

[Review of the book *Pedagogy and the Practice of Science: Historical and Contemporary Perspectives. (Inside Technology Series.)*]

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Corry. As Ivor Grattan-Guinness rightly claims, this volume is not a *general* study of the history of mathematics. With its collection of seventy-seven original essays on the best writings in mathematics, chosen for “the novelties they contained and/or ‘the state of the art’ which they comprehensively summarized” (p. xv), however, it is both a rich introduction to the history of mathematics and a rich resource for scholars in the field. Read with a discerning eye that may be willing, at times, to overlook technical details, the text raises questions and issues that can “bridge” disciplines and open historical discussions “for all of us.”

Each piece begins with a biographical introduction to the author of the writing under discussion, with especial attention given to the place of that writing in his career. Consequently, readers meet the minds that breathed life into some of the most innovative mathematical ideas of their day. Following a look at the writing and its origins, each article takes up the delicate and difficult question of the impact of the particular piece under discussion. One does not need to understand the details of Carl Friedrich Gauss’s *Disquisitiones arithmeticae*, for example, to appreciate how, in the words of the historian Olaf Neumann, it transformed an entire branch of mathematics—number theory—“from a scattering of islands into an established continent in mathematics” (p. 304).

One gains an overall sense of the history of mathematics from this volume. In general, the selected writings call attention to France, Germany, and Britain as vibrant areas in the history of (Western) mathematics from 1640 to 1940. The volume features few American contributions, reflecting both the nonexistence of the country until the late eighteenth century and the still later emergence of a mathematical research community in the closing quarter of the nineteenth century. Descartes’s *Géométrie* and Newton’s *Principia* were both conceived of and published in various editions long before Thomas Jefferson wrote the first lines of the Declaration of Independence. Moreover, the editors did not find a single piece by a woman—on either side of the Atlantic—to include as a “landmark writing” in this volume.

Read sequentially, the volume provides keen insight into the delicate issues related to the genesis of ideas. In Michel Serfati’s opening contribution, for example, we see the philosophical underpinnings that gave rise to Descartes’s influential *Géométrie*. In this seminal text, inspired by his “specific and novel view of the world” (p. 1), Descartes established a relation

between curves and algebraic calculation and introduced a sophisticated symbolic notation (e.g., exponents). This 1637/1649 work represented some of the “best” (p. 24) ideas of the first half of the seventeenth century and helped to inspire John Wallis’s *Arithmetica infinitorum* (1656), the second contribution discussed here. Wallis’s work, as Jacqueline Stedall describes it, served as a “key text in the seventeenth-century transition from geometry to algebra and in the development of infinite series and integral calculus” (p. 23). That is, Wallis drew from and extended the ideas of Descartes’s algebraic geometry; and Newton, “the most astute reader” of the *Arithmetica infinitorum* (p. 36), recognized and explored Wallis’s ideas in their full potential. While this may seem like a fluid development, free from tensions or controversies, the details emphasize the arduous nature of this progress.

These initial contributions point to far more significant questions related to the transition from a largely geometric mathematical framework to an algebraic one. Many of these themes are explored further in subsequent contributions in *Landmark Writings*, providing a more comprehensive perspective on the development of mathematical ideas. Roger Cooke, for example, emphasizes the role of Descartes’s symbolism (including the notions of negative and irrational numbers, among other tools) in the 1826 work of Niels Henrik Abel that sought to answer the question of whether (or not!) an equation of degree five or higher could be solved using algebraic operations alone.

Thus *Landmark Writings* calls attention to the vibrant tensions that produced the theories showcased in the form of tidy blue boxes (lamented by Thomas Kuhn) in science (and mathematics) textbooks. Just as important, the discussions related to the genesis of ideas, the impact of a particular writing, and the influence of a specific philosophical view, among other topics, raise questions that historians of *science* can take up among themselves.

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David Kaiser (Editor). *Pedagogy and the Practice of Science: Historical and Contemporary Perspectives*. (Inside Technology Series.) vi + 426 pp., figs., apps., index. Cambridge, Mass.: MIT Press, 2005. \$45 (cloth).

Despite the emphasis that Thomas Kuhn placed on the training of scientists in *The Structure of Scientific Revolutions*, pedagogy has remained of limited concern to most historians and soci-

ologists of science. Indeed, historians have largely ignored the question of how individuals learned within specific historical contexts, rarely considering how studies of cognition, learning, and historical thinking might enhance our understanding of the reception and production of knowledge as well as the establishment of social norms. Apart from isolated exceptions—including the pathbreaking “research schools” *Osiris* volume that Frederic L. Holmes and Gerald L. Geison edited in 1993—few scholars have systematically explored what we can learn by examining the shared experiences of generational cohorts or how tacit knowledge is acquired and passed on to others.

David Kaiser’s important new edited volume does much to place this approach on a sound footing. This wide-ranging work, based on an MIT conference held in 2002, brings together eleven substantial studies of pedagogical practices in the physical sciences and engineering from the late 1700s to the present under such headings as “Teaching Practices,” “Pedagogical Cultures in Collision,” “The Action of Textbooks,” and “Generational Reproduction.” A skilled editor, Kaiser has kept his contributors on track: while several chapters are analytical gems, all of the essays are uncommonly well constructed.

The fresh, provocative historiographic claims advanced by individual chapter authors may be the most significant contribution of this volume. Many of the subjects highlighted here are already familiar to historians of modern science, among them nineteenth-century German research schools, twentieth-century industrial research centers, Cold War nuclear weapons laboratories, and Japanese high-energy physics facilities. Yet by reexamining these topics from the perspective of pedagogical practices, Kaiser’s writers recast familiar narratives in novel and unexpected ways, arguing that scholars have not sufficiently appreciated the importance of textbooks as dynamic tools, the role of verbal communications in understanding tacit knowledge in scientific practice, or the varied ways that students learned laboratory-based problem-solving approaches that strongly shaped the production of knowledge. Michael D. Gordin asserts that the Russian-born and German-educated chemist Friedrich Konrad Beilstein produced his *Handbuch der organischen Chemie* in response to shifting pedagogical opportunities after he left Göttingen for the less prestigious Technological Institute at St. Petersburg to meet family obligations: Beilstein’s professional isolation in Russia led him to produce the now-famous

Handbuch instead of pursuing alternative textbook approaches. Early nineteenth-century French chemistry textbooks, Antonio García-Belmar and his colleagues suggest, were hardly staid catechisms of orthodoxy, as is often assumed, but, rather, dynamic spaces where conflicting interpretations were fought out. Buhm Soon Park argues that by the 1950s Michael Dewar’s molecular orbital theory had won out over a competing interpretation by Linus Pauling largely because Dewar’s approach was more easily taught and thus gained a firm foothold in chemistry textbooks. In a crisp, insightful essay, the sociologist Sharon Traweek reminds historians of the importance of verbal communications: no one can understand experiments in physics solely by reading published articles, since a great deal of knowledge is transmitted orally through gossip and informal talk. If physicists disparage histories of their field written by professional historians, she writes, they do so “in part because they are based only upon published articles, laboratory records, formal interviews, and funding documents” (p. 358), thus overlooking crucial pedagogical practices.

Pioneering books often raise even more questions than they resolve, and this work is no exception. Because Kaiser’s contributors focus exclusively on physical laboratory sciences, an unresolved issue is whether pedagogical practices in the biological sciences (and field sciences such as geology) would resemble their lab-bench counterparts or exhibit distinctive moral economies. In his summary comments Kaiser also might have reflected on the fact that all of his contributors writing on post-1920s science utilized oral history interviews. Is the lack of attention that historians have traditionally shown to pedagogy and mentoring in science simply myopia, or does it partly reflect the limitations of traditional archival sources, since the collections of scientists rarely extend back to their graduate years? That Gordin, García-Belmar, Kathryn M. Olesko, and other volume contributors have successfully discussed nineteenth-century pedagogical practices in physics and chemistry through the judicious use of notebooks, diaries, textbooks, letters, and surviving practical exercises mitigates against pointing a finger at source materials alone; but whether the field sciences will prove harder to examine remains an open question. The ultimate value of *Pedagogy and the Practice of Science* may well be the large number of new questions it will inspire historians to pursue.

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