Book Reviews

Life and Work of Fourier

Joseph Fourier. The Man and the Physicist. JOHN HERIVEL. Clarendon (Oxford University Press), New York, 1975. xii, 350 pp. + plates. $31.25.

It is a matter of great good fortune that Fourier's famous *Analytical Theory of Heat* reached the light of day. Now recognized as a masterpiece of mathematical analysis and theoretical physics, it was not highly admired by the leading mathematicians at the Academy of Sciences, Laplace, Lagrange, Poisson, and Biot. They seemed to be unable to recognize Fourier's merit and worked to delay, if not actually to prevent, the publication of his work. As if this were not obstacle enough, the guillotine almost took Fourier before he even began his research. He survived because his great administrative skills were in demand and because he was able to change sides deftly as the Revolution oscillated between terror and reaction. Even so, he was in prison twice during the Terror and twice afterward. He would almost certainly have been guillotined if Robespierre had kept his head for a few more days.

Fourier held a series of positions that reveals the breadth of his competence. He taught at the newly founded Ecole Polytechnique, and was called by Napoleon to be a scientific leader in the Egyptian campaign (Fourier was editor of the *Description of Egypt*, which laid the foundation for the field of Egyptology). He then became prefect of Isère under Louis XVIII and prefect of the Rhône under Napoleon. After Waterloo he survived as director of the Statistical Bureau of the Seine, and finally became permanent secretary for the mathematical sciences at the Academy of Sciences.

The drama of this story comes out well in Herivel's straightforward reporting of it. By careful scholarship he has made it much more complete than any previous account, and he has resolved some of the ambiguities in Fourier's own recollections. Fourier always seemed to be explaining his actions after the tide of battle had turned, and it was frequently necessary for him to color the facts a bit. For instance, Napoleon's triumphant return from Elba passed through Grenoble where Fourier was situated as prefect, and where he supposedly served as a loyal subject of Louis XVIII. When Napoleon seized the city, Fourier found it expedient to flee, but he left accommodations prepared for Napoleon and his staff. Later he returned to Grenoble; but was it as an old friend, or was he captured by Napoleon as he claimed? Herivel weighs the conflicting evidence and concludes that Fourier joined Napoleon voluntarily when the royal cause was clearly lost.

Fourier's career had other oddities. He did not begin his study of heat conduction until about 1804, when he was 36, and he worked on this one problem to the exclusion of almost everything else. Because of this single-mindedness, Herivel has chosen to divide his biography into two parts: Fourier the man and Fourier the physicist. The two parts are not very well matched. The reader who has enjoyed the biographical section may find himself in difficulty when he comes to the section on Fourier's scientific work, particularly if he is not already familiar with the *Analytical Theory of Heat*. Herivel has wished to avoid duplicating the work on Fourier's mathematics done by I. Grattan-Guinness and others, and has therefore limited his treatment to Fourier the physicist. But since the physics and mathematics are so closely related the exclusion of mathematics produces some awkwardness.

Rather than attempt a general description of Fourier's contributions that would be more helpful to the reader unfamiliar with the subject, Herivel has concentrated on the development of certain specific problems in Fourier's physics. Thus he stresses the importance of the concept of heat flux developed by Fourier in his prize essay of 1811, a concept that his detractors could not seem to understand. Equally important in Herivel's judgment was the transition in Fourier's treatment of heat conduction from consideration of the heat exchanged between slices of the material of infinitesimal width to consideration of heat flow across a *section* or geometrical *surface* within the medium.

Herivel attributes much of the advance in Fourier's work to a better understanding of the physical phenomena of heat conduction. An early draft indicates that Fourier already had command of his famous trigonometric series in 1804, but it was only in 1807 after a long series of experiments that he began to understand the underlying physical processes, which he then described mathematically.

In his concluding chapter Herivel raises several interesting points, all of which merit further development. Fourier insisted that the science of heat conduction was independent of any atomic model or other mechanism for heat transfer. His contemporary Augustin Fresnel approached the wave theory of light in the same way. It may be significant that neither man made any important contribution to analytical mechanics, and they both suffered from the hostility of Laplace, Poisson, and Biot. In many ways their careers show interesting parallels and indicate a new nonmechanical approach to theoretical physics in the early 19th century. Fourier's reluctance to create atomic models is sometimes regarded as "positivistic," but what kind of positivism? He knew August Comte, who dedicated the first volume of his *Cours de philosophie positive* to Fourier. One wonders to what extent positivism has its origins in these new nonmechanical physical theories.

The final third of Herivel's book is devoted to a collection of 27 highly illuminating letters, mostly unpublished, to which the author has added explanatory notes and short biographies of persons mentioned.

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Origins of Social Science

Condorcet. From Natural Philosophy to Social Mathematics. KEITH MICHAEL BAKER. University of Chicago Press, Chicago, 1975. xiv, 538 pp. $22.

Condorcet is often the point of departure for discussions of the origins of sociology and positivism and the general development of 19th-century social science. Keith Baker's book, however, clearly shows Condorcet as the last gasp of the Enlightenment and only incidentally the first breath of the 19th century. Baker does not make a great deal of this point, although he is careful to show that St. Simon and Comte did considerable violence to the spirit and meaning of Condorcet's work as they translated it into their own idiom, for he is really more interested in social science than he is in Condorcet the man. And if social science had its beginning in the Enlightenment, then the great break of the French Revolution is a mere incident in its