

Essay Review

David Cahan's *Helmholtz: History of Science in European History* by Mitchell G. Ash

David Cahan. *Helmholtz: A Life in Science*. 937 pp., notes, bibl., index. Chicago/London: University of Chicago Press, 2018. \$55 (cloth); ISBN 9780226481142. E-book available.

Monumental people require monumental biographies. As David Cahan makes clear in this long-awaited and much-needed volume, the term “monumental” applies to his subject in more than one sense. Hermann Helmholtz, who received a hereditary title of nobility and the right to add the honorific “von” to his name from the Prussian King and German Emperor in 1883, was internationally celebrated as a great scientist while he lived. When he entered a banquet hall at scientific society meetings, those in attendance might rise to their feet and burst into applause or even cheer, so honored were they by his presence. He is still cited as the author of important achievements in many disciplines and was also placed on multiple pedestals, literal and symbolic, after his death—not least among them the life-sized statue of him located near the entrance to the Friedrich Wilhelm University of Berlin, now called the Humboldt University. How should the biography of such a man be written in a time when the history of science no longer presents itself primarily as the story of great scientists and their outstanding ideas? David Cahan is well aware that this daunting challenge has also been faced by others—for example, in Crosby Smith and Norton Wise’s study of Lord Kelvin (a friend and colleague of Helmholtz’s), Margit Szöllösi-Janze’s and Dietrich Stoltzenberg’s biographies of Fritz Haber, and Janet Browne’s two-volume study of Darwin.¹ His response is worthy of study, both as an account of Helmholtz’s life and science and as an important contribution to modern German and European history.

Cahan gives us a classical study of Helmholtz’s life, times, and science. This contrasts with Szöllösi-Janze’s treatment of Haber as an embodiment of multiple social roles and with Smith and Wise’s sustained effort to work through the conceptual and practical linkages of Kelvin’s

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Editor’s note: Owing to a series of unfortunate circumstances, the reviewer did not receive a copy of this volume until the autumn of 2019.

¹ Crosby Smith and M. Norton Wise, *Energy and Empire: A Biographical Study of Lord Kelvin* (Cambridge: Cambridge Univ. Press, 1989); Margit Szöllösi-Janze, *Fritz Haber 1868–1934: Eine Biographie* (Munich: Beck, 1998); Dietrich Stoltzenberg, *Fritz Haber: Chemist, Nobel Laureate, German, Jew*, abridged ed. (1994; Philadelphia: Chemical Heritage Press, 2004); and Janet Browne, *Charles Darwin: A Biography*, Vol. 1: *Voyaging* (Princeton, N.J.: Princeton Univ. Press, 1995), Vol. 2: *The Power of Place* (Princeton, N.J.: Princeton Univ. Press, 2002).

science and industrial society and culture. However, Cahan's more traditionally crafted account also has dimensions familiar to general historians of Europe. First of all, he treats Helmholtz's story as part of the history of the German *Bildungsbürgertum*, or educated middle classes, of which the Helmholtz family is a good example. Like many German professors in his time, Helmholtz was the son of a *Gymnasium* teacher, Ferdinand Helmholtz, who was himself a close friend from student days of I. H. Fichte, son of the Berlin philosopher Johann Gottlob Fichte and a professor of philosophy in his own right. This background in itself may seem unremarkable, but the upward social mobility that followed was extraordinary. Cahan details Helmholtz's climb up the career ladder from student in his father's *Gymnasium* in Potsdam, to medical studies and training as a military physician in Berlin, to an associate professorship of medicine in Königsberg, full professorships in Heidelberg and Bonn, and, finally, a chair of physics in Berlin, the Prussian and German capital. Every step of the way, he also lists his subject's accumulation of what Max Weber called "status honor," including election to membership in the Prussian Academy of Sciences (corresponding member in 1857, full member in 1871), honorary degrees and honorary memberships in scientific societies around the world, the Copley Medal of the Royal Society of London (awarded in 1873), and induction into the prestigious Prussian honorary society *Pour le Mérite* (also 1873).

As Cahan also notes, however, Helmholtz's later career took him far further than other successful *Bildungsbürger*, thus exemplifying the increasing integration of the higher ranks of the German *Bürgertum* and the nobility in the course of the nineteenth century. This part of the story began with his second marriage, to Anna von Mohl, daughter of a Heidelberg law professor, and progressed rapidly after their arrival in Berlin, where the Helmholtz family soon joined the upper reaches of the Prusso-German elite. Their daughter Ellen married a son of the inventor and industrialist Werner von Siemens, they were invited to "more or less intimate gatherings" (p. 488) at the residence of Emperor Wilhelm I, and they were favorites of Crown Prince Friedrich (briefly Emperor Friedrich III) and Crown Princess Victoria, with whom Anna became good friends; members of the royal entourage regularly attended Anna's soirees at their home. The award of the noble title mentioned above (also given to Siemens) is the most obvious example of this elite integration; another was the personal message of gratulation from the Prussian King and German Emperor Wilhelm II on Helmholtz's seventieth birthday (1891). This was rather more than a career open to talent.

Also relevant from the viewpoint of social history, in particular the history of elites, is Cahan's depiction of Helmholtz as an example of the expanded social power and prestige of the German professoriate resulting from the emergence of the research university in the mid-to-late nineteenth century. The institutionalization of laboratory instruction as part of the normal course of study in the natural sciences (following the example of the research seminar in philology) went together with increasing standardization of academic studies and careers. The production of a piece of original research was becoming an accepted standard for academic qualification in medicine at the time Helmholtz earned his degree, and the accumulation of doctoral students soon became a sign of academic quality and prestige for German professors, while participating in doctoral examinations became an administrative burden. As Cahan notes, Helmholtz took his administrative duties—especially his role of patron and placement agent for his better students, later his terms as Dean of the Medical Faculty and then Vice Rector in Heidelberg and, still later, as Dean of the Philosophical (Arts and Sciences) Faculty and then Rector in Berlin—very seriously. But he also notes with remarkable honesty that Helmholtz was less engaged as a lecturer than he was as a research supervisor of upper-level students, though here too he generally took a hands-off approach. Helmholtz himself said that he found lecturing in medicine, especially in anatomy, dreary. The stories of poorly prepared, listlessly presented entry-level physics courses and difficult-to-follow lectures in theoretical physics in Berlin, already known to

specialists, appear here in full detail, alongside a few more positive accounts of Helmholtz's teaching.

A third aspect of Cahan's approach that is relevant to general history is his account of Helmholtz's family history and personal life, which, like the account of his career, draws on the voluminous correspondence in his papers at the Archives of the Berlin-Brandenburg Academy of Sciences and many other sources. Although Cahan does not explicitly present this material as a contribution to the history of private life, it could be taken as such—to the extent that someone who led such a public existence could be said to have had a private life. Recounted in detail here are the young Hermann's distant relations with his father, a difficult man subject to bouts of depression, and his warmer feelings for his practical and loving mother. His giftedness was recognized early, and his remarkably calm temperament appears to have helped him survive multiple personal tragedies, including the death of his first wife and the mental illness and premature death of his eldest son, Robert. The most rewarding feature of this aspect of Cahan's contribution—indeed, of the volume as a whole—is his empathetic account of Helmholtz's two marriages—the first to Olga von Velten, which ended with her untimely death, and the second to Anna von Mohl, already mentioned—and their relations with their children. The gendered dimensions of this story are by no means slighted: Anna's role in organizing Helmholtz's home and social life, while also translating some of his work into English, and the high-level contacts and friendships she maintained once they came to Berlin, are brought out in full. Helmholtz's reticence at his wife's soirees appears at first to conform to well-known gender stereotypes, but Cahan also writes that he was a fine pianist and thus possessed cultural skills common to his class.

A fourth dimension of this biography of relevance to general historians is the political. Helmholtz's generation lived through remarkable political transformations, from the abortive revolutions of 1848 to German unification under Prussian domination in 1871 and the emergence of the Prusso-German Empire as an industrial and military power in the last third of the century. In Cahan's account Helmholtz was essentially apolitical, in contrast to other prominent scientists of his generation, such as Rudolf Virchow or his friend and Berlin colleague Emil du Bois-Reymond. He was nonetheless a Prussian-German patriot, who gave a clear public sign of his views in his address to the Association of German Naturalists and Physicians in Innsbruck in 1869. Speaking on Austrian soil three years after the Habsburg Empire's defeat by Prussia at Königgrätz and two years before German unification, he proclaimed that “in science we need not look to political boundaries; for our Fatherland extends so far as the German tongue is heard, wherever German industriousness and German courage in the struggle for truth find favour.”² Cahan cites this statement of cultural nationalism (on p. 388) but gives it no particular emphasis in his lengthy account of the speech. Elsewhere, however—for example, in the discussion of Helmholtz's activities during the Franco-Prussian War—he leaves no doubt about his Prussian patriotism.

Cahan devotes far more attention to what might be called academic politics, especially those aspects of that game that affected professorial appointments in physiology and physics, and not least the micropolitics of Helmholtz's own career. As he shows, political authorities came into play here—for example, during the Badenese government's effort to keep Helmholtz in Heidelberg after his call to Berlin, in which Baden's Grand Duke was personally involved, and later to overcome delays in the construction of a grand physics building to his own specifications in Berlin. Cahan presents Helmholtz as an adroit player in this field—well connected and skilled at

² Hermann Helmholtz, “On the Aim and Progress of Physical Science” (1869), in Helmholtz, *Science and Culture: Popular and Philosophical Essays*, ed. David Cahan (Chicago: Univ. Chicago Press, 1995), pp. 204–225, on p. 225 (I have modified Cahan's translation slightly).

networking, with the help of Du Bois-Reymond, and aboveboard in his dealings—whose reputation for integrity increased his standing and impact. He showed similar talents in international scientific relations, most notably in his well-tended relations with admiring British colleagues (where his excellent English helped), and also in his signal role in the complex negotiations of standards for the measurement of electrical units. But Cahan also notes that his relations with French colleagues were more difficult at first, for political and cultural reasons.

By now, readers of *Isis* might well have grown impatient and begun to ask, What about the science? Of course, Helmholtz's extraordinary career was only possible on the basis of his scientific achievements, and no one else in his time accomplished so much in so many disciplines. Cahan does not stint in his description of Helmholtz's scientific work, presenting detailed accounts of his contributions in each of the many fields in which he published—from his famous paper on the conservation of force (1847) and the invention of the ophthalmoscope and other optical instruments to his measurement of the speed of nervous transmission in frogs' leg muscles (1851), his book on the sensations of tone (1862), which was influential among scientists and musicians alike (an example being the Steinway family of New York, who claimed to have developed their piano design with the help of the book), the three-volume *Handbook of Physiological Optics* (1856–1867), including his discussion of the role of unconscious inferences in perception, as well as his later work on meteorology, theoretical chemistry, non-Euclidean geometry, and theoretical physics. All this is interspersed with equally detailed discussions of Helmholtz's efforts in science popularization, dating from the 1850s, including both his popular-scientific lectures and his leadership of local natural history societies in Königsberg and Heidelberg, as well as his writings on the relations of science, music, and the visual arts. The scientific aspect of Cahan's account culminates, appropriately, with the founding of the Physikalisch-Technische Reichsanstalt, the world's first institute for the determination of physical standards, in 1888, the presidency of which marked both the apex and the end point of Helmholtz's career.

Cahan's own expertise is in the history of physics, and his account of Helmholtz's writings in this field is not always easily accessible to nonspecialists. But he acquits himself reasonably well in his discussions of Helmholtz's work there and in other fields, mainly by providing straightforward narrative summaries of the works involved, supported to some extent by references to the relevant secondary literature on the history of each discipline or topic. The relative lack of deeper conceptual analysis may disappoint specialists, but going into depth in so many fields would have increased the book's length even more. Cahan's informative presentations suffice to show the positions Helmholtz took on each topic and to situate them and their reception in the contexts of contemporary debates.

Most important for both historians of science and general historians is Cahan's account of Helmholtz's conception of science. A central issue here is the discussion of Helmholtz's self-proclaimed allegiance to Kantianism. As Cahan convincingly argues, by this Helmholtz meant less Kant's critiques of reason and judgment than the Kant who had himself been a natural philosopher. The impact of Kant's epistemology is evident in Helmholtz's account of perception, which is based on the Kantian claim that we cannot know the external world directly but only through the mediation of the sense organs, which provide us with "signs" that are then interpreted by the mind. How this interpretation happens he left to psychology; neither he nor Cahan mentions Kant's transcendental categories of understanding.

A second point of emphasis is Helmholtz's commitment to the primacy of theory in scientific knowledge, which for him was not divorced from, but always stood in close connection with, measuring experimentation. Cahan reemphasizes here the well-known point that what linked Helmholtz's physics and his physiology was the belief, shared with his colleagues and friends Ernst Brücke, Carl Ludwig, and Du Bois-Reymond, that organic and nonorganic matter alike are governed by principles of physics and chemistry, ultimately formulated in exceptionless laws

expressed in mathematical terms. Cahan argues, correctly, that although Helmholtz was a determinist in the sense that he believed in the primacy of causal law, he was not a philosophical materialist, as his theory of unconscious inference in perception shows.

A third point of emphasis is Cahan's account of Helmholtz's broader views on science and culture. Most important of these was Helmholtz's commitment to "the intellectual mastery of nature" as the goal of science, stated first and most clearly in his 1862 Heidelberg vice-rectoral address, "On the Relation of Natural Science to Science in General." The rhetorical move toward the end of that lecture—beginning with the claim that man does not live from ideas alone, but also from actions, continuing with an allusion to Francis Bacon's phrase "Knowledge is power," and then citing triumphs of technology such as steam engines, long-range cannons, and steam-powered warships as proofs of the power of natural science—has had staying power. With such rhetoric Helmholtz formulated an ideology that has played a fundamental role in the public justification of basic science to this day. The idea that Helmholtz's 1862 remarks express far more than a personal commitment, and mark a formative moment in the history of modernity itself, seems underappreciated here. However, Cahan does make it clear at least by implication that commitments such as these made Helmholtz a literal embodiment of the merger of science and technology in the public mind (his work was much admired by Alexander Graham Bell and Thomas Edison) and of the technoscientific optimism central to the cultural life of his time.

The wealth of honors accorded to Helmholtz made him a monumental figure in his own lifetime. As Cahan shows in the epilogue to *Helmholtz: A Life in Science*, the work of monument construction continued without a break after his death, thanks to the efforts of his colleagues and friends, most notably in his student Leo Königsberger's biography (published in 1904), and also to those of his widow, who—for example—approved of the design of the statue near the front door of the Berlin university's main building mentioned at the beginning of this essay. As Cahan shows, that statue became a *lieu de memoire* in its own right. All this and multiple commemorations since have helped to secure Helmholtz's place (not only) in German cultural memory. Here, too, Cahan's account draws on and has relevance for broader debates in European history, in this case on the politics of commemoration.

In view of the extraordinarily broad range of Helmholtz's activities and achievements and the recognition he received in his own time, the enormous size of this volume is surely justified. Nonetheless, it seems fair to say that this book is more likely to be consulted as an indispensable reference when needed than to be read straight through. Cahan's workmanlike and straightforward writing style will aid in this. His rejection of a more conceptually driven analytical approach, which would have required some sort of selectivity, in favor of a full-scale, comprehensive narrative might but should not be faulted. Given that this is the first full-length biography of Helmholtz in more than a hundred years, and given the sheer scope of the archival and published material that Cahan has mastered, complaints about details seem petty. Justified instead is gratitude for a major contribution to both the history of science and nineteenth-century European history, which in this case cannot and need not be separated from one another.