and practice in medical journals and one by Elizabeth Knoll on the American Medical Association and its journal *JAMA* round out the volume.

Though overall the essays in the volume may be said to concentrate on laying the groundwork for further research rather than tackling the more intriguing questions relating to medical journalism, they do show that the interaction of journal publication and medical knowledge over time is an area well worth study.

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Engaging the Past

A Skeptical Biochemist. JOSEPH FRUTON. Harvard University Press, Cambridge, MA, 1992. xii, 330 pp. $29.95.

When a scientist of distinction puts forth his reflections on the last 60 years of his own subject historians of science may display symptoms of nervous anxiety. Does not such literature, with all the attendant dangers of writing "history" from the standpoint of the present, get their discipline a bad name? Is not such an enterprise foredoomed by envisioning science solely in terms of its internal structure and neglecting the insights suggested by social history, sociology, and anthropology? Do we not have here the ultimate and unspeakable heresy of "Whiggishness"? When such an author ventures moreover to offer an extended critique of current and recent historiography the impulse may well be to reach for one's Kalashnikov (or its literary equivalent).

Such misgivings about what might be called "a scientist's approach to history" are not entirely unfounded. But this book by Joseph Fruton should be taken seriously by the historical community precisely because it does address with courage and skill many of the issues that have divided scientists and historians with regard to recountings of the past. The author is not "merely" a distinguished worker in the field of protein biochemistry. By many earlier publications he has also shown himself to be a very competent historian of his science and a formidable opponent of those who would undervalue a scientist's insight in historical writing.

The title of Fruton's book echoes that of Robert Boyle's *Sceptical Chymist* of 1662, and so does his program. Like his English predecessor, he is deeply concerned with clarity of expression and fundamental definition. In the final chapter of his book Fruton offers a series of reflections on biochemical literature, stressing the transformation of chemical language by Lavoisier and his contemporaries and the subsequent fortunes of terms like "gene," "enzyme," "affinity," and other "words of the tribe." And he has some wise things to say about the role, fraudulent as Peter Medawar argued or otherwise, of the scientific paper and journal.

Just as Boyle was profoundly skeptical about many hallowed beliefs of the 17th century, particularly the traditions of Aristotelianism and alchemy, so Fruton maintains a healthy skepticism toward much of the received doctrine of our own day. "Skepticism has played a large role in the interplay of chemical and biological thought," he writes, instancing the well-known reluctance of chemists to take seriously chemical hypotheses advanced by biologists and *vice versa*. And underlying the whole book is a profound skepticism about the degree of illumination shed by modern analytical philosophy upon the interplay between biology and chemistry. One chapter provides a truly magisterial survey of a century of such interplay, touching on such important concepts as specificity, individuality, holism, and reductionism.

Fruton's skepticism extends to various popular characterizations of "the scientific method." The Popperian views of Medawar come in for special criticism, not least for their emphasis on inductivism, which Fruton regards as obscuring the real historical development of science. Apparent support for inductivism by various notables is dismissed as rhetoric called forth by particular circumstances, not as representing a considered agenda for their work in science. The polemic of Claude Bernard (cited by Medawar) is regarded as a manifestation of an egocentric desire to project himself as the founder of "experimental medicine," and Liebig's fulminations against Bacon are seen as part of a general campaign against the English, who were, in the 1860s, forsaking Liebig's theories on agriculture for the more modern

Vignettes: Publicity

[Richard] Feynman resented the polished myths of most scientific history, submerging the false steps and halting uncertainties under a surface of orderly intellectual progress, but he created a myth of his own. When he had ascended to the top of the physicists' mental pantheon of heroes, stories of his genius and his adventures became a sort of art form within the community. Feynman stories were clever and comic. They gradually created a legend from which their subject (and chief purveyor) seldom emerged.

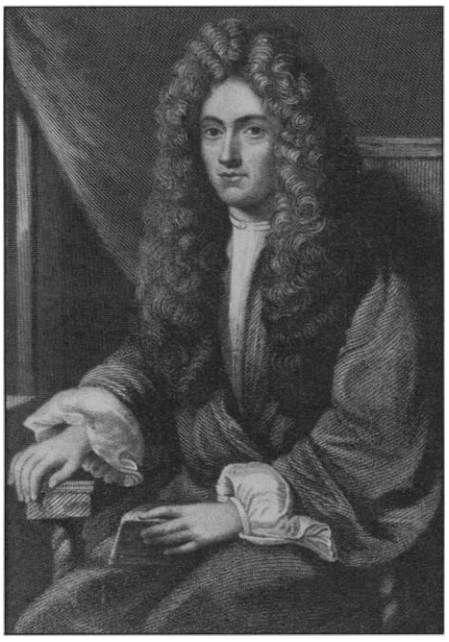
—*James Gleick*, in *Genius: The Life and Science of Richard Feynman* (Pantheon)

In writing this book, I have become very much aware that my training is as a viewspaperman rather than a scholar. A viewspaperman when in full employment publishes perhaps one thousand words a day, and is anxious to have his views considered and words used, with or without attribution, so as to keep the discussion going . . . . Scholars . . . publish far fewer words a year, and can become very cross if somebody repeats them without attribution. Johnny [von Neumann] did not belong to this company. He wanted the ideas pulsing each moment through his mind to get quickly into the public domain, though preferably not through journalists.

—*Norman Macrae*, in *John von Neumann* (Pantheon)

Whistleblowers, nemesis figures, and journalists are often lumped together in the same analytical stew, perhaps because the publicity-prone whistleblowers or determined nemesis figures have so often used the press as the means for drawing attention to their accusations. The role that science journalism has actually played in the fraud controversy, however, has not been either as aggressive as its critics charge or as courageous as the journalists themselves might like to think. They have been drowsy watchdogs, not hyperactive pit bulls.

—*Marcel C. LaFollette*, in *Stealing into Print: Fraud, Plagiarism, and Misconduct in Scientific Publishing* (University of California Press)



Robert Boyle, skeptical chemist. [Mary Evans Picture Library/Photo Researchers, Inc.]

views of Lawes and Gilbert. Above all, Fruton repeats his well-known view that the development of biochemistry owed more to techniques than to ideas. That the role of craftsmanship has been undervalued is now being recognized by historians of science. Both biochemistry and organic chemistry offer ample evidence for its historical importance.

As for historians of science themselves, Fruton's observations will be greeted with a mixture of puzzlement, annoyance, and delight. I confess my response to be in the last category. Deprecating some early criticisms of Partington's monumental *History of Chemistry* for its overwhelmingly factual content, Fruton berates the critics for inconsistency (they do the same thing themselves), for "opportunistic pandering" to a wider audience, and for simply not knowing enough science. His prescription for good history of biochemistry will not please everyone:

> A detailed knowledge of the present state of these areas of scientific inquiry is, in my view, indispensable for the understanding of the past, and the counsel to historians of science that the less they know about the present, the better their perception of the past, is therefore misguided.

Fruton's latest book is a shining demonstration of that thesis and should be read by scientists and historians of science alike.

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Grains in Space

Dust in the Galactic Environment. D. C. B. WHITTET. Institute of Physics, Philadelphia, 1992 (distributor, American Institute of Physics, New York), xii, 295 pp., illus. $95; paper, $39. Graduate Series in Astronomy.

Interstellar dust, composed of submicron particles between the stars, has a huge influence on the properties of interstellar matter and on the galaxies themselves. By radiating efficiently in the far infrared, it provides a means by which dense molecular clouds can rid themselves of gravitational energy and collapse further, eventually forming stars. Dust is the site of molecule formation within the clouds, certainly of H_2 and possibly of others that are observed (contrary to theoretical expectations) by radio astronomers. Warmed by starlight, it is the source of a substantial fraction of the total energy radiated by the Galaxy per second.

Much is known about the properties of dust, such as the wavelength-dependence of its extinction (scattering plus absorption) and polarization, and some of the implications thereof. This book clearly describes the relevant observations and theories. In addition, there are several mysteries, based upon apparently conflicting (and certainly puzzling) data, with appeal to physicists, chemists, and astronomers. For instance, the only spectral feature in the ultraviolet extinction law (down to about 100 nm) is a very strong resonance at 217.5 nm. It is almost, but not quite, at a fixed wavelength among various lines of sight but has a highly variable width. This feature is so strong that the abundant element carbon is almost surely responsible for it, but there is no agreement about the form of the carbon. There are aromatic rings present (judging from infrared emission bands), but individual molecular species have strong ultraviolet absorptions that are not seen.

Another major mystery is the origin of the optical "diffuse interstellar bands," over 100 spectral features spanning a wide range of widths and strengths. The first were discovered in 1922 and recognized in 1934 as interstellar. The bands are still completely unidentified, even as to whether they arise from impurities within the solid dust grains or from molecules in the gas phase (there are good reasons against either hypothesis). Their properties present a fascinating puzzle.

The book discusses well the origin and evolution of grains, both of which are subjects of considerable controversy. Grains of at least two distinct chemical compositions (depending upon whether carbon or oxygen has the larger number density when condensation occurs) are injected into the interstellar medium from a variety of stellar sources. Chemical modification of grains within the interstellar medium is very interesting because the chemical and physical state of grain surfaces (highly processed by radiation, cosmic rays, and interstellar shock waves and sometimes possessing mantles of various ices) is quite conjectural. There is a major discrepancy in our understanding of grain destruction: according to reasonable theoretical estimates, grains within the interstellar medium should be returned to the gas phase rather quickly because of the severe buffeting they receive from the occasional violently expanding supernova shell. Observations, however, show that almost all of certain elements is contained in the grains. Whittet takes the best approach, which is to trust observations of molecular species in clouds, meteoritic abundances, and spectra whenever possible.

The book is aimed at an advanced-undergraduate or beginning-graduate level. It presents several points of view on various subjects and discusses the strengths and weaknesses of each, instead of dwelling upon the theories currently favored by a majority of workers in the field. There is a very complete list of references to the original literature. The necessary astronomical background is given in the first chapter.

I recommend this book to workers in a variety of fields involving the interactions of solids and gases under conditions that are not encountered in our laboratories. The author presents the relevant observations, with theories as useful frameworks for interpretation. He is not at all shy about pointing out gaps in our knowledge and weaknesses in our interpretation, and the reader learns much in the process.

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ET and Company

Organic Superconductors (Including Fullerenes). Synthesis, Structure, Properties, and Theory. JACK M. WILLIAMS, JOHN R. FERRARO, ROBERT J. THORN, K. DOUGLAS CARLSON, URS GEISER, HAU H. WANG, ARAVINDA M. KINI, and MYUNG-HWAN WHANGBO. Prentice-Hall, Englewood Cliffs, NJ, 1992. xvi, 400 pp., illus. $66. Inorganic and Organometallic Chemistry Series.

This work attempts to cover what is described by the series editor, Russell N.