This is a true statement that may do damage. Without this startling beginning the paragraph on weightlessness gives a sensible picture of practical troubles. No "explanation" of weightlessness is offered there, but an earlier chapter says "Gravity has been cancelled out by the satellite's speed, so the satellite has no weight." (Physicists must cry aloud for a simple experiment: let the children throw two stones out together, with the same velocity. "Watch them move together, on the same orbit. Now imagine the big stone is a satellite and the small stone some object inside the satellite. Things inside—rocks, lumps of metal, balloons, scientists themselves—all just hover there, as seen by an observer inside. They seem to be weightless.")

Γ raises a different issue of editing. It is one of the Science Study Series that is part of the PSSC program, though the series has spread beyond that program in a most gratifying expansion. As such, this book, too, deserved, and seems to have missed, a careful review by an outside physicist to ensure accuracy and consistency with the PSSC program that it supplements. Such review would have saved some minor mistakes: for example, Poynting's "weighing of the Earth" experiment is attributed to Boys, who made a different and more famous measurement of "*G*." The explanation of tides contains a familiar mistake that would make the lunar tide 90 feet high on the Earth instead of a few feet. But, far more important, a reviewer would have urged the author to reduce the conflict between his occasional use of centrifugal force and the position of the PSSC text, which takes a stern view against it. Gamow starts with centripetal acceleration v^2/r for moon and planets and then switches to a centrifugal force that balances gravitational pull. We are all tempted to make such switches—all three books under review seem to make them—and here all would be well if a few words were added to explain the change of frame of reference. For a book that is part of the PSSC system, with all the care for consistent and reliable science teaching that that title implies, I plead for an editor to add the necessary bridge.

Where science books are sponsored by educational groups, I think advisory boards are not enough: a final revision by an independent scientist is a duty to young scientist readers.

Inglis and Burton Lectures

The Teaching of Science. Two essays. Joseph Schwab and Paul Brandwein. Harvard University Press, Cambridge, Mass., 1962. 152 pp. $3.25.

This small book contains two essays on science teaching in secondary and elementary schools, presented as the Inglis and Burton lectures, respectively, at Harvard University in 1961. The first, by Joseph Schwab of the University of Chicago, is entitled *The Teaching of Science as Enquiry*. The second, entitled *Elements in a Strategy for Teaching Science in the Elementary School*, is by Paul Brandwein of Harcourt, Brace and World.

Schwab makes a plea for teaching science in the spirit of enquiry rather than as rhetoric or a collection of dogma. He usefully defines both *stable* and *fluid* enquiry, the latter being fundamental to the invention and creation of new scientific knowledge while the former provides the fruits for technological development. The author points out three reasons for converting school science "from the dogmatic to the enquiring mode." The reasons are our need for scientists, the competences required for our political leaders, and our need for a public that is cognizant of the nature of scientific enquiry.

Specific suggestions for achieving such a curriculum are offered, including the following unusual boundary conditions: that the laboratory lead, at least in part, rather than lag the classroom; that the classroom concern itself with an exhibition of the course of enquiry rather than with a rhetoric of conclusions; that doubt be specifically injected; that appropriately selected, original papers be included to provide experiences in depth as well as familiarity with true enquiry; that we include "invitations to enquiry" by providing suitable problems.

Every enlightened science teacher will recognize many of Schwab's observations and suggestions as being similar to his own. However, this essay is an unusually perceptive and concise statement which clearly identifies the contrast between two types of enquiry and which convincingly delineates the steps that can be taken to orient the teaching of science toward science itself as a living intellectual adventure. Its pertinence goes far beyond the secondary school to both the undergraduate and graduate curriculum. The author emphasizes that only by positive changes throughout the years of formal scientific education can we revise a situation in which we find our fluid enquirers by identifying them as the men "who run the obstacle course of an indoctrinational curriculum and emerge at the other end not yet wholly indoctrinated."

The second essay, by Paul Brandwein, is concerned with the role of the science teacher at the elementary level. Brandwein dwells primarily on the importance of each child's creativity, on concept forming, and on "teaching rather than telling." He stresses the importance of understanding to what extent children of different ages and abilities can comprehend specific concepts. As in the previous essay, emphasis is on the individual child's intellectual growth through realistic scientific experiences. While this essay makes a contribution to the general problem, it does not strike as boldly at the heart of the matter as the other. As its title implies, however, it provides a strategy for teaching science at the elementary school level, a strategy based upon conceptualization and "a mix of learning in which enquiry plays its appropriate part."

LEONARD M. RIESER
Dartmouth College,
Hanover, New Hampshire

Needed: More Scholars

Great Chemists. Eduard Färber, Ed. Interscience, New York, 1961. xxvi + 1642 pp. Illus. $29.50.

This is a large and impressive work. In its more than 1600 pages it contains the biographies of over 100 scientists who have contributed to the evolution of chemistry. It ranges in time from the era of the chemical technologists in ancient Mesopotamia to 1937 when the subject of the last biography, Wallace Hume Carothers, died. It can be safely stated that there is no other volume quite like it. Its nearest competitor, Günther Bugge's *Das Buch der Grossen Chemiker*, does not range so widely either in number, time, or space; but it should be pointed out that the present volume does not entirely displace Bugge from its honorable position in the history of chemistry.

The size and scope of this volume have created editorial difficulties which the editor, Eduard Färber, has not always surmounted. The basic problem seems to have been to find enough qualified historians of chemistry to write really first-rate accounts of those men considered worthy of the epithet "great." There simply are not enough to do the job. Färber has exercised considerable ingenuity in getting around this fact, but his solutions lead to a great variation in the level and quality of the various contributions. There are essentially three kinds of essay here: the modern treatment by a competent scholar; the estimate of the contributions of a colleague by one of his contemporaries familiar with his work; and the rather pious and uncritical article written by either a student or an acquaintance as a kind of long obituary. This approach sometimes leads to strange results. There is no decent study today of Auguste Kekulé, and, to my knowledge, no one is actively engaged in a biography of Kekulé or in a detailed analysis of his work. Färber, therefore, must take what he can get, and this, it must be confessed, is very little. Kekulé, one of the seminal minds in the history of organic chemistry, receives exactly three pages, whereas Robert Hare, a man whose name is not associated with any discovery of real importance, receives 12. Similarly the work of Walther Nernst is discussed chattily by Albert Einstein in two and one half pages. With all due respect to Einstein, this is not one of his more important essays in the history of science.

A different criticism may be leveled at the essays by the subjects' contemporaries. Here there is an almost total loss of historical perspective, and this fault is, of course, magnified by distance from the present in time. Félix Vicq d'Azyr's *éloge* (1783) of Duhamel du Monceau really tells us very little of Duhamel's work and importance. Indeed, on the basis of this essay, I would challenge the inclusion of Duhamel in a work on great chemists. The essays by contemporaries also may serve to illustrate another editorial shortcoming. The chemical language of the 18th century was quite different from that of our own. An editor is therefore faced with an important choice: he must either leave the original essay as he found it and thereby run the risk of the modern reader finding much in it that is incomprehensible, or he must tactfully intervene to explain terms without introducing concepts foreign to the original author. Färber chooses neither of these alternatives consistently.

In the *éloge* of Duhamel the editor intrudes to inform the reader that what Vicq d'Azyr meant in the phrase "contains only the basis of marine salt" is sodium. This is done by using a simple parenthesis thus: "(i.e., Sodium)," without any previous warning that this is how the editor is going to clarify matters. In point of fact, of course, since sodium was not discovered until some time after Vicq d'Azyr himself had died, this cannot be his meaning, and the editor has served to obscure and falsify a passage. On the other hand, in another article, some modern readers may find the statement that at Uppsala, Scheele "started the experiments concerning the dephlogistication by means of *magnesia nigra*" a bit perplexing even though *magnesia nigra* is translated into manganese dioxide.

There are some eight or ten essays of this type which seem to me to be unworthy of serious attention. Fontenelle on Lemery is of purely antiquarian interest; Lord Brougham's essay on Joseph Black is totally inadequate in terms of modern knowledge of the history of chemistry; Cuvier's *éloge* of Henry Cavendish, William Henry's speech on Priestley, Flourens' *éloge* of Thenard, and Arago's account of Gay-Lussac's life and work may serve as the starting points for further investigation, but in most cases recent research has revealed far more than is here presented. The only excuse for their inclusion appears to be convenience which, while it may carry considerable weight with the editor, should not be expected to influence the potential purchaser of the volume.

As we approach the present, the force of these criticisms is considerably reduced. Sir Harold Hartley's essay on Henry Edward Armstrong, for example, is a beautiful little piece fully worthy of being reprinted from *Chemistry and Industry*, where it was first published. And, in many cases, the *éloge* or memorial lecture is all that is available. Until historians of chemistry really come to grips with the last 150 years, these essays will continue to have considerable value.

The third type of article, that written by a scholar fully conversant with his subject, is what gives *Great Chemists* its true importance. Many articles have been translated from Bugge's work, and they can now be perused with profit by those to whom German is less than a pleasure to read. Other articles were commissioned expressly for this work, and they are quite consistently good. Robert Multhauf's articles on Paracelsus, Libavius, and Beguin are models of clarity and historical judgment; Milton Kerker's essay on Boerhaave illuminates the career of this great teacher and shows why he had such influence in the 18th century. Marie Boas on Boyle is what one expects from the leading Boyle scholar. Denis Duveen presents a clear and precise summary of the life of Lavoisier, although Lavoisier's theoretical and philosophical ideas seem not to emerge. Duveen's enthusiasm for his subject also leads him to refrain from mentioning that Lavoisier's *system*, but not his method, only lasted two decades before Humphry Davy blew it up. I would quarrel with Robert Siegfried who insists upon Davy's extreme empirical temper; Davy had very deep theoretical ideas and used them to guide his research (on the diamond and on the condensation of gases). Mention, unfortunately, cannot be made of all the essays in this group: suffice it to say that they are all worth reading.

Physically, this volume is a handsome one with a good index that greatly enhances its usefulness. There are some misprints, but considering the enormous size of the book, they do not appear to be excessive. The chemist, teacher, and historian of science will each want to have this volume on his shelf. If used with caution, it will provide many, many hours of enjoyment and stimulation and much food for thought.

L. PEARCE WILLIAMS
Department of History,
Cornell University

Rockwell Lecture Series

Darwin and the Modern World View. John C. Greene. Louisiana State University Press, Baton Rouge, 1961. viii + 141 pp. $3.50.

This clearly written and easy to read small book is, in part, a continuation of the author's earlier work, *The Death of Adam: Evolution and Its Impact on Western Thought*. Each of this book's three chapters covers the ground of a lecture John Greene gave in the Rock-