Engravings of the 17th Century, Thames & Hudson, London, 1988.

271. S. Matton, "XXIV thèses de Iacopo Mazzoni sur l'alchimie", *Chrysopoeia*, **1989**, *3*, 91-96.

272. I. Merkel and A. G. Debus, *Hermeticism and the Renaissance: Intellectual History and the Occult in Early Modern Europe*, Folger Books, Washington, D. C., 1989.

273. D. Merkur, "The Study of Spiritual Alchemy: Mysticism, Gold-Making, and Esoteric Hermeneutics", *Ambix*, **1990**, *37*, 35-45.

274. W. Newman, "Prophecy and Alchemy: The Origins of Eirenaeus Philalethes", *Ambix*, **1990**, *37*, 97-115.

275. M. Papathanassiou, "Stephanus of Alexandria: Pharmaceutical Notions and Cosmology in his Alchemical Work", *Ambix*, **1990**, *37*, 121-133.

276. M. Pereira, *The Alchemical Corpus Attributed to Raymond Lull*, The Warburg Institute, University of London, London, 1989.

277. W. F. Ryan, "Magic, Poisons, and the Virtues of Stones in the Old Russian *Secretum Secretorum*", *Ambix*, **1990**, *37*, 46-54.

278. F. Secret, "Alchimie, palingénésie et métempsychose chez Guillaume Postel", *Chrysopoeia*, **1989**, *3*, 3-60.

279. Z. R. W. von Martels, ed., *Alchemy Revisited: Proceedings of the International Conference on the History of Alchemy at the University of Groningen 17-19 April 1989*, Brill, Leiden, 1990.

280. G. Zanier, *L'Espressione e l'Immagine: Introduzione a Paracelso*, Edizioni Lint, Trieste, 1988.

Reprints, Reproductions and Translations

281. H. Bessemer, *Sir Henry Bessemer, F.R.S. An Autobiography*, Institute of Metals, London, 1989 (reprint of the 1905 edition).

282. V. Biringuccio, *Pirotechnia*, Dover, New York, NY, 1990, (reprint of the 1942 English translation of the 1540 edition).

283. Constantine of Pisa, *The Book of the Secrets of Alchemy*, Brill, Leiden, 1990 (translation and commentary on the manuscript of 1237 by B. Obrist).

284. Damigeron, *De virtuibus lapidum*, Ars Obscura, Seattle, 1989 (translated by P. T. Tahil).

285. P. Duhem, *Le mixte et la combinaison chimique, essai sur l'évolution d'une idée*, Fayard, Paris, 1985 (reprint of the 1902 edition).

286. E. Egg, ed., *Schwarzer Bergbuch*, Akademische Druck- und Verlagsanstalt, Graz, and Verlag Glückauf GmbH, Essen, 1988 (reproduction of the 1556 manuscript with a commentary).

287. H. Guerlac, *Lavoisier - The Critical Year: The Background and Origins of his First Experiments on Combustion in 1772*, Gordon & Breach, New York, NY, 1990 (reprint of the 1961 Cornell edition).

288. E. J. Holmyard, *Alchemy*, Dover, New York, NY, 1990 (reprint of the 1957 Penguin edition).

289. D. McKie, *Antoine Lavoisier: Scientist, Economist, Social Reformer*, Da Capo, New York, NY, 1990 (reprint of the 1952 Schuman edition).

290. J. D. van der Waals, *On the Continuity of the Gaseous and Liquid States*, North Holland, Amsterdam, 1988 (a new translation by J. S. Rowlinson of van der Waals' 1873 thesis and his 1890 paper on mixtures).

291. C. J. S. Thompson, *The Lure and Romance of Alchemy*, Bell, New York, NY, 1990 (reprint of the 1932 Harrap edition).

292. L. P. Williams, *Michael Faraday*, Da Capo, New York, NY, 1987 (reprint of the 1964 Basic Books edition).

BOOK NOTES

A Science of Impurity: Water Analysis in Nineteenth Century Britain. Christopher Hamlin, University of California Press, Berkeley and Los Angeles, 1990. xiii + 342 pp. Cloth (Typeset). $45.00.

This is an extremely interesting case study of a little explored aspect of the rise of the professional chemist - the role of chemists - or, indeed, of scientists in general - as expert consultants on matters of public health. Beginning with the analysis of mineral waters in the 18th century and extending through the debates on the relative roles of bacteriology versus chemistry in water purification and management at the end of the 19th century, Hamlin gives a disturbing picture of chemists willing to assume the role of public expert, both for reasons of enhancing the public status of their profession and in order to financially supplement their often none too remunerative academic and industrial positions, while at the same time admitting within the chemical literature that the analytical procedures they employed in making their expert pronouncements were lacking a sound scientific basis.

The problems plaguing scientific water analysis were of two kinds. The first of these, and the only one which properly fell within the province of the chemist, was the problem of destructive versus nondestructive methods of analysis. Were the ingredients reported by the chemist actually present as such in the water or were they generated from other ingredients by the process of chemical analysis?

In modern terms, this reduces to the question of whether one is using chemical or physical methods of analysis. Classical chemical analysis, which was the only kind available for most of the 19th century, basically consists of synthesizing known compounds from unknown compounds and is decidedly destructive. Though it can be used to infer unambiguously the elemental composition of the unknown, inference of its molecular composition and structure requires additional, and often highly questionable, assumptions.

A very suggestive theoretical analysis of these problems had been given by Berthollet early in the 19th century, and the implications of Berthollet's theory for water analysis were clearly spelled out by the Scottish chemist, John Murray, in 1815. Nevertheless, many chemists concerned with water analysis continued to ignore these difficulties throughout the rest of the century. Writers on the history of analytical chemistry have frequently commented on the fact that an explicit

theory of chemical analysis did not begin to develop until the last decade of the 19th century and nowhere is this lack of a guiding theory for the design and evaluation of empirical methods of analysis more apparent than in Hamlin's account of 19th century water analysis.

The second problem which plagued water analysis was whether the chemical ingredients the chemist was attempting to detect actually had the cause and effect relation to public health claimed by the medical profession. This question is really outside the province of the chemist, though this did not stop several of them from taking public stands on this issue.

Aside from a rather cumbersome method of recording the references and footnotes, this volume is highly recommended on all counts, especially to those interested in the history of chemical analysis, in the rise of the chemical profession, and in the larger question of the role of science in public policy decisions. *William B. Jensen, University of Cincinnati, Cincinnati, OH 45221.*

Aproximación a la evolución histórica de los métodos de adjuste de las ecuaciones químicas. Lluis Garrigós i Oltra, Instituto de Cultura Juan Gil-Albert, Alicante, 1990 (in Spanish). 110 pp. Paper (Typeset). $6.00.

This short monograph is basically an historical review of various methods that have been proposed for balancing chemical equations. As such, it falls somewhere between the history of science literature, on the one hand, and the educational literature, on the other. On the whole, it is probably of most relevance to chemists interested in chemical education, but may also be of interest to philosophers of science looking for an entrée into the meaning and ontological status of chemical equations.

Though the author cites a few late 18th and early 19th century textbook discussions (mostly from Spanish texts) of how to balance chemical equations, the vast majority of the monograph deals with the late 19th century literature found in Crookes' *Chemical News* and the 20th century literature found in both the *Journal of Chemical Education* and in *Chemistry Magazine*. Since this is a subject that has long interested the reviewer, he can verify that the author has done a thorough job of tracking down most of the pertinent references.

The author concludes that all of the methods are equally valid. While this is certainly true in the obvious sense that ultimately they all lead to the same result - namely a properly balanced equation - the reviewer would disagree that all of them are equally explicit in revealing the basic assumptions involved in the use of balanced equations. Ever since its introduction by James Bottemley in 1877, it has been known that the so-called algebraic method of balancing equations, also known as the "method of equations of balance", is the most fundamental available, since it is explicitly based on the twin principles of conservation of elements and conservation of charge in all chemical reactions. Not only does this approach allow one to balance the most difficult equations, it provides, in the form of a "degree of freedom" calculation, a check on whether pertinent information is missing in the equation and on whether one is actually dealing with a single chemical reaction or with the sum of several simultaneous reactions.

However, since the method requires the solution of a set of simultaneous algebraic equations (one for each element and one for the net charge), its lack of appeal in an introductory chemistry course is self-evident. In lieu of this rigorous approach, students are taught instead to balance equations by "inspection" and, when the equation is too complex to readily do this, they are given various rules for formally dissecting it into a set of simpler "half-reactions", each of which, when coupled with such artifical devices as oxidation state conventions and hypothetical electron transfers, is separately amendable to the inspection method. The balanced half-reactions are then added together to give the final overall balanced equation.

Granted that there are sound pedagogical reasons for avoiding the rigorous approach at the introductory level, the question remains as to why this subject is not reviewed again in a more sophisticated manner in introductory physical chemistry courses. As things now stand, chemical engineers are exposed to the algebraic approach but not professional chemists. One result of this educational hiatus has been the continued propagation of an embarrassing literature on "nonstoichiometric reactions" in the *Journal of Chemical Education*. Translation of this book into English would do much to alert American chemical educators to this flaw in our training.

Copies of the book can be ordered by writing to the Editor, Ins "Juan Gil Albert", Av. Estacion 6, 03005- Alicante, Spain. *William B. Jensen, University of Cincinnati, Cincinnati, OH 45221.*

The Japanese and Western Science. Masao Watanabe, University of Pennsylvania Press, Philadelphia, PA, 1990. xiv + 141 pp. Cloth (Typeset). $28.95.

This is an English translation, by O. T. Benfey of the Beckman Center for the History of Chemistry, of a German translation of the original Japanese text published in 1976. The book contains seven, largely independent, essays dealing with various aspects of late 19th and early 20th century contacts between Japan and Western science, mostly in the fields of biology and physics. The emphasis is on how the Western scientific concepts (and their early representatives) were subtly modified by their contact with traditional Japanese culture. The essays are straightforward accounts unmarred either by national chauvinism or the historiographic pretensions which

abound in much of the recent literature in history of science. The book is amply illustrated with both photographs and line drawings, though some of the former are of rather poor quality.

Though chemistry is not discussed, the volume is recommended to those interested in the history of Oriental science and in the larger question of how science both reflects and impacts on the culture of which it is a part. Chemists may wish to read it in conjunction with the detailed account by Shilhara and McBee of the introduction of chemistry into Japan which appeared in *Chemical & Engineering News* in 1988 (Oct. 31, pp. 26-40).

Svante Arrhenius. Yu. I. Solovyov, Nauka Publishing, Moscow, 1990 (in Russian). 320 pp. Cloth (Typeset). NPG.

Directed at a general audience interested in the history of science, rather than just at physical chemists, this short biography of Arrhenius deals not only with his work on the ionic theory of dissociation and the temperature dependency of reaction rates, but with his later sorties into the fields of immunology and cosmology. The book is properly footnoted and contains a complete bibliography of Arrhenius' publications. It isn't apparent to what extent this volume derives from the earlier biography of Arrhenius by Solovyov and Figurovski published in 1959.

From Chuit & Naef to Firmenich. S.A. Roger Firmenich, Firmenich Incorporated, Geneva, 1990. 139 pp. Paper (Typeset). NPG.

This lavishly illustrated volume traces the history of this well-known Swiss-based perfume and flavor company from its founding by Philippe Chuit and Martin Naef in 1895 to its present status as an international operation employing more than 2000 persons in 18 different countries. The volume traces not only the administrative aspects of the company's history but its involvement in research and development, including its interactions with such famous chemists as Léopold Ruzicka and Max Stoll.

LETTERS

Lavoisier's Instruments

The apparatus and instruments used by Lavoisier are discussed by a number of authors in the Winter 1989 (No. 5) issue of the *Bulletin*. However, contrary to what is commonly believed, much of his extant equipment was known to exist well before the 20th century. The first modern notice of Lavoisier's apparatus is probably the publication of Truchot in 1879 ("Les Instruments de Lavoisier", *Ann. Chim. Phys.*, **1879**, *18*, 289-319). This paper provides an account, in somewhat embellished style, of a visit to the château of M. Étienne de Chazelles, a descendent of Madame Lavoisier, near Aigueperse, Puy-de-Dôme and, in addition, mentions other items then in the Conservatoire des Arts et Métiers. Truchot describes the balances and other pieces of equipment preserved by the family of Madame Lavoisier. The famous painting of Lavoisier and his wife by David is also mentioned as being viewed during the vist to the château.

Ronald K. Smeltzer, Princeton, New Jersey

AWARDS

The Dexter Award

The 1991 Dexter Award for outstanding accomplishment in the history of chemistry has been awarded to Dr. Owen Hannaway of Johns Hopkins University. The award, which consists of a cash prize of $2000 and an engraved plaque, was presented to Dr. Hannaway at the Fall National ACS Meeting in New York City.

Born in Scotland, Dr. Hannaway received his B.Sc. in chemistry from the University of Glasgow in 1961. This was followed by a Ph.D. in 1965 for a thesis on "Early University Courses in Chemistry" with particular emphasis on the 17th century. After one year as a postdoctoral fellow under Aaron Ihde at the University of Wisconsin, Dr. Hannaway went to Johns Hopkins in 1967 as an Assistant Professor in the History

Owen Hannaway