that applies as much to himself as it does to his favored classics: "First, it seems pleasant to examine the foundations from which the sciences have been raised to their present height. Second, it will be of some interest to sample the sources from which virtually all the discoveries of the moderns are derived."

SIMON SCHAFFER
Department of History and Philosophy of Science, Cambridge University, Cambridge CB2 3RH, United Kingdom

Mathematics after Newton

The Development of Newtonian Calculus in Britain, 1700–1800. NICCOLÒ GUICCIARDINI. Cambridge University Press, New York, 1990. xii, 228 pp., illus. $54.50.

Guicciardini here aims to qualify the traditional view that British mathematics "declined" in the century after Newton, slipping from the creative leadership associated with such names as Wallis, Barrow, Gregory, and Taylor to the point, early in the 19th century, when few, if any, in England could follow the mathematical papers routinely presented to the French Academy of Sciences. To convey a more accurate appreciation of what happened after Newton, Guicciardini surveys the British mathematical community over the 18th century, dividing the period into three main segments. During the first three decades, Cotes, Taylor, and Stirling transformed Newton's sketchy presentations of fluxions into a system of mathematics and Berkeley dissected its conceptual foundations. From the mid-'30s to the mid-'80s textbook writers conveyed the subject with an emphasis on application rather than on theory. Writers admired Maclaurin's painstakingly rigorous *Treatise of Fluxions* (1742) as a definitive response to Berkeley, but they did not emulate it. Nor could others follow Maclaurin's lead in applying fluxions to such problems as the attraction of ellipsoids. Some writers did begin at this time to explore fluxions as a form of symbolic algebra, the "analytic art," laying the groundwork for the period of gradual reform that Guicciardini dates from 1785 to 1809 and follows at the Scottish universities, the military schools, and Dublin and Cambridge.

Given Guicciardini's broad focus, much of the book consists of capsule biographies and brief characterizations of the mathematical literature and of the institutions where mathematics was taught. He leaves the details to the primary and secondary literature cited in the ample bibliography. Curiously, the evidence he does present and the conclusions he draws from it often tend to reinforce the traditional view he is trying to refute. Fluxions did not lead as easily as differentials to such important concepts as partial derivatives and partial differential equations; notation did make a difference. British mathematicians did, on the whole, prefer a geometrical approach to their subject, including in geometry an intuitive concept of motion through space over time. The many textbooks published dealt largely with elementary material, conserving rather than raising the low level of mathematical education. Despite the promises of curricula and published lectures, not much mathematics was either taught or learned in British universities and military schools, the latter of which catered to boys in their early teens. As impressive as Maclaurin's or Simpson's work may have been in its own right, it had no influence on the development of mathematics.

Indeed, in the last chapter Guicciardini brings out an irony of the "reform" that offers a measure of the decline it was meant to reverse. Trained to think in terms of series and fluxions, the Cambridge analysts embraced Lagrange's algebraic version of the calculus, which treated differentiation as an operation and identified derivatives with the coefficients of series expansions of functions. As outside observers of Continental mathematics, they did not see the new directions in which Cauchy's work was taking analysis. Hence, while the Lagrangian view steered Babbage and others to interesting new work in the calculus of operators and functional analysis, it diverted their attention from the mainstream that flowed toward Weierstrass, Cantor, and Dedekind. Though not in isolation, British mathematics would follow its own course during much of the 19th century as well.

MICHAEL S. MAHONEY
Program in History of Science, Princeton University, Princeton, NJ 08544

Evolutionary Themes

Population Biology of Genes and Molecules. NAOYUKI TAKAHATA and JAMES F. CROW, Eds. Baifukan, Tokyo, 1990. xii, 370 pp., illus. ¥9,270. From a symposium, Tokyo, Dec. 1988.

It is somewhat unfortunate that the name of Motoo Kimura has become synonymous with the neutral theory of molecular evolution in the minds of many biologists. Kimura is rightly given credit for much of the current structure of the neutral theory, which has had an enormous impact on modern biology (for example, molecular biologists constructing consensus sequences are in effect applying the neutral-theory result that regions under the most selection evolve the most slowly). What is unfortunate is that biologists are ignorant of Kimura's other major contributions to population genetics. Indeed, models introduced as alternatives to the neutral theory often rely on methods of analysis introduced by him. His influence on quantitative genetics and on the study of genome evolution, population structure, and molecular evolution is apparent in *Population Biology of Genes and Molecules*, a collection of 21 papers presented on the occasion of Kimura's being awarded the Fourth International Prize for Biology. (He is the first Japanese biologist to win this major award, established in 1985 by Emperor Hirohito, himself a renowned biologist.) I found the papers uniformly interesting, although they are mainly reviews of previous work rather than new material. There is a roughly equal mix of theoretical and empirical work, and this collection serves as a nice introduction to much of current population genetics.

The quantitative genetics papers in this volume by Hill, Tachida and Cockerham, and the recently deceased Terumi Mukai testify to Kimura's influence on this field. Kimura's results on the fixation probability of a selected allele were used by Robertson in his landmark 1960 paper on the expected selection limit in artificially selected populations. Likewise, Kimura developed the first detailed model specifying the amount of genetic variability maintained in a quantitative character by mutation and selection. This is currently a major growth area for theoreticians. As reflected in the papers by Ohta, Watterson, and Yamazaki, the neutral theory underpins much of current theories of the evolution of genomic structures such as mobile elements and tandem arrays.

An especially interesting paper is by Provine, who traces the historical development of the neutral theory. Though genetic drift is a major component of Sewall Wright's shifting-balance theory of evolution as well as in Kimura's development of the neutral theory, Provine notes a critical distinction between the role of drift in the two theories. Wright did not view drift, by itself, as an important evolutionary process. Rather, he envisioned it as a process for generating genetic combinations to be acted on by selection. Although Wright acknowledged the presence of neutral alleles, he was more concerned with alleles having direct physiological effects on some aspect of the phenotype. Conversely, Kimura viewed drift itself as a major evolutionary force, especially when considering evolution at the level of individual nucleotides. Thus, whereas Wright's theory deals with evolution at the phenotypic level, Kimura's deals