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Logic and theory of science in the 19th century philosophy

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Abstract: In the paper, I discuss some key milestones of the program, which strived, in the 19th century, to reduce the general theory of science to (formal) logic. Projects of this kind were inconsistent with the basic tenets of the Kantian theory of knowledge. Therefore, the former developed mostly in the framework of the traditions that were minimally influenced by the latter. Most attention is paid to the historical development of this program in Austria. I have shown that the basic principles of this approach were laid down by B. Bolzano, who identified the “Wissenschaftslehre” project with logic. The originality of the Bolzanian concept of a logical form is analyzed. It is shown in particular that the Kantian opposition of form and content is not relevant for Bolzano’s doctrine. Further, I consider the reception and development of the Leibnizian project of the “Characteristica universalis” by philosophers from the Bolzano circle, namely F. Exner and R. Zimmermann. Unlike Trendelenburgh’s influential, these two authors very firmly and decisively associated the project with a progress in formal logic. Exner in fact set the goal of creating a pure logical calculus which would be based on the Bolzanian method of variation of representations. Zimmermann, among other things, proposed that any kind of traditional category should not be used as a primitive conceptual basis for such a calculus; rather some special expressive means that can be used to construct structures of knowledge from units should serve for this goal. I also consider the role of R. Zimmermann’s textbook for gymnasiums entitled “Formal Logic”, in particular its second edition. I also try to inquire by what means he hoped to achieve the assumed purpose of logic, which, in his view, consists in elaborating the unity of the methods of science and the full ordering of knowledge.

Keywords: logics, theory of science, 19 century, Bolzano, Characteristica universalis, Zim-mermann


By the middle of the 19th century, the intention to develop a general theory of science that was one of the principal leitmotifs in the European philosophy of Modern Times had led to creating several fundamental programs, which were not always compatible with each other. One of them used to connect the formation of such a theory to creating some kind of new logic.

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In German philosophy at least since Kant, it became common-shared to draw a distinction between form and content of knowledge. The section, identified by the Koenigsbergian thinker as “general logic” was described as formal because it abstracted from any content and particular features of knowable objects. Hence, general logic could not be the method of scientific knowledge. Trendelenburg, due to whom this interpretation of the subject of this science was denoted as “formal logic” argued determinedly against capabilities of formal logic itself. As a consequence, within the framework of German philosophy of the 19th century, if some logic ever could pretend to play the role of a general theory of science at all, then certainly by it never could be meant the formal logic.

In Austria, where Kant’s philosophy did not have a dominated influence, abilities of formal logic were estimated more favorably. So, B. Bolzano considered science as “a completed whole of propositions, in which the most noteworthy truths of a certain kind are already arranged and presented along with others” [Bolzano, 2014, vol. 1, p. 8]. Hence, taking into account his Platonist views not only on science, but on logic as well, it is not surprising that the theory of science, according to him, is supposed to be nothing but logic: “According to the concept I have of logic, it is a theory of science, that is, instructions on how to divide the entire domain of truth appropriately into individual parts or sciences, and how to develop and present each of these sciences in writing” [Bolzano, 2014, vol. 1, pp. 44–45].

Bolzano would like to avoid denoting his understanding of logic as formal. However, first, his interpretation of form and content essentially differs from the Kantian one. By content, he does not understand a matter of knowledge, but only a composition, a collection of parts from which an objective representation/proposition is formed only. By form, he does not understand a form of thinking, but a form of objective representations/propositions. He considers this form as an attributes “which several propositions have in common”; and identifies it with the shape, structure (Gestalt) of a proposition [Bolzano, 2014, vol. 2, p. 180]. Second, when speaking of logic, Bolzano’s followers, as a rule, did not mean a form of thinking, but a form of object in general.

An original interpretation of the Leibnizian project of the characteristica universalis played the special role in the development of this program. In Germany, the interpretation of Trendelenburg had a decisive influence; he rejected the view that this project might be connected to formal logic. The interpretations of both F. Exner and P. Zimmermann, the two Austrian authors, were considerably different. E.g., Exner beleived that logic plays the central role in the project of Leibniz: “For him, logic was the science that forms the ideal for all sciences towards which every science is approaching in its own way” [Exner,
Moreover, in opposition to Trendelenburg, he thinks that Leibniz means that logic is nothing but a formal knowledge: “according to Leibniz, the welfare of science rests on a careful attention to logic in the formal sense of this word” [Exner, 1843 S. 39]. Elements of the calculus which satisfies these requirements have occurred in some sciences already. There are two ways for developing this approach in logic: first, by direct applying the methods of the mathematical calculus; second, by creating the proper logical calculus that is not a direct application of the mathematical technique to the logical content. According to Exner, the first and probably the only essential step towards the latter direction was made by Bolzano due to invention the method of variations of representations.

In his review of Exner’s paper, Zimmermann shares his main theses. When discussing an idea of the key primitive concepts of the calculus, he came to an interesting conclusion that the central attention of philosophy should not be focused on postulating the categories in the spirit of Aristotle, Kant, or Hegel, but on the means by which one achieves a distinct knowledge of both a composition and a structure of concepts. They correspond to such linguistic means which have never been considered as categories — particles, junctions, and the other auxiliary words. “It would be impossible to connect two concepts without the word ‘and’. The word ‘though’, Jean-Paul states, hides a whole philosophy” [Zimmermann, 1846 S. 796]. One can only regret that such a breaking thought that had been manifested just one year before the epoch-making works by both Boole and De Morgan had not been continued.

In addition, Zimmermann much firmer stressed the close connection between the Leibnizean project and the idea of a general theory of science; the latter being interpreted in a full consent to Bolzano’s doctrine. E.g., in evaluating the perspectives for creating the scientific calculus, he writes: “It is likely that a solution to this task would be closer, if logic were not treated as just a doctrine about thinking, but rather as an art which divides all sphere of knowledge into separate sciences and presents them in the corresponding textbooks, i. e. as a doctrine about science” [Zimmermann, 1846 S. 798].

Afterwards, Zimmermann authored two different editions of the textbook “Formal logic”, the basic textbook of logic in Austrian gymnasiums for a long time. The first edition (1853) reproduced a large number of the principles of Bolzano’s doctrine, and in such a scrupulous and lengthy way that the author had attracted the accusations in plagiarism. The second one (1860) reflects an essential shift in Zimmermann’s views. Here he describes a scientific knowledge as a collection of “right and valuable [giltigen]” concepts related to certain field of research. Moreover, connections and combinations of these notions plus their ordering should be right and valuable as well. These requirements force
the call to developing a special discipline which should guarantee an ability for a system of notions to be a bearer of the scientific knowledge: “Such a science that is grounded on the notions themselves... is logic or a doctrine of science” [Zimmermann, 1860, S. 13]. Every particular science has its own applied logic based on the specifics of objects which it studies; however, all of them go towards the unified universal logic that is supposed to guarantee a unity of scientific methods and a complete ordering of the scientific knowledge.

A very prominent and influential during his lifetime philosopher A. Riehl whose works were intensively translated into many languages including Russian, graduated from the University of Graz and was studying logic in the gymnasium by the Zimmermann’s textbook. That is why his views on the subject and nature of logic are not surprising. Indeed, he thinks that “form of science itself constitutes a subject of a special science, and this science is logic”, and “the laws of thought in the sense of logic are the laws of thinkable, objectual in general, and, therefore, logic is a science of the primitive relations between the objects of thought” [Riehl, 1907, S. 76].

It remains to add that, being a professor of philosophy at the University of Vienna for many years, Zimmermann, in fact, became a kind of the conductor for Bolzano’s ideas inside the school of F. Brentano. The words of E. Husserl occurring in the beginning of his dissertation (R. Zimmermann was his formal advisor) are remarkable: “Modern logic came, in contrast to the older logic, to understand its true task to be that of practical discipline (that of a technique [Kunstlehre] of judging correctly) and came to seek, as one of its principal goals, a general theory of the methods of the sciences” [Husserl, 2003, p. 307]. Husserl, who faced this approach to logic for a first time during his fellowship in Vienna, in essence, identifies logic of Modern Times with just one of its branches, the Austrian one. Nevertheless, due to Husserl, the Austrian logical style broke through borders of the Danube monarchy and made a huge (sometimes unconscious) impact on a number of turns, that occurred in logic and philosophy in the first decades of the 20th century.


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Логика и теория науки в философии XIX века*

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Аннотация: В статье обсуждаются ключевые моменты и основные этапы развития программы, стремившейся свести теорию науки к (формальной) логике. Подобные проекты были несовместимы с некоторыми из основных принципов кантианской теории познания, поэтому развивались главным образом в рамках традиций, испытавших наименьшее влияние этой философии. Основное внимание уделяется истории развития этой программы в Австрии. Показано, что основные принципы этого подхода были заложены Б. Больцано, который отождествил проект «Wissenschaftslehre» с логикой. Анализируются своеобразие больцанистской концепции логической формы, в частности обращается внимание, что кантианское противопоставление содержанию для него не имеет отношения к сути дела. Далее рассматриваются особенности восприятия и развития лейбницевского проекта универсальной характеристики философами из круга Больцано — Ф. Экснером и Р. Циммерманном. В отличие от влиятельной интерпретации А. Тренделенбурга, эти авторы достаточно твердо и решительно увязывали этот проект с развитием формальной логики. Экснер фактически поставил задачу разработки чисто логического исчисления на основе больцановского метода вариации представлений; Циммерманн, среди прочего, предложил, что в качестве простейших понятий такого исчисления должны использоваться не те или иные категории, а средства выражения, с помощью которых из отдельных элементов строятся структуры знания. Рассматривается роль двух изданий учебника Р. Циммерманна «Формальная логика» для гимназий в утверждении соответствующих подходов. При этом мы пытаемся исследовать, за счет чего Циммерманн надеется достигнуть главной цели логики, которую он видит в том, что эта наука должна обеспечить единство научных методов и полное упорядочение научного знания. В заключение кратко прослеживается воплощение описанной программы в философских проектах А. Риля и Э. Гуссерля.

Ключевые слова: логика, теория науки, XIX век, Больцано, универсальная характеристика, Циммерманн

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