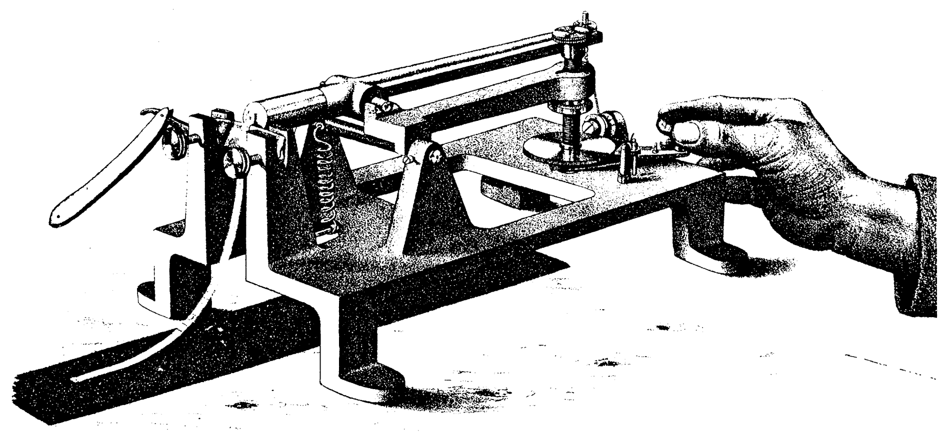
Instrument Makers

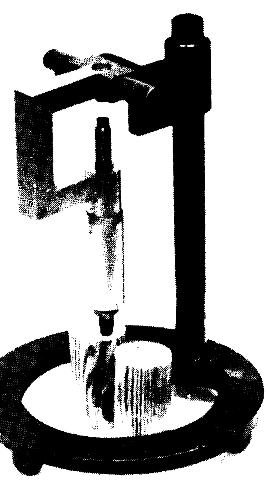
Horace Darwin's Shop. A History of the Cambridge Scientific Instrument Company, 1878–1968. M. J. G. CATTERMOLE and A. F. WOLFE. Hilger, Bristol, U.K., 1987 (U.S. distributor, Taylor and Francis, Philadelphia). xvi, 285 pp., illus. $77.

This chronicle by two former employees of the Cambridge Scientific Instrument Company records the company's story, mainly emphasizing the instruments themselves. An overall narrative in part 1 is followed in part 2 by more detailed discussions of the history and technical development of several of the company's most significant products.

Though Horace Darwin did not found the company, he guided it during its rise to prominence, from the early 1880s until his death in 1928. A mediocre finish in Cambridge University's mathematical tripos in 1874 effectively meant that Horace, one of Charles's sons, would not pursue a career involving high-level mathematics, unlike his brother George Howard, who did well in the tripos and became the professor of astronomy at Cambridge. Horace's talents lay toward engineering, especially the design of instruments, and, later, management of a firm of a few hundred employees. After serving an engineering apprenticeship and gaining recognition for his design of instruments, Horace bought into the recently established firm as joint proprietor in 1881. At that time it became known officially as the Cambridge Scientific Instrument Company, but among the Darwin family as "Horace's shop." He became sole proprietor a decade later.



The "Darwin Rocker" microtome. In 1883–84 the Cambridge Scientific Instrument Company made about 20 automatic microtomes based on a design by Richard Threlfall. Threlfall's design, the first of its kind, was not commercially successful. "Within two years [Horace] Darwin had designed a better microtome. . . . The classical simplicity of the design can be seen in [this illustration,] which was printed in the 1885 sales leaflet. . . . In the years which have followed many other microtomes have been designed by many other manufacturers but surely none have enjoyed the reputation achieved by the 'Darwin Rocker.'" [From *Horace Darwin's Shop*]



Micrometer system devised by Horace Darwin for use with the "worm stone" at Down House, the Darwin family home. "To enable his father to study the rate at which stones on the surface of the ground were buried by the action of worms beneath them, Darwin devised [an] arrangement of a large flat stone, 460 mm in diameter, with a hole in the centre. Three metal V-grooves set into the stone radially about the central hole supported a vertical micrometer and the gradual sinking of the stone . . . was registered against metal rods, 2.63 m long, driven into the ground through the central hole. Experiments with the worm stone and micrometer (which may still be seen at Down House) were begun by Charles Darwin in 1877 and continued . . . until the stone was accidentally moved in 1896. Horace Darwin reported the results in a paper to the Royal Society in 1901." Here the metal stakes are represented by wooden cylinders. [From *Horace Darwin's Shop*; Cambridge University Library]

The shop's early successes reflected the successes of late-Victorian Cambridge science, physiology and physics. The firm manufactured, for example, microtomes (including a version known as the "Darwin Rocker") for cutting thin slices of tissue, electrocardiographs based on the design of the Dutchman Willem Einthoven, thermometers and pyrometers using the design of the Cambridge graduate H. L. Callendar, and, just before the First World War, cloud chambers developed in the Cavendish Laboratory by C. T. R. Wilson. The company was a "controlled factory" during the war, with necessities of the time dictating its production: optical pyrometers previously imported from Germany, kathometers for detecting chlorine gas, and sound-ranging outfits for locating enemy artillery, for example. Darwin was knighted for the company's wartime efforts. Typically, it seems that throughout Darwin's reign the company refined and manufactured instruments that were initially created by others, with Darwin himself only occasionally involved in the actual process of design. The concluding chapter of part 1 sketches the firm's history after the war and after Darwin up to its takeover by the George Kent Board in 1968.

This is the story of a company obviously of some importance in the history of science, the history of medicine, and the history of Britain. The character and exact significance of its various roles, however, are not much explored in the book. Indeed, the book's major weakness is its paucity of generalization—not only on such topics as the history of scientific instrument makers, the connection between the professionalization of science and the manufacture of scientific instruments, or the mutual influence between scientific instruments and scientific theory, but even regarding the specific subjects of each chapter. The strength of the book is its information-packed narrative, constructed with knowledge and affection.

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Astronomical Spectroscopy

The Analysis of Starlight. One Hundred and Fifty Years of Astronomical Spectroscopy. J. B. HEARNSHAW. Cambridge University Press, New York, 1986. xvi, 531 pp., illus. $79.50.

The analysis of starlight by spectroscopic means has been a singularly powerful tool in astronomy during the past century. From it has come knowledge of the composition and structure of stellar atmospheres, motions of stars in the line of sight, the existence of pulsating stars, and countless other ingredients of what today is called observational astrophysics. Furthermore, more than any other observational technique, spectroscopy drew the attention and expertise of physicists to problems in astronomy, and from this marriage modern theoretical astrophysics was born.

It is the wish of the author of *The Analysis of Starlight* to provide the practicing astronomer with "an interpreted guide to the literature covering the development of observational stellar spectroscopy" (p. ix). This formidable goal is met in a quantitative sense. The reader is led through a series of thematic chronologies on the growth of spectroscopic instrumentation in the 19th century; problems faced by early workers concerned with the origins of the Fraunhofer spectrum; schemes of stellar spectral classification; the exploitation of the Doppler effect; the emergence of quantitative astronomical spectroscopy; the birth of astrophysics; and a host of miscellaneous topics ranging from the analysis of peculiar stellar spectra to supernova spectra and the influence of the interstellar medium on stellar spectra.

Hearnshaw, a New Zealand astronomer, has produced an impressive collection of detail that should delight some specialists. There are, to be sure, some nice insights, but because Hearnshaw elected not to utilize the wealth of secondary literature on the history of modern astronomy, alas, there are serious defects as well.

One persistent problem is a failure to convey a sense of who many of the players were: where they came from and what in their training, position, or character led them to make their mark. Names move in and out of the scene, with too little introduction or context provided to give the reader an appreciation of why they did what they did.

Hearnshaw's treatment of Norman Lockyer's work is a case in point. Misrepresenting his theory of stellar evolution, Hearnshaw claims that Lockyer's rhetoric was "woolly" and would be "entirely unacceptable in scientific publications of today" (p. 93). Without benefit of the later work of Thomson, Einstein, Bohr, and Saha, feels Hearnshaw (p. 100), Lockyer was limited to "unproductive theorising" in his development of the meteoritic hypothesis (p. 93). A more satisfactory conclusion could have been drawn from an exemplary biography of Lockyer (A. J. Meadows, *Science and Controversy*, MIT Press, 1972), which reports his arguments properly. Historians of science specializing in Victorian Britain appreciate Lockyer's behavior and work in the context of his times, and utilization of their efforts would have been logical. Rather inconsistently, Hearnshaw later states, "The early theories of stellar evolution were plausible enough in the context of the known laws of physics at the time" (p. 209).

If there is something lacking for Hearnshaw in contemporary historical studies, there are still numerous places in his text where he could have exploited review articles and advanced textbooks by astronomers. But except for an all-too-brief reference to the 108-page review of astronomical spectroscopy prior to 1930 by R. H. Curtiss ("Classification and description of stellar spectra," *Handbuch der Astrophysik*, vol. 5, part 1, Springer-Verlag, 1932) Hearnshaw has also ignored such sources. When he does mention Curtiss's review paper, he criticizes it for being "a little harsh" on the classification efforts of Antonia Maury because she turned out to be right about luminosity criteria. Apparently Hearnshaw does not sense his own proclivity to judge on contemporary evidence as he feels Curtiss did. When Hearnshaw concludes that Cecilia Payne probably did not trust her own 1925 Ph.D. thesis research that showed a great abundance of hydrogen in stellar atmospheres, he strangely does not cite her own autobiography ("The Dyer's Hand," included in *Cecilia Payne-Gaposchkin*, K. Haramundanis, Ed., Cambridge University Press, 1984), which claims something quite different.

Added to the rather judgmental character of the text, there is an almost complete lack of thoughtful editing; the text is often turgid. Finally, Hearnshaw himself must be disappointed at the poor quality of reproduction of the many illustrations.

Though this is not a book to ignore—in addition to specialist historians, those who teach astronomical spectroscopy and modern physics who are in search of anecdotal material will find it useful—it is a book to be used with some caution and a bit of regret that the publisher did not invest in more editorial support to turn out what could have been a milestone addition to the historical literature.

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Some Other Books of Interest

High-Technology Ceramics—Past, Present, and Future. The Nature of Innovation and Change in Ceramic Technology. W. D. KINGERY and ESTHER LENSE, Eds. American Ceramic Society, Westerville, OH, 1987. x, 388 pp., illus., + plates. $60; to society members, $48. Ceramics and Civilization, vol. 3. From a symposium, Chicago, IL, April 1986.

Derived from a session of an annual meeting of the American Ceramic Society, this volume is concerned both with technological innovation broadly and with its manifestations in the production of ceramics. The volume opens with a chapter by S. C. Reber and M. R. Smith describing recent trends in the study of the history of technology, with particular reference to the writings of Thomas P. Hughes, David Hounshell, David F. Noble, and Ruth Schwartz Cowan. There follows a collection of 14 papers, ranging in length from 8 to 48 pages and of varying degrees of technicality, dealing with specific innovations in ceramics, among them Egyptian faience, Roman glass and concrete, Chinese celadon, refractories in the steel industry, aluminum oxide spark plug insulators, television tubes, and uranium oxide nuclear fuel. The third and final section of the book comprises a summary by Eric von Hippel of his research on "the functional locus of innovation"; a case study by Kim B. Clark and Elaine Rothman of the evolution of ceramic packaging for integrated circuits, an enterprise in which the Japanese firm Kyocera emerged as dominant; an essay by Rustum Roy entitled "The nature and nurture of technological health"; and a discussion by Kingery of recent and projected future developments in ceramics.—K.L.

The New Alliance. America's R&D Consortia. DAN DIMANESCU and JAMES BOTKIN. Ballinger (Harper and Row), Cambridge, MA, 1986. xxii, 209 pp. $29.95.

"The 1980s might be called America's 'R&D consortia years,'" write the authors at the outset of this volume, going on to note that between 1982 and 1986 the number of such collaborations between industry, government, and universities increased fivefold. This volume is the upshot of research the authors, both management consultants, conducted on the phenomenon during that period. Writing in an informal style and quoting extensively from interviews and other sources, the authors present thoughts on such issues as the creation of new technology, technology transfer, the "reshaping" of universities to play a more "activist" role in the economy, the appropriate size and membership of R&D partnerships, the setting of their research agendas, and consortium leadership. The text ends with a 13-page case study of the Microelectronics and Computer Technology Corporation in Austin, Texas, to which "funds are flowing" and which "is so new, different, and on such a grand scale" that its prospects for success are viewed skeptically by some. Appendixes to the book give basic data and brief evaluative comments on the 14 consortia studied by the authors, an "equipment list" for a sample consortium, and the texts of two sample agreements between universities and their partners.—K.L.

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