BOOK REVIEWS

Chemistry & Art. Further Adventures of a Chemist Collector. Alfred Bader, Weidenfeld & Nicolson, London, 2008, x + 246 pp, ISBN 978-0-297-85512-5, £18.99.

This publication is the sequel to Alfred Bader's first book, titled *Adventures of a Chemist Collector* (Weidenfeld & Nicolson, 1995). As readers (and movie goers) will always appreciate, Dr. Bader provides a brief, two-page summary of the earlier book. Born in Vienna in 1924, the young Alfred in 1938 was spirited out on the first *Kindertransport* leaving Vienna, interned briefly as an "enemy alien," landing in a Canadian prisoner of war camp, and then being accepted to Queen's University in Kingston, Ontario (one of the greatest "investments" ever *unknowingly* made by a university). From there followed major steps: enrolling at Harvard and earning a Ph.D. with Louis Fieser, meeting Isabel Overton in 1949, falling in love yet unable to wed because of perceived religious issues, and starting the Aldrich Chemical Company in 1951—the gold standard in fine chemicals for generations of organic chemists, including this reviewer. Marriage to Helen Daniels followed in 1952, the births of David and Daniel, divorce in 1981, and marriage to Isabel in 1982. As Aldrich prospered, Dr. Bader indulged an early interest and assembled a world class collection of paintings with particular strength in seventeenth-century Dutch masters including Rembrandt. Aldrich catalogs of this era featured beautiful, full-color reproductions of gems in the Bader collection as cover art. Even today, one occasionally finds these collectable catalogs on Ebay. Merger to form Sigma-Aldrich in 1975 was not ultimately as happy a union as anticipated and, in 1992, Dr. Bader was "expelled" (his term) from the company. Freed from the grind of business and business politics, Alfred Bader turned his formidable knowledge and entrepreneurial and management skills toward collecting and dealing in art masterworks as well as a range of philanthropic causes.

In reviewing of the present book, it is fair to say that chemistry plays only a minor role in it. There is a fairly complex mystery involving art as well as chemistry related in Chapter 9 (*Prussian Blue*). A painting titled *A Chemist's Laboratory* in the Museum of the History of Science at the University of Oxford is said to depict Sir Humphry Davy conducting an experiment with an assistant. The painting is signed and dated "LR 1827" and reproduced in Plate 48. (This book contains 81 glossy plates, and more than half are excellent photographs of paintings). The questions include: Who is the artist? Is this an original subject or a derivative? Is it indeed Humphry Davy? Or is it William T. Brande, Davy's successor at the Royal Institution in 1813? Is the young assistant in fact Michael Faraday, who had strong associations with Brande as well as Davy? To make matters more interesting, Dr. Bader was contacted by an art dealer in North Carolina, who sold him a somewhat larger version of the same scene that more clearly depicted the mixing of two solutions to produce a blue precipitate (Plate 50). At one point, Dr. Bader offered a £1,000 award to the person who could solve the puzzle or most contribute to its solution. I will not spoil the fun by disclosing the (likely) solution. Chapter 15 is a photographic reprinting of a 1998 article authored by Dr. Bader and published in the *Bulletin for the History of Chemistry*. Its topic is the connection in chemical symbolism between William Joseph Wiswesser and the nineteenth-century chemist Josef Loschmidt. During the 1960s, Wiswesser developed the Wiswesser Line Notation (WLN), which provided a simple way to describe any chemical structure in printable line notation. WLN was employed in Aldrich catalogs. Wiswesser admired Loschmidt, whose depiction of benzene anticipated that of the more well-known Kekulé.

The largest portions of the book, however, describe Dr. Bader's adventures (once again) in collecting, verifying, buying, and selling great paintings, primarily those of the seventeenth century as previously noted. Now, it is fair to say that an "absolutely pure" chemist might find this material irrelevant and perhaps even a bit boring. However, this reviewer is considerably "impure" and eclectic in interests and suspects there are numerous like-minded chemists among the potential readership of this book. I have collected rare books in chemistry and alchemy for over three decades. So the "inside game" of auctions, including strategic positioning behind opposing bidders, consortia of purchasers, dealing with auction houses on unsold items, verifying provenance, and just "plain old *hondling*" (*hondling* is a Yiddishism for bargaining) make for enjoyable reading. Since my purchases are usually three to four orders of magnitude lower in price than those of Dr. Bader, he is my surrogate for flights across the Atlantic and visits to the elite dealers, auction houses, and scholars.

There are eighteen chapters in this book, and some briefly relate deep friendships as well as Alfred's and Isabel's dedication and decision making in the cause of philanthropy: Jewish philanthropies, the American Chemical Society's Project SEED for economically-disadvantaged high school students interested in science, efforts to promote the well-being of Israeli Arabs, aid to the Roma people. The Helen Bader Foundation, administered by son Daniel, is another effective charitable organization; and Queen's University has received major contributions including funding of its new chemistry building, donations of artwork worthy of any great museum, and the 140-room, fifteenth-century Herstmonceux Castle in England dedicated to international and interdisciplinary learning (see Plate 55, itself a photographic artwork). These points are made with a quiet pride rather than self proclamation—all in all a life well lived. That is not to say that Dr. Bader does not enjoy some S*chadenfreude* at the expense of those at Sigma Aldrich, who treated him so rudely, or the occasional unprincipled art dealer. What is abundantly clear is that Dr. Bader is a passionate man of generous spirit. Here is my own experience (and proper disclosure): a few years ago, I requested permission to reproduce in full color a print from the Collection of Isabel and Alfred Bader of the 1671 oil painting *The Alchemist*, by Hendrick Heerschop for a pictorial book I was writing. Although I had very briefly met Dr. Bader a few years earlier in Milwaukee and certainly also knew that his business was not in need of my funds, I followed the publisher's protocols in formally requesting permission and offering to pay a fee. Here was the delightful response:

> Dear Dr. Greenberg, Why should I charge you for a reproduction which it gives me great pleasure to send you, enclosed..With best wishes, Alfred. Bader.

In summary, although chemistry and chemical history account for only a fraction of this book's content, the book provides a peek at many wonderful paintings, an enjoyable and rarified view of the backrooms of the powers that collect, buy, and sell these paintings, and further insight into a major figure in the practice of late twentieth-century chemistry. *Dr. Arthur Greenberg, Department of Chemistry, University of New Hampshire, Durham, NH 03824*

EL COLOR LÍQUIDO. Instrumentos y útiles de la colorimetría en el siglo XIX. Lluis Garrigós-Oltra, Carles Millán-Verdú, and Georgina Blanes-Nadal, Publishing AguaClara, Alicante, 2008, 311 pp, ISBN 84-8018-270-9.

Three representatives of the History of Chemistry, currently professors in the University of Alcoi, bring us this book on the instruments used for colorimetric analysis over time. The authors come from different scientific and technical areas—chemistry, physics, and engineering—but conduct their research in the History of the Sciences and the Technologies. They publish their findings in books and journals of quality, and some of these publications, like those from professor Blanes-Nadal, deal with the history of colorimetry.

There is little in the way of literature and historical studies on the twentieth century design and development of chemical analysis with optical instruments, and even less on the history of how instrumentation was being designed as the different methods of colorimetric analysis were emerging. This lack is due to the interest of industry, and in some cases of public health, in executing rapid tests at the expense of the accuracy of the results, as well as to the fact that this has been an area little cultivated by the historians of science and technologies. Therefore, it is not surprising that the practical applications of colorimetry during the middle of the 19th century remain unnoticed today. In its practical applications, colorimetry assisted the oil and sugar industry, aided in determining the potability of drinking water, or in analyzing the fat content in milk. This was possible because colorimetry is an instrumental technique whose aim is to measure the absorption of visible light by a pure substance or a mixture or a solution.

This book is a good and accurate contribution to the recovery of a scattered, or with respect to some concepts and instruments, nonexistent record of the hereditary toolbox of colorimetry. The authors have been moved to write this book in order to incorporate these materials in a history of analytical chemistry, which is being approached after the parsing of classical sources, while also incorporating new historical, scientific, and technical perspectives. The authors overcame serious difficulties in order to draft a number of valuable pages as they have described in the preface (pp 14-15).

The authors have also had the good sense to contextualize the capital importance that the outlined tools have for museums of science and technology, as well as for their intrinsic historiography. The exploitation of the niche which is presented in this book has not thus far been a priority of these museums, whose tasks are more oriented to the teaching of science than to its history. Thus, it is to be granted that, in the prologue, the former director of the National Museum of Science and Technology in Madrid, Amparo Sebastian Caudet, shows that the museum is interested in the instrumental heritage from industry, university, and research centers. Nevertheless, we, the historians of science and technology, still long for greater attention from both national and regional authorities on this subject.

Divided into nine chapters, the book covers, from the beginnings of the nineteenth century, the usefulness of colorimetry in quantitative chemical analysis, revising the original use of color as an analytical technique, without forgetting the discussions raised between Houtou of Labillardére and Payenabout the titration of chlorine dissolved in water and of charcoal as a decolorizer. The entry about photometry by light absorption and the description of *the Cianometer of François Aragó* serve to display devices like those designed by Descroizilles and Gay-Lussac for the volumetric analysis of chlorine.

If colorimetry means measurement of color, one must collect, describe and classify the instruments used; but, before that, it is also necessary to know their working foundation and explain the theoretical concepts on which they are based. The authors serve this purpose by explaining in detail the law of Lambert-Beer: its development, shaping, and interpretation, together with an outline of the optical parts of the spectrometer of Patterson.

The authors demonstrate their historical knowledge when reviewing the history of the early colorimeters (among them: Payen, Labillardére, Collardeau) and also when describing their theoretical and practical foundations. A special dilution colorimeter appeared near the middle of the nineteenth century, and its first use is attributed to Carl Heine. This colorimeter was used for the analysis of steel (Blodget Britton's colorimeter), for the measurement of Cu (II) (Bishop's colorimeter), for the quantification of bromine dissolved in water (Jacquelain' colorimeter), for the analysis of indigo (Salleron's colorimeter), for the content of salicylic acid in wine (Remont's procedure), for a rapid check for the coloration of wine (Dujardin' colorimeter), in the sugar industry (Pellet-Demichel's colorimeter), and for the quantification of iodine in a solution (Garraud's colorimeter).

In the decade of the 1860s the Duboscq colorimeter appeared; this is the longest used instrument in the history of colorimetry, which, with improvements, was used until the 1940s. Chapter 5 is centered around this instrument. A history of balance colorimetry is presented, by covering the colorimetric proposals of Casaseca, Müller, Stamm, and Dehms, and ending with the already mentioned Duboscq colorimeter. The appearance of this instrument forced the modification of the optics of the colorimeter of Stammer and the introduction of improvements in the prototypes with which the new colorimetric era was initiated: the colorimeters of Günsberg and Wolff. The end of the century was accompanied by the emergence of low-cost and noncommercially manufactured instruments (for instance, that of Giannetti), and of some commercial ones (those of Gallenkamp, Laurent, Pelline, and Krüss).

Colorimetric methods were advancing in lockstep with the advances in the scientific and technical knowledge of chemistry; thus, in the twentieth century there arose a number of colorimetric methods applied to the determination of a wide range of chemical species. Although commercial manufacturers offered modern instruments to researchers and research laboratories, their price forced the potential users in many cases to build the instruments themselves. Among the variables involved in the colorimetric processes, one finds the colorimeters of Bottomley, Mills, Harvey, Davis, Leeds, Stokes, and Müller; the chromometers of Stead and Ridsdale; the reagents of Nessler; and the Nessler and Hehn tubes. A technique to determine the degree of dissociation of solutes enabled the invention of the colorimeters of Donan and Bayley, the latter one being used to detect Cu (II) ions (cuprimeter). The technique was also used for the assessment of the alkalinity of water, among other applications. To measure the purity of industrial alcohols, the diafanometer of Savall was employed, and for very dilute solutions one could use the colorimeter of Nugues.

From the outset the colorimetric technique attracted the interest of commercial manufacturers of analytical instruments. Thus, I believe it is necessary to make a thorough study of the relationships between theoretical science, applied science, economics, and society by using this certain fact to draw other conclusions. This is especially significant nowadays, when there is so much said about the interest of society for certain areas of scientific, technical, sociological and humanistic knowledge.

The technique of determining the color of liquids was responsible for the interest of some companies in publishing catalogs of their instruments, as was the case, among others, of the company The Tintometer Limited, which did so with the intention of providing its distributors with information related to how the different colorimeter models would fit the specific needs of researchers and industrialists. The study of the colorimetric characteristics of drinking water (chemical and organoleptic behavior) was of concern for the technician in charge of the fabrication of instruments in the second half of the twentieth century, and from this emerged the colorimeters of Bowdtich, Ledds, Croque, Holding and Tidy, R. P. Wilson, and Engler. There followed also the colorimetric scale of Falkoner King; the measurement of the color of wine resurfaced with the manufacture of the chromatometer of Andrieu, the wine-colorimeter of Salleron and the colorimeter of Papasogli. The color of blood was measured with the *hemocromatometer* of Harem.

One of the contentious issues in the early development of color theory was the question of the existence of a given set of colors. On this issue the authors present a brief but rich history of the development of ideas and theories for the standardization of color, from what was believed in the early Middle Ages up until the present. With the colorimetric base of Lovibond, the colorimeter that bears his name was fabricated, and it is given wide coverage. Under this scheme the authors describe the colorimeter of Procter as a modification of the previous tintometer.

The last chapter, devoted to the transparency of solutions, leads to the presentation of *lactoscopios* and other related instruments, and ideas which have been modernized with respect to the originals: the *nephelometry, diafanometry*, and *difusometry*. Some of these devices were used for quick detection of milk fraud with the *lactoscopio* of Donné. The authors signal that the success of *lactoscopios* has been dependent on the country where they have been considered; but still, there are several models which have been employed: those of Vogel, Heusner, Feser, Heeren, and Mittelstrass. *Hematoscopios* were also used in hematology.

Everything that is presented in the book serves to introduce the wide dissemination and application which colorimetry has had in the analysis of organic and inorganic substances, living or inert.

We have at hand a work which is an essential addition to the history of the broad field of chemical analysis. Today's students are only familiar with modern laboratories, equipped with sophisticated spectrophotometers. For this reason it is particularly fortunate that there are works like the one here reviewed, which serve to present an understanding of the past, to study the present, and to foresee the future, these being the fundamental issues to be pursued in the historical study of any discipline.

The present generation seems to lack interest in history, sees and reads only what is strictly contemporary, and generally only grasps a history of the immediate past. At the same time there are growing numbers who want to learn about the past, lest they be condemned to repeat it without knowing that it is repeated, and therefore to become mere epigones. Many of today's "creators," usually those who believe themselves to be the most innovative and modern and who allow themselves to ignore as outdated that which is a little older than they themselves, generate stale, repetitive, trite questions. With a mixture of naivety and arrogance, they have decided there are no lessons from the past, that history will be born or reborn with them. Whoever wants to cultivate a science should quickly absorb what has preceded it, to avoid being unknowingly anachronistic.

We have no doubt that this scenario will not evolve among the young students who are taught the provenance of the knowledge they are learning, that everything has its own history and that before them, many others spent many efforts in the advancement of science. The reviewer expresses this hope as an added incentive for readers to gain such an experience after the reading of this book. *Manuel Castillo Martos, Professor of History of Science at the University of Seville*. [The editor expresses deep gratitude to Dr. Gorka Peris for invaluable assistance in the editing of the English version of this review.]

The Rise and Decline of Colloid Science in North America, 1900-1935: The Neglected Dimension. Andrew Ede, Ashgate, Aldershot, Hampshire, UK and Burlington, VT, 2007, 208 pp, ISBN 978-0-7546-5786-6, $99.95.

The study of colloids was one of the most vital and attractive subjects for chemists during the first three decades of the twentieth century. Wolfgang Ostwald, the German leader of colloid chemistry, defined colloids as dispersed systems consisting of particles of a size too small to be seen microscopically and too large to be called molecules (or, what he called "the World of Neglected Dimensions"). The study of the neglected dimensions, or colloid science, rapidly grew as a promising scientific discipline, especially in the United States. In his present book, Andrew Ede focuses on the study of colloid science in North America from 1900 to 1935. The book stemmed, with some minor changes, from his Ph.D. dissertation, "Colloid Chemistry in North America, 1900-1935. The Neglected Dimension," submitted to the University of Toronto in 1993. In his words, "In 1920, colloids were the hottest topic in American science, whether it was chemistry, physics, or physiology. Fifteen years later, colloid science was in almost complete retreat" (p 2). In this book he attempts to answer how and why the field gained such a high status and then degenerated.

The colloid science boom reached its peak in America in the 1920s, as reflected by the flood of literature on colloids and the large number of practitioners. During the decade, according to Ede, a minimum of twenty percent of American research chemists were working on colloids or colloid-related topics. In 1916 the National Research Council organized a Committee on the Chemistry of Colloids as the major organ to encourage and promote research and education in this field. Many American universities began to offer courses in colloid chemistry. The annual National Symposium on Colloid Chemistry was first held in 1923. The American Chemical Society created its Division of Colloid Chemistry in 1926.

European influence is apparent in its development. The rise of colloid chemistry coincided with the expansion of physical chemistry. America's leading colloid chemists, such as Wilder Dwight Bancroft at Cornell and James William McBain at Stanford, were students of Wilhelm Ostwald, Wolfgang's father and the founder of physical chemistry. Another of Wilhelm Ostwald's students, the German Herbert Freundlich, was invited as a guest of honor to the third National Colloid Symposium, and later became a professor at the University of Minnesota. These colloid chemists were actually physical chemists by profession. Wolfgang Ostwald's series of lectures on colloids in America drew considerable attention. Theodor Svedberg, the Swedish colloid chemist, spent two terms at the University of Wisconsin where, together with his American disciples, he developed his ultracentrifuge for the study of proteins. Bancroft's *Journal of Physical Chemistry* carried a large number of articles on colloids.

Ede explains the rise of colloid research within a broader context as well. It took place during the Progressive Era, a time when there was explosive growth in American science and industry. The study of colloids, then, was a largely untouched area of research and could be conducted at a low cost. The field offered American researchers an ample opportunity to contribute to the international scientific community when resources were limited. The utility of colloid chemistry also made such research attractive during a period of industrialization. The mobilization of science during World War I further enhanced the status of colloid chemistry, which formed an important area of wartime research on gas and masks.

By 1935, however, colloid science had come under attack from outsiders and suffered embarrassment caused by members within the colloid ranks. While other areas of chemistry continued to expand, work on colloids declined. The National Research Council omitted colloid chemistry from its annual review of American chemistry. Colloid research failed to achieve an institutional niche. Why did this happen? Despite the alleged grand scope and high expectations for colloid science, it turned out that it covered only limited areas of research with success. No general consensus was reached regarding basic theories and methodology in the colloid community. For example, the isolationist Bancroft believed that colloids were unique and that colloid science must have unique laws. By claiming this, he marked his approach toward colloids as being largely qualitative. Bancroft's harsh critic, Jacques Loeb, was eager to make colloid research more quantitative by applying Donnan's equilibrium to colloid membrane behavior. The unionist Loeb believed that colloids were not unique and that colloids could be studied in terms of existing physical-chemical principles. Singling out Bancroft as the scholar responsible for the decline of American colloid science, Ede spends Chapter 8 delineating Bancroft's ill-fated attempt to apply a colloid theory to cure insanity, drug addiction, alcoholism, and allergies—all of which came to naught and only created a social stigma for colloid science. In this way, the study of colloids ended up consuming itself. Here, Ede employs the metaphor of ouroboros, a dragon-like creature that swallowed its own tail and disappeared, in that the research program "disappeared, consumed by the very act of studying colloids" (p 1).

Yet, a critical blow came rather from outside: the emergence of macromolecular chemistry, led by the German organic chemist Herman Staudinger. In Staudinger's view, colloidal particles were not the aggregates of small molecules held together by physical forces, as most colloid chemists argued, but were, in many cases, "macromolecules" that were composed of between 10^3 and 10^9 atoms linked together by the normal "Kekulé" bonds. Chapter 9 vaguely outlines the conflict between the micelle theory versus the macromolecular theory, but does not expound on how American colloid chemists reacted to the macromolecular theory and changed their minds. No mention is made of Wallace Hume Carothers and Paul J. Flory, who pioneered American macromolecular chemistry at DuPont, although Ede describes some work by DuPont's colloid researchers, including Victor Cofman, Elmer O. Kraemer, and J. Burton Nichols, in other chapters.

Today's colloid researchers might be bewildered by the author's use of the ouroboros metaphor for the rise and decline of colloid science. Unlike ouroboros, colloid science did not disappear, but rather continues to live on. Although the popularity and status it enjoyed in the 1920s are no longer evident and its scope and definition have been changed, the legacy that colloid chemists of the time bequeathed has been succeeded and developed into various works such as the DLVO theory (which explains the stability of colloids) advanced in the late 1940s, and the surface forces apparatus (SFA), an instrument for the direct measurement of surface forces made in the early 1970s.

Ede bases his narrative principally on published sources. However, he should also have examined a rich store of manuscripts, such as the Wilder Dwight Bancroft Papers at Cornell University, the Jacques Loeb Papers at the Library of Congress, and the Wolfgang Ostwald-Martin Fischer Correspondence at Wittenberg University, Ohio. Ede also should have consulted a number of important works on the history of colloid chemistry and macromolecular chemistry that appeared after he completed his 1993 dissertation, but well before the 2007 publication of its book version. It is also a pity that there are many typographical and grammatical errors, which should have been eliminated through the editorial process. Aside from these shortcomings, *The Rise and Decline of Colloid Science in North America* does provide us with a good survey of the history of American colloid science as a useful starting point for further study.

Yasu Furukawa, Nihon University.