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M. Norton Wise. *Aesthetics, Industry, and Science: Hermann von Helmholtz and the Berlin Physical Society.* Chicago: University of Chicago Press, 2018. xxi + 405 pp. $45.00, cloth, ISBN 978-0-226-53135-9.

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For many years, Norton Wise has been exploring Berlin's "streets and buildings, rivers and canals, parks and gardens, museums and libraries" (p. 359). This book aims at an "interpretative synthesis" (p. xi) of this extensive search for multifaceted interconnections, allegedly with a "strongly local" focus on Berlin in the mid-nineteenth century, but de facto executed in a typical Wisean manner: an interlinking of far-flung aspects and subjects. The topics of this book thus range from Kantian metaphysics to the aesthetics of line drawings, and from the beginnings of industrialization in Prussia to the aggressive search for scientific progress among the members of a closely knit thought collective. The subtitle implies a strong focus on Hermann von Helmholtz and the members of the Berlin Physical Society, founded in 1845 as the predecessor to the later German Physical Society. Indeed, the early history of the latter and of its early members Helmholtz, Emil Du-Bois Reymond, and Ernst Wilhelm Brücke are detailed in chapter 6, while the story zooms in on Helmholtz in chapters 7 and 8, which deal with his co-discovery of the principle of energy conservation (which Helmholtz termed "Erhaltung der Kraft") and his work on the transmission of electrical impulses through nerves. One of the author's claims is that these two strands are much more tightly intertwined than hitherto realized. However, these two most famous discoveries of Helmholtz have been covered innumerable times in the existing literature, whereas the most original and innovative chapters of the book under review precede these three focal chapters.

The nicely designed cover (commented upon on pp. 88f.) beckons the reader with a well-chosen painting showing the iron works and machine factory of Johann Friedrich August Borsig in Berlin. Painted by Karl Eduard Biermann in 1847, it shows the plant near Oranienburger Tor, with remnant green bushes in the front and industrial buildings in the distance. Black smoke escapes from Borsig's factory funnels, fueled by wood stacked up in front of the building. A brand-new steam locomotive is being transported away from the factory. Since railway tracks up to the factory did not yet exist, the locomotive has to be hauled away on a cart drawn by eight horses. This painting nicely captures the socioeconomic context of the study, that is, the transition to industrial times, which Prussia in general and Berlin in particular had entered so late in the mid-nineteenth century and then pursued so aggressively and successfully in the subsequent decades.

Chapter 1—inspired by the author's wife, Elaine—interprets a history painting from 1830 of a parade that had taken place on the Opera Square in Berlin in 1824. Wise uses this image cre-

atively as a wonderful entrée into the still-stratified Berlin society, which he unfolds layer by layer, singling out marked and recognizable individuals, their hierarchies and interconnections, their social backgrounds, training, and professional practice. Under the figurehead of "Pegasus and the Muses," the next two chapters then discuss the interplay of art, industry, and science in this local context, that is, the various museums and collections, the newly founded university (in front of which this parade had taken place), the Bauschule, the Gewerbeschule, the Gewerbehaus, various *Vereine*, and other such highly interconnected institutions, organizations, and collaborations that together defined the specific Berlin constellation and marked what Wise calls the "conditions of possibility" (p. ix) of this society. Chapter 4 moves to the modernization of the Berlin and Potsdam military schools and discusses their teachers and curricula.

Historiographically, Wise's study stands in line with earlier work by Sven Dierig on Emil Du Bois-Reymond and his laboratories in a city of machines (*Wissenschaft in der Maschinenstadt*, 2006), by Henning Schmidgen on Helmholtz's curves (*The Helmholtz Curves: Tracing Lost Time,* 2014), and Robert Michael Brain's account of *The Pulse of Modernism: Physiological Aesthetics in Fin-de-Siècle Europe* (2016). Brain's and Soraya de Chadarevian's nonlocal perspective on the history of self-registering instruments and their aesthetics of mechanical objectivity are more convincing than Wise's efforts to find specific Berlin answers to the question "What's in a line?" (chapter 5).[1] Yet another precursor to Wise's historiography, especially in chapters 3 and 4, is Ursula Klein's studies on Berlin technologists and what she (inappropriately, in my view) calls techno-scientists.[2] Wise traces many of these figures in the newly founded museums of art, industry, and science (such as the Gewerbehaus), and in newly founded societies such as the Preussischer Verein zur Förderung des Gewerbefleisses, of which many of the teachers of the later members of the Berlin Physical Society had also been members.[3] Wise's network graph of Berlin schools as connected by Helmholtz's teachers (p. 14) is very original. I would have loved to see similar social network diagrams, for example, of Helmholtz's collaborators or the closely knit members of the Berlin Physical Society. Wise does not provide a full prosopography but rather a tabular list of all the early members (pp. 198-202) and quite a lot of neatly contextualized and well-interconnected portrayals of this fascinating group of people that one might, for lack of a better term, call applied scientists, or technologists with fundamentalist aspirations, some of them rather artists or artisan-scientists (*Handwerkergelehrte*, in Otto Sibum's sense).[4]

Berlin's instrument makers are too rarely explicitly mentioned (one brief exception is pages 216-17, whereas the makers of various other instruments depicted with contemporary images are not even identified). The multifaceted roles of Carl Philipp Heinrich Pistor and Carl Martins; the Siemens brothers, William, Werner, and Carl Heinrich; and Johann Georg Halske, C. G. F. Leonhardt, and F. M. Bötticher, plus numerous others within the Berlin research collective, six of them even having been fully accepted active members of the Berlin Physical Society (p. 214), are not brought out sufficiently, nor are their research agendas, which were de facto of crucial importance for the German electrical industry and the foundation of the Physikalisch-Technische Reichsanstalt in 1884, of which Helmholtz would become the first president. Johann Erdmann Hummel, for instance, who was a professor of perspectival painting, optics, and architecture at the Berlin Art Academy (Preußische Kunstakademie), actually was the brother of Caspar Hummel, a mechanic with a workshop on Johannesstrasse who delivered the pulleys displayed in one of Hummel's paintings depicting the mounting of the famous polished granite bowl in the Berlin Lustgarten in 1831 (https://upload.wikimedia.org/wikipedia/commons/3/30/Johann_Erdmann_Hummel_-_Aufrich-

tung_der_Granitschale_im_Packhof_zu_Berlin.jpg). This painting was formerly housed in the Berlin Märkisches Museum, which burned down in 1945 during an Allied bomb raid. This Hummel painting, although relevant to Wise's story, does not appear in his book.

I am not quite sure of the intended audience for this complex effort at a ***histoire totale*** of Berlin around 1845 (a term used in the brief comments by Anke te Heesen on the back cover). Norton Wise himself considers his book a "cultural history of science, meaning one that looks to cultural contexts for the intellectual and material resources that made the Physical Society possible" (p. 355). But do cultural historians have the background knowledge required to understand Wise's highly technical accounts of the inner workings of Helmholtz's thermocouple, or Edme Regnier's dynamometers, or the subtle metaphysics of Immanuel Kant's schematics of the categories of relation?

Perhaps readers will have the necessary background knowledge or the patience to explore one or a few of these strands, but quite likely not all of them at once. Wise hopes to instill a fruitful "double communication" (p. xi) between these various camps, but my fear is that cultural historians will stop by the end of chapter 5, whereas philosophers will find most of the philosophical arguments brought forward in this book (e.g., about Helmholtz's Kantianism) relatively superficial. Historians of science and technology, in turn, will enjoy the breadth of sources presented and discussed, but might find some of Wise's interconnecting terms, such as "Kunst-Technik," overblown and some of his claims, for instance about the "curve as the emblem of progress in scientific knowledge" (p. 148), at least unproven by the rather impressionistic evidence presented in their favor. The problems with Wise's argumentation are aggravated by his well-known refusal to talk in terms of causality, influence, or impact. He intentionally limits himself to a circumscription of available resources and interprets the "choices and actions of members of the Berlin Physical Society ... as an unfolding of possibilities available to them within their context" (p. ix).

This allegedly local context, studied thus in an "intensely local stance," was in fact highly nonlocal, co-determined, ***inter alia***, by French techniques of calculus and by French textbook traditions and by a revival of the early-modern aesthetics of Dürer drawings, which had circulated throughout Germany as well as many other parts of Europe in the nineteenth century. Some actors introduced as "local," such as Moritz Jacobi, were in fact based far away in Königsberg and St. Petersburg, whereas others, such as Alexander von Humboldt, were actively building up international networks of cooperation for new research areas, for example, comparative geography or geomagnetic measurements. Various other contexts in quite different cities, such as Edinburgh, London, Paris, or Copenhagen, brought about quite similar research results, a point obvious with respect to the co-discovery of the law of energy conservation in at least twelve different contexts throughout Europe.[5] Therefore, Wise's "very local" stance will not do. On the contrary, comparisons to other centers of research would have been helpful—in my opinion even necessary—to come to grips with his findings. For instance, the great importance of technical training including drawing and painting skills, rightly pointed out by Wise in his case study of Du-Bois Reymond and Helmholtz, has also been documented in various other cases situated elsewhere and is in fact typical of the formation stage of visual science cultures,[6] a term conspicuously absent in Wise's cultural history, which misses larger patterns due to the focus on the local.

The aesthetics of lines and curves, celebrated here as in resonance with local Berlin resources, was in fact also the product of a highly nonlocal, at least European, if not European-American movement, toward the usage of graphs for data

analysis, descriptive geometry as an import from Gaspard Monge and Charles Dupin in France, and self-registering instruments. Therefore Brain's approach to "physiological aesthetics" is so much more fitting than Wise's "intensely"—that is, overdone—"local stance."[7] Indeed, society, industry, science, and aesthetics formed a complex quadrangle in the mid-nineteenth century, and Wise's book brings this out beautifully. But the same kinds of interconnected stories—perhaps without Kantian metaphysics and Prussian militarism—could also be told about many other cities or nations on the verge of industrialization and the scientification of many sectors of public life, from street illumination to communications during this time of transition. In fact, Wise himself has already given us the British counterpart to this German story in his book (co-authored with Crosbie Smith) ***Energy and Empire: A Biographical Study of Lord Kelvin*** (1989). Unfortunately, Wise intentionally did not use this opportunity for systematic cross-referencing and comparisons between these and other local studies of contemporaneous sites.

Despite this historiographic critique, I found Wise's book inspiring, especially its very innovative reading of unusual sources such as history paintings (by Biermann, Hummel, Franz Krüger, or Eduard Gaertner), or the ornamentation on membership certificates issued by the Berlin Physical Society (p. 149), or architect Karl Friedrich Schinkel's playful representation of industrialist Peter Beuth's mind in a Christmas card from 1836 (p. 72). Wise has the unmitigated courage and freedom of a retired UCLA research professor to point to hitherto unrecognized, fascinating, though often far-flung interconnections. The book can therefore be recommended to readers open to broadening their perspective and to looking well beyond their own horizons, and who are willing to test their skill at critical discrimination between many convincing and a few contentious historical arguments. Wise's book has all this to offer.

Notes

[1]. Soraya de Chadarevian, "Graphical Method and Discipline: Self-registering Instruments in Nineteenth-Century Physiology," ***Studies in History and Philosophy of Science Part A*** 24, no. 2 (1993): 267-91.

[2]. Wise's bibliography includes three of her papers and her book ***Humboldts Preussen: Wissenschaft und Technik im Aufbruch*** (Darmstadt: Wissenschaftliche Buchgesellschaft, 2005), but unfortunately not her very pertinent book ***Nützliches Wissen: Die Erfindung der Technikwissenschaften*** (Göttingen: Wallstein Verlag, 2016); his brief discussion of her work is unfortunately mostly packed away in footnotes (e.g., p. xxi).

[3]. Perhaps best translated as "commercial industriousness," which is indeed a typically German virtue. On the importance of such associations for German society in the nineteenth century, see Myles Jackson, ***Harmonious Triads: Physicists, Musicians, and Instrument Makers in Nineteenth-Century Germany*** (Cambridge, MA: The MIT Press, 2008); and Kathryn Olesko, ***Physics as a Calling: Discipline and Practice in the Königsberg Seminar for Physics*** (Ithaca, NY: Cornell University Press, 1991), which is missing from the bibliography even though it would be pertinent for understanding the Prussian system of education.

[4]. Otto Sibum, "Handwerksgelehrte oder Was für eine Wissenschaft ist Experimentalphysik?," ***Jahrbuch/Max-Planck Gesellschaft*** (2005): 661-67.

[5]. The paper by Thomas S. Kuhn that documents this is quoted by Wise only marginally (on pp. 280 and 294—the latter page missing from the index, which seems not to refer to annotation). The paper is "Energy Conservation as an Example

of Simultaneous Discovery," in ***Critical Problems in the History of Science***, ed. Marshall Clagett (Madison: University of Wisconsin Press, 1959), 321-56, reprinted in Thomas S. Kuhn, ***The Essential Tension: Selected Studies in Scientific Tradition and Change (***Chicago: University of Chicago Press, 1977), 66-104.

[6]. See Klaus Hentschel, ***Visual Cultures of Science and Technology: A Comparative History*** (Oxford: Oxford University Press, 2014) with a prosopographic analysis documenting the statistical correlation of technical training and strong visuality.

[7]. In one of the footnotes we learn that Wise's project had begun as a joint project with Brain but that Brain stepped out of it (for unspecified reasons) and published his own monograph, ***The Pulse of Modernism: Physiological Aesthetics in Fin-de-Siècle Europe*** (Seattle: University of Washington Press, 2016), briefly mentioned by Wise on p. 356. In the index, Bob Brain's name is missing altogether.