

extensive primary sources to document Halley's skill as a military engineer in Istria and as a navigator and chart-maker on voyages to the South Atlantic. Waters's evidence contradicts the summary judgment of Halley's seamanship in Westfall and Funk's essay and should qualify the balance they draw between merit and patronage in Halley's command of a British naval vessel. In Waters's view, Halley was England's "greatest scientific seaman."

Turning to comets in part 4, F. Richard Stephenson matches modern retrodiction against Babylonian and Chinese records to conclude that we have been sighting Halley's comet on each of its returns since 240 B.C. but that the record most likely goes no farther back. Just how one knows when a particular comet has been sighted is the subject of Eric Forbes's "The comet of 1680–1681" and of Simon Schaffer's "Halley, Delisle, and the making of the comet." The latter is a richly detailed contribution to the still open question of the diffusion of Newton's system in Europe. Schaffer follows Joseph-Nicolas Delisle's career in Paris and St. Petersburg to show how "the construction of the 1759 return as a vindication of a Newtonian program in celestial mechanics involved a complex process of negotiation by astronomers, who were compelled to clarify the precise achievements of the past half century of cometography and then to show that the predictions generated by that program had now triumphed." The currency of those negotiations was the increasingly sophisticated mathematics needed to match theory and observation, as Craig B. Waff brings out in the wider context of "The first international Halley watch."

Published "essentially as they were received, but with some light editorial work to convert them from oral to written form," the papers offer at best a mosaic of their common subject. Depending on the reader's interest, the titles may need rearranging. For example, Sara Schechner Genuth's discussion of "The teleological role of comets," though placed in part 3, belongs together with Kubrin's and Force's essays in part 2. David W. Hughes's survey history of cometography as background to "Halley's interest in comets" would be more helpful at the beginning of the volume than in its current penultimate position. So too would the editor's brief biography of Halley, illustrated by the dedications of the maps Halley prepared for his patrons over the course of his career.

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Victorian Friends

The Correspondence Between Sir George Gabriel Stokes and Sir William Thomson, Baron Kelvin of Largs. DAVID B. WILSON, Ed. Cambridge University Press, New York, 1990. Two volumes, boxed. lxxx, 783 pp., illus. \$195.

William Thomson (Lord Kelvin) and George Gabriel Stokes were two of the most important figures in 19th-century British physics, and the letters they exchanged constitute one of the great primary sources on Victorian science. Separately and in collaboration, Kelvin and Stokes did pioneering work in optics, hydrodynamics, and electrical theory, and they played leading roles in Britain's scientific institutions for most of the second half of the 19th century. They were also close friends for nearly 60 years, from Kelvin's undergraduate days at Cambridge to Stokes's death in 1903. Stokes remained at Cambridge as Lucasian Professor of Mathematics while Kelvin took up the chair in natural philosophy at Glasgow, and their friendship thus had to be conducted mainly by mail. Over 650 of the resulting letters survive and have now been brought together by David B. Wilson in two handsome volumes that provide a unique insight into Kelvin's and Stokes's work and into the texture of Victorian scientific life.

These volumes had their origin in the early 1970s when Wilson was given the task of cataloging the enormous Kelvin and Stokes collections held by Cambridge University Library. To cap this work, the library planned to publish the correspondence be-

tween the two (including some letters from other collections), and by 1980 the letters, along with Wilson's notes and introduction, were ready to go to press. But financial strictures prevented the completion of the project, and it was only after Cambridge University Press took it up a few years later that it was finally brought to fruition. The delay is regrettable; earlier publication of these letters would have been a boon to researchers in what has recently become a very active field. But the final product, with its careful editing and informative notes and introduction, is worth the wait and will become a standard source for historians of Victorian science.

Kelvin and Stokes had much in common: both were Irish Protestants by birth; both were educated at Cambridge, where they were trained in the distinctive "Tripos" style of mathematical physics; and both eventually became elder statesmen of British science. But as Wilson points out, and as their letters make clear, the two men had very different personalities and styles of work. Kelvin was a scientific enthusiast, always bubbling over with ideas, some brilliant, many fated only to be discarded in his next hurried letter or postcard. Stokes was calmer and more methodical; he often served as Kelvin's sounding board and critic and made some of his most valuable contributions by gently (and sometimes not so gently) pointing out flaws in Kelvin's reasoning or alternative solutions to problems he had posed. The nature of their collaboration comes across especially clearly in the many letters they exchanged between the 1840s and 1890s on hydrodynamics and its possible application to the structure of matter and ether. These letters allow us to trace the gradual rise of Kelvin's famous "vortex atom" theory and its eventual demise, a victim in large part of doubts about stability that Stokes had raised from the first. They also allow us to trace the rise and fall of the grand program of mechanical explanation that was a hallmark of Victorian physics.

Also visible in the letters, though less prominent, is the growing tie between science and technology. This was more Kelvin's doing than Stokes's; while Stokes worked quietly and mostly on his own in Cambridge, Kelvin took a central role in work on the Atlantic telegraph cables of 1858 and 1866 and in a series of other big engineering projects. Even here, however, Stokes had an important contribution to make: it was a letter he wrote in October 1854 that first prompted Kelvin to work out the equations governing the propagation of signals along submarine cables—which he proceeded to publish in a paper consisting largely of extracts from his replies to Stokes.



George Gabriel Stokes. [Originally published in *Nature* 12, facing p. 201 (1875)]

A brief review can do little more than hint at the contents of these volumes. Besides abundant materials on the strictly scientific work of Kelvin and Stokes, their letters provide an unusually detailed look at the inner workings of British scientific institutions during a period of profound change. They also allow us to recapture, however imperfectly, something of the lives and personalities of two remarkable men.

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Aspects of Darwin

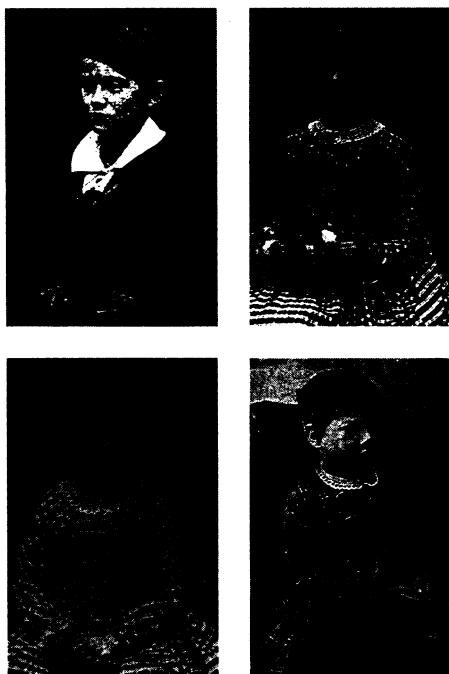
Charles Darwin. A Biography. JOHN BOWLBY. Norton, New York, 1991. xiv, 511 pp., illus. \$24.95.

Charles Darwin. The Man and His Influence. PETER J. BOWLER. Blackwell, Cambridge, MA, 1990. xii, 250 pp., illus. \$21.95. Blackwell Science Biographies.

Biographies of great scientists are difficult projects. The author needs to capture both the personal life and the scientific accomplishments in a well-rounded picture, but a writer with a gift for one of these tasks may be ill-equipped for handling the other. The best solution may simply be to emphasize what one understands best and leave the other half the job to those with a taste for it. John Bowlby and Peter Bowler have both made this choice, and the books they have written complement one another effectively.

Bowlby's biography is a newsy, intimate account of private life among comfortably situated Victorians. He makes particularly good use of the recently published volumes of *The Correspondence of Charles Darwin* (Cambridge University Press). At the same time, though, he tends to slight Darwin's scientific work. He gives significant attention to the *Origin of Species* and its reception, but most of Darwin's publications get a rather quick dusting. Furthermore, Bowlby's reading in recent Darwin scholarship has been hit-or-miss. When he has put his hands on the appropriate literature, his summaries have a crisp authority; thus, he is quite good on the *Beagle* voyage and Darwin's early evolutionary thinking. However, the gaps in his reading show awkwardly when he is talking about geology or Darwin's response to critics like William Thomson (later Lord Kelvin) or Fleeming Jenkin.

Where Bowlby really excels is in his account of Darwin's personal life. A psychiatrist with a strong background in child development, he is sensitive and enlighten-



Four of Darwin's children. Left to right, from Top, William Erasmus, born in 1839; Anne Elizabeth, born in 1841; Henrietta Emma, born in 1843; and George Howard, born in 1851. [Reproduced in *Charles Darwin: A New Life*; daguerreotypes from Darwin Museum, Down House, and (for Henrietta) Mrs. Sophie Gurney]

ing on many emotional difficulties and psychosomatic illnesses. Bowlby sees a key to Darwin's character in a somewhat overscrupulous upbringing that left him sensitive to the needs of others but tormented by the burden of his own responsibilities. Added to this difficulty was the death of his mother when he was nine years old plus the anguished determination of his father to repress all discussion of the event and all normal expressions of family grief. As a result, the mature Darwin was subject to anxiety attacks and incapacitating bouts of weakness, nausea, and depression.

Attempts to explain Darwin's illnesses as psychosomatic are not new: in recent years Ralph Colp has argued that Darwin suffered particularly from the stress of presenting his controversial evolutionary views to a hostile public. Bowlby does not ignore Darwin's anxieties about his work. However, he differs from Colp in laying greater emphasis on Darwin's concerns for close family members. For example, he explains Darwin's first lengthy period of illness in the years 1839–1841 by his distress at Emma Darwin's first two pregnancies. He notes that Darwin was completely prostrated by the death of his father in 1848 and that he suffered morbid fears about the health of his children, especially after the death of his daughter Anne in 1851. Bowlby is reluctant to assign a cause

to Darwin's severe illness and depression in 1865 but notes that it may have been intensified by the gruesome suicide of the former captain of the *Beagle*, Admiral FitzRoy. A little more archival work would also have netted him evidence of Darwin's deep grief at the death of his daughter-in-law Amy Ruck in 1876.

Our knowledge of Darwin's physical and emotional health is necessarily limited and will always remain so; Bowlby may have leaned too far in favoring psychological, as opposed to somatic, explanations for Darwin's difficulties. Still, insofar as psychological explanations do apply, Bowlby makes a serious case for the importance of close personal ties in accounting for Darwin's most serious periods of illness. Darwin did require an extended period of hydrotherapy after the publication of the *Origin of Species*, but for the most part his health problems do not seem particularly work-related. Indeed, Bowlby finds that work was frequently a solace for Darwin, a helpful distraction from his griefs and anxieties about the people he loved. Yet if Bowlby is right about the limited relevance of work to Darwin's health history, the question remains just what we are to think about the connection between his inner life and the scientific theories he developed. Unfortunately, Bowlby has too weak a grasp on the science to be of much help on this question.

In contrast to Bowlby, Peter Bowler concentrates specifically on the science; in fact, Bowler gives Darwin's personal life the same slight attention that Bowlby bestows on the science. However, Bowler has mastered the recent scholarly literature on Darwin, and his account is a good introduction to modern knowledge of Darwin's life and career. Bowler is especially good on the period of Darwin's early work up to the publication of the *Origin of Species*. One of the main achievements of recent Darwin scholarship has been to bring out the ambiguity of Darwin's thinking on a number of critical issues. Darwin believed that evolution was somehow a progressive process, yet he shared with Lyell and Malthus a deep skepticism about the idea of progress and employed it only cautiously in his work. Darwin was proud of his own idea of natural selection, yet he never abandoned the concept of use-inheritance. Perhaps under the influence of his *Beagle* collections, he first adopted the concept of geographic speciation, but in the 1850s he shifted to an ecological interpretation of speciation—without ever quite ruling out the importance of geographic distribution. Shortly after his return from the *Beagle* voyage, Darwin gave up the Christianity of his early life, and over the years he gradually drifted