The Reception of Leibniz's Logic in 19th Century German Philosophy

Volker Peckhaus

1. The problem

Leibniz's impact on the emergence of mathematical (algebraic, algorithmic or symbolic) logic is an important topic for understanding the emergence and development of the current views on logic.[1] However, the question whether Leibniz had any influence at all, or whether his ideas were not more than ingenious anticipations of later developments, is still disputed. The significance of this problem can be shown by referring to Louis Couturat who claimed that in respect to the logical calculus Leibniz had all the principles of much later logical systems of the algebra of logic (George Boole, Ernst Schröder) and in some points he was even more advanced than they (Couturat 1901, 386). One important step in dealing with the problem can be seen in an answer to the question whether early "modern" logicians like Boole, Schröder, or Frege had had any knowledge of Leibnizian logic, i.e., could Leibniz have had any influence on these pioneers of modern logic?

1.1. Diverging claims

In dealing with these questions we are faced with different theses:

> Thesis 1: Leibniz had no impact on modern logic because his contributions were not known.

Wolfgang Lenzen, e.g., wrote that Leibniz was the most significant logician between Aristotle and Frege, but despite the enormous significance of his logic it played hardly any role in the history of logic.[2] According to Lentzen, Leibniz's mature logical theory was present in his *Generales Inquisitiones de Analysi Notionum et Veritatum* which was only published in Louis Couturat's edition of Leibniz's small writings and fragments (C 356–399). Couturat, however, referred to it already in his book on Leibniz's logic which appeared two years earlier (Couturat 1901).

[1] For a full scale study on the topic see Peckhaus 1997.
[2] Lenzen 2004a, 15. See also Lenzen 2004b.

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If this thesis is accepted, it is possible to connect the discovery of the logician Leibniz to the Leibniz renaissance in early 20th century. Besides Couturat's book *La logique de Leibniz d'après des documents inédits* (1901), with a presentation of Leibniz's logic in the spirit of the new logic, the following landmark publications have to be mentioned: Bertrand Russell's *A Critical Exposition of the Philosophy of Leibniz* (1900), providing an axiomatic deductive reconstruction of Leibnizian metaphysics, and Ernst Cassirer's *Leibniz' System in seinen wissenschaftlichen Grundlagen* (1902), focusing on a Neo-Kantian interpretation of Leibniz's philosophy. Undoubtedly, Louis Couturat's edition of Leibniz's *Opuscules et fragments inédits de Leibniz*, taken from the manuscripts in the Royal Library in Hanover and published in 1903, gave access to the wealth of Leibniz's different approaches to logic for the first time.

Thesis 2: Leibniz had an impact on the emergence of modern logic.

Among the proponents of this thesis, Eric J. Aiton is to be mentioned; he wrote that the Leibnizian project of a universal characteristic and the logical calculi resulting from it "played a significant role in the history of logic" (1985, ix). Franz Schupp assumed, starting from Couturat's evaluation quoted earlier "that the Leibnizian logic might be relevant for the further development of modern logic, beyond the historically interesting aspect of an 'ingenious anticipation' " (Schupp 1988, 42). Every step in the development led to new insights into the Leibnizian logic, but sometimes dealing with Leibniz influenced the development itself.

1.2. Referring to the Leibnizian heritage

The second thesis has a big advantage over the first one, as it helps to explain why the pioneers of modern logic themselves referred to Leibniz. Mary Everest Boole, i.e., George Boole's widow, wrote that her husband felt "as if Leibnitz had come and shaken hands with him across the centuries," after having been informed of Leibniz's anticipations of his own logic.[3] William Stanley Jevons, who was responsible for the great public success of modern logic in Great Britain, claimed that "Leibnitz' logical tracts are [...] evidence of his wonderful sagacity" (Jevons 1883, xix). Ernst Schröder, the German pioneer of the algebra of logic, thought that Leibniz's ideal of a logical calculus had been brought to perfection by George Boole (Schröder 1877, III). The particular controversy between Ernst Schröder and Gottlob Frege became dicisive for the later distinction between the two kinds of modern logic: the algebra of logic and the Frege style mathematical logic. Both circled around the question how far the Leibnizian heritage was present in the respective variations of logic. In his *Begriffsschrift,* Frege wrote that the idea of a general characteristic of a *calculus philosophicus* or *ratiocinator* was too mammoth to be achieved by Leibniz alone. With his own *Begriffsschrift*, Frege wanted to supplement the first steps towards this goal of a general characteristic which can be found in the formula languages of arithmetic and chemistry (Frege 1879, VI). In his review of Frege's *Begriffsschrift*, Schröder criticized the title "Begriffsschrift" as promising too much (Schröder 1880, 82). Frege's system does not bend towards a 'General Characteristic' but towards the Leibnizian *calculus ratiocinator* which could be called commendable, if a significant part of

[3] Mary Everest Boole 1905, quoted in Laita 1976, 243.

it had not already been achieved by others (esp. by Boole). Frege replied that he had attempted to express content, contrary to Boole (Frege 1883, 1). Therefore the *Begriffsschrift* is not a mere *calculus ratiocinator*, but a *lingua characteristica* in the Leibnizian sense, although he accepted that deductive calculation [*schlussfolgernde Rechnung*] was a necessary constituent of the *Begriffsschrift*.

2. The first editions

Given these examples it seems to be clear that referring to Leibniz was a common place in the initial period of the development of modern mathematical logic. In order to determine Leibniz's influence on this development, answers to the following questions may be helpful: (a) "Was Leibniz's philosophy of logic available in the 19th century?", (b) "Were Leibniz's attempts to create logical calculi available in the 19th century?"and (c) "Who read what?" A big problem is, of course, that Leibniz did not publish much during his lifetime. Thus answers have to be found by analyzing the early editions of Leibniz's works.

The edition of Leibniz's philosophical works in Latin and French, published by Rudolph Erich Raspe (Leibniz 1765), contains some up to then unpublished letters and six pieces from the unpublished papers, among them "Difficultates quadam logicae" and "Historia et commendatio linguae charactericae". The most important feature of Raspe's edition was the first publication of the "Nouveaux Essais sur l'entendement humain" which were missing for 60 years. This publication caused a stir, maybe the reason for Johann Gottfried von Herder to call Raspe "the man who found Leibniz".[4] In 1768 Louis Dutens published the *Opera omnia nunc primum collecta in Classes distributa praefationibus & indicibus exornata* (Dutens), a rather complete collection of Leibniz's published works. It contained some hitherto unpublished correspondences.

It may be sufficient to proceed in an exemplary way in order to determine how far contemporaries could go into the details of Leibniz's philosophy of logic. The *Nouveaux Essais* may serve as an example, although they are usually not regarded as a core text of logic.

3. Logic in the *Nouveaux Essais*

The *Nouveaux Essais* count as Leibniz's main work in epistemology. They were written between 1703 and 1705 containing criticism of John Locke's *Essay in Human Understanding* of 1690. Locke died in 1704 when Leibniz was still working on the essays. They are composed as a dispute between Philalethes, the *alter ego* of Locke, and Theophilus who represents Leibniz's position. Logical considerations can be found in the fourth book "De la connaissance". There Leibniz distinguishes primitive ideas, i.e., simple and original truths which can be found by intuition, into two groups: necessary truths of reason and contingent truths of matters of fact (Ch. II, § 1). The truths of reason are logically

[4] Herder in a letter to Raspe of May 1774, quoted according to Hallo 1934, 175.

relevant, among them in predominantly identical truths. In its affirmative form an identical truth claims that everything is as it is (principle of identity). In its negative form it follows the principle of contradiction. In a very general version this principle says that a sentence is either true or false. The principle of contradiction, thus, constitutes bivalence. This principle includes the principle of excluded contradiction according to which a sentence cannot be true and false at the same time. It also implies the decidability of the system, i.e., the impossibility that a sentence is neither true nor false (ibid.).

Leibniz rejects the view that identical sentences are superfluous because of being not informative, and therefore do not serve any purpose. He argues that all inferences in logic are proved by identical sentences. Furthermore, all indirect proofs in geometry are done with the help of the principle of contradiction. Finally, the second and the first figure of the syllogism are justified with the help of the principle of contradiction. Leibniz, hence, uses pragmatic arguments by hinting at the benefit these sentences offer. He consequently stresses their character as tools (ibid.).

Leibniz does not discuss logical calculi which were in the focus of his interest in the 1690s, but syllogistics, the traditional theory of inferences. He discusses analytical and synthetic aspects. Analysis in syllogistics means, as already in Aristotle's work, the art of discovering the idea mediating between the two premises in a syllogistic inference which makes the inference possible (*terminus medius*). The art of analysis serves for evaluating given sentences in respect to the question, if they can be derived from premises recognized as true with the help of syllogistic inferences (Ch. II, § 7). This kind of analysis is therefore regressive analysis used to solve problems (heuristics).[5] In this context Leibniz stresses his preference for synthetic procedures. It is more important, he says, to find truth by oneself than to find proofs for truths found by other persons. It is very difficult, however, to find the tools for discovering what one is looking for exactly when one is looking for it. The combinatorial method does not help, although Leibniz had already called it the germ of a *logica inventiva*, logic of invention, in the subtitle of his *Dissertatio de arte combinatoria* of 1666. Frequently, it seems to be rather easy to drink up an ocean than to set up all required combinations. Therefore it is necessary to find the Ariadne thread through this labyrinth (ibid.).

The tool of choice is syllogistics which is part of some sort of universal mathematics, an art of infallibility. This art, however, is not restricted to syllogisms. It concerns all kinds of formal proofs, i.e., all reasoning in which inferences are done by virtue of their form (Ch. XVII, § 4). According to Leibniz there are some problems with algebra. It is still far from being an art of invention. It has to be supplemented by a general art of signs or an art of characteristic (Ch. XVII, § 9).

In sum one can say that Leibniz's rationalistic philosophy of logic with its characteristic demands to use logic as a tool box for finding new truths and to determine the validity of given hypotheses was "on the market". So it is not astonishing that there were several authors writing in the Leibnizian spirit, to name only the most important Christian Wolff (1679–1754) and his school, Johann Heinrich Lambert (1728–1777), and Gottfried Ploucquet (1716–1790). This rationalistic movement dominating German philosophy in

[5]For regressive analysis cf. Peckhaus 2002. For varieties of the notion of analysis cf. Beaney 2008.

the late 18th century was stopped by Immanuel Kant's Transcendental Idealism and by German Idealism (Fichte, Hegel, Schelling). A combination of Kant's Critical Philosophy and elements of Leibnizian Rationalism can be found in the Critical Realism of Johann Friedrich Herbart (1776–1841) and his school.

4. Second wave of reception

When access to Leibniz's papers stored in Hanover became possible in the 1830s, a new interest in Leibniz arose almost immediately. It can be said that the opening initiated German research on Leibniz (Glockner 1932, 60). The pioneers in this period of research were the first editors of the papers. Although the philological interest stood in the center, an emerging interest in Leibniz's logic could be observed. The following works have to be named: Gottschalk Eduard Guhrauer (1809–1854) edited the *Deutsche Schriften* (Leibniz 1838/40). Georg Heinrich Pertz directed the edition of the collected works of which a first series with the mathematical writings was edited by Carl Immanuel Gerhardt (GM). Pertz also edited Leibniz's *Annales imperii occidentis Brunsvicenses* (Leibniz 1843–1846).

4.1. Johann Eduard Erdmann

The edition of Leibniz's philosophical works *God. Guil. Leibnitii opera philosophica quae extant Latina Gallica Germanica omnia* (Leibniz 1839/40) was the most important among the editorial projects. It was prepared in two volumes by Johann Eduard Erdmann (1805–1892) in which, for the first time, fragments were published containing elaborations of Leibniz's ideas concerning logical calculi. Among the papers edited, Leibniz's letter to Gabriel Wagner, written in 1696, can be found which contains the famous definition of logic or the art of reasoning as the art of using the intellect ["Verstand"], i.e., not only to evaluate what is imagined, but also to discover (invent) what is hidden. The edition also contains the seminal fragments "Specimen demonstrandi in abstractis" and "Non inelegans specimen demonstrandi in abstractis" (E 94–97), the last with the algebraic plus minus calculus, i.e., a central specimen of Leibniz's various attempts to formulate logical calculi.

Johann Eduard Erdmann studied theology and philosophy at Tartu and Berlin. Friedrich Schleiermacher and Georg Friedrich Wilhelm Hegel were among his teachers. He later became a member of the right wing Hegelian school. In 1839, he was appointed full professor of philosophy at the University of Halle. Erdmann became well-known for his comprehensive history of modern philosophy entitled *Versuch einer wissenschaftlichen Darstellung der Geschichte der Neueren Philosophie*, published in seven volumes (Erdmann 1834–1853). This history of philosophy covers the period between Descartes and Hegel. Shortly after having published the edition of Leibniz's philosophical works, he presented a discussion of Leibniz and the development of idealism before Kant in pt. 2 of vol. 2 of his history published in 1842. There he stresses the connection between mathematics and philosophy. Erdmann deals with Leibniz's logic in the section on the philosophical method. He mentions Leibniz's definition of "method" as the way of deriving all knowledge with the help of "principles of knowledge" (*Erkenntnisprinzipien)* (Erdmann 1842, 109). These principles are the law of contradiction and the law of sufficient reason. Given

the definition that logic is the art of using the intellect, it is the key to all sciences and arts. According to Erdmann, Leibniz identifies the logical method with the mathematical method being the true philosophical method. Erdmann, furthermore, deals at length with Leibniz's "mathematical treatment of philosophy" not only because it was important for Christian Wolff and his school, but also "because just this point is usually ignored in presentations of Leibniz's philosophy" (ibid., 114). He has good reasons for this evaluation because most of the relevant writings became only accessible by his own edition (E). Erdmann deals with Leibniz's calculi as "methodic operations" with data in the "way of calculating". He discusses Leibniz's idea of a character script for the calculus which allows using signs without always remembering their meaning. Such "pasigraphy" would erase the differences between the languages; however, according to Erdmann's evaluation, the idea of a universal language was not in the center of Leibniz's interests. Leibniz's main point was that "all mistakes in reasoning will at once show up in a wrong combination of characters, and therefore the application of the characteristic script provides a means to discover the mistake in a disputed point like in every other calculation" (ibid., 122–123).

Erdmann's discussion of Leibniz can be evaluated as follows. He opens the way for Leibniz's conception of logic into the actual philosophical debates on logic. This is the more astonishing as Erdmann was a Hegelian. Hegel was known and heavily criticized for his depreciation of formal logic. On the other hand, stressing the close connection between philosophy and mathematics fits into a time when many philosophers tried to bring philosophy back into contact with sciences.

Erdmann reported that, while preparing his history, he became unsatisfied with the available editions of Leibniz's works. He therefore intended to unite Raspe's edition with the philosophical parts of Dutens' edition and some pieces from the unpublished papers. He started editorial work at the archive in Hanover in 1836.

4.2. The impact of Erdmann's edition

Erdmann's edition immediately stimulated further research on Leibniz's logic. Gottschalk Eduard Guhrauer criticized extensively Leibniz's universal characteristic in the first volume of his biography of Leibniz (Guhrauer 1846). He stressed its absurd and utopian character: one can hardly avoid putting the general characteristic and the philosophical calculus in one box with the philosopher's stone and the secrets of producing gold.

In a paper entitled "Über Leibnitz'ens Universal-Wissenschaft" (1843), the Austrian philosopher Franz Exner referred explicitly to Erdmann's edition. For Exner the edition throws a brighter light on Leibniz's conception of a universal science. It has its weaknesses, but Exner prognoses a healthy impact on philosophy. Exner wrote (Exner 1843, 39):

> For him, the universal science is the true logic; both, universal science and logic, are the arts of judgment and invention; writing mathematically means for him writing *in forma*, what he believes to be possible outside mathematics; for him, the logical form of reasoning is a calculus; formulas, relations and operations of his universal science correlate with the concepts, judgments and inferences of his logic; finally, the second part of the universal science, the art of invention, is an epitome of relatively general methods. We cannot

> accuse him of having overestimated logic. It was not his opinion that simple knowledge of logical rules would do great things, but its application. There, however, men who had the knowledge to a great extent had shown weaknesses.

In 1857, the Herbartian philosopher from Bohemia, František Bolemír Květ (1825–1864), published a booklet entitled *Leibniz'ens Logik*. Květ reconstructed the elements of Leibniz's *scientia generalis* stressing that although the elements might not be original, their combination is. He discussed the "extremely meager" fragments concerning the philosophical calculus. They showed, Květ wrote, how far their author stood behind his aims. He dismissed Leibniz's *ars inveniendi*, calling it embarrassing because of its infirmity, defects and impossibility.

4.3. Friedrich Adolf Trendelenburg on general characteristic

The most important figure in this second period of reception was Friedrich Adolf Trendelenburg (1802–1872). He had studied philology, history and philosophy at the Universities of Kiel, Leipzig and Berlin. Among his teachers were Karl Leonhard Reinhold and Johann Erich von Berger. In 1833, Trendelenburg became professor, followed by a professorship of practical philosophy and pedagogic at the Friedrich Wilhelms University, Berlin, 1837, where he grew into one of the main leaders of Prussian education and German philosophy. Being an ordinary member of the Royal Prussian Academy of Science at Berlin since 1846, he became 1847 secretary of the Philosophical-Historical Section of this Academy. Trendelenburg was an anti-Hegelian who started from Hegelian philosophy. His fame as a neo-Aristotelian goes back to his *Elementa logices Aristotelicae*, first published in 1836 with five further editions. In his systematic work on logic he pleaded for a unity of logic and metaphysics as being present in the Aristotelian organon. This systematic attitude is developed in a comprehensive work containing heavy criticism on logical systems of his time: his *Logische Untersuchungen*, published in two volumes 1840.

As a secretary of the Academy, Trendelenburg had to care for the memory of Leibniz who had been the first president of the "Societät der Wissenschaften" at Berlin, founded on his initiative in 1700 and preceding as an institution the Royal Prussian Academy of Science. In 1856, he delivered a seminal lecture "Über Leibnizens Entwurf einer allgemeinen Charakteristik" at the Leibniz ceremony of the Royal Academy of Science at Berlin (Trendelenburg 1857). This paper was reprinted in the third volume of his *Historische Beiträge zur Philosophie* (1867). In this discussion of Leibniz, Trendelenburg stresses the essential role of signs in communication and reasoning. There is no logical relation between sign and intuition. Science has given us the opportunity to "bring the composition of the signs into immediate contact with contents of the concept" (Trendelenburg 1857, 3). The composition of the sign presents the characteristic distinguished and comprehended in the concept in a distinguishing and comprehending way (ibid.). The beginnings of such a "Begriffsschrift" (Trendelenburg's term) are made, e.g., in the decadic number system. Trendelenburg sees the objectives of the Leibniz program in widening such an approach to the whole domain of objects aiming at a "characteristic language of concepts" and a "general language of matter". He mentions the different names used by Leibniz: *lingua characterica universalis* (in fact Trendelenburg's term), alphabet of human thoughts, *calculus philosophicus*, *calculus ratiocinator*, *spécieuse générale*. These

names prove the significance of Leibniz's philosophy for this program. According to Trendelenburg, Leibniz aimed at "an adequate and therefore general signification of the essence, namely such an analysis into the elements of concepts, that it becomes possible to treat them by calculation" (ibid., 6). He mentions historical precursors, Raymundus Lullus' *ars magna*, and other concepts of universal languages. Because of its generality, Leibniz's *characteristica universalis* stands out compared with competing conceptions by George Dalgarno (1661) and John Wilkins (1668) which were mixed from "choice, nature and chance", and leaned upon existing languages (ibid., 14–15).

Trendelenburg, however, heavily criticizes the practical side of the program, in particular calculation in logic. The connection of properties in a concept is much more complicated than it can be expressed with Leibniz's operations (ibid., 24). He gives the advice to abstain from calculation (ibid., 25):

> If the side of calculus, invention and discovery is excluded from general characteristic, still an attractive logical task remains: [to find] the sign distinguishing the element and therefore being clear, avoiding contradictions; to reduce blind intuition to a sharply thought content; to reduce the intricate to the simple contained in it. It remains the task to find a sign that is, like our number script, determined by the concept of the matter itself.

For the last task it is necessary to analyze the concepts completely. However, this is not always possible given the actual state of science. Therefore arbitrary assumptions would have to be accepted until they can be replaced by better knowledge.

4.4. Evaluation

Erdmann's edition induced a second wave of reception. This reception is characterized by an interest in Leibniz's ideas on logic. Its context was the reorganization of the philosophical scene after Hegel's death (1831). This process was connected with a discussion on the so-called "Logical Question", a term presented by Adolf Trendelenburg (Trendelenburg 1842). The discussion concerned the role of formal logic in the system of philosophy overcoming Hegel's identification of logic and metaphysics. The philosophical dominance of metaphysics was subsequently replaced by that of epistemology.

Trendelenburg's results were typical for a line of reception stressing the metaphysical character of Leibniz's philosophy: He was interested in the *characteristica universalis* as a tool for knowledge representation, although he stressed its utopian character. He had no interest in the logical calculus due to a philosophical scepticism towards mechanical tools. They cannot explain creativity in the emphatic sense and have no relations to the contemporary philosophy's interest in dynamical (temporal) logics which should help to model the movement of thought ("Denkbewegung").

Given Trendelenburg's special emphasis in presenting the Leibnizian system, his significance for the mathematical reception of Leibnizian ideas in the context of the emergence of formal mathematics and mathematical logic in the second half of the 19th century is astonishing. Trendelenburg's paper on Leibniz's program of a general characteristic became, e.g., a point of reference of the logical pioneers such as Gottlob Frege and Ernst Schröder.

5. Discovery of Leibniz in mathematical logic

The discovery of Leibniz in mathematical logic can be shown exemplarily in the case of George Boole, the founder of the algebra of logic. In his first writing on logic, the booklet *The Mathematical Analysis of Logic* of 1847, he gave an algebraic interpretation of traditional logic. His fame of being one of the founders of modern logic goes back to his *An Investigation of the Laws of Thought* of 1854. According to Boole's own evaluation, his main innovation was the Index Law (1847), later revised to the Law of Duality, also called "Boole's Law", expressing the idempotency

$$A = AA.$$

What are the connections to Leibniz's logic? Are there anticipations of the Boolean calculus in the work of Leibniz? One of those authors looking for anticipations was Robert Leslie Ellis (1817–1859) who edited Francis Bacon's *Novum Organon* in *The Works of Francis Bacon* (1858–1874; vol. 1: 1858). During his editorial works he found a parallel to Boole's Law (p. 281, footnote 1): "Mr. Boole's *Laws of Thought* contain the first development of ideas of which the germ is to be found in Bacon and Leibnitz; to the latter of whom the fundamental principle in logic $a^2 = a$ was known." As reference he gave Erdmann's edition (E p. 130). Robert Harley (1828–1910), Boole's first biographer, discussed this information in a paper entitled "Remarks on Boole's Mathematical Analysis of Logic" (1867). He did not find the proper quote at the place indicated by Ellis, but he found other relevant texts. About the significance of Ellis' remark he wrote: "Boole did not become aware of these anticipations by Leibnitz until more than twelve months after the publication of the 'Laws of Thought,' when they were pointed out to him by R. Leslie Ellis" (p. 5).

Harley's research was taken up by the Manchester economist and philosopher William Stanley Jevons (1825–1882). He posited his philosophy of science as being present in the *Principles of Science* (1877, 2nd ed. 1883) against John Stuart Mill's predominant inductive logic. His alternative was the Principle of Substitution, the "substitution of similars": "So far as there exist sameness, identity or likeness, what is true of one thing will be true of the other" (Jevons 1883, 9). He included a section "Anticipations of the Principle of Substitution", which was enlarged in the later edition with a long discussion of Leibniz's anticipations. There he expressed his thanks to Robert Adamson for the information that the Principle of Substitution can be traced back to Leibniz. Jevons asked for the reasons for the long ignorance of Leibniz's anticipations. Only Dutens' edition was available in Owens College Library, Manchester. He regrets having overlooked Erdmann's edition, but this was also done by other "most learned logicians".

Finally John Venn (1834–1923) has to be mentioned. His *Symbolic Logic* (1881) is important for the historical contextualization of the new logic. He criticized Jevons' statement on the Law of Duality according to which "the late Professor Boole is the only logician in modern times who has drawn attention to this remarkable property of logical terms" as being simply false. Besides Leibniz, Lambert, Ploucquet and Segner had anticipated the law "perfectly explicitly" and Venn had no doubts "that any one better

acquainted than myself with the Leibnitzian and Wolfian logicians could add many more such notices" (Venn 1881, xxxi, footnote 1).

6. Conclusions

No doubt, the new logic emerging in the second half of the 19th century was created in Leibnizian spirit. The essentials of Leibniz's logical and metaphysical program and of his idea concerning a logical calculus were available at least since the 1840s. Erdmann's edition of the philosophical works and Trendelenburg's presentation of Leibniz's semiotics were the most important steps towards the further reception of Leibnizian ideas among mathematical logicians at the end of the 19th century. As soon as these logicians were aware of the Leibnizian ideas they recognized Leibniz's congeniality and accepted his priority. However, the logical systems had already been established. Therefore there was no initializing influence of Leibniz on the emergence of modern logic in the 2nd half of the 19th century.

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Volker Peckhaus
Universität Paderborn
Institut für Humanwissenschaften: Philosophie
Warburger Str. 100
D-33098 Paderborn, Germany
volker.peckhaus@upb.de

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