Review
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Mathématisations: Augustin-Louis Cauchy et l'École Française
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mentalism and romantic theoretical speculation were mutually exclusive, but also that empiricism played no role in the philosophy of Schelling or other extreme romantics. Furthermore, Snelders condemns those he defines as "real" romantics when he claims that the application of Schelling's intuitive philosophy to the study of nature "was an obstacle to the free development" of science (p. 183). Schelling, however, never opposed experiments in the natural sciences but, rather, spoke for a philosophical system in which science would no longer maintain the sharp distinction between theory and experience. Many historians of science will object to Snelders's conclusion that German science recovered from the shackles of *Naturphilosophie* only when a renewed interest in experimental practice arose as a reaction against romanticism (p. 184).

Because few historians have explored romantic research in Europe's smaller countries, some *Isis* readers may find the chapter on the Netherlands of interest. Snelders tells us that, in general, *Naturphilosophie* had few adherents in the Netherlands. More specifically, many Dutch researchers espoused the romantic ideal of the unity of natural forces, but they rarely indulged in the unbridled speculation that Snelders sees as extreme romanticism. He exonerates, for example, the university professors Simon Speyert van der Eyck and Gerrit Moll because they performed numerous experiments on electromagnetic phenomena but did not attempt to explain them theoretically. That a real romantic science and medicine never arose in the Netherlands, Snelders says, can be attributed to the sober spirit of Dutch scientists who focused on practical applications and elaboration of experimental findings rather than on theory (p. 169). While Snelders may be right, he uncritically and unconvincingly invokes the stereotypical image of the practical Dutch as historical explanation. If romanticism never took hold in the Netherlands, the point begs for further consideration. To explain why a movement so popular in Germany held little appeal for the Dutch requires deeper analysis of the national historical context.

In *Wetenschap en Intuïtie,* Snelders covers no original territory (even a similar version of the chapter on Dutch romantic research was previously published in *De Negentiende Eeuw* in 1984) and offers little historical insight. Listed in the useful annotated bibliography are many of the recent secondary sources that provide more fruitful analyses of romanticism and romantic science than this book. Furthermore, most secondary literature is more accessible to *Isis* readers because it appears in English or German. But scholars and students most comfortable reading Dutch will learn here about important episodes in German and Dutch history in the romantic era.

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Amy Dahan Dalmedico. *Mathématisations: Augustin-Louis Cauchy et l'École Française.* 460 pp., illus., figs., bibl., index. Argenteuil: Éditions du Choix; Paris: Librairie Albert Blanchard, 1992. (Published with the support of CNRS and the École Polytechnique.) Fr 260 (paper).

In a review in this journal (*Isis,* 1986, *77*:119), Peter Galison noted that experiment "is endlessly hailed as one of the two pillars—along with mathematics—of the scientific edifice." He deplored the way in which traditional accounts in the history and philosophy of science have in practice idealized or ignored the actual working of experimentation. A similar criticism could be made with respect to the other pillar of the scientific edifice. Although mention is commonly made of the role of mathematics in the development of science, substantive and detailed studies of mathematization are in rather short supply. Historians of physics concentrate on the formation of new physical concepts and tend to take the underlying mathematics for granted. Historians of mathematics, on the other hand, document the evolution of mathematical technique—an evolution that is as fascinating as it is difficult—but often neglect the associated context provided by physical theory and application.

Amy Dahan's ambitious book concentrates on an exciting and rich development in the history of mathematical science, the work of the French savant Augustin-Louis Cauchy during the period 1810–1850. Although first and foremost a mathematician, Cauchy carried out substantial investigations in wave mechanics, elasticity, and optics. These applied researches resulted in important new physical concepts—the general concept of elastic stress being the most famous—as well as major additions to linear algebra and the theory of partial differential equations.

Dahan devotes the first third of the book to a survey of leading eighteenth- and early nineteenth-century figures, including Leonhard Euler, J. L. Lagrange, P. S. Laplace, Sophie Germain, and Joseph Fourier. While focusing on Cauchy, she describes the related work of his contemporaries and professional rivals Siméon-Denis Poisson, Claude Navier, and Augustin Fresnel. The French scientific milieu of the period was notable for its political tensions, social

ferment, and competitiveness. Dahan is, however, most interested in the science itself. Using both primary and secondary literature, she sets forth in some detail Cauchy's progress in analyzing the three subjects of wave propagation, elasticity, and optics. In the last topic she draws on Jed Buchwald's historical studies of the wave theory of light to produce an unusually extended treatment of Cauchy's optical researches.

In the introduction Dahan characterizes her historical approach as one of French epistemology, "an historical analysis which attempts to study the filiation of concepts and of theories, which proceeds by the presentation of procedures and by a comparison of theoretical domains at their points of closure" (p. 5). She distinguishes three major approaches to the mathematization of physical reality in the research of Cauchy and other scientists of the period. The first, which she traces to Euler's writings on hydrodynamics, is characterized by an emphasis on physicogeometrical idealization; it is evident in Fourier's work on heat conduction and Cauchy's first theory of elasticity. The second involves the postulation of molecular mechanisms, as in Laplace and Poisson's program of molecular physics, in Cauchy's second theory of elasticity, and in his optical conception of a punctiform ether. The third, associated with Lagrange and variational methods, entails a strong emphasis on analysis and formal abstraction at the expense of physical concepts and intuition.

Although Cauchy's research in physics was informed by different methodological perspectives, there was an underlying unity to his thought. In 1844 he declared that the complete theory of any part of physics will consist of the integrals of a certain system of differential equations. During the period in which he worked, the study of partial differential equations was assuming a central place in mathematics. Dahan suggests in the conclusion that Cauchy's strongly analytical approach and his influence in French scientific life had important repercussions on the emergence of French theoretical physics later in the century. Certainly the continued prominence of analysis in applied mathematics would be echoed in the work of such great French mathematicians as Joseph Liouville, Henri Poincaré, and Jacques Hadamard.

The material that Dahan is documenting is so thoroughly technical that even a reader with a good scientific background will need assistance to follow the story. This sort of history demands a very considerable emphasis on exposition of the science itself. Dahan does not generally provide this, apparently on the grounds that it can be found elsewhere, either in the classical textbook literature or in the various historical writings listed in the bibliography. (I found the chapter on the integration of partial differential equations particularly difficult to follow.) Those who wish to arrive at a clear understanding of Cauchy's contributions to mathematical physics will need to read Dahan's book in conjunction with these other sources. Viewed in this light, it is a useful addition to the historical literature, providing an interesting and wide-ranging account of the work of a central figure in the history of modern exact science.

CRAIG FRASER

Martin Guntau; Peter Hardetert; Martin Pape (Compilers). *Alejandro de Humboldt: La naturaleza, idea y aventura: Libro de la exposicion.* xx + 128 pp., illus., bibl., index. Essen, Germany: Projekt Agentur, 1993. (Paper.)

Ever since 1804, the year in which Alexander von Humboldt returned from his celebrated journey of exploration to Central and South America, his work and fame have served to promote various and sometimes clashing political ends. The *Essai politique sur le royaume de la nouvelle Espagne* (1808), for example, was dedicated to the Spanish king Charles IV and contributed to North American and Western European avarice for the mineral wealth of Spanish America. Yet Humboldt's name became used, too, in conjunction with that of Simon Bolivar, as a symbol of the revolt against Spanish colonial rule. In Europe, and more particularly in Germany, Humboldt's name was included in the roll call of sympathizers with the revolution of 1848; yet Humboldt ended his illustrious career in the service of a reactionary Prussian court. More recently, in the wake of World War II, the name of Humboldt was put to good use by the West Germans in the naming of the Alexander von Humboldt Stiftung. At the same time, the East Germans cultivated Humboldt scholarship in the service of international goodwill politics, especially toward Latin America. The latest cause that Humboldt's name has been made to serve is that of German reunification.

In a recently staged exhibition of "Humboldtiana," three of these interests came together, namely, mineral exploration, contact with South America, and German unity. Supported financially by the German-Venezuelan oil industry, the exhibition was shown from 24 April 1993 to 18 December 1994, first in what used to be West Germany (Gelsenkirchen), then in the former East Berlin (Humboldt University), and finally