dergraduate days at Trinity College, Cambridge. Some 30 years ago, A. R. Hall first called attention to the *Quaestiones* as the opening chapter of Newton's career in science. His estimate of its importance has not been challenged; nearly every Newton scholar finds it necessary to explore the document. Now at last, with this fine edition, McGuire and Tamny place it before the public. To the *Quaestiones* they add another document of similar importance for Newton's work in optics, the short essay "Of Colours," composed (they argue, in agreement with most but not all students of his optics) in 1665–66. Anyone seriously interested in Newton will rejoice at the appearance of this volume.

In fact, the texts themselves form the lesser part of the book, the first two-thirds of which contains extensive essays introducing them. A footnote (p. 58) indicates that the authors have prepared a book-length study of "Philosophical Themes in the Early Thought of Isaac Newton." Some may think they have already presented such a study and wonder how much is left to be said on the subject. In any event the essays are themselves an important contribution, and they cannot fail to be the focus of great attention. Unless I am mistaken, the authors will need to answer some objections before their conclusions are universally accepted. Two of their points, which figure prominently in the interpretation as a whole, concern the influence of Epicurus's *Letter to Herodotus* and of the works of Hobbes on certain aspects of Newton's early thought. One is therefore surprised when one turns to the edited documents to see how few the passages traced to those two sources are and how hesitant the attributions. I found exactly two passages (pp. 340 and 352) ascribed to Epicurus, in each case represented as only possibly from him. I also found two ascribed to Hobbes. One of them (p. 376) is to me less obviously derived from Hobbes than it is to the authors; the other (p. 450) takes explicit exception to Hobbes's opinion. This leaves a rather slender foundation for the argument the editors build on it.

Probably the most important point in the introductory essays is a new interpretation of the origin of Newton's central insight in optics, the heterogeneity of light. No doubt McGuire and Tamny's argument, that Newton's work in optics flowed from speculations on the physiology of sight based on Hobbes, will require—and receive—the extended consideration of informed scholars before it is finally assessed. I will say that to me there appears to be a major gap, unfilled by any convincing argument I saw, between Newton's speculations on the physiology of sight, which are wholly compatible with the theory that colors arise from the modification of white light held to be homogeneous, and Newton's insight that colors arise from the analysis of white light, which is shown to be heterogeneous.

Much as I welcome the edition I will express one disappointment, and that is with the relative paucity of new sources that the editors identify. Scholars have been at work on the *Quaestiones* for three decades and have identified a number of Newton's sources. This is important information; it establishes the intellectual context from which Newton set out. In this edition the authors who appear in the footnotes as the sources of individual passages are the ones we have known for some years—Charleton, Descartes, More, Glanvill, Boyle, Wallis, Galileo, and a small number of others. Meanwhile the sources for quite a few passages clearly drawn from specific reading (see, for example, pp. 393 and 402) remain unidentified. The most important of these is the long essay on motion. Perhaps the editors are correct in their assertion that Newton was developing his own ideas here as he wove together reading from a number of sources. Some of those ideas appear to involve rather specific information, however, and it seems to me that a young student would have needed more explicit guidance in order to tackle a subject as difficult as motion. I continue to think there is a source for this discussion that no one has yet found. This is not grounds for serious censure of the editors. Nevertheless, a fuller identification of Newton's sources would have painted a more detailed picture of the scientific milieu that stimulated the greatest career in the annals of science. Such details are the essence of editorial work. Success in supplying them marks the difference between a good edition and a great one.

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A 19th-Century Mathematician

A Convergence of Lives. Sofia Kovalevskaia: Scientist, Writer, Revolutionary. ANN HIBNER KOBLITZ. Birkhäuser, Boston, 1984. xx, 305 pp. + plates. $19.95.

"You see how expensive I am. I went for two 'ordinaries'!" (p. 187). So the mathematician Sofia Kovalevskaia (1850–1891) wryly summarized Gösta Mittag-Leffler's tactic to assure her an extraordinary professorship (roughly equivalent to a modern assistant professorship) at Stockholm University. Kovalevskaia's professorship was not the result of universal recognition of her mathematical talent in spite of her gender, but rather of a deal according to which Mittag-Leffler, a fellow mathematician and shrewd politician, conceded promotions to ordinary (full) professorships to two protégés of Kovalevskaia's foes in exchange for her professorship.

The preceding is one of the many carefully sketched incidents in Ann Hibner Koblitz's biography that demystify the woman known in her lifetime as "a princess of science." Characterizing Kovalevskaia as "an extremely gifted but in some ways perfectly ordinary woman" (p. 7), Koblitz presents a realistic, popular biography of her subject, who was the first woman in modern times to obtain a doctorate in mathematics, hold a chair in the subject, and serve on the editorial board of a major scientific journal. Koblitz succeeds in reducing Kovalevskaia to human (rather than superwoman) stature primarily by viewing her from a broad sociocultural perspective. This perspective, that of Russian nihilist women of the 1860's, dominates the biography and accounts for its special allurement.

Koblitz argues that the three major roles assumed by Kovalevskaia—scientist (mathematician), literary writer, and revolutionary—were consistent in the matrix of Russian nihilism of the 1860's. Opposed to the tsarist regime, the young Russian intelligentsia coming of age in that decade pinned its hopes for reform on the natural sciences and education, believed in the equality of women, and sought to serve the common people. A product of this nihilist circle, Sofia Kovalevskaia determined in her late teens on a career of public service as a physician. Blocked by her gender from attending any Russian university and by law from emigrating without her father's consent, Kovalevskaia contracted in 1868 a "fictitious marriage." This ruse involved her legal (but supposedly Platonic) marriage to Vladimir Kovalevskii, who, according to nihilist theory, was obliged to escort her to the educational

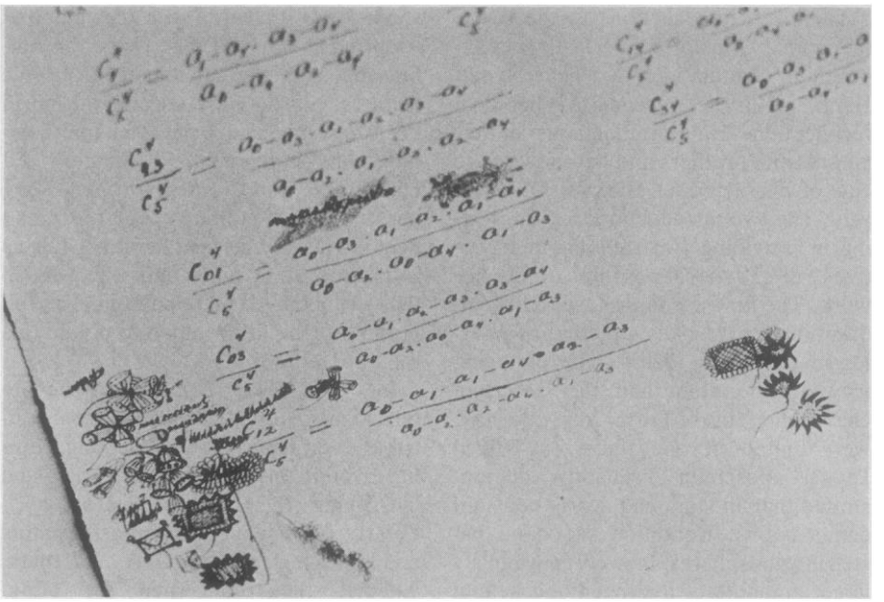
opportunities of western Europe and then offer her total independence, disappearing from her life if she so dictated. After marriage Kovalevskaia decided to study for a career in mathematics rather than medicine, and the Kovalevskiis (whose complicated marriage eventually produced a daughter before ending in separation) moved around western Europe in search of a university and a mathematical adviser for her. Kovalevskaia finally received a doctorate in mathematics in 1874 from Göttingen for work done in Berlin under Weierstrass, whose own university refused even to grant her admission.

Doctorates in hand, the Kovalevskiis soon returned to Russia with expectations of university teaching positions. Their hopes were dashed, however, as old-line Russian academics disapproved of the couple's foreign degrees; in addition, Kovalevskaia found that she, as a woman, was barred from all university positions. Only in 1883, after Kovalevskii's suicide conferred the respectability of widowhood on her, did she obtain a university appointment—an unsalaried one at Stockholm that was converted later into the extraordinary professorship assured by Mittag-Leffler's politics and eventually into a lifetime professorship.

According to Koblitz, nihilism inspired not only Kovalevskaia's commitment to science but her nonscientific activities as well. In the middle of their doctoral studies, for example, the Kovalevskiis spent a month in the Paris Commune of 1871, where Kovalevskaia served as a nurse. Throughout her life, Kovalevskaia supported higher education for women, by signing petitions and offering her own western European apartments as havens for scholarly émigrées. Her literary writings were also political statements; her reminiscences, plays, novels, and essays covered topics in socialism, communism, feminism, and public education.

Thus this biography succeeds in integrating Kovalevskaia's science, radical leanings, and literary writings. Interestingly, however, as Koblitz struggles to achieve this unified portrait, she comes close to slighting her subject's mathematics. The mathematical ideas of Kovalevskaia are, in essence, confined to a 17-page chapter (chapter 13, "Kovalevskaia's mathematics"), which offers lean prose descriptions of Kovalevskaia's ten mathematical papers, supplemented by a few relevant quotations from such leading mathematicians as Weierstrass and Poincaré. Koblitz follows her sketches of the papers with the observation that "it is possible . . . Sofia's main importance lies in what she did in a general mathematical sense even more than in what she wrote" (p. 245). But the ensuing discussion of Kovalevskaia's role as a bridge between Russian and western European mathematics and mathematicians is also weak in detail. This section, following the lead of earlier parts of the biography, posits basic differences between Russian and German mathematics. The differences, however, are never delineated beyond the repetitious assertion that Russian mathematicians preferred a "down-to-earth" approach emphasizing problems whereas the Germans engaged in "analysis for analysis' sake." Kovalevskaia, Koblitz's argument continues, was comfortable in both worlds and transmitted ideas between the two. Intriguing and important, this thesis would probably improve with elaboration, refinement, and supporting examples.

Not then a scientific biography of Kovalevskaia and her mathematics, Koblitz's work is recommended as a good popular biography whose strength rests on use of the main Russian and Swedish manuscripts and on successful integration of Kovalevskaia's multiple roles. The biography is especially fine reading for those with a contemporary interest in women in science. These readers will want to note Kovalevskaia's responses to such problems as: juggling a career and motherhood (she temporarily relinquished care of her daughter); coping with success (upon her appointment at Stockholm, Kovalevskaia experienced feelings of inadequacy, which Koblitz attributes to internalized prejudice); and caring for a house (a messy housekeeper, Kovalevskaia once remarked that, if a man, she would marry a pretty housewife!).



"Typical page of Kovalevskaia's mathematical computations, complete with doodles." [From *A Convergence of Lives*; Institut Mittag-Leffler archives—Angela Wanglert photo]

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A Life in Astronomy

Cecilia Payne-Gaposchkin. An Autobiography and Other Recollections. KATHERINE HARAMUNDANIS, Ed. Cambridge University Press, New York, 1984. vi, 269 pp., illus. $34.50.

The first quarter of this century brought with it swift developments in atomic and chemical physics. Astronomy rapidly changed from its purely mathematical emphasis to stressing its physical bases and recognizing the importance of preserving carefully collected observational data. Harvard Observatory was a major force in the advancement of astronomy during this period, when Harlow Shapley gathered around him gifted young researchers. The astronomer Cecilia Payne-Gaposchkin (1900–1980) played substantial roles both in the interfacing of modern physics with astronomy, notably in her acclaimed Ph.D. thesis on stellar atmospheres (1925), and in the sustenance of the heady intellectual climate at Harvard. Katherine Haramundanis (Payne-Gaposchkin's astronomer daughter) has put together an unusual memorial in this book.