

# BOOK REVIEWS

## The Making of a Biochemist

**Hans Krebs.** Vol. 1, *The Formation of a Scientific Life, 1900–1933.* **FREDERIC LAWRENCE HOLMES.** Oxford University Press, New York, 1991. xx, 491 pp., illus. \$49.95. Monographs on the History and Philosophy of Biology.

Out of favor since the “lives and letters” of Victorian days, the multi-volume biography may be making a comeback. Despite risks for authors and publishers, recent years have seen the appearance of several notable examples of such ventures, Robert Caro’s ongoing life of Lyndon Johnson being perhaps the best-known. To date, historians of science have not participated in the trend, if such it is. The standard modern works on such central figures as Galileo, Newton, and Darwin are single-volume affairs that stress broad conceptual themes rather than the day-to-day activities of their subjects. While spotlighting certain crucial experiments or experiences, they leave much in shadow.

Holmes, insofar as is possible, has banished shadows from the life of Hans Krebs. In this large first volume of what will be a colossal biography, Holmes reconstructs the education and early career of a remarkable scientist with equally remarkable clarity, comprehensiveness, and detail. We don’t merely read about the biochemical controversies of the early 20th century, we follow Krebs’s groupings as he encountered them in the journals and devised ways to explore them in the laboratory; we don’t receive generic descriptions of experimental methods, we watch as Krebs learned to slice tissue and manipulate manometers; we are not just given summaries of Krebs’s scientific papers, we see how the lucid public results emerged from the refractory data, balky experiments, and sketchy musings of his notebooks. Interspersed with the careful analysis of written documents are Krebs’s recollections as recorded in more than 150 hours of interviews with Holmes. Through these sources, Holmes reveals to us not only the young Krebs as he defined a career and performed his earliest creative science, but also the older Krebs who could reflect on his beginnings with fuller knowledge of outcomes.

Krebs, as most readers will know, was a master of intermediary metabolism, the biochemist who did more than any other single

investigator to specify the pathways by which urea is produced and the energy in foodstuffs is made usable by cells. It must be asked, however, if even such an important figure merits the meticulous examination accorded him in this book. Impatient readers may well answer “no.” Relentless detail will likely overwhelm those seeking quick historical background on the Krebs cycle or a handy recap suitable for undergraduate lectures. Indeed, this volume ends just as Krebs was beginning to study the metabolic cycle with which his name has become associated. Those who bring to this biography a serious interest in scientific creativity, the history of biochemistry, or the conduct of laboratory science will, however, find that the concentration this book demands is well worth the investment. Indeed, it is only by providing lavish detail that Holmes is able to fulfill the central goal that he sets himself in this volume: to understand, insofar as possible, the process by which a conscientious but by no means brilliant student became an independent and highly original scientist.

Like many biographers before him, Holmes finds part of the answer in his subject’s teachers. Krebs had many of these during a lengthy education that took him from his home in Hildesheim to medical studies at Freiburg, Munich, and Berlin and eventually to an assistantship at the Kaiser-Wilhelm Institute for Biology in Dahlem. There was the physiological chemist Franz Knoop, whose lectures at Freiburg stressed both the importance of intermediary metabolism and chemists’ modest knowledge of the subject; the pathologist Ludwig Aschoff, who impressed on Krebs the role of metabolic processes in etiology; the anatomist Wilhelm von Möllendorff, who gave Krebs his initiation in research; the clinicians Friedrich von Müller and Siegfried Thannhauser, whose lucid treatment of metabolic diseases reemphasized the centrality of chemistry in medicine. Not all of Krebs’s models were professors. A friend and fellow physician in Berlin, Bruno Mendel, showed Krebs that pluck and resourcefulness could overcome inexperience in research—perhaps a crucial lesson as the young Krebs was weighing a choice between a career in the laboratory, for which he had patchy preparation, and medical practice. Before all others, there was his father, a

successful physician, whose stingy praise and sharp criticism supplied Krebs with both ambition and an antidote to smugness. Holmes’s leisurely reconstruction of Krebs’s youth shows us how a young mind and personality can accept many impressions. By tracing out the sources of those formative impressions, Holmes gives us not only a superb sense of the origins of the young biochemist but also a cross-section of middle-class life and academic culture in Germany in the years around World War I.

Important as were these early influences in shaping Krebs’s habits and interests, Krebs’s apprenticeship in the laboratory of Otto Warburg at Dahlem was decisive in making a scientist of the young physician. Working at the same table with Warburg from 1926 until his abrupt dismissal in 1930, Krebs learned the tools of his trade from a demanding and masterful craftsman. Independent, fierce toward enemies both real and supposed, meticulous in his laboratory administration and experimental arrangements, suspicious of the standards of other workers, and especially contemptuous of medical dilettantes in research, Warburg showed Krebs how to dig deep trenches in areas that seemed essential to understanding the chemistry of respiration and to state his findings with precision and concision. Perhaps most important, he taught Krebs how to coax results from delicate manometric measurements of respiration in tissue slices, a method that was, in competent hands, at once accurate, quick, and versatile.

Only after leaving Warburg’s institute did Krebs find the opportunity, and, one might add, the necessity, to flourish as an independent scientist. Warburg, convinced that the study of intermediates in the degradation of foodstuffs was a quagmire, had kept Krebs engaged in his own research program, which was directed toward discovering simple models of metabolism based upon the idea that oxygen-carrying metals catalyzed cellular oxidations. Once on his own, first in a hospital near Hamburg and soon in his own laboratory at Freiburg, Krebs adapted the methods he had acquired from Warburg toward other goals: tracing the formation of urea and the deamination of amino acids and the broader study of metabolic intermediates. By 1933, Krebs had achieved one spectacular success—the description of the ornithine cycle—and several modest although important advances in intermediary metabolism, enough to make even Warburg take note.

A close analysis of Krebs’s parallel investigations of deamination and urea synthesis bulks large in this book, and it is through this analysis that Holmes takes us beyond most scientific biographers. In what is very nearly a day-by-day examination of Krebs’s

research in the early 1930s, Holmes reveals in exquisite detail the workings of a creative mind on recalcitrant problems. His scrutiny allows us to follow the ebb and flow of Krebs's work, to see its multiple lines as they sometimes interacted and sometimes diverged, to trace his relations with colleagues and assistants, to appreciate the uncertainties he faced, and to feel something of the confusion that accompanies inquiry—the "fog of research," one might say.

If any readers still need be disabused of the idea that some singular method explains scientific change, this account should accomplish the job. It is equally corrosive, however, of platitudes about the determinative role of community structure in science. The traditions of his discipline, the precepts of his teachers, the results of his predecessors, local circumstances, and the nature of his tools all helped define, but did not fully specify, Krebs's path. At crucial junctures, Krebs was carried along by persistence, an ethos of constant optimistic labor, and, more than once, sheer luck. Krebs had an abiding "confidence that unexpected leads really would turn up, and that they would guide him toward goals he could not foresee in advance" (p. 384). His capacity for the routine work that produced such leads, his alertness to unanticipated results, and his energy in exploiting them depended as much upon temperament and upbringing as upon any formal training. This magnificent biography demonstrates, as few books do, the intimate relations between personality and science.

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## Translocations

**To the Ends of the Earth.** Women's Search for Education in Medicine. THOMAS NEVILLE BONNER. Harvard University Press, Cambridge, MA, 1992. xvi, 232 pp. + plates, \$34.95.

In the 50 years before World War I European and American women bent on medical careers managed to overturn most of the legal and educational obstacles that had denied them full admission to the profession. Since the conditions for this achievement were (grudgingly) established by male doctors and politicians, however, women's right to practice medicine continued to be hedged around in various ways that pertained directly to their sex. Even friendly voices acknowledged these strictures, as in

the praise delivered in 1871 by the Zurich medical professor Hermann von Meyer to his university's first woman graduate, the American Susan Dimock: "You have shown by your example that it is possible for women to devote themselves to the medical profession without denying your female nature." As Dimock's example also indicates, it was easier for women to earn medical degrees abroad than in their own countries. Any account of this fascinating and complex story must therefore consider the remarkably international nature of women's medical education in these years. At the same time, women's accomplishments in the age of the nation state may be fully assessed only in particular national settings, and the chief virtue of Thomas Bonner's succinct history of these developments is the comparative perspective he brings to it.

In 1870 there were 525 women physicians in the United States, more than in the rest of the world combined, but as recently as the 1960s women made up a smaller proportion of students in medical schools here than in virtually any other industrialized nation, constituting only about 5 to 8 percent while Germany grad-

uated women at a rate of 30 percent, Great Britain 25 percent, and France and Holland 20 percent each. As Bonner explains, the free market in education and licensing that prevailed in the United States encouraged the early growth of women's medical colleges as well as minimal certification procedures, whereas state control of education and licensing on the European continent acted effectively to exclude women until very late in the century. But once European political and medical authorities became convinced of the benefits, if not the justice, of training more women physicians, enrollments increased steadily under the umbrella of state sanctions, whereas in America the hit-or-miss patchwork of local and federal regulations permitted discrimination and practical obstacles to remain partly in place. Uniform legal reform in Europe often swept away all barriers to women within several years, whereas American laissez-faire created a situation where women might join co-ed classes in prestigious schools but continue to be denied access to internships in private hospitals or membership in medical societies, a characteristic aspect of the double-edged nature of "freedom."

Depending on their nationality, the choices for female medical aspirants in the last half of the 19th century were different but everywhere limited. American and British women could attend private women's medical colleges, some of which offered degrees for a course of study (without clinical experience) as short as a year, but even the best of these, like the Women's Medical College of Pennsylvania, provided an education far beneath the standards of the best European and American faculties. On the Continent, German, French, and Russian women agitated for equality of education, but until the end of the century they gained only token access to the state system or made do with lesser titles such as "learned midwife." For women with the means and the drive, the preferred alternative was to seek out those few places in Europe where foreign women were permitted to study alongside men in respected medical faculties. The first institutions to graduate women in the late 1860s were the medical faculty of Zurich, joined shortly thereafter by other cantonal universities in Bern, Geneva, and Lausanne, and that of Paris, which waived for foreigners the rigorous admission standards it maintained for Frenchwomen.

Bonner tells us much of interest about women of several nationalities who followed this challenging option, based on a study of the archives of many of these faculties. He has found evidence of their networks of mutual support, of the often fierce resistance of townspeople to the un-



"A caricature of women students in Zurich. Above: How they are! Below: How they should be!" [From *To the Ends of the Earth*; Medizin-historisches Institut, University of Zurich]