[Review of the book *Pierre Curie, 1859-1906: Le reve scientifique (Un Savant, Une Epoque)*]

Isis 2001

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edy. He suffered from ague (now identified as malaria), contracted during his Languedoc sojourn. His patents were circumvented and successfully challenged in a series of court rulings. All his industrial ventures failed, and he lost his entire dowry in the mayhem of the French Revolution. To complete the grim picture, his marriage was unhappy and his only son died in a childhood accident.

The strict chronology of *Brandy, Balloons, and Lamps* sometimes renders the narrative a little tedious, and it is not always clear from where the author quotes. But the aficionado will find many interesting anecdotes. The historian may mine this work for the intricacies of personal credit, ranging from the polite language employed in the letters through the intrigues to the working of patent law in both France and Britain. The book contains thirty-four pages with color plates of various Argand lamps and many black-and-white reproductions. Almost all are very nicely produced and render browsing a pleasant experience. It is striking that the design of the lamps is not discussed at all. Lamps produced in Britain resemble silverware, whereas the French lamps are usually japanned. The Sheffield silver-plated candlestick in the illustration is a typical example. The container at the top holds the oil flowing to the wicks contained in the cylinders on each arm. The perforations in each "elbow" let in the air.

ARNE HESSENBRUCH

■ Nineteenth Century

Loïc Barbo. *Pierre Curie, 1859–1906: Le rêve scientifique.* (Un Savant, Une Époque.) 336 pp., illus., figs., apps., index. Paris: Belin, 1999. (Paper.)

Pierre and Marie Curie have been among the best-known names in the history of science ever since they, along with Henri Becquerel, received the Nobel Prize in Physics in 1903. The award recognized the significance of the Curies' study of the spontaneous radiation emitted by substances termed "radioactive" that Becquerel had discovered in salts of uranium. The Nobel citation did not mention the Curies' discovery of radium, which could thus be attributed to Marie Curie alone when she was awarded the Nobel Prize in Chemistry in 1911, five years after Pierre Curie was killed in a street accident.

Pierre Curie is most famous for his collaborative work with his wife from January 1898 until his death in April 1906. As Loïc Barbo notes in this finely detailed biography, the collaboration can be followed in laboratory notebooks in which the clear, precisely dated handwriting of Marie Curie alternates with the abbreviated, barely decipherable, and undated handwriting of her husband. Their work on radioactivity has been well studied and well documented by historians, science journalists, and biographers. Marie Curie, née Sklodowska, has been the subject of excellent biographical studies.

What has been missing from the story, notes Barbo, is a detailed study of Pierre Curie, especially his scientific work before his experiments with radioactivity. Marie Curie herself wrote the first biography, *Pierre Curie,* published by Payot in 1923. A more recent book is Anna Hurvic's *Pierre Curie* (Flammarion, 1995), which Barbo mentions only in a footnote. Both Hurvic and Barbo largely follow the main themes of Marie Curie's original account of Pierre Curie's family life, his close relationship with his older brother Jacques, the nonelite character of his Paris education, and the difficulties he faced in getting a first-rank academic appointment because he was not a graduate of the École Normale Supérieure or École Polytechnique. The biographers all emphasize not only his sense of independence but also his impatience with many social rituals and forms, including traditional procedures (namely, visits) that were expected from candidates for the Academy of Sciences and traditional behavior (namely, acceptance) when selected for the Legion of Honor. (Curie declined.) Like Hurvic, Barbo discusses some aspects of Pierre Curie's scientific career that Marie Curie passed over—for example, his lengthy and troubled negotiations with the dean of the faculty of sciences at Geneva in 1900.

Where Barbo makes a clearly important and novel contribution to biographical understanding of Pierre Curie is in his detailed analysis of Curie's work on crystals, piezoelectricity, magnetism, and the physical significance of symmetry during the period from 1880 to 1898. In collaboration with his brother, who completed his doctoral thesis on aspects of their work, Curie discovered piezoelectricity, or electrical phenomena in crystals caused by changes in pressure. The two developed instruments that became important for the precise detection of small electric charges. Following up on symmetry properties in crystals, Pierre Curie used the mathematical tool of group theory as a tool for classification of symmetry properties, publishing the text *Sur la symétrie dans les phénomènes physiques* in 1894. For his doctoral thesis of

1895, however, Curie focused on the experimental problem in magnetism of the effects on a body's magnetic properties of different conditions of temperature, pressure, and intensity of the magnetic field. He determined what came to be called the "Curie temperature" or "Curie point" of transition between ferromagnetism (strong magnetic properties) and paramagnetism (feeble magnetic properties). Although Curie avoided theoretical questions in his experimentally focused thesis, Paul Langevin gave a successful explanation in 1905 in terms of paired and unpaired electrons.

Also of special interest in Barbo's work is his account of Pierre Curie's teaching at the École Municipale de Physique et de Chimie Industrielles (EMPCI) and later at the Sorbonne. At the EMPCI there was considerable criticism that Curie's teaching was too difficult, especially on the subjects of piezoelectricity, magnetism, electrolysis, and symmetry. After 1900, at the Sorbonne, Curie lectured on cathode rays, x-rays, and radioactivity. As Barbo notes, the fact that Curie never published his course notes meant not only that historians could not find them easily but also that Curie's students had no help from textbooks.

A matter of continuing interest and some perplexity for anyone studying the Curies' early work in radioactivity is their apparent indifference to the dangers the radiations posed to their health, even though Pierre Curie himself had studied biological effects of radiation on small animals. By 1905 Pierre Curie was taking strychnine as an antidote for pain and fatigue, writing his friend Georges Gouy that he thought he was suffering from neurasthenia rather than rheumatism. Ernest Rutherford noted years later that he may have been fortunate in having smaller samples of radioactive materials at his disposal than the Curies. In commenting on these matters, as well as in constructing his narrative and analysis of many aspects of the scientific work of Pierre Curie, Loïc Barbo has made an important contribution to the history of modern science and French science.

MARY JO NYE

Detlef Laugwitz. *Bernhard Riemann, 1826–1866: Turning Points in the Conception of Mathematics.* Translated by **Abe Shenitzer** with **Hardy Grant** and **Sarah Shenitzer.** xviii + 357 pp., illus., index. Boston/Basel: Birkhäuser, 1999. DM 178.

No mathematician of the nineteenth century had a greater impact on the twentieth than Bernhard Riemann, whose name is synonymous with several of the deepest results and most fertile ideas of modern mathematics. Detlef Laugwitz, perhaps best known for his contributions to and reflections on nonstandard analysis, has had a long-standing interest in the history of analysis. What he offers here in the form of an intellectual biography represents the first serious detailed assessment of Riemann's intellectual legacy. Laugwitz's study aims to account for the enduring importance of Riemann's ideas, in part by contrasting these with other competing research traditions and methodological approaches. Arguing forcefully throughout that Riemann's mathematics was based on the primacy of conceptual over computational considerations, Laugwitz also takes note of the profound influence this conceptual approach had on modern mathematics. According to Laugwitz, Riemann's ideas gradually overturned conventional views regarding the representation of mathematical constructs, paving the way for modernism in the tradition of Richard Dedekind, David Hilbert, and Nicolaus Bourbaki. Looking backward, Laugwitz also has much to say about earlier research traditions and the impact of Leonhard Euler, Augustin Cauchy, Karl Friedrich Gauss, and Peter Gustav Lejeune Dirichlet on the young Riemann. But the viability of his overall interpretation of the Riemannian legacy hinges on his assertions concerning the reception of Riemann's work, a thorny issue in the historiography of modern mathematics.

In the 1860s several circumstances acted to undermine the smooth reception of Riemann's ideas; indeed, that reception extended over several decades. Before his early death, Riemann had a brief teaching career in Göttingen, during which he failed to attract disciples capable of spreading his gospel. Although some scholars have suggested that the master himself was no gifted proselytizer, Laugwitz argues otherwise, pressing his case for Riemann's pedagogical talents. Drawing on lecture notes only recently published by Erwin Neuenschwander, he observes that these contain the very first introduction to elementary complex function theory as developed by Cauchy. Indeed, their content differs only slightly from Konrad Knopp's popular little textbook *Funktionentheorie* (1913). What prevented the dissemination of these fertile ideas and why the sixty-year delay? Laugwitz strongly suggests that it was not Riemann who should bear the blame but, rather, the German mathematical community, which failed to rise to the challenge of absorbing his ideas. Even those who