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.

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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-

well Lecture series at Rice University. In these lectures, the author placed Charles Darwin in the scientific, philosophical, and religious setting of his time and traced Darwin's influence on the development of these three overlapping fields. His treatment is lucid and objective, and it is given in some detail.

We can trace the conflict between revealed religion and Deism back to the time when Sir Isaac Newton first described the universe as operating according to law, rather than according to impulse or whim or a series of unlawful acts. Darwin entered the fray much later, and his contribution to the dispute was made nearer to our own time than to the beginning of the controversy. Darwin's demonstration of how natural selection caused species to evolve helped to undermine all static views of nature. It also helped to destroy any belief in the verbal accuracy of Scripture. But more important than this, Darwin applied the methods of natural science to the study of man as an individual and to the study of human society.

It was inevitable, perhaps, that this application would be accompanied by some confusion. For instance, the "struggle for existence" in nature was assumed by many to be homologous with business competition in a *laissez faire* economy and, if the results of the struggle in nature were beneficial, those in society were also assumed to be good; this in spite of the easily observed fact that social and biological successes were often antithetical! In evolution, biological success consists exclusively in leaving offspring. In human society, the social failures were, in general, the biologically successful because of the number of children they left, sometimes for the state to support.

The author holds that Darwin's influence on social thought has been both good and bad; good in that it showed man's relation to the animal kingdom, bad in that it encouraged Herbert Spencer's emphasis on individual, racial, and national competition and in that it encouraged the idea that the methods of the natural sciences are fully adequate for the study of human nature and human society. Science, the author holds, needs the support of both philosophy and religion before we can use it as a guide.

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Entropy in Communication

Life and Energy. An exploration of the physical and chemical basis of modern biology. Isaac Asimov. Doubleday, New York, 1962. 380 pp. Illus. $4.95.

This introduction to the manner in which living organisms derive energy from their surroundings is written in layman's language and starts with the assumption that the reader will not have even a high school background in physics, chemistry, biology, or mathematics. The first half of the book treats the underlying principles of work, energy, heat, chemical bonding, and kinetics of reaction. The second half, which is appreciably more successful and up-to-date than the first, then uses these concepts to discuss the action of enzymes, the assimilation of foodstuffs, intermediary metabolism, and the role of high-energy compounds in the chemistry of life.

The general organization of topics is excellent, and the author effectively uses concepts already developed to undergird subsequent presentations. The basic principles are illustrated with examples from the more familiar inorganic realm before they are applied to biological chemistry. Isaac Asimov, the author, is well-known for his readable style and his flair for putting scientific concepts into clear, understandable language. Unfortunately, however, that ability was not applied uniformly throughout this book. Marked unevenness in the presentation gives the impression that the volume was too hastily put together. A disappointing number of errors and distorted statements occur throughout the text (and in at least one quarter of the figures). Several of these will confuse readers who have little background in the subject. In general, both the figures and the uses of analogy are quite helpful aids to understanding; but a number of them are confusingly constructed, and the reader will wish for others that are not provided.

The concept of entropy, introduced in the first part and widely used in the second part, suffers from a particularly uninspired explanation. This is especially unfortunate since the average reader initially has little intuitive feeling for this thermodynamic property. The chapters on chemical bonding and on photosynthesis are also less ably written than one would hope for in a book of this kind. In the first part of the book, the author takes great pains to avoid using powers of ten—even Avogadro's number is written out at length. Subsequently he introduces them in a figure, without further explanation, and continues to use them in the latter part of the book.

The presentation is almost entirely historical and descriptive and does not contain the rigor and thoroughness that would be expected of an elementary textbook. Unfortunately, it also neglects much of the excitement of science, by failing to emphasize those areas in which present knowledge is lacking and in which scientists are actively seeking answers to profound questions. Furthermore, there are no references to additional sources for the interested reader. For these reasons, this book is not well-suited to the high school student contemplating a career in science, in spite of the fact that its style of writing might make it seem attractive.

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Packets of Thought

Human Values and Science, Art, and Mathematics. Lillian R. Lieber. Norton, New York, 1961. 149 pp. Illus. $3.95.

This nicely issued and charmingly illustrated small volume consists essentially of two parts. The first half deals with a few key mathematical concepts presented with the conciseness and lucidity for which Lillian Lieber has won her well-earned, if limited, fame, and in the free verse which serves her manner so effectually. She conveys in pleasing phrases the meaning of geometrical systems, the role of the axioms or postulates that constitute their foundations, and the rules demanded of and the freedoms permitted to the superstructures erected upon them. She then elucidates the meanings of truth and functionalism in mathematical exploration and applies her particular gift of lucidity to some of the new systems of algebra, with their novel language and meanings. Even readers familiar with the essence of the modern vistas of mathematical thought, will delight in these lightly uttered free-verse lines, rich in ideas and carrying solid packets of thought and explanation.