The follow-up interviews suggested that only the minority of students who approached school with the genuine orientation to "learn from experts" and to master a body of knowledge that they saw as useful were able to translate career interests into actual careers. For most of the students, getting good grades or simply getting a degree and getting out defined their orientation to their academic work. Their classwork was unrewarding, their grades disappointing to them. Over time, they shifted to less demanding fields of study and put less of their time or energy into career preparation relative to the pursuit of romance. And years later most were in marginal jobs, replicating the gender division of labor in their career "choices."

As much as I would like to believe that this disappointing pattern occurs today only in southern colleges, I fear that it is more widespread. Though it perhaps does not occur for the majority of women students elsewhere and though the peer culture of the North may have more subgroups of students who actively and collectively challenge the ethos of romance, the capitulation that Holland and Eisenhart describe is surely pervasive on coeducational campuses around the country. The "sexual auction block" on which women students are placed by peer culture is an influence strongly competing with the achievement messages that faculty endorse.

Instead of blaming women for succumbing to the pressure of peer expectations, Holland and Eisenhart make a good case for the complicity of the schools in making romance the hidden curriculum of coeducation. If administration, faculty, and other organized groups in the institution fail to mount a successful challenge to the dominance of peer culture, how can individual young women hope to resist? The peer culture is itself, the authors argue, a form of resistance to the debilitating and dehumanizing dynamics of the classroom, but this type of resistance backfires for women. Peer indifference to what happens inside the classroom is mirrored by faculty indifference to what happens outside it. In the clash of cultures, women students are the losers.

What is of necessity missing from this book is any indication of where and how peer culture could function *for* women, rather than undermining them. Similar ethnographies of women's colleges with good records of placing women in career paths, of subcultures of support for women students in women's studies at coeducational schools, and of other "experimental" programs that do not strictly separate the students' personal lives from their classroom experiences would contribute to sketching the outlines of successful solutions to the dilemmas that Holland and Eisenhart depict so graphically. For faculty and students to confront together in the classroom the issues that this book raises might even be a step in that direction.

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Cosmic Thinkers

Standing on the Shoulders of Giants. A Longer View of Newton and Halley. Essays Commemorating the Tercentenary of Newton's *Principia* and the 1985–1986 Return of Comet Halley. NORMAN W. THROWER, Ed. University of California Press, Berkeley, CA, 1990. xxvi, 429 pp., illus. $39.95. From a conference, Los Angeles, CA, Aug. 1985.

Mark Twain delighted in telling audiences he had come into the world with Halley's comet and expected to go out with it, as indeed he did. It is an ironic coincidence, given the astronomical phenomenon's crucial role in moving comets from the realm of the ominous to the system of the world. The comet's return in 1985–86 presented another such coincidence, occurring as it did on the eve of the tercentenary of Newton's *Principia*, in which, in a real sense, the comet had its origin as an orbiting body. Although Edmond Halley's name attaches only to the comet, he bears responsibility for the book as well. He coaxed it out of Newton and saw it through the press, ready to pay its way if need be. The papers in this volume, originally delivered at a conference prompted by the more recent coincidence, look beyond Halley's role as facilitator to probe the intellectual relations between the two men; to bring out from behind Newton's shadow Halley's own considerable talents as an astronomer, geographer, and military engineer; and to explore the scientific and cultural implications of putting comets into orbit.

The 18 papers in the volume are grouped in four categories: Newton and Halley; Newton; Halley; and Comets. Part 1 deals less with the honorees' collaboration than with their parallel careers. In "Newton, Halley, and the system of patronage," Richard S. Westfall and Gerald Funk place the two men in quite different orbits of influence. The strange relation between them stemmed in part at least from the fact that Halley did not need Newton's help as a patron; he had others even more powerful. Derek Howse reviews the tortuous relations between Halley and John Flamsteed at the Royal Observatory, and Suzanne Débarbat follows the traces of Newton and Halley through the archives and murals of the Paris Observatory.

Except for I. Bernard Cohen's account of "Halley's two essays on Newton's *Principia*," part 2 focuses on a Newton less familiar to the general reader. Despite the subtitle, the book has little to say about the *Principia* as a whole or even about the theory of comets in it. In "Such an impertinently litigious lady: Hooke's 'Great Pretending' vs. Newton's *Principia* and Newton's and Halley's theory of comets," David Kubrin examines the context of Robert Hooke's notorious claim on the inverse-square law to reveal its role in Hooke's theory that earthquakes caused changes in the earth's axis and magnetic poles. Halley, following Newton, argued that comets were responsible for those changes. But as comets became cyclical rather than extraordinary events, that theory entailed an eternal, cyclically changing, yet passive earth, rather than an active earth with a beginning and an evolving history. Priority was less at stake than was a whole way of looking at the world. James E. Force asserts a "sleeping argument" in Newton's writing, uniting science and religion not only in the argument from design but in the realization of scriptural prophecy; history moved to the heavens. Betty Jo T. Dobbs then pulls the two views together in "Newton as alchemist and theologian," concluding that "it is thus in a religious interpretation of all of Newton's work that we may find a way to reunite his many strangely divergent but well-polished facets."

Part 3 brings out the many dimensions of Halley. His most important contribution to astronomy, argues Albert van Helden, lay in establishing the study of transits and in showing how the transits of Venus could resolve the question of the sun's parallax. Alan Cooke and D. W. Waters make use of 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 between 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.

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

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.