 1954, 209

Seiten" [book review], *Deutsche Zeitschrift für Philosophie*, 3 (1955): 260–266.

[S20] "Andreas Speiser: *Elemente der Philosophie und der Mathematik*. Verlag Birkhäuser, Basel 1952. 115 Seiten" [book review], *Deutsche Zeitschrift für Philosophie*, 3 (1955): 519–526.

[S21] "Vorwort" (with G. Asser), *Zeitschrift für mathematische Logik und Grundlagen der Mathematik*, 1 (1955): 1–2.

[S22] "Theorie des logischen Schließens I", *Zeitschrift für mathematische Logik und Grundlagen der Mathematik*, 1 (1955): 37–86

[S23] "Methoden zur Axiomatisierung", *Zeitschrift für mathematische Logik und Grundlagen der Mathematik*, 1 (1955): 241–251.

[S24] "Theorie des bestimmten Artikels", *Zeitschrift für mathematische Logik und Grundlagen der Mathematik*, 2 (1956): 37–56.

[S25] "Über den Zusammenhang der in den Implikationsaxiomen vollständigen Axiomensysteme des zweiwertigen mit denen des intuitionistischen Aussagenkalküls", *Zeitschrift für mathematische Logik und Grundlagen der Mathematik*, 2 (1956): 173–176.

[S26] "Die Unabhängigkeit der elementaren prädikatenlogischen Schlussregeln", *Zeitschrift für mathematische Logik und Grundlagen der Mathematik*, 2 (1956): 218–227.

[S27] "Die Tragweite und die Grenzen der axiomatischen Methode", *Deutsche Zeitschrift für Philosophie*, 5 (1957): 476–488.

[S28] "Eine Umformung des Heytingschen Axiomensystems für den intuitionistischen Aussagenkalkül", *Zeitschrift für mathematische Logik und Grundlagen der Mathematik*, 3 (1957): 18–29.

[S29] "Die Vollständigkeit der die Implikation enthaltenden zweiwertigen Aussagen- und Prädikatenkalküle der ersten Stufe", *Zeitschrift für mathematische Logik und Grundlagen der Mathematik*, 3 (1957): 81–107.

[S30] "Theorie des logischen Schließens II", *Zeitschrift für mathematische Logik und Grundlagen der Mathematik*, 4 (1958): 10–65.

[S31] "Axiomatisierung de k-zahlig allgemeingültigen Ausdrücke des Stufenkalküls" (with G. Asser), *Mathematische Nachrichten*, 19 (1958): 73–86.

[S32] "Mathematik und Sprachen", pages 192–193 in *Jahrbuch der Deutschen Akademie der Wissenschaften zu Berlin 1964*, Berlin 1965.

[S33] "Mathematik und Gesellschaft", pages 1–18 in *Kleine Enzyklopädie Mathematik*, ed. by W. Gellert., H. Küstner, M. Hellwich, M. Kästner, Leipzig 1965.

[S34] "Zum Geleit. (Vorwort zum Leibniz-Heft)", *Wissenschaft und Fortschritt*, 16 (1966): 481.

[S35] "Leibniz und das Problem der Begründung der Mathematik", pages 99–111 in *Jahrbuch der Deutschen Akademie der Wissenschaften 1966*, Berlin

1967; *Wissenschaft und Fortschritt*, 16 (1966): 489–496; *Spektrum*, 12 (1966): 339–346.

[S36] "Mathematik und Gesellschaft. I.", "Die Stellung der Mathematik in der menschlichen Gesellschaft, II", "Die philosophische Bedeutung der Mathematik", *Mathematik in der Schule*, 4 (1966): 626–639; III. "Mengentheoretisch-logischer Aufbau der Mathematik", IV. "Die Rolle der Mathematik beim Aufbau des Sozialismus in der DDR", *Mathematik in der Schule*, 4 (1966): 705–715.

[S37] "Bericht über den Stand der Leibniz-Ausgabe der Deutschen Akademie der Wissenschaften zu Berlin", *Jahresberichte für deutsche Geschichte*, 3 (1968/1969): 209–214.

[S38] "Konstruktive Teiltheorie", *Zeitschrift für mathematische Logik und Grundlagen der Mathematik*, 17 (1971): 197–204.

[S39] "Das Problem der Geometrisierung der Physik vom Standpunkt der mathematischen Grundlagenforschung aus", pages 31–42 in *Der heutige Stand der Geometrisierung der Physik und der Physicalisierung der Geometrie*, ed. by H.-J. Treder, Berlin, 1976. https://doi.org/10.1515/9783112584903

[S40] "Paradigmatische mathematische Probleme", pages 116–122 in *Akademie der Wissenschaften der DDR. Jahrbuch 1975*, Berlin 1976.

[S41] "Tradition und Anspruch unserer mathematischen Forschung", pp. 201–209 in *Wissenschaft im Interview*, ed. by G. Lange, J. Moerke. Leipzig, Jena, Berlin 1978.

3. Karl Schröter in Münster (period from 1936 to 1948)

3.1. Academic activities

The collected archival documents and works devoted to him show that Schröter's academic activities in Münster consisted of 1) working with Scholz and his school of mathematical logic and the foundation of mathematics; 2) preparing, defending and publishing his doctoral and habilitation dissertations (see above); 3) and teaching duties.

Schröter stated that from 1936, he lived in Münster. As an assistant at the Logistic Seminar [*Logistisches Seminar*], where Scholz was the director, he is recorded from the winter semester of 1939/1940 (see PV, Wintersemester 1939/40, p. 42).[6] An example of the cooperation

[6] All information regarding Schröter's lectures in Münster is taken from the PV published for each academic year.

between Schröter and Scholz is described in Scholz's letter to Andrzej Mostowski. In January 1941, almost a year before defending his PhD, Schröter replaced ill Scholz in delivering a lecture titled: *Metaphysics as Mathematical Science. A semantics of identity theory restricted to propositions* [*Metaphysik als mathematische Wissenschaft. Eine Semantik der auf Aussagen beschränkten Identitätstheorie*] [(NHS, Scholz–Mostowski, 6.03.1941), cf. 5].

Below, you will find information on Schröter's didactic activities and four preserved bound lecture notes from his time in Münster. Polish logicians are mentioned in the books and in the bibliography.

In the first post-war winter semester, 1945/1946, Scholz and Schröter were listed as teachers on mathematical logic. These classes were likely intended for students of mathematics. There is a bound lecture notes in the archive BBAW, probably related to a lecture from that semester: K. Schröter: *Introduction to Mathematical Logic Based on Examples from Infinitesimal Calculus*, Münster i, W, W[inter] S[emester] 1945/46 (NKS, Bestand 28).[7] In the bibliography, one find A. Tarski [8]. It is worth adding that Scholz owned this book and its earlier Polish edition as well [7]. Both are still available in FMI.

In the summer semester 1946, Schröter and Scholz taught mathematical logic in the Department of Mathematics and Natural Sciences [Mathematisch- naturwissenschaftliche Abteilung]. They together gave a two-hour lecture titled "Theory of unary predicate calculus (with special consideration of the decision problem)". The lecture was attended by one hundred mathematics students, as Scholz wrote to Alonso Church on 22 May 1946.

A bound set of lecture notes with a title similar to these lectures has survived: K. Schröter, "Theory of unary predicate calculus of the first stage" (NKS, Bestand 31). In the winter semester 1946/1947, Schröter similarly lectured to mathematics students in the Faculty of Natural Sciences on the following topics: a two-hour lecture "The decision problem in elementary number theory", and three-hour classes "Introduction to the proof technique of modern algebra". A handwritten example of Schröter's bound lecture notes with the same title as the lecture has survived, dated to the summer semester of 1948 (NKS, Bestand 33). In a letter from 29 January 1947, Scholz wrote to Bocheński about his younger colleague's teaching activities:

[7] Another example of it you will find in the reading room FMI.

> My colleague, Dr. Schröter, gives a four-hour lecture for a smaller circle — in a form whose degree of accuracy meets our rather high requirements — on the consistency of elementary number theory within the limits within which it is developed in the first volume of Hilbert-Bernays [cf. 4]. [...] There will also be a second main topic added — the constitution and theory of semantic concept of consequence for first-order predicate calculus — lectured by Mr. Schröter [2, p. 11]. This topic will keep us busy until the end of the semester (end of February).[8]

In the summer semester 1947, Schröter gave the following two-hour lecture "Theory of unary predicate calculus of the second level", and a two-hour class "Exercises in mathematical logic". No bound lecture notes have been found yet.

In the winter semester of the following academic year of 1947/48, Schröter gave a two-hour lecture "Mathematical logic", a one-hour class "Exercise in mathematical logic", and a one-hour lecture "Decision problem in multiplicative number theory". No bound lecture notes have been discovered to date. In the summer semester 1948 he taught a two-hour lecture "Mathematical logic", a one-hour class "Exercise in mathematical logic". No bound lecture notes have surfaced so far. In the teachers and lectures list PV, Schröter is mentioned for the last time in the winter semester of the 1948/1949 academic year. However, he was no longer teaching at that time, and in the summer semester 1949, an annotation was added next to his name: on sabbatical leave [*beurlaubt*].

Another example of Schröter's bound lecture notes, the fourth, has survived: *The Decision Problem in the Predicates of the First Levels.* Based on a lecture by Prof. Dr. Karl Schröder. Edited by Ginsbert Hasehjaeger [*Das Entscheidungsproblem im Prädikaten der ersten Stufen.* Nach einer Vorlesung von Prof. Dr. Karl Schröder. Ausgearbeitet von Ginsbert Hasehjaeger] Münster i. W S[ommer] S[emester] 1948. The date of completion of the script has been added: 16.03.1949 (NKS, Be-

[8] "Mein Mitarbeiter, Herr Dr. Schröter, trägt in einer vier-stündigen Vorlesung für einen kleineren Kreis in einer Form, deren Genauigkeitsgrad unsern ziemlich hochliegenden Anforderungen genügt, die Widerspruchsfreiheit der elementaren Zahlentheorie vor in den Grenzen, in denen Sie im ersten Band des Hilbert-Bernays entwickelt ist. [...] Als zweites Hauptthema wird jetzt noch die Konstituierung und Theorie des semantischen Folgerungsbegriffs für den Prädikatenkalkül der ersten Stufe hinzukommen, die Herr Dr. Schröter vortragen wird. Dieses Thema wird uns bis zum Ende des Semesters (Ende Februar) beschäftigen." For transcribed German original of the all letters and their Polish translations see [1], pp. 21–22.

stand 34). The intended use of this script for specific lectures remains unknown.

As a member of the Münster Group led by Scholz, Schröter participated in two conferences in 1937 (Paris): International Congresses for the Unity of Science; International Congress of Philosophy (UM UA, Bestand 63, 173).

At this point, it is worth mentioning that, while still working in Münster, Schröter was a reviewer for the PhD thesis of another Scholz student, Jürgen von Kempski (1910–1998), titled *On Hypotheses Underlying the Social Sciences* [*Ueber Hypothesen, welche den Sozialwissenschaften zugrunde liegen*], defended at the Westphalian Wilhelm University of Münster. At the beginning of his positive review, Schröter stated that he would assess it solely from the perspective of applying mathematical logic to the social sciences (NKS, Bestand 123).

3.2. Interest in Polish Mathematical Logic

Schröter's interest in Polish mathematical logic is confirmed by documents found in his legacy (NKS). They were created when Schröter was working in Münster. Some are originals, others are copies, and a few of the originals were sent to Scholz.

Schröter's interest in Polish logic began with his arrival in Münster in early 1936. He became interested in the 'logistics' (he uses this term) of Leśniewski, Łukasiewicz, Mostowski, Tarski and Wajsberg (HU UA, Bestand K. Schröter. PA nach 1945), which will be discussed in more detail below.

Stanisław Leśniewski (1886–1938). Four important documents related to Leśniewski, found in NKS, Bestand 2, provide evidence of Schröter's keen interest in Leśniewski's logic [cf. 13].

In 1938 Schröter attended two lectures given by Leśniewski in Münster and his handwritten notes from these lectures are preserved in the NKS archive:

1. [K. Schröter], *Ontology* [*Ontologie*], Münster 23.04.1938.
2. [K. Schröter], *On Russell's Antinomy* [*Über Rssell'sche Antinomie*]. Münster 24.04.1938.
3. A copy of a letter sent by Stanislaw Leśniewski to Heinrich Scholz dated 1935.01.16. The original of this letter has not yet been found.

4. [S. Leśniewski], *The Basic Scheme of a Proof* [*Das Grundschema eines Beweis*], written in May, and sent to Scholz in December 1938. Handwritten, two pages, signed by Leśniewski [cf. 3]. This is the most important document in the NKS collection.

In his lecture on Russell's antinomy and in his paper on the basic scheme of a proof, Leśniewski sought to prove that the correction Frege had made to his system to protect it from antinomy was ineffective and that Frege's logical system would always lead to antinomy. This subject is now referred to as Frege's 'way out'. Since Leśniewski's entire legacy was destroyed during or after the Warsaw Uprising in August 1944, the archival documents listed here form the basis for reconstructing some of his later research in mathematical logic.

In the post-war period, already as an HU professor, Schröter briefly reviewed two articles by Sobociński on Leśniewski's criticism of Frege's way out [S9] and [S10].

Jan Łukasiewicz (1878–1956). There are at least three important documents related to Jan Łukasiewicz's logic in NKS.

1. Two undated handwritten documents titled: "Lecture: Łukasiewicz" (NKS, Bestand 40). The author of the notes is still unknown, but it is definitely not Schröter, as the handwriting does not match his. It is also an open question on what occasion the notes were taken and whether they were from Łukasiewicz's lectures during one of his stays in Münster. These notes pertain to, among other things, equivalential calculus and three-valued logic.

2. The second document is related to a competition announced by Scholz on 10 May 1938, shortly after Leśniewski's stay in Münster. The goal was to construct a complete and independent system of axioms for propositional calculus, incorporating implication and negation, that satisfied specific conditions. Łukasiewicz submitted his solution first, on 20 May 1938. Shortly afterward, on 2 June, Paul Bernays (1888–1977) submitted his results, unaware of Łukasiewicz's submission. Schröter's evident interest in this topic is reflected in numerous notes on the competition found in his legacy (NKS, Bestand 29).

3. The third document is an original: J. Łukasiewicz, "Preliminary note on a three-valued system of propositional logic" [*Vorlaufige Notiz ueber ein 3-wertiges System der Aussagenlogik*], dated 30 March 1941 (NKS, Bestand 2). It is typed and a wonderful dedication is added: "To Prof. Dr. Heinrich Scholz from Jan Łukasiewicz, Warsaw" [*An Prof. Dr.*

Heinrich Scholz in Münster i.W. von Jan Łukasiewicz in Warschau]. It means it was sent during the Second World War to Scholz. The NHS holds a collection of Łukasiewicz's 'wartime' letters to Scholz from 1943–1944. The main subject of them is the organisation of Jan Łukasiewicz and his wife Regina's escape from Poland. Thanks to Scholz and his acquaintances, the escape was successfully carried out two weeks before the Warsaw Uprising, which broke out on 1 August 1944. In addition to this subject matter, there are sections devoted to the results of Łukasiewicz's logical research conducted during the war [12].

Andrzej Mostowski (1913–1975). Another important archival document stored in Nachlass Karl Schröter is Andrzej Mostowski's *The Completeness of the Multiplicative Theory of Natural Numbers. A Letter from A. Mostowski to H. Scholz, dated 20.06.1941* [*Die Vollstaendigkeit der multiplikativen Theorie der natürlichen Zahlen. Brief von 20.06.1941 von A. Mostowski an H. Scholz*] (NKS, Bestand 2).[9] In addition to its logical content, the document provides information about lost correspondence between Scholz and Mostowski, as well as Scholz's exchanges with Wanda Szmielew.[10]

In a letter dated 26 August 1947 Scholz wrote to Mostowski on Schröter's scientific interest as follows:

> From the actual scientific work, I am now interested in intuitionistic logic and especially in the algebraization of the intuitionistic predicate calculus. There are many unsolved problems here, e.g., I do not know whether Behmann's theorem about the decidability of the unary calculus can be transferred to intuitionistic logic. Perhaps this question will interest Mr. Schröter.[11]

Although Schröter and Mostowski were interested in similar logical problems, we do not know whether they exchanged letters on it.

[9] One-page copy or summary of the original document is stored in ULM, Nachlass Heinrich Scholz. The original document is lost.

[10] Wanda Szmielew (1918–1976) — a Polish mathematician; she earned her PhD under Tarski's supervision at the University of Berkeley.

[11] "Von der eigentlichen wissenschaftlichen Arbeit interessiere ich mich jetzt mit der intuitionistichen Logik und insbesondere mit der Algebraisierung des intuitionistisches Pradikätenkalküls. Es gibt hier viele ungelöste Probleme, z.B. weiss ich nicht, ob sich der Behmannsche Satz über die Entscheidbarkeit des einstelligen Kalküls auf die intuitionistische Logik übertragen lässt. Vielleicht wird diese Frage Herrn Schröter interessieren." (NHS, Sholz – Mostowski, 26.08.1947).

Alfred Tarski (1901–1983). Alfred Tarski is mentioned in all of Schröter's bound lecture notes from his time in Münster, both in the text and in the bibliography. Further evidence of Schröter's strong interest in Tarski's logical research is provided by a copy of a document sent to Scholz. It concerns a letter from Tarski, dated 8 January 1941, sent to Mostowski via Scholz due to wartime circumstances. At the beginning of the document, the copyeditor outlined the subjects of the letter: theories affected and unaffected by the problem of decidability; the decidability problem for Boolean algebra; and the Peirce-Schröder axiomatisation of the calculus of relations.

Schröter maintained scientific correspondence with Tarski during his time in Münster and beyond. He sent at least two letters to Tarski, now lost, dated 25 April 1946 and 18 July 1946. Tarski referenced these letters in his correspondence with Scholz on 21 October 1946. Via Scholz, Tarski also sent Schröter an article [9].

Mordchaj Wajsberg (1902–1939/1945). Scholz and Schröter showed great interest in the logical research of the young logician Mordchaj Wajsberg. The NKS contains a five-page document entitled: *The One-Element Axiom System of M. Wajsberg for Propositional Calculus in Implication* [*Das ein-elementige Axiomensystem von M. Wajsberg fuer Aussagenkalkuel in der Implikation*] (NKS, Bestand, 29).

A note under the title indicates that the paper is based on a document sent by Wajsberg to Scholz on 16 May 1935. There is a collection of Wajsberg's letters to Scholz from a later period in the NHS: 15.10.1935, 20.10.1935, 21.10.1935, 11.01.1936, 30.04.1937, 2.08.1939. The document from NKS is therefore probably a copy of a lost letter (or a paper attached to a letter) sent by Wajsberg to Scholz on 16.05.1935.

4. Karl Schröter in Berlin (period from 1948 to 1977)

4.1. Academic activities

Based on collected archival documents and published works on Schröter's academic activities in Berlin, we can state that he 1) founded the Institute of Mathematical Logic at HU and created an academic environment for this field in the GDR; 2) participated in numerous classes, sections and commissions of DAW; 3) was a member of the management staff of HU and DAW; 4) founded a journal and served on the editorial board

of another journal; 5) published approximately 40 papers; 6) attended international conferences; 7) taught mathematical logic and promoted PhD students in mathematics and logic.

Humboldt-Universität zu Berlin. In 1948, Schröter was appointed as a professor with a teaching contract [*Professor mit Lehrauftrag*] to teach mathematical logic at the Mathematisch-Naturwissenschaftliche Fakultät of the Humboldt University Berlin (HU UA, Bestand K. Schröter. PA nach 1945). From 1952, Schröter was a professor with a full teaching assignment [mit vollem Lehrauftrag; ibidem]. From 1 September 1956, Schröter held the chair [*Professor mit Lehrstuhl*] of mathematical logic at the Mathematisch-Naturwissenschaftliche Fakultät at HU until his retirement on 1 September 1971.[12] From 1 September 1969, he was appointed as a full professor (*ordinaries*) in the field of mathematical logic and the foundation of mathematics.[13] Beginning in 1950, he served as the director of the Institute of Mathematical Logic [*Institut für mathematische Logik*], which was founded at HU on 1 November 1949 [18, p. 86]. The institute was dissolved in 1968/1969 due to the reform at GDR universities and following the establishment of the Section Mathematics. After his retirement in 1971, Schröter's chair of mathematical logic in Berlin remained vacant [Ibidem, p. 455]. On 1 September 1969, Schröter was appointed ordinary professor [*der ordentliche Professor*] of mathematical logic and the foundation of mathematics at HU (HU UA, Bestand K. Schröter. PA nach 1945).[14] He also served as Vice-Chancellor for Research at the HU, from 1 July 1962 to 1966 [Ibidem; 27, p. 305].

The subject matter of Schröter's lectures at HU has not been definitively established. However, an example of bound lecture notes from this period has been preserved: K. Schröter: *The Decision Problem in Elementary Number Theory* [*Der Entscheidungsproblem in der elementaren Zahlentheorie*]; Berlin 1948 [NKS, Bestand 33]. Below are titles of some of his other, mostly one-time lectures.

[12] Ibidem. Vogt states that Schröter held the chair in 1954, presumably based on an archival document: Schröter's short biography (*Kurzbiographie*) dated 16.02.1962. However, a document confirming his appointment as a professor with a chair, effective from 1.09.1956, has survived [cf. 28].

[13] See a document confirming his appointment as a full professor, HU UA Karl Schröter. PA nach 1945.

[14] An archival document of nomination was preserved, dated 1.09.1969.

In 1964 (JDAWB 1964, Berlin, 1965, p. 392): "On the representation of real relationships by mathematical concepts" [*Über die Abbildung realer Verhältnisse durch mathematische Begriffe*]; "Foundational research of mathematics – the end of the philosophy of mathematics?" [*Die mathematische Grundlagenforschung – das Ende der Philosophie der Mathematik?*]; "Proof of Church's hypothesis" [*Beweis der Churchschen Hypothese*]. In 1965 (JDAWB 1965, Berlin, 1966, p. 301, 304): "Construction of intuitionistic mathematics with classical tools" [*Aufbau der intuitionistischen Mathematik mit klassischen Hilfsmitteln*]; "Foundation of mathematics as a mathematical problem" [*Begründung der Mathematik als mathematisches Problem*]. In 1966 [JDAWB 1968, Berlin 1969]: "General algebra and theory of models" [*Allgemeine Algebra und Modelltheorie*]; "On the theory of algebraic structures" [*Zur Theorie der algebraischen Strukturen*]; "Algebraic structures and theory of models" [*Algebraische Strukturen und Modelltheorie*]; [S35]; "Universal algebra and foundational research of mathematics" [*Universalle Algebra und mathematische Grundlagenforschung*]; "Report on the Leibniz edition of the German Academy of Sciences Berlin" [S37]; "The scope and limits of the axiomatic method" [S27].

During his time in Berlin, Schröter actively participated in the European international scientific community. We want to mention here some examples. Between 24 March and 12 April 1955, he visited the Soviet Union and wrote a 26-page report, now kept in NKS. He planned to participate in the Fifth German Congress for Philosophy [*Fünfter Deutscher Kongreß für Philosophie*] in Marburg in 1957. In a letter to the president of this congress, Helmuth Plessner (1892–1985), he proposed the topic: *The Problem of the Foundation of Logic and Mathematics* [*Das Problem der Begruendung der Logik und Mathematik*].[15] He participated in the International Congress of Mathematicians [*Internationaler Mathematiker-Kongress*] in Amsterdam in 1956, Stockholm 1962 (Comp. HU UA, Bestand K. Schröter. PA nach 1945; [15]). Moreover, he participated in conferences in Berlin, Göttingen, Frankfurt am Main, Stuttgart, Vienna, and Würzburg (See HU UA, Bestand K. Schröter. PA nach 1945; [24, 25, 26, 20]).

While in Berlin, Schröter continued collaborating with the mathematical logic community in Münster, as evidenced by his surviving correspondence with its members. Scholz also referenced Schröter's work in

[15] It has not been confirmed whether Schröter attended this congress.

Berlin in his extensive correspondence; for example, in a letter to Carnap dated 30 April 1949, he wrote:

> In the meantime, our Good Cause has also been established in Berlin. For a year now, Mr. Schröter has held a scheduled associate professorship [Extraordinariat] for mathematical logic and basic research at the University of Berlin. He reads [liest] excellently, and he has already advanced our Cause there very nicely over this year.[16]

In 1960, Schröter was awarded the Nationalpreis, which he subsequently listed in every scientific curriculum vitae and which was highlighted in DAW reports as he prepared to join the Academy. He also received additional awards, including the Gold Johannes-R.-Becher-Medaille of the Deutscher Kulturbund and the Silver Dr. Theodor-Neubauer-Medaille (JDAWB 1964, Berlin 1965, p. 11).

A complete list of the PhD theses that Schröter supervised has not been established yet.

During his time in Berlin, Schröter wrote reviews for the following journals: Zentralblatt für Mathematik, Jahrbuch über die Fortschritte der Mathematik, and Deutsche Literaturzeitung.

Schröter was a member of the society Deutscher Kulturbund and served as chairman [*Vorsitzende*] of its higher education group in 1956 (HU UA, Bestand K. Schröter. PA nach 1945; [27, p. 299].). He was also involved in the development of mathematics didactics in schools across the German Democratic Republic.

Deutsche Akademie der Wissenschaften zu Berlin; Akademie der Wissenschaften der DDR. Beginning in 1956, Schröter developed a long, varied, and flourishing collaboration within the Deutsche Akademie der Wissenschaften zu Berlin (DAW).[17] It appears that Schröter was the only student and collaborator of Scholz to become a member of this esteemed German scientific institution.

[16] "Inzwischen ist unsere Gute Sache auch in Berlin auf die Beine gestellt worden. Seit einem Jahr hat Herr Schröter ein planmässiges Extraordinariat für mathematische Logik und Grundlagenforschung an der Berliner Universität. Er liest ausgezeichnet, und er hat unsere Sache dort im Laufe dieses Jahres schon sehr schön vorangebracht." (NHS, Scholz – Rudolf Carnap, 30.04.1949).

[17] The name of the academy was changed several times. 1946–1972 Deutsche Akademie der Wissenschaften zu Berlin; 1972–1987 Akademie der Wissenschaften der DDR; 1987–1990 Akademie der Wissenschaften zu Berlin. Since 1992 until now Berlin-Brandenburgische Akademie der Wissenschaften [14].

On 21 June 1962, Schröter became a Corresponding Member of the DAW. Less than two years later, on 28 April 1964, he was elected as an Ordinary Member.

At the DAW, Schröter also did organizational and manager work. From 1961 to 1970, he served as a member of the board of directors, and in 1964 he became the chief director of the Institute for Pure Mathematics [*Institute für Reine Mathematik*] at the DAW (JDAWB 1964, Berlin 1965, p. 386; [29]).

From the outset of his affiliation with the DAW, he actively contributed to its work across various sections. He was also interested in philosophical themes related to mathematics, language, Leibniz's achievements, and cybernetics. He was involved in the following sections, classes, and commissions of the DAW, thus promoting mathematics and related topics:

1. Section for Philosophy, Class for Philosophy, History, Political, Legal and Economic Sciences [*Sektion für Philosophie*, *Klasse für Philosophie*, *Geschichte, Staats-, Rechts- und Wirtschaftswissenschaften*], 1956 (JDAWB 1956, Berlin 1957, p. 62).
2. Commission for Mathematical Linguistics and Automatic Translation [*Kommission für mathematische Linguistik und Automatische Uebersetzung*]; 1962–1964 a member of this committee; 1964–1965 a secretary (JDAWB 1962, Berlin 1963, p. 74; JDAWB 1964, Berlin 1965, p. 272; JDAWB 1965, Berlin 1966, p. 199).
3. Section for Cybernetics, from 1962 a member; 1963 a secretary, 1963–1965 a chairman (JDAWB 1962. Berlin 1963, p. 75; JDAWB 1963. Berlin 1964, p. 244; JDAWB 1964, Berlin 1965, p. 277).
4. Einstein-Commission, 1964–1965 a member (JDAWB 1964, Berlin 1965, p. 276).
5. Class for Mathematics, Physics and Technic, from 1964 a member; in 1968 a secretary; 1969–1977 a chairman (JDAWB, comp. 28).
6. Sektion for Mathematics, 1965 a member (JDAWB 1965, Berlin 1966, p. 233).
7. Leibniz-Commission, 1966–1967 a chairman.
8. Class for Mathematics, 1973–1977, a member [10, p. 7].

Some of the lectures he presented at the academy include: *Mathematics and Languages* [S32]; *Classical and Intuitionistic Foundation of Mathematics* [*Klassische und intuitionistische Begruendung der Mathematik*] (1963); *General Algebra and Foundational Research of Mathematics* [*All-*

gemeine Algebra und mathematische Grundlagenforschung] (1967); *A New Proof of Craig's Lema* [*Ein neuer Beweis des Craigschen Lemmas*] (1968); *Set Theory as the Content Related Foundation of Mathematics* [*Mengenlehre als inhaltliches Fundament der Mathematik*] (1968); *Paradigmatic Mathematical Problems* [S40] (JDAWB 1963, Berlin 1964, p. 345; JDAWB 1964, Berlin 1965, p. 192; JDAWB 1968, Berlin 1969, p. 169; JDAWB 1967, Berlin 1968, p. 258; [10, p. 267]).

From *Archiv für mathematische Logik und Grundlagenforschung* to *Zeitschrift für mathematische Logik und Grundlagen der Mathematik*. From 1950 to 1954, Schröter collaborated with the journal *Archiv für mathematische Logik und Grundlagenforschung*. The first issue was published in 1950 as a section within another journal, *Archiv für Philosophie*, founded in 1947 by Jürgen von Kempski, another collaborator of Scholz.[18] Over time, the section devoted to logic evolved into an independent journal, later titled *Archive for Mathematical Logic*, and it is still published today. In the first issue, published in 1950, Schröter contributed the article [S5]. Scholz's colleagues, including those from outside Münster, also published their research results on mathematical logic in the journal.

In 1954, Schröter, together with his student and later collaborator Günter Asser (1926–2015), founded another journal devoted to mathematical logic, *Zeitschrift für mathematische Logik und Grundlagen der Mathematik*, which was renamed *Mathematical Logic Quarterly* in 1993. He served as editor of this journal until the end of his life. Today, it is regarded as one of the most important professional journals of international standing [18, p. 18].

It is worth noting that from 1953 to 1956, Schröter also served on the editorial board of the philosophical journal, *Deutsche Zeitschrift für Philosophie*.

4.2. Interest in Polish Mathematical Logic

Between 1956 and 1957, Schröter was deeply involved in organising Tarski's visit to Berlin. Correspondence on this matter has been preserved, including: 1) a letter from Tarski to Schröter; 2) copies of letters from Schröter to Tarski; and 3) Schröter's letters to professors at other

[18] Scholz was a member of editorial board of this journal. He published an article in its first issue [6].

universities in the German Democratic Republic requesting financial support for the visit (HU UA, Bestand 189). Unfortunately, despite the funds raised, it was not possible to transfer money to purchase airplane netherts for Tarski at that time. With great embarrassment, Schröter apologized for the situation and expressed hope that he would be able to arrange Tarski's visit to Germany at a later date.

The HU archive contain a document about Schröter and Asser's trip to Warsaw to participate in a symposium on the foundations of mathematics, held from 2 to 8 September 1959 (HU UA, Bestand K. Schröter. PA nach 1945). We were able to establish that this was the Symposium on Foundations of Mathematics. Infinistic Methods. It was organised by the Mathematical Institute of the Polish Academy of Sciences under the auspices and with the financial support of the International Mathematical Union. Many world-renowned logicians and mathematicians attended it, including Tarski.

Materials from this symposium have been published [16]. Asser is listed among the participants; unfortunately, Schröter is not, which implies that he attended the conference without delivering a talk or submitting a paper for publication.

It has not been possible to determine the occasion on which the five-page paper was written: [K. Schröter]: "Ueber die Entwicklung der mathematischen Wissenschaften in Polen seit 1918". The paper is dated 11 July 1960 (NKS, Bestand 113). It mentions the following Polish logicians and mathematicians: Łukasiewicz, Leśniewski, Bolesław Sobociński, Alfred Tarski, Kazimierz Ajdukiewicz, Andrzej Mostowski, Kazimierz Kuratowski, and Hugo Steinhaus. It also references Polish logical journal such as *Studia Logica*.

From the first issue until their death, Polish logicians Stanisław Jaśkowski and Andrzej Mostowski were members of the editorial board of the logical journal *Zeitschrift für mathematische Logik und Grundlagen der Mathematik*, founded by Schröter. Jaśkowski and Mostowski also published in this journal.

Documents show that Schröter ordered books written by Polish logicians, such as those by Mostowski, as well as Polish logical and mathematical journals: *Studia Logica*, *Annales de la Société polonaise. De mathématique* and *Fundamenta Mathematicae* (HU UA, Bestand 189). He also reviewed several Polish articles [see S9, S10, S11], though the complete list may be longer.

To the best of our knowledge, Schröter's contributions to logic were and remain largely unknown in Poland.

5. Conclusion

The German archives still contain many undiscovered documents directly related to the Warsaw School of Logic and its connections with German mathematicians, including those from Scholz's school. The goal of this paper was to inform about some yet-unpublished archival documents confirming Karl Schröter's interest in Polish mathematical logic. The documents show how Schröter's relationship with Polish logic shifted after his move from Münster to Berlin from learning and teaching about individual results obtained by Polish logicians to systematically promoting their work in the GDR and establishing deeper cooperation with persons like Tarski and Mostowski.

Although Schröter himself is rarely mentioned in publications on the Lvov-Warsaw School, he was certainly a promoter of it; moreover, he was known to at least some Polish logicians even while he was still in Münster. The German archives not only document Schröter's connections with Polish mathematical logicians but also serve as a valuable source for corrections and additions to his scientific biography. The research on the archival materials was an opportunity to create a complete list of Schröter's works.

Further detailed research of these archival materials including the bound lecture notes seems necessary. There are many topics that merit deeper discussion: in what ways Schröter's works were influenced by the Lvov-Warsaw School; whether his lectures were informed by developments in mathematical logic; whether his lectures made use of the axiomatic method, formalisation, or other developments associated with the Lvov-Warsaw School; what Schröter's position was on non-classical logics, particularly Łukasiewicz's many-valued logic; whether and how Schröter's research and teaching were influenced by his exchange with members of the Lvov-Warsaw School; and to what extent the numerous theses he supervised reflected this influence.[19] We believe that in the near future we will receive answers to these and other questions regarding Schröter's scientific activity.

[19] We thank the anonymous reviewer for the suggestion to expand the article by addressing the listed topics.

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