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Reviews

Hermann von Helmholtz, *Philosophische und populärwissenschaftliche Schriften*, Michael Heidelberger, Helmut Pulte, Gregor Schiemann (eds.), 3 vols. Hamburg: Meiner, 2017., ISBN 978-3-7873-2896-3.

Hermann von Helmholtz is a key figure of modern science and modern philosophy. Not only did he promote a classical view of the liberal arts as intimately related to the scientific endeavor, but in doing so he adopted an approach that was considerably ahead of his time.

He offered a paramount example of philosophical investigation motivated by concrete scientific research, which he practiced in his extensive work as a physiologist and a physicist.

Helmholtz's body of work in philosophy and the popularization of science enjoyed remarkable success among his contemporaries. His first collection of popular lectures on scientific subjects, ranging from experimental physiology and mechanics to musicology, appeared in two volumes in 1865 and 1871, respectively, under the title "*Populäre wissenschaftliche Vorträge*". The full collection, including Helmholtz's popular lecture on the foundations of geometry of 1870, appeared in three volumes in 1876. Helmholtz himself included relevant additions and later substantial contributions to this collection in two subsequent editions as "*Vorträge und Reden*" in 1884 and 1896 (appeared posthumously). In sum, Helmholtz's collected popular lectures enjoyed three editions during his life time and five editions, all of which were followed by English translations, until 1903.

Helmholtz's philosophical work, in particular his work on physical geometry and the foundations of measurement, enjoyed a new wave of interest after Einstein's general theory of relativity. This culminated with the collection of his epistemological writings as "*Schriften zur Erkenntnistheorie*", edited and commented by Paul Hertz and Moritz Schlick on the occasion of the centenary of Helmholtz's birth, in 1921. This collection, along with Schlick's comments, contributed to set the philosophical agenda for logical empiricism and is still one of the main references for the philosophical scholarship. More generally, Helmholtz's epistemological views were seminal for the late nineteenth-century project of a scientific philosophy and remain an important contribution in contemporary philosophy of science.

More recent scholarship initiated in the 1990s has emphasized that the originality of Helmholtz's approach, even beyond his impact on later philosophy, lies in its constant connection with scientific research. The transformation of physiology in the nineteenth century plays a particularly important role here. Not only did Helmholtz engage in the debates surrounding the establishment of experimental methods in the life sciences, but he started from these debates to develop insights in other fields of knowledge. To put it in the words of a well-known collection of studies on these topics (Krüger 1994), Helmholtz deserves a very particular place in intellectual history as a "universal genius". This title is indeed no exaggeration when one thinks about Helmholtz ability to answer general philosophical questions while at the same time deliver groundbreaking work in diverse special sciences.

The broadening of perspective brought by these historical studies gave new impulse to further collections of Helmholtz's works that aimed to better reflect the wide spectrum of his scientific and cultural interests (see esp. Cahan 1995).

The new edition of Helmholtz's philosophical and popular writings on scientific subjects offers the most comprehensive existing collection in the wake of this tradition, along with an informative introduction on Helmholtz's life and work. The first two volumes include all of the papers originally published in the different editions of "*Populäre wissenschaftliche Vorträge*", supplemented by Helmholtz's subsequent additions, relevant papers published by him in English and relevant texts or extracts from his scientific works, including *Ueber die Erhaltung der Kraft*, *Handbuch der physiologischen Optik*, *Wissenschaftliche Abhandlungen*, *Vorlesungen über theoretische Physik*. For each text, the editors provide a full editorial history, including all reeditions and translations into English and French. The third

volume includes all philosophically relevant texts from Helmholtz's Nachlass at the Archives of the Berlin-Brandenburg Academy of Sciences and Humanities and from Königsberger's (1902–1903) transcription, followed by a complete bibliography of Helmholtz's published work in German, English and French.

On the whole, this collection provides new and extremely valuable materials for historical and philosophical studies. The authors offer a chronology of Helmholtz's work amended in the light of new historical research. This sheds further light on how Helmholtz's philosophical ideas emerged from the thematic affinities between different areas or knowledge, as well as from a wider circulation of ideas within the international scientific community. Helmholtz's extensive exchanges with English and French-speaking scientists and philosophers is well documented by his publications in these languages listed in the third volume of the collection.

The editors also provide a selected bibliography of the secondary literature, with a particular focus on the German-speaking literature. For a more comprehensive account of the secondary literature in English, see especially Patton (2014).

Given the extent and variety of the material collected in the volume, the editors had to renounce to provide the original texts with a critical apparatus. A critical edition of Helmholtz's philosophical writings remains a desideratum for both a more accessible reading and scholarly work. As Hertz and Schlick emphasized, Helmholtz's texts raise several interpretative issues, the discussion of which is still controversial in the literature. Besides the abovementioned edition of Helmholtz's epistemological works, a useful introduction to some of the texts, along with new English translations, has been provided by David Hyder in Luft (2015).

These interpretative issues notwithstanding, the collection is a very valuable philosophical contribution. This is in virtue of the covered topics and the critical organization of the collected materials. A few examples will help to show the relevance of this collection to a variety of issues, which range from intellectual history to history, philosophy and sociology of science.

The opening text of the collection, the introduction to "Ueber die Erhaltung der Kraft", offers a synthesis of Helmholtz's research program across experimental physiology, chemistry and mechanics. Helmholtz was a student of Johannes Müller, who founded the physiological school in Berlin. This school was characterized by the reliance on experimental methods and by a mechanistic view of nature. This implied a reduction of organic processes to mechanical laws. Helmholtz addressed this issue from a more general viewpoint by investigating the conditions for a reduction of all motions to motions dependent on spatial relations alone. In Helmholtz's terminology, all "forces" ought to be reduced to central forces of the kind of Newton's gravitational law. Helmholtz's law is known today as the conservation of "energy", after the formulation given by William Thomson (Lord Kelvin), namely, as the constancy of the sum of potential and kinetic energy.

While Helmholtz presented "Ueber die Erhaltung der Kraft" as a treatise in physics, the broader scope of this work is well documented by Helmholtz's introduction as well as by his popular writings. This includes "Ueber die Wechselwirkung der Naturkräfte und die darauf bezüglichen neuesten Ermittelungen der Physik", "On the Application of the Law of the Conservation of Force to Organic Nature",

“Ueber das Ziel und die Fortschritte der Naturwissenschaft”, all of which are found in the first volume of the collection. Helmholtz also held a lecturing course with the title “Ueber die Erhaltung der Kraft” in Karlsruhe in 1862–1863. The introduction to this course was first published in *Populäre wissenschaftliche Vorträge* in 1871. The collection includes a reproduction of the original edition with illustrations and the “Lectures on the Conservation of Energy” held by Helmholtz at the Royal Institution of Great Britain in 1864. Among the various applications of the conservation of force, Helmholtz here drew special attention to how his law offers a better account of some processes in animals and plants than the assumption of a vital principle or force.

The collection also offers a thorough account of how Helmholtz modified the formulation of his law at different stages of his intellectual career, by comparing the original texts with later additions. It emerges clearly from this comparison that Helmholtz had to restrict his law to empirically given points and relative coordinate systems following Rudolf Clausius’s critiques. Consequently, Helmholtz distanced himself from the mechanism of the physiological school and admitted dynamical shifts in drawing the borderline between the principles and the experimental part of physics.

In the measure that Helmholtz defined his empiricist attitude towards the principles of science, he also took different stances towards the assumption of a priori elements of knowledge. Helmholtz maintained in “Ueber das Sehen des Menschen” that at least the principle of causality and the subjective forms of intuition can be considered a priori in a modified Kantian sense, as conditions for the comprehensibility of nature. Unlike Kant’s a priori knowledge, a priori assumptions in Helmholtz sense allow for an empirical investigation. So, for example, in the abovementioned lecture, Helmholtz maintained that the Kantian theory of perception found a new confirmation in Johannes Müller’s theory of the specific nerve energies. However, Helmholtz later distanced himself from his former teacher’s theory as a form of nativism. In order to account for spatial perception, Helmholtz proposed a “sign” theory, according to which the perceiving subject learns to form associations via unconscious inferences from the sense data to their unknown causes. In this view, different kinds of sensations are signs that allow for different combinations and the representation of space is the common denominator of all possible forms of localization.

Subsequently, Helmholtz addressed these issues from a different angle in his investigation of the foundations of geometry. Helmholtz’s arguments for the empirical origin of geometrical axioms and the imaginability of non-Euclidean spaces became a standard reference in the post-Kantian debate on the possibility of a priori knowledge in the face of scientific change. Helmholtz’s popular lectures on these topics, including “Ueber den Ursprung und die Bedeutung der geometrischen Axiome”, “The Axioms of Geometry”, “Die Thatfachen in der Wahrnehmung”, set up the conceptual framework for different strategies to deal with physical geometry, from geometrical conventionalism to the relativization of a priori knowledge.

Besides the abovementioned popular lectures and writings, the collection includes the most relevant texts for a reconstruction of Helmholtz's thought from the nativism/empiricism debate in the physiology of vision to his first geometrical papers. This includes the public lecture "Ueber das Sehen des Menschen" and the lecturing course "Die neueren Fortschritte in der Theorie des Sehens", as well as the opening chapter of the psychological part of Helmholtz's *Handbuch der physiologischen Optik*, "Von den Wahrnehmungen im Allgemeinen". As Helmholtz suggested (17, p. 554), his investigation of spatial perception provided a starting point for his attempt to deduce a Riemannian metric of constant curvature from the free mobility of rigid bodies in "Ueber die thatsächlichen Grundlagen der Geometrie" and "Ueber die Thatsachen, die der Geometrie zum Grunde liegen".

Another recurrent theme in Helmholtz's scientific and philosophical work is his engagement with measurement problems. As mentioned above, in order to counter Clausius's objections against Helmholtz's proof of the positional dependence of forces, he had to take into account the problem of establishing the empirical conditions for the determination of distance and of direction. Helmholtz attained new standards of precision in his physiological work by offering one of the first measurements of the propagation velocity of nerve impulses. Another of his seminal contributions was the invention of the ophthalmometer, which has become a standard medical device. Helmholtz used the ophthalmometer to show that the retina adjusts to the perceived objects according to their distance. He relied on this result in his geometrical papers to describe the hypothetical adjustments of spatial perception to non-Euclidean displacements.

Helmholtz proposed a new standpoint for establishing the conditions of measurement in general in "Zählen und Messen, erkenntnistheoretisch betrachtet". Not only did he address the problem of measurability in the life sciences (in particular the psychophysics), but he was one of the first to propose an axiomatic approach to the characterization of quantities. In doing so, he foreshadowed a new branch of mathematics, which became known in the twentieth century as measurement theory.

The collection includes a reedition of "Zählen und Messen", along with the relevant texts for the scientific background of Helmholtz's theory of measurement. This includes the abovementioned popular lectures on physics, geometry, and perception, as well as Helmholtz's introduction to his *Vorlesungen über theoretische Physik*. This lecturing course provides evidence of Helmholtz's engagement with the discussions on measurement by British physicists such as Michael Faraday and James Clerk Maxwell.

The collection offers extensive evidence of Helmholtz's engagement with scientific policy and education. Although these topics have not been in the focus of the secondary literature, they deserve a closer consideration for the philosophical relevance of lectures delivered for scientific organizations, including "Ueber Goethe's naturwissenschaftliche Arbeiten" (*Deutsche Gesellschaft*, Königsberg 1853), "Lectures on the Conservation of Energy" (*Royal Institution*, London 1864), "Ueber die akademische Freiheit der deutschen Universitäten" (*Rektorsrede*, Berlin 1877), "Bemerkungen über die Vorbildung zum akademischen Studium" (*Kommission des preußischen Unterrichtsministeriums*, Berlin 1890), to mention

only a few. Moreover, Helmholtz was one of the first physicists in Germany to appreciate the inductive approach of Anglo-Saxon physicists and generally to defend the methodological pluralism of the international community, for example in “Zöllner contra Tyndall” and in “Heinrich Hertz”, the preface to his former student’s *Prinzipien der Mechanik im neuen Zusammenhange dargestellt*.

These are only some of the examples of themes from Helmholtz’s work as a scientist, which reflect back on how he created an original synthesis of ideas in his popular and philosophical writings. To sum up, this new edition delivers an essential tool for a better understanding of the different but interrelated paths of Helmholtz’s investigations. It is my conviction that less explored paths will deserve closer attention from the philosophical and scientific community, after a careful consideration of the material collected for the first time in this edition.

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Cheryl Misak, *Cambridge Pragmatism. From Peirce and James to Ramsey and Wittgenstein*, 2016, Oxford University Press, 321pp., ISBN 978-0-19-871207-7.

The aim of the book is to show how pragmatism made its way into the philosophical discussions starting in Cambridge Massachusetts and appearing at nearly the same time in Cambridge England. The author argues against two standard stories, which she admits she used to tell herself, namely that: (1) Russell, Moore, and, to a lesser extent, Wittgenstein “savaged pragmatism, leaving it never to fully recover” [Misak, 2016, 1]; and (2) Ramsey and especially Wittgenstein put forward their novel positions without drawing much influence from outside of Cambridge England.

Now, instead, the main thread running through the whole manuscript is the connection between both Cambridges, and specifically the influence American pragmatism had on Cambridge England. Furthermore, the readers follow the development of Russell’s thought from his anti-pragmatist attacks on James and Schiller, to the final pull pragmatism had on him, to the extent that Ramsey holds in “Facts and Propositions” that his pragmatism is derived from Mr. Russell. We also discover how Peirce’s writings shaped Ramsey’s own ideas, leading him to develop

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