Introduction

In 1890, a hundred years ago, Ernst Schröder, professor of mathematics at the *Polytechnicum* in Karlsruhe, published the first volume of his *Vorlesungen über die Algebra der Logik (Exakte Logik)*. This issue of *Modern Logic*, appearing as a double number, is dedicated to the commemoration of this event.

Volume I of the *Vorlesungen* was Schröder's second book on formal logic. In *1877*, he had published the *Operationskreis des Logikkalkuls*, an "important pamphlet" (according to A.N. Whitehead in his *Universal Algebra*, *1898*, 115) which gave a short presentation and development of Boole's logical system. Schröder prepared his new book in a series of six winter term lecture courses on the algebra of logic between 1883 and 1889. He originally intended to publish a set of two volumes, the first of which would (and does) contain a general philosophical introduction and a first systematic part on the calculus of classes. The second volume was to contain the propositional calculus as the second part, and as a third part a short and sketchy treatment on the logic of relatives. But gradually, Schröder's *Vorlesungen* grew to a monumental, though nevertheless unfinished, three volume series. The first part of the second volume was published in *1891*. Before publishing the second part of this volume, Schröder decided to treat the logic of relatives in a seperate third volume, of which a first part appeared in *1895*. As shown in my paper „Ernst Schröder und die ‚pasigraphischen Systeme' von Peano und Peirce" appearing in this issue, the third volume entitled *Algebra und Logik der Relative* indicates a substantial change in Schröder's attitude towards logic. This change was induced by Schröder's thorough examination of Peirce's logic of relatives, and by his logical analysis of Cantor's set theory. In the focus of his interests we do not yet find the application of mathematical methods to the analysis of logic, but, in accordance with the basic logicist thesis, the attempt to describe and analyse of mathematics by the means of logic. This change of interest was one of the major causes for the eventual incompleteness of Schröder's monumental plan to represent and discuss the logical knowledge of his time. Schröder was kept from studying the logic of relatives until the second part of volume II was published. It seems that he was unable to finish his work on volume II since he believed that the logic of relatives provided the key for the creation of a scientific univeral language, his dream since his first scientific studies. The second part of volume II was eventually published from the *Nachlass* by Karl Eugen Müller in *1905*. Although Müller worked on the material of the planned second part of volume III it was never published — and there is no hope that it will ever be published, since Schröder's

Nachlass was destroyed in Münster in World War II (*cf*. Peckhaus *1988* and Dipert's paper on "The Life and Work of Ernst Schröder" later in this issue).

The publication of volume I of the Vorlesungen led to enthusiastic reviews but it also evoked critical remarks. Paul Carus stressed in his review for *The Monist* (signed with $\kappa\rho\sigma$) that the whole work, when completed, "will be the most comprehensive treatise on the algebra of logic that has as yet appeared" (Carus *1892*, 620). Don Zoel García de Galdeano ends his two part discussion (*1893*, 203) considering Schröder's book as

> el tratado magistral destinado á la enseñanza de lo que hoy constituye una rama digna de ser estudiada por todo el que aspire á tener idea acabada del organismo de la ciencia matemática
>
> the masterly treatise, destined for teaching what today constitutes a subject worthy of being studied by anyone who aspires to get a perfect idea of the organism of the mathematical science.

Alwin Korselt's review in the *Zeitschrift für den mathematischen und naturwissenschaftlichen Unterricht* grew into a 34-pages essay and it elicited the following editor's comment (Korselt *1897*, 578, note):

> Die hohe Bedeutung des Werkes mag die ungewöhnliche Länge dieser einem Kommentar gleichenden Besprechung [...] entschuldigen, ein Umfang, der von keiner der Besprechungen der 28 Jahrgänge d. Z. auch nur annähernd erzielt worden ist.
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> The great importance of the work may excuse the unusual length [...] of this review which is close to a commentary, a size far from being reached by any other review in the 28 volumes of this Journal.

Christine Ladd-Franklin wrote in her critical discussion for *Mind* that the appearance of the first volume "of Schröder's great work marks an important stage in the progress of Exact Logic". Dismissing Frege's now famous contributions to formal logic she noted that with the exception of the *Operationskreis* the subject had "hitherto received no presentation in Germany", and for those who approach "Exact Logic" for the first time, "this presentation is practically the only thing that yet exists in any language" (Ladd-Franklin *1892*, 126)

A good deal of resignation shines through these lines, and in the first sentence of her review Christine Ladd-Franklin calls Schröder's book "a very bulky" one. This bulkiness, and in parts unreadability, which was due to the fact that Schröder exhibits his material "so to speak, *in statu nascendi*, with all reflections and all difficulties made explicit", as Paul Bernays noted,

well to the point, in his voluminous review of the reprint edition of volume I (Bernays *1975*, 614), may be the cause for the fact that Schröder's *Vorlesungen* did not reach the audience it deserved. Although Schröder was a highly respected member of the 19th century "logical community" (so called by Thony Christie, member of the Erlangen group of historians of logic) his ideas could not transcend the limits of the inner circle of working logicians.

So, shortly after Schröder's death in 1902, his work on logic nearly fell into oblivion. In the first days of the mathematical *Grundlagenkrise* no one thought that it could help to solve the pressing logical problems. To illustrate this, we may cite David Hilbert, one of the main figures in the discussion of the foundations of mathematics since the turn of the century (see Peckhaus *1990*). Hilbert expressed his opinion on previous work in mathematical logic in a lecture course on "The Principles of Mathematical Thinking" in the summer term of 1905 (Hilbert *1905*, 216):

> Ich möchte das hier bisher geleistete jedoch als zu sehr formal bezeichnen, da diese Logikkalküle keine weitergehenden principiellen Ziele und Aufgaben sich stellten, sondern ihnen nur an der formalen Ausbildung des Kalküls zur Darstellung der alten logischen Schlüsse lag.
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> In this respect I would like, however, to call what had hitherto been achieved as too formal, since these logical calculi had no further aims and tasks beyond the formal development of the calculus in order to represent the old logical inferences.

No doubt Schröder would have protested strongly if he had still been alive.

Today we see the emergence of a trend towards a revival of interest in Schröder and the algebra of logic, and not only in historical respects. Günter Schenk (*1984*, 841) notes a growing interest

> bei der Suche nach neuen Varianten der Axiomatisierung, der Darstellung der Beziehungen von Algebra und Topologie zur Logik und bei der Erschließung von Anwendungsmöglichkeiten algebraischer Methoden zur Untersuchung von logischen und metalogischen Problemstellungen u.s.w.
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> in the search for new variants of axiomatization, in the exposition of the relations between algebra and topology on the one hand, and logic on the other, and in the development of applications of algebraic methods for the investigation of logical and metalogical problems etc.

This special issue of Modern Logic aims at increasing this interest in Schröder and his work, and at familiarizing a new generation of logicians with his achievements.

References

BERNAYS, Paul *1975* review of Schröder *1966*, vol. 1, *The Journal of Symbolic Logic* **40**, 609–614.

CARUS, Paul *1892* $\kappa\rho\sigma$, review of Schröder *1890*, *The Monist* **2** (1891–92), no. 4 [July 1892] 618–623.

GALDEANO, Zoel García de *1891* review of Schröder *1890*, *El Progreso matemático* **1**, 139–142, 194–203.

LADD-FRANKLIN, Christine *1892* review of Schröder *1890*, *Mind* n.s. **1**, 126–132.

KORSELT, Alwin *1897–98* review of Schröder *1890*, *Zeitschrift für den mathematischen und naturwissenschaftlichen Unterricht* **28** (1897), 578–599; **29** (1898), 30–43.

PECKHAUS, Volker *1988* „Karl Eugen Müller (1865–1932) und seine Rolle in der Entwicklung der Algebra der Logik", *History and Philosophy of Logic* **9**, 43–56.

— *1990 Hilbertprogramm und Kritische Philosophie. Das Göttinger Modell interdisziplinärer Zusammenarbeit zwischen Mathematik und Philosophie*, Göttingen.

SCHENK, Günter *1984* „Schröder, Ernst", in *Philosophenlexikon* ed. Erhard Lange/Dietrich Alexander, Berlin 1984, 839–842.

SCHRÖDER, Ernst *1877 Der Operationskreis des Logikkalkuls*, Leipzig.

— *1890 Vorlesungen über die Algebra der Logik (Exakte Logik)*, vol. I, Leipzig.

— *1891 Vorlesungen über die Algebra der Logik (Exakte Logik)*, vol. II, pt. 1, Leipzig.

— *1895 Vorlesungen über die Algebra der Logik (Exakte Logik)*, vol. III: *Algebra und Logik der Relative*, pt. 1, Leipzig.

— *1905 Vorlesungen über die Algebra der Logik (Exakte Logik)*, vol. II, pt. 2, ed. Karl Eugen Müller, Leipzig.

— *1966 Vorlesungen über die Algebra der Logik (Exakte Logik)*, 3 vols., repr. as 2nd ed. Bronx, New York.

Erlangen, December 1990 Volker Peckhaus