

1 HIST'S SIXTY YEARS OF SPONSORED PUBLICATIONS: AN EXPANDED  
2 BIBLIOGRAPHY

3 Mary Virginia Orna (maryvirginiaorna@gmail.com)  
4

5 INTRODUCTION

6 For sixty years, the Division of the History of Chemistry (HIST) has sponsored publications  
7 of history-related volumes drawn for the most part from symposia that were presented at  
8 American Chemical Society (ACS) meetings. The origin of each volume depended upon  
9 individuals who organized symposia, or in some cases, proposed book volumes. It has been  
10 the practice of the Division to provide some financial support for these ventures; many  
11 organizers were able to obtain additional support from various types of grants and  
12 contributions. Generally, the editor of the volume was also the organizer of the event. Except  
13 for the Archaeological Chemistry volumes, there were no set series or themes over the years,  
14 but the volumes naturally fell into the six categories given in the Outline and Overview of  
15 this article.

16 Since this paper has as its goal a permanent record of this HIST-initiated activity,  
17 each volume will be highlighted with a re-publication of parts of its Preface and if warranted,  
18 some additional information on the contents of the volume. Since a large percentage of the  
19 volumes' contents (titles and abstracts of papers) can be found on the ACS website,  
20 [www.acs.org/publications], they will not be repeated here but a link to the volume on the  
21 ACS website will be provided. However, several volumes were published elsewhere, and  
22 even some volumes published by the ACS have no presence on its website. In these cases,  
23 tables of contents will be provided.  
24

25 OUTLINE AND OVERVIEW  
26

27 I. ARCHAEOLOGICAL CHEMISTRY – 9 VOLUMES

28 “Archaeological chemistry is a topic which, when mentioned in a general public  
29 gathering, makes heads turn, eyes brighten, smiles burst forth and questions  
30 emerge.” [Orna, M.V.; Rasmussen, S.C., Preface, *Archaeological Chemistry: A  
31 Multidisciplinary Analysis of the Past*, Cambridge Scholars Publishers, Newcastle  
32 upon Tyne, UK, 2020, p. viii.] This, the opening sentence of the most recently  
33 published volume on archaeological chemistry, has held true for the entire 47-year  
34 history of this series.

35 The symposia, followed by volume publication, and held on average about  
36 every six years since 1973, have been co-sponsored by HIST's Subdivision of  
37 Archaeological Chemistry since 1977, although four unpublished symposia  
38 preceded this one. Many of the latter's members are associate members, which  
39 means that they are not ACS members due to ineligibility, international status, or  
40 practice of a related discipline. But they come out in droves for this long-awaited  
41 event, lending a visibility and camaraderie to both HIST and to the ACS that can  
42 only be described as envious. As a collection, the nine volumes have traced the  
43 development of archaeological chemistry from an emphasis on excavations,  
44 instrumental methods, and interdisciplinary coverage to an emphasis on cultural  
45 context, combined analytical techniques and chemometrics to interpret results and  
46 discoveries.

47 II. THEMATIC BIOGRAPHICAL COLLECTIONS – 6 VOLUMES

48 These biographical collections are unique in the chemical literature. They gather  
49 together the stories and contributions of individuals who have made important  
50 contributions to certain fields, such as quantum chemistry and magnetic

51 resonance, or whose life's work are deemed worthy of recognition for  
 52 extraordinary human characteristics or commendation for one of the world's  
 53 highest honors, the Nobel Prize. The names of some of these persons are virtually  
 54 "household words," while others may be more obscure, some even overlooked.  
 55 These volumes, taken together, are setting the record straight.

56 III. ANNIVERSARIES AND LANDMARKS – 8 VOLUMES  
 57 These eight volumes, together, commemorate a total of 750 years of  
 58 groundbreaking activity in the chemical sciences. They celebrate the advent of  
 59 structural organic chemistry, all the implications of the tetrahedral carbon atom's  
 60 elucidation, Werner complexes and coordination chemistry in general, the dawn of  
 61 the plastics era, the 20<sup>th</sup> century development of chemical education, a half-  
 62 century of progress in physical organic chemistry, and the sesquicentennial of the  
 63 "Chemist's Bible," the Periodic Table. Numbered among the editors of these  
 64 volumes is an ACS President; all the others have served on the HIST Executive  
 65 Committee at one time or other. These volumes are all, so to speak, inside jobs.

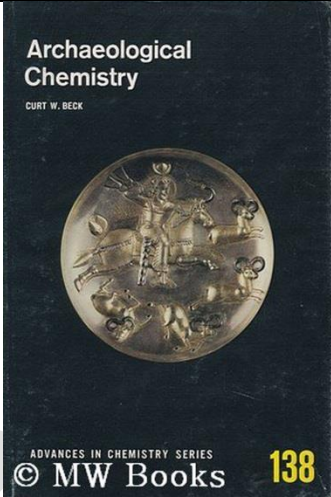
66 IV. ENTERTAINMENT AND DIVERSION – 4 VOLUMES  
 67 Some may argue that chemistry is entertaining in all of its many facets. While this  
 68 is certainly true as far as chemists are concerned, we may have a hard time  
 69 convincing the general public unless we can show chemistry's relationship to such  
 70 perennial TV and film favorites such as crime and science fiction. After all, who  
 71 wouldn't enjoy a chemistry lesson from Sherlock Holmes or a primer on how to  
 72 detect arsenic in a murder victim? Even the nonsense of Edward Lear can be  
 73 commandeered for chemical usage and crazy analogies used to teach units (e.g., 1  
 74 ppm = 1 jigger of vermouth in a tankcar full of gin). Or how many of you could  
 75 expect to see "series of dyestuffs used to color fats or oils" as a crossword puzzle  
 76 clue? So, run, don't walk, to grab one of these volumes before they sell out.

77 V. SUBDISCIPLINES – 8 VOLUMES  
 78 On the serious side, eight volumes published by HIST document the histories of  
 79 important chemical subdisciplines: chemical and nuclear dating techniques,  
 80 chemical engineering, electrochemistry, heterogeneous catalysis, chemical  
 81 instrumentation and its preservation, atomic theory, chemical technology in  
 82 antiquity and chemistry's role in food production and sustainability.

83 VI. PLACES – 2 VOLUMES  
 84 Finally, HIST took on a global presence by publishing two volumes that, together,  
 85 encircle both hemispheres. The first documents many places in the world where  
 86 pioneering chemists and other scientists lived and worked, and how a scientific  
 87 traveler can access these unique venues. The second records the growth of the  
 88 international collaborative efforts of the chemical communities of the Pacific Rim  
 89 as a worldwide phenomenon, an extension of the same theme presented at the  
 90 Pacifichem Conference in 2018.

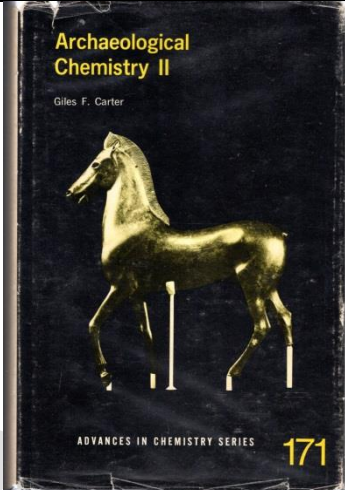
91  
 92 I. ARCHAEOLOGICAL CHEMISTRY  
 93

Date	Publisher	Editor(s)/Title	Cover Image
------	-----------	-----------------	-------------

1974	<a href="#">ACS Advances in Chemistry Series 138</a>	Curt W. Beck Archaeological Chemistry	
------	------------------------------------------------------------------	------------------------------------------	------------------------------------------------------------------------------------

**Preface.** In his introduction to the fourth symposium on archaeological chemistry ("Science and Archaeology," MIT Press, 1971), Robert H. Brill states that archaeological chemistry is emerging from the phase of a service science to the field archaeologist and the museum curator into a discipline of its own. The papers collected here from the fifth symposium support this view. By its very nature, archaeological chemistry has had its own distinct parameters all along; the unique quality and the value of the objects analyzed have always been a goad towards the development of micro methods or, ideally, of completely non-destructive methods. As the number of analyses of artifacts increases and the composition of large groups of artifacts reveals patterns which are becoming more and more useful for determining the time, place or method of manufacture, other specific considerations emerge: accuracy and precision in the context of their archaeological significance. The choice of analytical method is often not determined by the greatest accuracy attainable but by the optimal means of obtaining, rapidly and economically, the accuracy needed to make archaeologically meaningful distinctions. Methodological studies inevitably lead to some revision and even rejection of past work. Archaeologists who were too readily persuaded to accept scientific results as absolute facts may be a little dismayed to find that some of these "facts" are now being questioned. They must remember that no discipline has a corner on infallibility and that knowledge, in the sciences as well as in the humanities, advances slowly by a kind of iterative process in which error is gradually reduced to reach an approximation of truth. Uninhibited self-criticism is the surest indication that archaeometry is coming of age. Along with these welcome signs of maturity there is continuing evidence of vigorous growth. Each year, new physical and chemical analytical methods are applied to old archaeological problems, and new types of archaeological materials are investigated by established analytical methods. This volume contains examples of both of these directions of expansion. A symposium on any rapidly growing field can only be a snapshot, showing one moment of development and not even all of that. Physical methods of dating and archaeological prospecting are only two important branches of archaeometry which fall outside the focus of this volume. Since artifact analysis is the particular province of chemists, it is especially appropriate that this book should appear in the ADVANCES IN CHEMISTRY series.

Curt W. Beck

1978	<a href="#">ACS Advances in Chemistry Series 171</a>	Giles F. Carter Archaeological Chemistry II	
------	------------------------------------------------------------------	------------------------------------------------	------------------------------------------------------------------------------------

**Preface.** Since this volume records the proceedings of the Sixth Symposium on Archaeological Chemistry, it is fair to say that archaeological chemistry is an "old" field, but unfortunately it is not yet mature. In the interval since the Fifth Symposium in 1972, advances have been made, particularly in the understanding of the origin and distribution of obsidian and pottery, principally through chemical analysis. Lead isotope studies have deduced the sources of many archaeological objects. The understanding of other types of specimens made of glass, metals, bone, pitch, and other organic materials is improving as additional analytical work unfolds. Accordingly this volume has been organized around the classification of materials—organic materials, ceramics, and metals—with five introductory chapters on perspectives and techniques. One of the main purposes of archaeological chemistry is to deduce history from the analysis and investigation of artifacts. Other major areas of importance include authenticity studies, identification of sources, deduction of production techniques, and dating. Archaeological chemistry involves many of the techniques of analytical chemistry admixed with patience, primarily in accumulating a large volume of data and in working with specimens frequently imperfectly preserved. As more and more data are obtained and reported by an increasing number of laboratories using various analytical techniques, the following are important problems to be addressed by archaeological chemists, archaeologists, and others interested in the field: (1) recommended procedures for data reporting, (2) recommended methods of specimen handling and sampling, (3) identification of sources of standards and synthesis of new standards, (4) computerized data storage and retrieval, and (5) round-robin test programs to ensure inter-laboratory agreement in the analysis of archaeological objects. To initiate progress on the above problems the group attending the Sixth Symposium on Archaeological Chemistry voted to affiliate with the Division of the History of Chemistry of the ACS and to create several taskforces to begin work in the various areas listed above. Preliminary organization of several task forces has occurred, and a directory of archaeological chemists and interested archaeologists is being prepared. Only when satisfactory progress has been made on the above problems will archaeological chemistry earn the distinction of being a mature field of chemistry. However, in spite of some present shortcomings, archaeological chemistry is a most rewarding (other than financially) field to pursue—in fact, it is just plain fun. Finally, I suggest the formation of a U.S. government-sponsored Archaeological Data Center for the computerized and conventional storage and retrieval of all sorts of archaeological data. The field is so diverse and the data so numerous that such a structure is needed to prevent archaeology itself from becoming something of a modern tower of Babel with the attendant problem in communication. I wish especially to thank Robert F. Gould, Editor of the

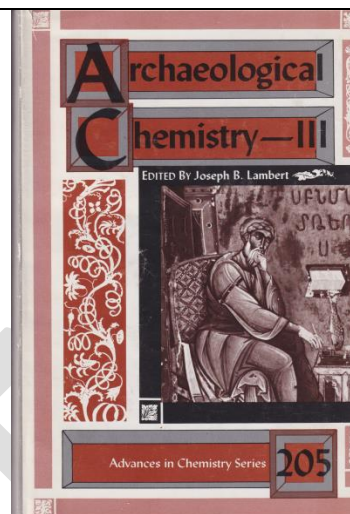
ADVANCES IN CHEMISTRY SERIES, Virginia de Haven Orr, Associate Editor, and all others who have contributed to the excellence of this volume.

Giles F. Carter

1984

[ACS  
Advances in  
Chemistry  
Series 205](#)

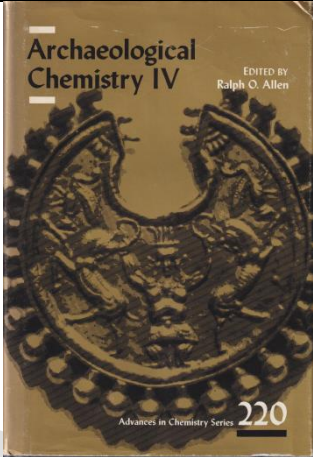
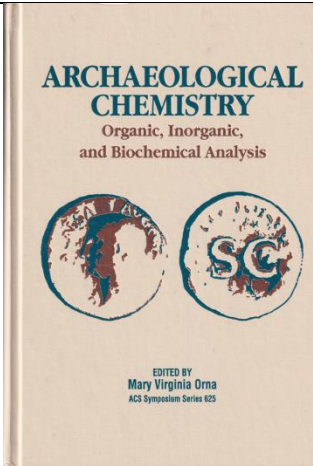
Joseph B. Lambert  
Archaeological Chemistry III



**Preface.** Archaeological chemists subject artifacts and other materials from archaeological or art historical sources to the scrutiny of modern instrumental analysis. Workers in this field find these investigations always intensely interesting, seldom financially remunerative, and sometimes archaeologically useful. We have been organized in the United States as a Subdivision of the American Chemical Society since the Sixth Symposium, held in Chicago in 1977. We met for the Seventh Symposium in Kansas City, September 14-15, 1982. The papers presented at this Symposium form the basis for the chapters in this volume. They comprise a representative cross section of current activities of chemists and of scientists in related fields on behalf of archaeology and art history. The workhorses of analytical chemistry (atomic absorption, x-ray fluorescence, and neutron activation analyses) continue to provide mainstream contributions to our understanding of pottery, glass, metal, and stone artifacts. Stronger attention is now also directed to archaeological soils, to bone and shell, to inks and pigments, and to organic materials such as gums, lacquers, and textiles. Advances in chemical instrumentation make possible entirely new applications to archaeology, although the marketplace must demonstrate whether these developments are as much of use to the archaeologist as they are of interest to the chemist. This volume, for example, describes initial applications of Auger spectroscopy and of particle accelerators, respectively, for dating inks and for dating small samples of carbonaceous material. Instrumental advances, both for separation and analysis, have made organic materials more tractable, and applications described in this volume include gums, lacquers, and a shroud. Chemical analysis continues to provide key data on the subject of provenance and trade routes, illustrated herein with soapstone, obsidian, native copper, majolica, and Maya ceramics. Finally, chemical analysis provides the archaeologist or art historian with a fuller characterization of materials, whether they be human bone, medieval stained glass, Egyptian Blue, Roman coins, or textile fabric pseudomorphs, all of which are examined in this volume. The Seventh Symposium on Archaeological Chemistry was supported by the donors of the Petroleum Research Fund, administered by the American Chemical Society.

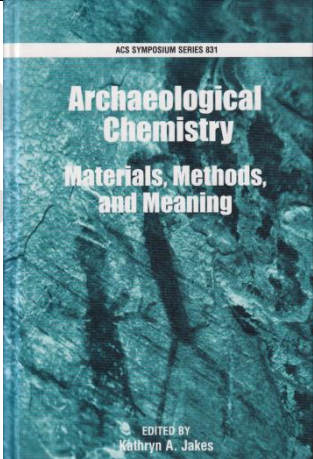
Joseph B. Lambert



1989	<a href="#">ACS Advances in Chemistry Series 220</a>	Ralph O. Allen  Archaeological Chemistry IV	
<p><b>Preface.</b> Most chemists do not have the opportunity to experience quite the same sense of awe and excitement as was experienced by archaeologist Howard Carter when he first opened the tomb of the boy king, Tutankhamun. However, a growing number of chemists have shared in the excitement of discovering the past in a more subtle manner. The application of chemical techniques to the study of archaeological materials has brought chemists, archaeologists, anthropologists, and historians together to enhance our knowledge of the past. The same techniques that help chemists characterize materials in their efforts to improve the future have also helped us understand the earlier uses of materials found in nature. Archaeological chemistry has not only allowed chemists to share in the study of the past, but has strengthened archaeologists' understanding of procedures that can be used to characterize archaeological materials. The chapters included in this volume show the interdisciplinary nature of archaeological chemistry. The symposium upon which this book is based included 1 day devoted to the growing contributions that chemists and biochemists have made to the study of proteinaceous materials in archaeological samples. Another day was devoted to the important contributions that have been made by nuclear techniques.</p> <p>Ralph O. Allen</p>			
1996	<a href="#">ACS Symposium Series Volume 625</a>	Mary Virginia Orna  Archaeological Chemistry V: Organic, Inorganic and Biochemical Analysis	
<p><b>Preface.</b> Tracing cultural evolution over centuries and even millennia is the exciting task shared by archaeologists and archaeological chemists. Seldom financially rewarding, but of perennial interest, it has been the subject of nine major symposia at national meetings of the American Chemical Society. These symposia have attracted practicing archaeologists, chemists, biochemists, cultural anthropologists, and members of related disciplines from all over the world. The proceedings of five of these symposia have been collected in volumes published by the American Chemical Society (ACS), four in the Advances in Chemistry Series and the present volume in the Symposium Series. New methods in analytical chemistry, particularly methods coupled to one another in tandem, have rendered</p>			

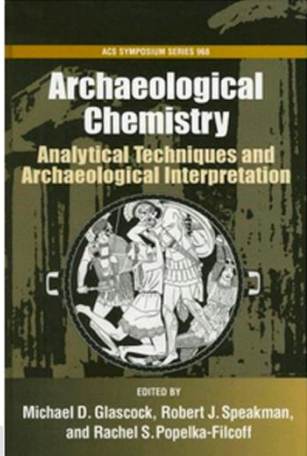
biochemical samples almost as accessible on the ultratrace level as inorganic materials have been over the past few decades. Exciting new discoveries in the field, and the growth of the science fiction that often accompanies such discoveries, have contributed to a burgeoning interest in the biochemical aspects of archaeological chemistry. In this hemisphere, interest has centered on what chemical analysis can tell us about pre-Columbian civilizations. Although no one is claiming that "Jurassic Park—The Reality" is right around the corner, imaginations have been fired by the popularization of DNA reconstruction and replication. These developments have given rise to questions based on new possibilities in archaeological research. Plans for the present symposium were initiated in 1992-93 to create a forum for presentation and discussion of these new possibilities in research. Special invitations were sent to some of the foremost workers in the field, and a call for papers was issued to every major venue of archaeological research worldwide. The resulting program contained papers from every major new area of archaeological research with an emphasis on the pre-Columbian and biochemical aspects. This symposium volume is a representative compilation of these papers. As such, it will be of interest to practicing archaeologists, archaeological chemists, anthropologists, historians of science, chemical educators, and all those interested in the story of how chemistry, not without some controversy, can help to trace the roots of humankind and the human environment through the millennia. I sincerely thank each author for the time, effort, and cooperation it took to prepare this material for publication.

Mary Virginia Orna

2002	<a href="#">ACS Symposium Series Volume 831</a>	Kathryn A. Jakes  Archaeological Chemistry VI: Materials, Method and Meaning	
------	-------------------------------------------------	---------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------

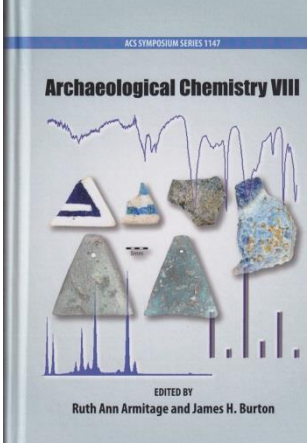
**Preface.** The chapters that comprise this volume provide a cross-section of current research in the area of chemistry applied to archaeological questions. The chapters were first presented as part of the 10th archaeological chemistry symposium, organized by the ACS Division of the History of Chemistry's Subdivision on Archaeological Chemistry, held in Chicago, Illinois, as part of the August 2001 national meeting of the American Chemical Society. The chapters present examples of the use of analytical methods in the study of a variety of archaeological materials. They also discuss the inferences concerning human behavior that can be made based on the patterns observed in the analytical data. Viewed as a whole, the chapters encompass differing viewpoints concerning the definition of *nondestructive* testing and new developments in determining an object's age and composition. The volume provides a stimulating panoramic view of ongoing research useful to the archaeologist, anthropologist, and chemist. It also may spur interest in the novice reader. As we use chemistry to study the remains of the past, we uncover the traces of human behavior that are embodied in those remains.

Kathryn A. Jakes

2007	<a href="#">ACS Symposium Series Volume 968</a>	Michael D. Glascock, Robert J. Speakman, Rachel S. Popelka-Filcoff Archaeological Chemistry VII. Analytical Techniques and Archaeological Interpretation	
------	-------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------

Archaeological chemistry is an interdisciplinary field of archaeological research in which techniques and approaches from the chemical, biological, physical, geological, and statistical sciences are employed to extract more information from the material record of past human activity. The range of research conducted is so broad that any attempt to describe the field in a comprehensive summary is difficult. Major developments within archaeological chemistry have relied on the development and improvement of new techniques and procedures in conjunction with their application to significant archaeological problems. The symposium upon which this book is based was held at the 231st National Meeting of the American Chemical Society, March 26-27, 2006 in Atlanta, Georgia. The chapters included in this volume were selected from the oral presentations at the symposium to demonstrate the interdisciplinary nature of archaeological chemistry. The editors felt that it was important for the papers in this volume to describe an archaeological problem, to explain the analytical techniques and procedures used to investigate the problem, and most importantly to present an interpretation of their results for appreciation by archaeologists, chemists, and others.

Michael D. Glascock  
Robert J. Speakman  
Rachel S. Popelka-Filcoff

2013	<a href="#">ACS Symposium Series Volume 1147</a>	Ruth Ann Armitage and James H. Burton Archaeological Chemistry VIII	
------	--------------------------------------------------	------------------------------------------------------------------------	--------------------------------------------------------------------------------------

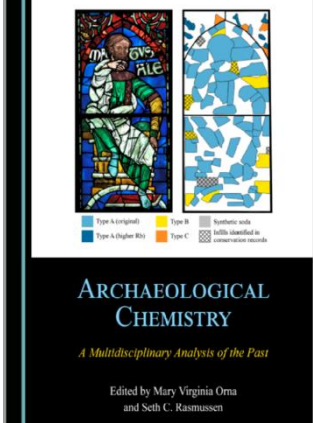
**Preface.** The 12th Archaeological Chemistry Symposium was held as part of the Spring ACS National Meeting in New Orleans, Louisiana, April 7–11, 2013. This volume is a compilation of presentations from the Symposium, the latest in a long tradition that began at the ACS National Meeting in Philadelphia in 1950... The symposium consisted of four half-day symposia, an evening poster session, and a keynote address by Dr. A. Mark Pollard, Edward Hall Professor of Archaeological Science and Director of the Research Laboratory for Archaeology and the History of Art at the University of Oxford. We chose four broad categories for the symposia: Pigments, Residues and Material Analysis, X-Ray Fluorescence



Spectroscopy, and Isotopes in Archaeology. These categories are by no means comprehensive. Rather, they serve as a snapshot perspective of archaeological chemistry today and are necessarily biased toward our areas of expertise and those of the participants in a chemistry meeting. Notably, studies of ancient DNA and other advances in biomolecular archaeology are underrepresented in this volume. The papers herein show that archaeological chemistry today is more than the usual studies of trace elements in pottery and lithics, which continue to contribute to our understanding of human behavior in the past. New areas of research include more focus on portability to analyze pigments in situ and artifacts in museums, nascent developments in non- and minimally destructive chemical characterization, new applications of isotopic analyses, and an increasing interest in archaeological biomolecules. This volume is divided into sections that roughly follow those of the Symposium. The first section, Pigments and Dyes, begins with a review of manuscript pigments by Dr. Mary Virginia Orna, the organizer of the 9th Archaeological Chemistry Symposium... Each of the following sections begins with a review paper from one of our invited speakers. Dr. Valerie Steele, now at the University of Bradford in the Department of Archaeological Science, provides an overview of the state — for better and for worse — of analyses of archaeological residues. Portable X-ray fluorescence instruments are becoming extremely common in archaeological chemistry investigations; Dr. Aaron Shugar of Buffalo State University provides in his chapter some perspectives and warnings against the indiscriminate use of this technology. Finally, Dr. Matthew Sponheimer gives an overview of the contributions of stable carbon isotope and trace metal studies in understanding early hominin diets. The final chapter of the book provides a perspective on the earliest work in archaeological chemistry in the 18th century and brings us up to today’s challenges. We find ourselves in Dr. Pollard’s text, carrying out our own research “on a wing and a prayer,” as both the solitary chemist supported by her institution in part for the accessible public interest aspect of her research and a scientist within an anthropology department, fighting for funding in this era of sequestration and downsizing. In the words of Dr. Pollard, we hope that this volume contributes toward the “open, respectful, meaningful and iterative dialogue across the many disciplinary boundaries” encountered in archaeological chemistry. We thank all of the contributors and reviewers for their time and effort. We especially thank technical editor Arlene Furman of ACS Books for her patience and help in producing this volume, and Seth Rasmussen, Tom Strom, and Vera Mainz from the Division of the History of Chemistry (HIST) for all their help in organizing and running the Symposium. HIST and the ACS Divisional Activities Committee provided the majority of the funding for the Symposium, with additional support from the Society for Archaeological Sciences and Bruker Corporation.

Ruth Ann Armitage

James H. Burton

2020	Cambridge Scholars Publishers	<p>Mary Virginia Orna and Seth C. Rasmussen</p> <p>Archaeological Chemistry IX Archaeological Chemistry: A Multidisciplinary Analysis of the Past</p>	
------	-------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------

**Preface.** Archaeological chemistry is a topic which, when mentioned in a general public gathering, makes heads turn, eyes brighten, smiles burst forth, and questions emerge. People are very interested in archaeology, and we sometimes fear that the “chemistry” part must ride along on its coattails. Chemists are also very interested in archaeology, so much so that thirteen multi-day archaeological chemistry symposia, accompanied for the most part by published volumes, have been organized intermittently at American Chemical Society (ACS) national meetings over the course of the past 70 years. Earle R. Caley, a distinguished chemist-humanist who organized the first symposium in 1950, remarked that it was a unique experiment, the first to apply chemistry to archaeology anywhere, anytime. He was also quick to point out how diverse the topic was and how it related to so many areas not thought to be even remotely related to chemistry. Perusing the tables of contents of successive symposium publications allows one to trace the evolution of the topic in terms of broadening disciplinary coverage and increased use of instrumental methods of analysis. However, as Curt W. Beck and Peter Oesper observed in the fifth symposium’s publication, “a symposium on any rapidly growing field can only be a snapshot, showing one moment of development and not even all of that.” C. W. Beck, above). These welcome glimpses have been afforded to an ever-growing audience of this popular series in seven additional volumes published by the ACS. All of them have enjoyed the sponsorship of the ACS Division of the History of Chemistry, and from 1977 on, the sponsorship of the Subdivision of Archaeological Chemistry. The latest of these Archaeological Chemistry symposia, the thirteenth, was generously supported by the ACS Division of the History of Chemistry and an Innovative Project Grant from the ACS Committee on Divisional Activities. The collection of talks given during the symposium then became the nucleus of the present volume, now under the guidance of Cambridge Scholars Publishing. This volume continues the multidisciplinary trend with a world-class, international roster of scholars from academic institutions, museums, scientific research centers and educational research centers. It is our hope that this collection gives readers a taste of the current breadth of this exciting and growing field.

Mary Virginia Orna  
Seth C. Rasmussen

## TABLE OF CONTENTS

---

**Chapter 1.** Introduction: Archaeological Chemistry as a multidisciplinary field. *Mary Virginia Orna and Seth C. Rasmussen.* **1**

### ARCHAEOLOGICAL CHEMISTRY AND APPLICATIONS TO EDUCATION

**Chapter 2.** Metals of Archaeological Interest: New Directions. *Patricia J. Smith and Mary Virginia Orna.* **14**

**Chapter 3.** Material Matter: Exploring Ancient Pigments in the Classroom. *Hilary Becker, Todd Rutkowski, V. Gökhan Ersan, Mark Poliks, Louis Piper, Mariah Postlewait, Lynn Schmitt, Joshua Young, Pamela Smart, and Valerie Imbruce.* **52**

**Chapter 4.** Metals chemistry for the classroom and lab, K-16: A tutorial on low melting alloys. *Alexandria Rogers, Clayton Blackwell, Tiffany Tieu Ngo, William Arce, Charles Baker, and Mark A. Benvenuto.* **73**

### ARCHAEOLOGICAL CHEMISTRY AND MATERIALS SCIENCE

**Chapter 5.** The Influence of Re-melting on the Composition of Lead Inclusions in Ancient Leaded Tin Bronze. *Sana Shilstein, Yishai Feldman, Yehoshua (Yeshu) Dray, and Sariel Shalev.* **84**

**Chapter 6.** Residual Stress in Struck and Cast coins. *Aleksander J. Kossolapov and Ksenia S. Chugunova* **96**

- Chapter 7.** Analysis of a Series of Japanese 100 Mon Coins via Energy Dispersive X-Ray Fluorescence Spectroscopy. *Tiffany Tieu Ngo, William Arce, and Mark A. Benvenuto.* **114**
- Chapter 8.** Glass-induced Metal Corrosion on Museum Exhibits (GIMME) – Two Case Studies from the Decorative Arts. *Katja Franziska Siebel, Lena Hönig, Andrea Fischer, and Gerhard Eggert.* **124**
- Chapter 9.** Development of Chemical Glassware: Evaluating Historical Narratives via Chemical Archaeological Data. *Seth C. Rasmussen.* **146**
- Chapter 10.** In Situ Methodology for Compositional Grouping of Medieval Stained Glass Windows: Introducing the “WindoLyzer” for pXRF. *Laura W. Adlington, I. C. Freestone, L. Seliger, M. Martín-Torres, F. Brock, A. Shortland* **176**

#### ARCHAEOLOGICAL CHEMISTRY AND ANALYSIS OF ORGANICS

- Chapter 11.** Archaeomics: Metabolomics Analysis and its Application to the Biomolecular Archaeology of Wine, Trunco Molas, Sardinia, Italy. *Kate Duffy and Peter van Dommelen.* **202**
- Chapter 12.** Structural Changes from Heating Amber and Copal as Observed by Nuclear Magnetic Resonance Spectroscopy. *Joseph B. Lambert, Truongan V. Nguyen, Allison J. Levy, Yuyang Wu, and Jorge A. Santiago-Blay.* **233**

#### ARCHAEOLOGICAL CHEMISTRY AND COLORING MATERIALS

- Chapter 13.** Archaeological Shades of Purple from Flora and Fauna from the Ancient Near East. *Zvi Koren.* **256**
- Chapter 14.** The Long-term Love Affair with Infrared Spectroscopy and Medieval Pigments: A Review. *Patricia L. Lang and Heidi F. Noneman.* **301**
- Chapter 15.** Archaeological Blue Pigments: Problem Children from the Get-Go. *Mary Virginia Orna.* **333**
- Chapter 16.** Color as Trace Evidence in Ancient Technology and Archeological forensics. *Ioanna Kakoulli, Roxanne Radpour, Yuan Lin, John K. Delaney, Christian Fischer* **397**
- Chapter 17.** Discovering Hidden Layers with X-ray Vision: New Applications of Portable X-Ray Fluorescence Spectroscopy to Rock Art Studies. *Karen L. Steelman, Victoria L. Roberts, and Carolyn E. Boyd.* **428**
- Chapter 18.** Scientific Research Supporting the Study of Pigments and Dyes in Armenian Miniature Painting Art. *Yeghis Keheyanyan and Maurizio Aceto.* **465**

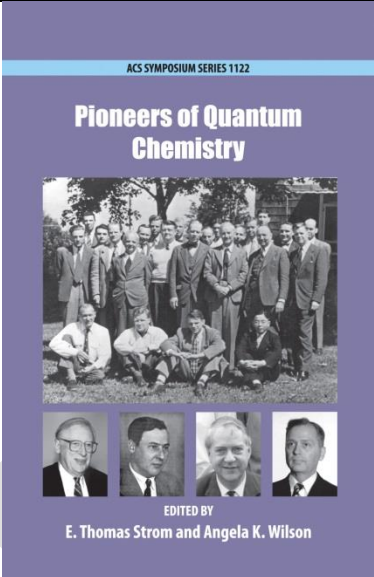
**Contributors 488**

**Index 505**

94  
95  
96

## II. THEMATIC BIOGRAPHICAL COLLECTIONS

Date	Publisher	Editor(s)/Title	Cover Image
------	-----------	-----------------	-------------

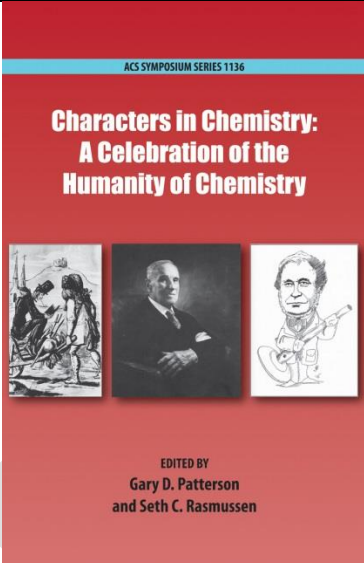
2013	<a href="#">ACS Symposium Series Volume 1122</a>	E. Thomas Strom and Angela K. Wilson  Pioneers of Quantum Chemistry	 <p>ACS SYMPOSIUM SERIES 1122</p> <p>Pioneers of Quantum Chemistry</p> <p>EDITED BY E. Thomas Strom and Angela K. Wilson</p>
------	--------------------------------------------------	---------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Preface.** The field of quantum chemistry has grown so immensely that the importance of some of the earliest work and the earliest pioneers of quantum chemistry is unfamiliar to many of today's youngest scientists in the field. Thus, this book is an attempt to preserve some of the very valuable, early history of quantum chemistry, providing the reader with not only a perspective of the science, but a perspective of the early pioneers themselves, some of whom were quite interesting characters. The symposium on which this book is based came about because one of the co-editors (ETS) came to a conviction that the contributions such as those by George Wheland to quantum chemistry and Otto Schmidt to free electron theory should be better appreciated and known. He organized a symposium in which quantum chemistry pioneers, both those celebrated by everyone and those seemingly overlooked by posterity, would be recognized. He sought out and received the help of a younger colleague (AKW) active in quantum chemistry, who also had interest in recognizing early contributions in the field, based upon her own experiences. Her Ph.D. advisor, Jan Erik Almlöf, was a prominent figure in the field, whose contributions have been core to many developments in molecular electronic structure theory, and, in many ways, is a more recent contributor than the pioneers featured in the present book. Unfortunately, he died in 1996 at a relatively young age. However, in seeing how many of today's youngest generation of quantum chemists are not familiar with his name, the need to provide the earlier history of the field has become ever clearer to her. (*Note, as Jan Almlöf is a later contributor than most of the pioneers featured in the present book, there is no chapter in his memory.*) As is evident from the list of chapters and contributors below, the symposium and book came together remarkably quickly with acceptances by noted quantum chemists and historians of chemistry, some of whom themselves are true pioneers of quantum chemistry. Present at the symposium was Nicholas Handy of Cambridge University, who was being recognized with the ACS Award in Theoretical Chemistry for his contributions to quantum chemistry, and a pioneer himself. Handy was interested in contributing to this book but was unable to do so because of his untimely passing on October 2, 2012. However, we were honored to have his presence during his last visit to the U.S. While this volume is certainly not a history of quantum chemistry, it does cover many highlights over a period of about sixty years. This volume consists of chapters based upon ten of the presentations at the symposium "Pioneers of Quantum Chemistry" held March 28, 2011, at the 241st ACS National Meeting in Anaheim, CA. This symposium was organized by the ACS Division of the History of Chemistry (HIST) and co-sponsored by the ACS Divisions of Computers in Chemistry (COMP) and Physical Chemistry

(PHYS). The opening chapter on “Three Millennia of Atoms and Molecules” by Klaus Ruedenberg and W. H. Eugen Schwarz covers close to three thousand years, starting with the atomic hypotheses of Greek philosophers and finishing with the advances of the late 1970’s. The next chapter by István Hargittai, “Pioneering Quantum Chemistry in Concert with Experiment”, is a survey chapter also, but it starts in more recent times with G. N. Lewis and finishes with John Pople. In “George Wheland: Forgotten Pioneer of Resonance Theory”, E. Thomas Strom makes his case for Wheland being a significant figure in quantum chemistry. William Jensen goes into “The Free-Electron Model: From Otto Schmidt to John Platt”, covering the relatively unknown Schmidt and the more recognized group at the University of Chicago. Michael Dewar was a colorful individual with a “take no prisoners” style in his oral presentations. Eamonn Healy contributes an equally colorful chapter on Dewar in “Michael J. S. Dewar, a Model Iconoclast”, Wes Borden discusses “H. C. Longuet-Higgins—The Man and His Science”, in his chapter, and Borden laments the fact that Longuet-Higgins left theoretical chemistry too soon after a career of just 25 years. In “The Golden Years at LMSS and IBM San Jose” Paul Bagus reflects on his time at the Laboratory of Molecular Structure and Spectra led by Robert Mulliken and C.C.J. Roothaan at the University of Chicago and at the Large Scale Scientific Computations Department at IBM in San Jose, CA, an effort led by Enrico Clementi. Those of us of “a certain age” remember well the Quantum Chemistry Program Exchange at the University of Indiana. Donald Boyd tells the tale of that incredibly useful endeavor. Many of us learned about molecular orbital calculations from Andrew Streitwieser’s *Molecular Orbital Calculations for Organic Chemists* published in 1961. In his chapter Streitwieser gives biographical material on Erich Hückel and Charles Coulson and then discusses his monograph/textbook on Hückel molecular orbital theory. The final chapter describes work of that giant of quantum chemistry, Nobel Laureate John Pople, as presented by his former student Janet Del Bene. Many quantum chemistry pioneers are pictured in the main photo on the cover. This photo is that of the participants in the famous 1951 Shelter Island Conference on Quantum Mechanical Methods in Valence Theory. Those in the photo are identified in the corresponding figure in the chapter by Ruedenberg and Schwarz. The young man at the far left of the standees is Klaus Ruedenberg. The four smaller photos below the main photo show, respectively from left to right, quantum chemistry pioneers John Pople, Erich Hückel, H. C. Longuet-Higgins, and George Wheland. We are grateful for financial support of the Anaheim Symposium by Q-Chem and also by HIST. We acknowledge additional presentations given at the symposium, including those by M. Katharine Holloway, Vera V. Mainz, Roald Hoffmann, and Henry F. Schaefer III. Thanks also go to Tim Marney and Arlene Furman at ACS Books for their encouragement, help, and advice, as well as to the many reviewers of the exciting chapters that follow. The chapters that follow are clearly a selective rather than a comprehensive survey of quantum chemistry, but they do illustrate the many avenues to be explored. Read and enjoy!

E. Thomas Strom  
Angela K. Wilson



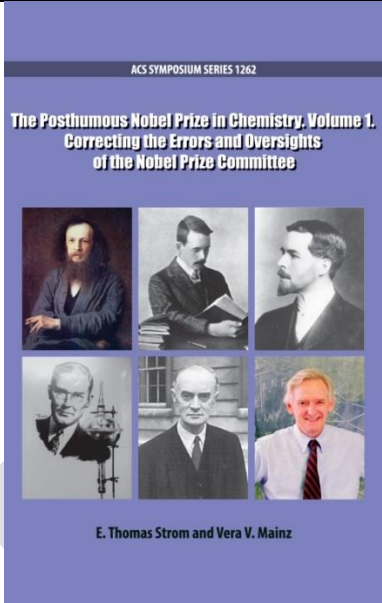
2013	<a href="#">ACS Symposium Series Volume 1136</a>	<p>Gary D. Patterson and Seth C. Rasmussen</p> <p>Characters in Chemistry: A Celebration of the Humanity of Chemistry</p>	
------	--------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------

**Preface (Abbreviated).** One of the recurring ideas at Bolton Society meetings over the last decade was a symposium on Characters in Chemistry. Jack Stocker and Jim Bohning were avid supporters of such an event. While neither of them lived to experience the symposium in person, they were definitely present in spirit. As the Chief Bibliophile, Gary Patterson agreed to organize such a symposium in 2012 and set out to recruit an international group of historians of chemistry known for their interest in characters (Chapter 1). The present volume is the written record of this event. William Jensen has established a long record of outstanding contributions to the biography of chemists. As the curator of the Ralph Oesper Collection in the History of Chemistry at the University of Cincinnati, he has access to a wealth of original material, including books, pictures and ephemera. One of the richest mines in the collection contains material on Robert Bunsen (1811–1899). The article is lavishly illustrated (Chapter 2). Bunsen was a favorite subject for Oesper himself, and his collection reflects this focus. Bunsen was even famous enough to inspire caricatures. This paper, which was read first on the program, set a fine standard for quality and humor. Another well-established biographer is the Head of the Society for the History of Alchemy and Chymistry, Robert G. W. Anderson. One of the most interesting early figures in the history of Scottish chemistry was Joseph Black (1728–1799) of Edinburgh University. Recent research into the letters of Joseph Black has revealed the extent to which he was deeply connected to Scottish Enlightenment society. In addition to the local thinkers, such as David Hume, Black was in correspondence with Montesquieu, a family friend of his father. Another friend was James Watt! Black’s life as a teacher of Chemistry is extensively reviewed.... (Chapter 3). Alan Rocke...in Chapter4, ... features English chemist: John Dalton. While every chemist recognizes Dalton as the father of the atomic theory, Rocke presents him in his social context as a Quaker rustic from Manchester. Unlike his younger contemporary, Humphry Davy, Dalton was simple in his manners, simple in the living style, and preferred Manchester to London. Dalton looked back to Newton, while Davy was taken by 19th century romantic idealism....Cathy Cobb is the author of the most entertaining book on the history of physical chemists: “Magick, Mayhem, and Mavericks” (Chapter 5). For this symposium she chose a historical character of great notoriety: Lucretia Borgia (1480–1519). Borgia was well-born, well-bred and well-educated. She held high positions in the Vatican administration, and was highly admired by all in Rome (both dressed and undressed). She was a skilled chemical practitioner, but the story of her use of poison awaits...One of the most famous chemical caricatures of all time is of William Crookes (1832–1919), holding his famous “tube” and

dressed too well to be anywhere near a laboratory. The current biographer of Crookes, William Brock of Leicester, kept the party going with many tales and pictures of Crookes (Chapter6). ..Soon after Priestley established that there were many different kinds of gases, Humphry Davy devoted himself to the study of pneumatic chemistry at the Beddoes Pneumatic Institution. Seth Rasmussen presents the life and follies of Davy from his humble roots to his lofty station in English society (Chapter7). Davy's early success led to his appointment at the Royal Institution and a career as the greatest public lecturer of his age....Characters do not need to be historical to be influential in human affairs. Carmen Giunta surveys the characters found in English literature that were chemists and "characters." Carmen pays homage to the historian Ian Rae who collected books and stories where chemists appear as plot devices or even major characters. .In P.O. Enquist's *The Book about Blanche and Marie* (Harry N. Abrams, 2006), a little known side of Marie Curie is revealed, as well as the celebrated Langevin affair. While the biographical material about Chaim Weizmann may be vaguely referential, the tale *The Sun Chemist* (1976) is a fictional account of the development of biofuels and the corporate attempts to suppress them. Historical fiction based on Isaac Newton has appeared in the works of Neal Stephenson. ...Chemists are all humans and the human story can be told in fiction, both fantasy and historically motivated. David Lewis is the leading adept of the resurrection of dead Russian chemists. His subject in Chapter 9 is Yegor Yegorovich Vagner (1849–1903). He was part of the famous Kazan mafia and learned his craft as a thespian chemist there. As a chemist he was especially brilliant in his inferences of the structures of organic molecules, long before modern structural methods...Russians are not the only characters in the history of chemistry. Hungary has also produced its share of interesting people. The leading historian of Hungarian science, Istvan Hargittai, and his son, Balazs Hargittai, brought this subject to the party with a paper on the "Martians of Chemistry" (Chapter 10). While von Karman, von Neumann, Szilard, Wigner and Teller are perhaps best known for their government work in the United States, they were all Hungarians who had backgrounds in chemistry or chemical engineering. These five legendary humans were also larger than life figures, both in Europe and the United States. ..(Chapter 11). James Traynham, a former chairman of HIST...presented a paper on George Rosenkranz (1916–), best known as the retired Director of Syntex in Mexico City. ...He was enterprising in the extreme, a useful skill for a Jewish student without a source of funds from "back home." His pilgrimage to the Americas landed him in Cuba in 1941 with no easy way to leave. He went to work for a pharmaceutical company and made the most of his opportunities. ..When he started at Syntex in 1945, the company was deeply in debt; when he sold the company to Roche in 1995, it fetched \$5.3 billion...The final paper presents some early work...of Paul John Flory (Chapter 12). Paul Flory received the Nobel Prize in Chemistry in 1974 for his pioneering work in the foundations of polymer science. He was fortunate to land a job a DuPont working with Wallace Carothers, the foremost synthetic polymer chemist in 1934. Flory, like Carothers, was fully committed to fundamental science, even if it was of use to industry! ..After his Nobel Prize, he devoted his passion and energy to human rights causes. He was the principal human rights advocate in the National Academy of Sciences. He was chosen by the United States government to be on the team that attended the review of the Helsinki Accords.

Gary D. Patterson

Seth C. Rasmussen

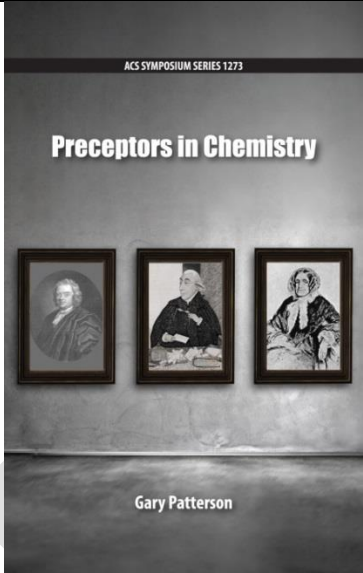
2017	<a href="#">ACS Symposium Series Volume 1262</a>	E. Thomas Strom and Vera V. Mainz  The Posthumous Nobel Prize in Chemistry. Volume 1. Correcting the Errors and Oversights of the Nobel Prize Committee	
<p><b>Preface (Abbreviated).</b> The symposium on which this book is based originated when one of us (Tom Strom) came to the belief that Wallace Carothers deserved equal credit with Hermann Staudinger for, first, the acceptance of, and, second, the flourishing of polymer chemistry from the 1920's on. Staudinger received the Nobel Prize in chemistry for his polymer work in 1953, while Carothers had died in 1937, never being nominated. With the passage of time, it's hard for present day chemists to appreciate the impact on chemists of the past when hearing about Carothers' magnificent work with condensation polymers. The culmination of Carothers' work was presented by him at the Sept. 1935 Faraday Society meeting at Cambridge, UK... Fortunately, the life and career of Wallace Carothers have been well covered...but Tom still felt Carothers' accomplishments were insufficiently appreciated by chemists. He proposed to give a presentation on Carothers with some additional detail about his education and with more technical descriptions about his chemistry.</p> <p>Tom's experience in doing history presentations/papers was that individual papers tend to be overlooked, while papers linked to an overarching theme receive recognition. The grand theme here just hits one in the face---the significant number of chemists who did Nobel Prize-level work but did not receive the award. Both of your editors have a degree from UC-Berkeley, and the belief when we were there in school, still held at Berkeley today, is that G. N. Lewis was unjustly deprived of a Nobel Prize in chemistry.</p> <p>Any chemist with a decent background in chemical history could readily add other deserving chemists to our list of Carothers and Lewis, but what are we to do about it? We have an avenue of approach based on that wonderful play by Carl Djerassi and Roald Hoffmann, "Oxygen." Recall that the theme of the play is the awarding of a Retro-Nobel Prize, essentially a posthumous Nobel Prize, for the discovery of oxygen. The potential candidates are Joseph Priestley, who first published on the discovery of oxygen, Carl Scheele, who actually first made oxygen, and Antoine Lavoisier, who figured out the role of oxygen in chemistry. Choosing a winner among these three is not at all simple, and we won't spoil things for you by giving you the answer. If some of you readers have not yet read the play, we urge you to do so. However, the giving of a posthumous Nobel Prize in chemistry would provide an avenue for redressing past wrongs. Therefore, the title of the symposium that Tom subsequently organized was "The Posthumous Nobel Prize in Chemistry. Correcting the Errors and Oversights of the Nobel Prize Committee." This symposium took place on March 14, 2016, at the ACS Spring National Meeting in San Diego, CA.</p>			

The theme of the symposium was announced in the Fall 2015 newsletter of the History Division, and it seemed to strike a nerve in HIST members. A number of people volunteered presentations on their favorite overlooked chemist, while Tom solicited a few other presentations to cover what he considered gaps. An overview presentation on the Nobel Prize was given by William Jensen (Chapter 1) and Tom followed by presentations on passed-over chemists Dmitri Mendeleev (Carmen Giunta; Chapter 3), Henry Moseley (Virginia Trimble; Chapter 4), Herman Mark (Gary Patterson; Chapter 5), Wallace Carothers (E. Thomas Strom; Chapter 7), Stephen Brunauer, Paul Emmett, and Edward Teller for the BET equation (Burtron Davis; Chapter 8), Yevgenii Zavoiskii (David Lewis; Chapter 10), Michael Dewar (Eamonn Healy), Louis Hammett (Charles Perrin; Chapter 11), Robert Woodward (Jeffrey Seeman), and Howard Simmons, Jr. (Pierre Laszlo; Chapter 13). A presentation on Neil Bartlett by Joel Liebman had to be cancelled because of illness. Some of you may wonder what Nobel Laureate Robert Woodward was doing in the symposium. Jeff Seeman argued persuasively that Woodward could have qualified for at least three more Nobel Prizes. The symposium was well attended, and it received substantial coverage in (the) *Chemical & Engineering News*. (Borman, S. *Chem. Eng. News*. **2016**, *94* (April 11), 19–21.) Indeed, that piece by Stu Borman was voted by readers as the tenth most popular article in the magazine in 2016. Consequently, ACS Books was very supportive of turning this symposium into a book. Tom asked his long-time friend chemical historian Vera Mainz to co-edit the volume, and she graciously agreed to do so.

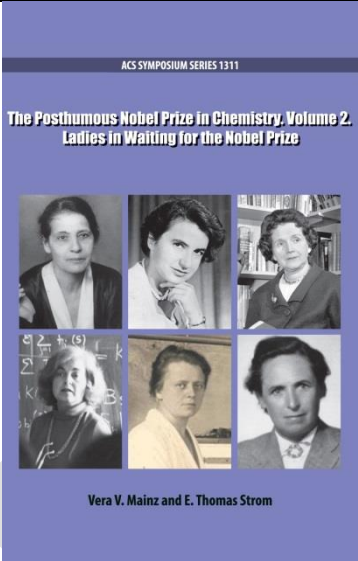
Much of the book's content was provided when the San Diego presenters turned their oral presentations into well-documented chapters. Only Eamonn Healy was unable to contribute a written chapter on Dewar because of the press of his other activities. This material was supplemented by additional chapters. Co-written by Kathleen Edwards, Joel Liebman's missing presentation finally surfaced as a chapter on Neil Bartlett (Chapter 12). Besides his opening overview of Nobel Prize history, William Jensen gave us a much-needed chapter on G. N. Lewis (Chapter 6). Jeff Seeman replaced his Woodward talk with the second chapter in this book (Chapter 2), an analysis of the difficulties the Nobel Prize Committee must go through in making a choice. Finally, John Ridd provided a chapter on Christopher Ingold (Chapter 9), whose lack of a Nobel Prize still stirs disbelief. The order of the chapters is roughly the order in which we think their Nobel Prizes should have been given. The book cover has photos of several of these under-appreciated chemists, those who one of the Editors (Tom) thought most deserving of a posthumous Nobel Prize. The readers are free to disagree with those choices, as did several of the chapter authors. The photos used come from the pertinent book chapters.

E. Thomas Strom

Vera V. Mainz

2018	<a href="#">ACS Symposium Series Volume 1273</a>	Gary D. Patterson  Preceptors in Chemistry	
<p><b>Abstract.</b> In the last 500 years, the worldwide community of chemistry has produced individuals who attempted to synthesize a coherent view of chemistry that could be taught to actual students. The following essay is neither exhaustive nor definitive, but it does attempt to paint a picture of how particular chemists carried out this task in their own times. It also attempts to define the characteristics of good chemical preceptors. Even chemical geniuses can become so focused on their own work that they are not understood by the bulk of their contemporaries and cannot contribute to the synoptic view of chemistry needed for effective teaching. It is hoped that the insights presented in this essay will be of benefit to all current preceptors in chemistry.</p> <p><b>Prologue.</b> The publication of the book <i>Inventing Chemistry: Herman Boerhaave and the Reform of the Chemical Arts (I)</i> by John Powers in 2012 led to a discussion of the role of Herman Boerhaave (1668-1738) as a preceptor in chemistry. Professor Powers and I shared a love both of the work and writings of Boerhaave and of the teaching of chemistry. It was proposed that a symposium on preceptors in chemistry be organized to further explore this area. This symposium was held at the American Chemical Society meeting in San Diego, California on March 13, 2016. The program included talks by Bruce Moran on Andreas Libavius, John Powers on Herman Boerhaave, Bernadette Bensaude-Vincent on the French chemists Macquer, Rouelle and Venell, Vera Mainz on Dmitri Mendeleev, Jay Labinger on Fred Basolo, Steve Weininger on Paul Bartlett and Gary Patterson on Linus Pauling. In order to continue the discussion in print, additional scholars were recruited to contribute chapters on additional preceptors. While some of the original presenters did not submit chapters for the present volume (Moran, Bensaude-Vincent and Weininger), additional chapters were received from Robert Anderson on Joseph Black, Gary Patterson on William Henry, Michal Meyer on Mrs. Marcet, Carmen Giunta on Stanislao Cannizzaro and William Jensen on Justus Liebig.</p> <p>Gary D. Patterson</p>			



2018	<a href="#">ACS Symposium Series Volume 1311</a>	Vera V. Mainz and E. Thomas Strom  The Posthumous Nobel Prize in Chemistry. Volume 2. Ladies in Waiting for the Nobel Prize	
------	--------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------

**Preface (Abbreviated).** The symposium on which this book is based originated after one of us (Tom Strom) organized a successful American Chemical Society (ACS) symposium in March 2016, on the Posthumous Nobel Prize in Chemistry. Afterward, the other of us (Vera Mainz) pointed out that the chemists represented in that symposium and its subsequent symposium volume were “all dead white guys.” The fact that only white men were included in the first symposium partly reflects the prevailing past (and continuing) gender imbalance in chemistry, but it also shows the power of the Matilda effect, first articulated by Matilda Joslyn Gage (1826–1898). The Matilda effect is an implicit bias against acknowledging the achievements of women scientists, whose work is often attributed to their male colleagues. An implicit bias is one which is not conscious or deliberate, but nevertheless real.

The gender imbalance in the previous symposium was also noted in the on-line comments for the *Chemical and Engineering News* article that reported on it. Redressing that imbalance was the purpose of the current symposium entitled “Ladies in Waiting for the Nobel Prize in Chemistry. Overlooked Accomplishments of Women Chemists.” This symposium, which took place in August 2017, was sponsored by the ACS History of Chemistry Division (HIST), the Women Chemists Committee (WCC), and ACS President Allison Campbell. As we began to organize the symposium, the primary question was which women should be the subject of talks. Two, Lise Meitner and Rosalind Franklin, were mentioned in the on-line commentary in *Chem. Eng. News* and we fully agreed that they should be included in the symposium. Lise Meitner, as the Editor of *Chem. Eng. News* noted, “made pioneering advances in radioactivity and nuclear physics, including the discovery of nuclear fission of uranium with German radiochemist Otto Hahn. Hahn, however, took home the 1944 Nobel Prize in Chemistry for nuclear fission all by himself.” Rosalind Franklin, because of her early death (1958), was not eligible for the Physiology or Medicine Nobel Prize won by James Watson, Francis Crick, and Maurice Wilkins in 1962. A fair and interesting question, however, is this: had she still been alive, would Franklin have been included.

We also wondered what other women had been nominated for a Nobel Prize in Chemistry but who had not won. The Nobel Prize website has a Nomination Archive that contains information on nominees and their nominators. It has the restriction that no nomination material other than the names can be accessed unless the nomination had been made more than 50 years ago, and unless all involved, nominee and nominator(s), are deceased. A search for all women nominated for the Nobel Prize in Chemistry between 1901 and 1965 returned a list of twelve names. Of these twelve, three actually won Nobel

Prizes in Chemistry—Marie Curie (1911), Irène Joliot-Curie (1935), Dorothy Crowfoot Hodgkin (1964)—and it is well known that the first of Marie Curie’s two Nobel Prizes was in Physics (1903). One other woman on the list, Maria Goeppert-Mayer, won the Nobel Prize in Physics (1963). Since 1965, the list of female Nobelists in Chemistry has increased by only one: Ada Yonath (2009).

The Ladies in Waiting symposium featured all eight women on this list who did not win a Nobel. Separate talks were given on Marietta Blau, Lise Meitner, Ida Noddack, and Marguerite Perey. One talk focused jointly on the other four nominees, Martha Chase, Joan Folkes, Thérèse Tréfouël, and Dorothy Wrinch, who were not as well-known as the other four. We then asked members of HIST and WCC to suggest other names to include. In its final form, the symposium included an introductory lecture by Magdolna Hargittai on the underrepresentation and underrecognition of women in science (specifically with respect to the Nobel prize), talks on the nine women named previously, and talks on six others: Agnes Pockels, Katherine Blodgett, Erika Cremers, Kathleen Yardley Lonsdale, Rachel Carson and Darleane Hoffman. All the women featured in the symposium are represented in this volume, except for Martha Chase, Joan Folkes, Thérèse Tréfouël, and Dorothy Wrinch; a variety of circumstances led to their being omitted. But, in compensation, chapters were added on three women whose work was not included in the symposium: Marjory Stephenson, Margherita Hack, and Isabella Karle.

The last event of the symposium was a dramatic presentation, *No Belles*, by the Portal Theatre Company, which told the story, through a variety of story-telling techniques, of women who won and didn’t win Nobel Prizes. It is one of the most effective means we have ever seen to communicate to nonscientists why one pursues a scientific career and why it matters.

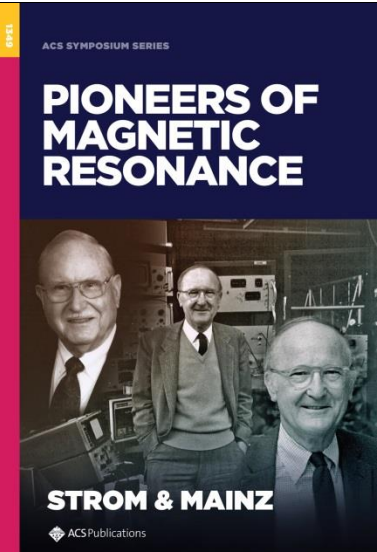
By highlighting this group of extraordinary women scientists, we raise awareness of the Matilda effect, but more importantly, we honor them and their accomplishments. In a review of five books on women in science, “Women in Science: Weird Sisters?” (*Nature* **2013**, 495, 43–44), Patricia Fara wrote:

*Biographers can shift attitudes, but they need to celebrate their subjects for being special scientists, not marvel at them as weird women. Just like men, female scientists have individual personalities and idiosyncrasies, and they have weaknesses as well as extraordinary capabilities – not because they are women, but because they are human beings.*

That is how we wanted to present the women portrayed in this volume. We hope we succeeded!

Vera V. Mainz

E. Thomas Strom

2020	<a href="#">ACS Symposium Series Volume 1349</a>	E. Thomas Strom and Vera V. Mainz  Pioneers of Magnetic Resonance	
------	--------------------------------------------------	-------------------------------------------------------------------------	------------------------------------------------------------------------------------

**Preface – Abbreviated.** On three previous occasions we two have co-edited ACS Books volumes based on symposia arranged by the ACS Division of the History of Chemistry. This volume is our fourth joint excursion into the history of chemistry, and for this volume we both return to our roots. Tom taught himself about Electron Paramagnetic Resonance (EPR) in graduate school at Iowa State University working with mentor Glen A. Russell. During Tom’s two years in the US Army at the Quartermaster Corps research facility in Natick, MA, he worked extensively on EPR. After his return to Mobil’s Field Research Laboratory in Dallas, TX, he continued to do work in EPR, but he also branched out into Nuclear Magnetic Resonance (NMR) and mass spectrometry. Vera has even more long term credentials in NMR. During her graduate training at Berkeley, she was the NMR teaching assistant, providing training and check outs on all NMR instrumentation. Her graduate research demanded work with multinuclear and low temperature NMR. During her time at Rohm and Haas, she helped train technicians to take NMR spectra. During her post-doc at Illinois, she worked for Walter Klemperer, a pioneer in oxygen-17 and tungsten-183NMR. She then transitioned to become head of the Molecular Spectroscopy Laboratory in the School of Chemical Sciences at Illinois. With the growth in NMR instrumentation, this facility eventually became the NMR Laboratory. Vera ran the facility from 1983 until 2010. Both NMR and EPR are old spectroscopies. If we remove Isadore Rabi from the picture (but we probably shouldn’t), NMR dates back to Bloch and Purcell’s discoveries in 1945. EPR is slightly older, a result of Zavoiskii’s work in 1944. There are several histories of these important spectroscopies, but we will limit ourselves to cite just one each. An important NMR history would be *Volume 1. Historical Perspectives* from the *Encyclopedia of Nuclear Magnetic Resonance*, edited by D. M. Grant and R. K. Harris. Our EPR choice would be *Foundations of Modern EPR* edited by G. R. Eaton, S. S. Eaton, and K. M. Salikhov. However, here we celebrate both spectroscopies in one volume. Almost all of the giants of magnetic resonance have passed on, but what about the generation that followed? They were the students and younger colleagues of the pioneers, who knew those pioneers intimately. The ranks of those later cohorts are also dwindling. Our HIST symposium held in Orlando, FL, in the spring of 2019 featured speakers who were familiar with those stalwarts of magnetic resonance. The morning session focused on EPR, and the audience heard David Lewis speaking on Zavoiskii (Chapter 6), James Norris telling about Sam Weissman (Chapter 7), Jack Freed discussing the career of George Fraenkel (Chapter 8), Lawrence Berliner talking about Harden McConnell (Chapter 9), Alex Smirnov describing the work of R. Linn Belford (Chapter 10), with the final talk

featuring Gareth and Sandra Eaton (Chapter 11) surveying the relationship between spin relaxation and EPR history.

NMR was covered in the afternoon session. Vera Mainz discussed those early NMR experiments carried out by Bloch and Purcell (Chapter 1). Herb Gutowsky was the main pioneer in applying NMR to chemistry, and H. N. Cheng gave a survey of Herb's many accomplishments (Chapter 2). Pierre Laszlo has had a long career in NMR, and he presented many highlights about NMR people and their accomplishments (Chapter 3). Tom Strom described the significant but underappreciated accomplishments of Don Woessner on NMR relaxation (Chapter 4). In a later presentation developed with Morton Meyers, Tom also surveyed the Lauterbur/Damadian dispute about the credit for Magnetic Resonance Imaging (MRI). Bob Griffin talked about the pioneering work of John Waugh on solids NMR. Jake Schaefer's topic was on magic-angle spinning for NMR, work that Jake originally carried out with Ed Stejskal (Chapter 5). Because of the press of other commitments, Bob Griffin was unable to transform his stunning presentation into a chapter for this book. We suggest that you readers explore John Waugh's short autobiography in *Annual Review of Physical Chemistry*, **2009**, *60*, 1-19. Because of unresolved copyright issues, the Meyers-Strom presentation is not one of our chapters. However, using a cache of previously unknown Woessner/Damadian correspondence, the Lauterbur/Damadian controversy is well-covered in the Woessner chapter (Chapter 4). The remaining five NMR presentations were transformed into chapters for this book. However, Vera Mainz was joined by Carmen Giunta as co-author for her chapter (Chapter 1), and H. N. Cheng was also joined with Gregory Girolami as co-author on his chapter (Chapter 2).

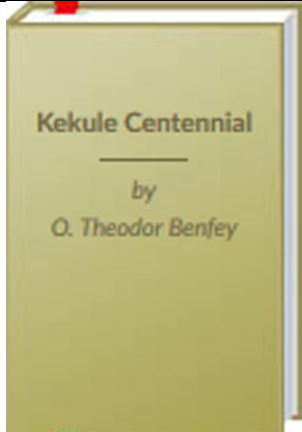
We are grateful to our presenters for taking the time to transform their oral presentations to these more comprehensive written chapters. We thank a cadre of unsung reviewers who insured that the chapters were of high quality. The staff of ACS Books, as always, were invaluable. We appreciate the efforts made by Amanda Koenig, Sara Tenney, Rachel Wright, and Grace Taylor. Last, but by no means least, we thank our respective spouses Charlotte Strom and Greg Girolami for their patience in what seemed a never ending task. The lot of a pioneer is often hard, but their accomplishments can also be inspiring. We hope you readers will be inspired by the stories of these many giants of magnetic resonance.

E. Thomas Strom

Vera V. Mainz

97  
98  
99

### III. ANNIVERSARIES AND LANDMARKS

Date	Publisher	Editor(s)/Title	Cover Image
1966	<a href="#">ACS Advances in Chemistry Series 61</a>	O. Theodor Benfey Kekulé Centennial	

**Preface.** Perhaps it is fitting to begin this volume the same way the Kekulé celebration was begun—with a quotation by the man we honor:

We all stand on the shoulders of our predecessors. Is it then surprising that we can see further than they? If we follow the roads built by our predecessors and effortlessly reach places they have attained only after overcoming countless obstacles, what special merit is it if we can penetrate further into the unknown?

Kekulé spoke these words at the 25th anniversary of the formula that he proposed 100 years ago. Today we honor Kekulé, the giant on whose shoulders we now stand. The occasion for this celebration is not the centennial of his birth or death but the centennial of a particular concept.

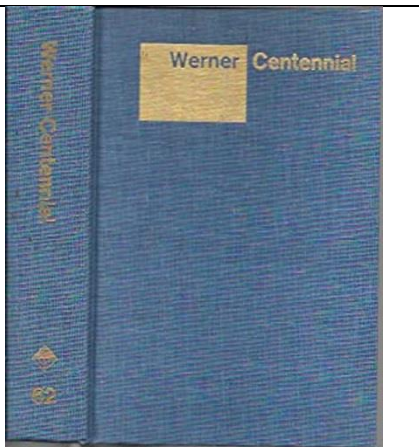
This is not the first benzene centennial celebration. Belgium has already celebrated Kekulé's benzene formula, using the occasion to announce the synthesis of some of the isomers of benzene. Coinciding with the American Chemical Society's Kekulé symposium, a Kekulé celebration was held in Bonn by the German Chemical Society. Kekulé had his vision of the benzene ring in Belgium, but for many years he taught in Bonn. The American Chemical Society was officially invited to send a delegate to the German celebration, and Professor Saul Winstein of U.C.L.A. was appointed to bring the greetings of the American Chemical Society to its sister society in Germany.

The Kekulé celebrations, both in Bonn and Atlantic City, had historical and contemporary facets. Papers were presented on historical subjects and on the current state of aromatic chemistry. The Atlantic City symposium was co-sponsored by the Divisions of History of Chemistry, Organic Chemistry, and Chemical Education. This volume presents only the historical papers.

Special articles commemorating the benzene formula have appeared in *Angewandte Chemie* [77, 770 (1965)]; *Chemical and Engineering News* [43, 90 (June 25, 1965)]; *Journal of Chemical Education* [42,266 (1965)]; *Chemistry* [38, 6 (January 1965)].

It is our hope that this volume will contribute to the understanding by scientists of the conceptual history behind modern structural chemistry, the significance of the individual in the ongoing path of science, and the interaction of science, technology, and society.

O. Theodor Benfey

1967	<a href="#">ACS Advances in Chemistry Series 62</a>	George B. Kauffman Werner Centennial	
------	-----------------------------------------------------	-----------------------------------------	--------------------------------------------------------------------------------------

**Preface**

*This book is dedicated to the memory of  
Alfred Werner*

Born: Mulhouse (Haut-Rhin), France, December 12, 1866

Died: Zurich, Switzerland, November 15, 1919

Doktor der Philosophie, Eidgenössisches Polytechnikum, Zurich, October 13, 1890

Privat-Dozent, Eidgenössisches Polytechnikum, January 4, 1892-



September 29, 1893

Ausserordentlicher Professor, Universität Zurich, August 31, 1893-June 7, 1895

Ordentlicher Professor, June 8, 1895-October 15, 1919

Nobel Prize in Chemistry, December 11, 1913

Alfred Werner, the undisputed founder and systematizer of coordination chemistry, played such a central role in this particular field of science that his name is virtually synonymous with the field. Werner devoted his entire scientific career to amassing the experimental evidence required to prove the validity of his coordination theory, which he proposed in 1893 at the age of 26. Beginning with a study of the hitherto unexplained "molecular compounds" (metal-ammines, hydrates, and double salts), his ideas soon encompassed almost the whole of systematic inorganic chemistry and even found application in the organic realm. He was the first to demonstrate that stereochemistry is a general phenomenon not limited to carbon compounds, and even today his experimental and theoretical papers remain a foundation and guide for investigations in coordination chemistry. In 1913 he was awarded the Nobel Prize in chemistry in recognition of "his work on the linkage of atoms in molecules, by which he has thrown fresh light on old problems and opened new fields of research, particularly in inorganic chemistry." Today, when the practical and theoretical significance of modern structural inorganic chemistry is unquestioned, it is clear that the foundations of this field were erected largely by Alfred Werner, the man sometimes honored by the epithet of "the inorganic Kekulé."

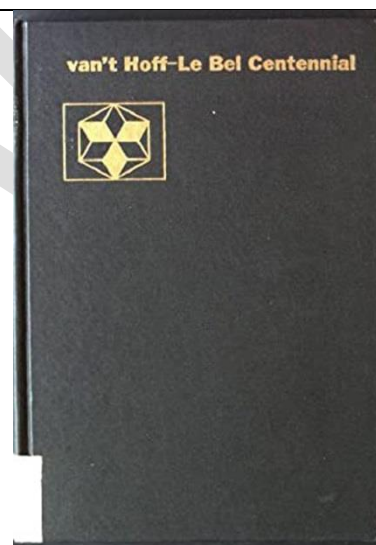
George B. Kauffman

1975

[ACS Symposium Series Volume 12](#)

O. Bertrand Ramsay

van't Hoff-Le Bel Centennial

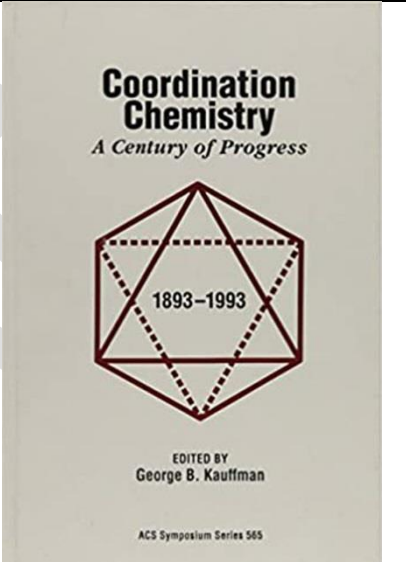


**Preface (Abbreviated).** The present volume derives largely from papers presented at the van't Hoff-Le Bel Symposium. The symposium included sessions concerned with contemporary aspects (sponsored by the Division of Organic Chemistry) and historical developments (sponsored by the Division of the History of Chemistry) of stereochemistry. This volume includes seven of the papers presented in the latter sessions. The paper by Ramsay that is included here is based on a talk presented at the centennial banquet held on the evening of September 11... Though the beginnings of the systematic study of stereochemistry might well be dated from 1874, this dating often obscures our understanding of prior stereochemical investigations and speculations. In the first paper in this volume, Jane Miller discusses some of the ideas considered earlier in the century and in particular those developed by the French chemist and crystallographer, M. A. Gaudin. Although Gaudin put forth some interesting proposals concerning the relationship between crystal shape and molecular architecture, his ideas remained virtually unknown to chemists

in the middle of the 19th century...As Trevor Levere states in the second paper, an awareness of the ideas of atoms and their arrangement was a necessary but not a sufficient condition for the formulation of stereochemical theories. The positivistic philosophy of Auguste Comte may have contributed to the reluctance of some scientists to speculate too deeply. Many chemists felt that the inner arrangement of the atoms in molecules was unknowable or at least could not be known from chemical studies...It was van't Hoff's attempt to understand the optical properties of lactic acid that led him to his stereochemical theory. Why was it then that Wislicenus was unable to see the solution since he had been grappling with the lactic acid problem for a number of years? He himself had seen that this was where the solution should be found...Nicholas Fisher convincingly shows us in his paper that the problem was much more complex than the text-book histories would lead us to believe. Fisher suggests, for example, that Pasteur's work on molecular dissymmetry may have had little impact in the stimulation of further research. Those who were concerned with the problem of isomerism found it difficult to disentangle structural isomers from optical isomers. Wislicenus was faced with numerous experimental difficulties so that even after many years of investigation he was left with the apparent existence of not merely two, but four, lactic acid isomers...It is not surprising therefore to find that Wislicenus greeted van't Hoff's ideas with great enthusiasm. Wislicenus was also influential in bringing van't Hoff's ideas to the attention of the chemical world. Other chemists, however, were either indifferent or hostile to van't Hoff's proposals. Some of the experimental and theoretical reasons that formed the basis of these objections are traced in the first of H. A. M. Snelder's two papers. For example, one of the experimentally based objections was derived from Pasteur's earlier report of the existence of an optically inactive, non-resolvable form of malic acid. A colleague of van't Hoff, J. W. Bremer was finally able to demonstrate experimentally that this was not the case and van't Hoff was able to show how his new stereochemical theory could be used to solve the problem. Le Bel has received far less attention from historians than van't Hoff, and he therefore remains somewhat obscure as to his contributions to stereochemistry. The ideas of van't Hoff and Le Bel are contrasted in the second of Snelder's papers. Most chemists would assume that the use of molecular models play an important role in the formulation and development of stereochemical ideas. Yet the history of the use of models has not been well documented by historians. In my paper I attempt to consider the consequences of the use of models in the early history of stereochemistry. The models prepared by van't Hoff in 1875 may have served to make his ideas more comprehensible to a chemical world that was not accustomed to the visualization of molecular geometries...Tonja Koeppel discusses some of the difficulties encountered in the formulation of a stereochemical theory in the absence of an adequate theory of bonding. As the basic tenets of stereochemistry became better established, the way was paved for more dynamic theories: the precursors of conformational analysis. However, the experimental and theoretical complications that accompanied the introduction of these ideas accounts for their lack of acceptance in the late 19th and early 20th centuries. G. V. Bykov discusses the early experimental and theoretical studies of C. A. Bischoff who attempted to establish a basis for the existence of conformational isomerism in acyclic systems. Bischoff even devised a graphic formula to illustrate these conformers that closely approximated the presently used Newman projections...The reasons for the delay in the acceptance of multiplanar forms of cyclohexane (first proposed by H. Sachse in 1888) are discussed in some detail by Colin Russell...One of the major extensions of stereochemical theory was into the area of inorganic chemistry. George Kauffman relates the circumstances surrounding the resolution of the first inorganic coordination compound in 1911 in Alfred Werner's laboratory. The resolution of a completely inorganic compound three years later finally

established that carbon need not be present for a compound to be optically active. Werner's triumph signaled the beginning of rapid advances in inorganic chemical research. The significance of stereochemical concepts was not lost on investigators in other fields. John Parascandola discusses some of the earlier applications in the area of pharmacology. By the turn of the century, for example, . . . chemists and pharmacologists began to associate the paralyzing properties possessed by onium salts with the change from a planar structure to a three-dimensional structure. . . . After 1950 there was a rapid change in the nature of stereochemical research; even the terminology had changed dramatically. One of those who contributed significantly to the change of character of stereochemical research was V. Prelog. In the paper which he has contributed to this volume, he recounts his own involvement. . . . in the development of an unambiguous method of denoting the configurational arrangement of groups about an asymmetric carbon atom. The R/S system withstood the tests and modifications so well that it found its way into organic textbooks within a few years of the publication of the joint paper in 1966. It may be hoped that the reader of the papers in this volume may find a new appreciation of the present state of stereochemistry from the perspective of the past.

O. Bertrand Ramsay

1994	<a href="#">ACS Symposium Series Volume 565</a>	George B. Kauffman  Coordination Chemistry: A Century of Progress	
------	-------------------------------------------------	-------------------------------------------------------------------------	-------------------------------------------------------------------------------------

**Preface.** Coordination chemistry is one of the most active research fields in chemistry today. Known since ancient times, coordination compounds attracted as much attention during the nineteenth century for their tremendous importance to the general problem of chemical bonding as for their own unique and fascinating properties. Thus Alfred Werner (1866-1919), the founder of coordination chemistry, was trained as an organic chemist and entered inorganic chemistry through the back door, so to speak. Yet, even before he began his quarter-century-long *tour de force* of research on what were known as "molecular compounds," he became vitally concerned with one of the most basic problems of chemistry—the nature of affinity and valence. Coordination compounds provided him with an exciting and challenging means to this end. In 1913 Werner was awarded the Nobel Prize in chemistry, the first Swiss chemist to attain this honor. In the words of the Royal Swedish Academy of Sciences, he received the prize for "his work on the linkage of atoms in molecules, by which he has thrown fresh light on old problems and opened new fields of research, particularly in inorganic chemistry."

However, as the chapters in this volume illustrate, the theoretical and practical aspects of coordination chemistry in general and Werner's work in particular have significance in fields far removed from classical inorganic chemistry. Because of the

importance of Werner's research on coordination compounds, they are sometimes referred to as Werner complexes, and the coordination theory is colloquially called Werner's theory. Werner's work was so complete and all-encompassing that for many years coordination chemistry was neglected because most chemists thought that all the important research had been done. It remained for chemists such as John C. Bailar, Jr., in the United States and Kai Arne Jensen and Jannik Bjerrum in Denmark to revive interest in the field as part of what became known as "the Renaissance in inorganic chemistry." Evaluations of the lives and works of these recently deceased chemists appear as Chapters 6-9 in this volume.

Werner was born in Mulhouse, France, on December 12, 1866. To commemorate the 100th anniversary of his birth, I organized and chaired a symposium at the 152nd National Meeting of the American Chemical Society held in New York City in 1966. Forty-two of the papers presented at that symposium, the longest in ACS history up to that time, were published as a book, *Werner Centennial* (Advances in Chemistry Series No. 62, American Chemical Society: Washington, DC, 1967).

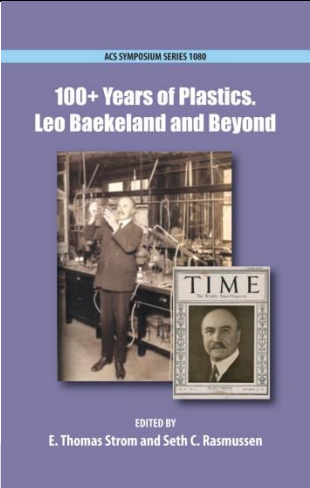
To commemorate the 100th anniversary of the publication of Werner's "Beitrag zur Konstitution anorganischer Verbindungen" (*Z.anorg. Chem.* **1893**, 3, 267-330), in which he first proposed his monumental coordination theory, a Coordination Chemistry Centennial Symposium (C3S), was held for four full days at the 205th National Meeting of the American Chemical Society in Denver, Colorado. Fifty-one papers on the historical, educational, review, and research aspects of the field were presented by speakers from 17 countries (Australia, Denmark, England, Finland, France, Germany, Hungary, India, Israel, Italy, Japan, New Zealand, Russia, South Africa, Switzerland, the United States, and Wales).

The well-attended symposium was opened by ACS President Helen M. Free and the famous trumpet fanfare from Ludwig van Beethoven's opera *Fidelio* played by symposium participant John G. Verkade. The distinguished participants included three 1993 ACS awardees (Robert H. Crabtree, Robert W. Parry, and me) and 10 past ACS awardees (Daryle H. Busch, Malcolm H. Chisholm, Gregory R. Choppin, Harry B. Gray, James A. Ibers, R. Bruce King, Steven J. Lippard, Arthur E. Martell, Alan M. Sargeson, and Jean'ne M. Shreeve).

One of the papers was coauthored by the 1951 Nobel chemistry laureate Glenn T. Seaborg. The 92-year-old Linus Pauling, a two-time Nobel laureate (for chemistry in 1954 and for peace in 1963), made a rare public appearance at the opening session. His entrance was heralded by another fanfare by Professor Verkade—this one from Benjamin Britten's operetta *Noah's Ark*, in which God's words to Noah are always preceded by this fanfare—appropriately, in view of Professor Pauling's megavitamin therapy research, in the key of C. Pauling's presentation (which is now Chapter 5 in this volume) featured his reminiscences and interpretations.

This volume contains 37 chapters: 28 were presented at the symposium on which this book is based; 9 are additional chapters. It includes biographical chapters and those dealing with the history of coordination chemistry as a whole and the history of various aspects of the field as well as reviews, research of more than ordinary interest, and chapters about the applications of coordination compounds. Therefore this book should be useful to historians of chemistry and of science, practicing chemists, students, and anyone concerned with the past, present, and future of one of the most intriguing and productive areas of chemistry. Eleven of the experimental research papers from the symposium appeared in a special "Coordination Chemistry Centennial Symposium" issue of *Polyhedron: The International Journal for Inorganic and Organometallic Chemistry* (Volume 13, Number 13, July 1994, for which I was the guest editor).

George B. Kauffman

2011	<a href="#">ACS Symposium Series Volume 1080</a>	E. Thomas Strom and Seth C. Rasmussen  100+ Years of Plastics. Leo Baekeland and Beyond	
------	--------------------------------------------------	-----------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------

**Preface.** Historians have the habit of characterizing past ages in terms of materials. We have the Stone Age, the Copper Age, the Bronze Age, and the Iron Age, followed at some remove by the Dark Ages, which couldn't have been a good time to be around. There would be some justification for calling the 20th century the Age of Plastics. The establishment of General Bakelite Corp. in 1910 initiated an age in synthetic polymers that provided plastics, fibers, and elastomers for a multitude of uses. Perhaps the importance and ubiquity of plastics is best demonstrated by the famous scene from the 1967 movie *The Graduate* in which recent college graduate Benjamin is given the following one word of advice by Mr. McGuire, "Plastics." McGuire goes on to tell Benjamin there is a great future in plastics. Screenplay writers Calder Willingham and Buck Henry probably intended the audience to believe that Benjamin was being tempted to sell out for mere financial success, but it has always seemed to us that this was good advice for its time and place. This volume consists of written chapters taken from the presentations at the symposium "100+ Years of Plastics: Leo Baekeland and Beyond", held March 22, 2010, at the 239th ACS National Meeting in San Francisco.

This symposium was organized by the ACS History of Chemistry Division (HIST) and cosponsored by the ACS Divisions of Polymer Chemistry (POLY) and Polymeric Materials: Science & Engineering (PMSE). The symposium celebrates the 100th anniversary of the formation of General Bakelite Corp., which was preceded by Leo Baekeland's synthesis of Bakelite in 1907 and the unveiling of the Bakelite process in 1909. It is quite reasonable to use the synthesis of Bakelite as the starting point of the Age of Plastics. Indeed, Time magazine in its June 14, 1999, issue on the 100 most influential people of the 20th century chose Leo Baekeland and his Bakelite synthesis as the sole representative of chemistry (*Time* **1999**, 153 (23), 8.). In a previous article detailing the merits of Baekeland's contributions, author Ivan Amato persuasively argued that the invention of this first true plastic transformed the world (Amato, I. *Time* **1999**, 153 (12), 80.). Although a brief sidebar also mentioned Wallace Carothers and Nylon, Carothers did not make it into the final top 100.

Leo Baekeland and Bakelite are the topics of the first four chapters of this volume. The first two chapters come from the perspective of Baekeland family members. Carl Kaufmann is related to the Baekeland family through marriage and is the author of the only full-length biography of Baekeland, published as a master's thesis from the University of Delaware. As a family member Kaufmann had access to all of Baekeland's papers. This first chapter (*Leo H. Baekeland*) is not only a biographical sketch, but an exploration of Baekeland's effect on the chemical industry. Hugh Karraker is Baekeland's great-grandson, and his chapter (*A Portrait of Leo H. Baekeland*) provides a family picture of the great inventor. Gary Patterson's chapter (*Materia Polymerica: Bakelite*) goes into the



history of Bakelite chemistry, while Burkhard Wagner's contribution (*Leo Baekeland's Legacy—100 Years of Plastics*) covers the history of Bakelite manufacture through time and space, finishing with a description of another Baekeland legacy, the Baekeland Award given through the North Jersey Section of the ACS.

The next chapters branch out somewhat. Les Sperling (*History of Interpenetrating Polymer Networks Starting with Bakelite-Based Compositions*) covers the improvements in interpenetrating networks. James Economy and Z. Parkar (*Historical Perspectives on Phenolic Resins and High-Temperature Aromatic Polyesters of p-Hydroxybenzoic Acid and Their Copolyesters*) follow the paths of resoles, novolaks, and related chemicals.

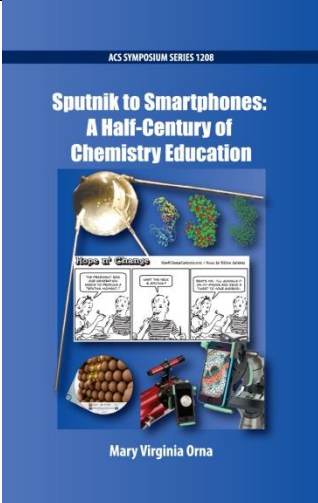
Leo Baekeland's invention brought forth a flowering of polymer products, so the remaining chapters are much more diverse. James Traynham (*In Their Own Words: Plastics Pioneers in the Chemical Heritage Foundation Oral History Archives*) tells the story of two pioneers in innovative fabrication techniques. Mehmet Demirors (*The History of Polyethylene*) tells the tale of probably the most widely used polymer of them all. The diversity of polymers is well illustrated by the fact that they can now be conductors. Remember that polyethylene was first valued as an insulator. However, this view of polymers as insulators changed with the work of Heeger, MacDiarmid, and Shirakawa on the conducting polymer polyacetylene, for which they were given the Nobel Prize for chemistry in 2000. Seth Rasmussen describes the work of Weissand Jozefowicz on the conducting polymers polypyrrole and polyaniline, respectively, which predated the polyacetylene work (*Electrically Conducting Plastics: Revising the History of Conjugated Organic Polymers*). Finally, Wen-Bin Zhang, Stephen Z.D. Cheng, and Mike Yaszemski take polymers well into the 21st century with their chapter (*Polymeric Biomaterials: A History of Use in Musculoskeletal Regenerative and Reconstructive Medicine*).

We are grateful for financial support of the San Francisco Symposium by Dow Chemical Co. at Freeport, TX, and by the ACS Division of Polymer Chemistry.

We want to particularly acknowledge the help and encouragement of Dennis Smith (POLY), Mehmet Demirors (Dow, Freeport), and Tim Marney (ACS Books). While the chapters to follow are clearly a selective rather than a comprehensive survey of polymer history, they show something of the many paths possible after that crucial Bakelite invention. Read and enjoy!

E. Thomas Strom

Seth C. Rasmussen

2015	<a href="#">ACS Symposium Series Volume 1208</a>	Mary Virginia Orna  Sputnik to Smartphones: A Half-Century of Chemistry Education	
------	--------------------------------------------------	-----------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------

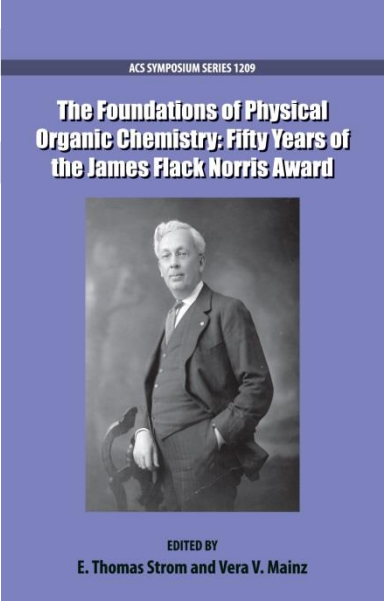
**Preface.** This book describes the profound changes that occurred in the teaching of chemistry in western countries in the years immediately following the Soviet Union's launch of Sputnik, the first artificial Earth satellite, in 1957. With substantial government

and private funding, chemistry educators introduced new curricula, developed programs to enhance the knowledge and skills of chemistry teachers, conceived of new models for managing chemistry education, and experimented with a plethora of materials for visualization of concepts and delivery of content. They also began to seriously study and apply findings from the behavioral sciences to the teaching and learning of chemistry. Now, many chemistry educators are contributing original research in the cognitive sciences that relates to chemistry education. This book, derived from the papers delivered at the Pimentel Award Symposium in honor of I. Dwaine Eubanks on 24 March 2015, documents this history over the past fifty years.

While Sputnik seemed to signal the dawn of far-reaching effects that would take place in political, diplomatic, and strategic, as well as in educational spheres, the seeds of these changes were sown decades before, mainly through the insight and actions of one individual, Neil Gordon, who, virtually singlehandedly, launched the ACS Division of Chemical Education and the *Journal of Chemical Education*. These two institutions provided the impetus for the United States to eventually become the undisputed leader in chemistry education worldwide.

However, the title, “Sputnik to Smartphones,” in no way is intended to book-end a chronological time period; rather, it offers two punctuation marks in a century of unprecedented change and growth that prompts us to ask “what next?,” and, “why?” and “how?” Each of us stands on the threshold and holds in our hands part of the answer to these questions.

Mary Virginia Orna

2015	<a href="#">ACS Symposium Series Volume 1209</a>	E. Thomas Strom and Vera V. Mainz  The Foundations of Physical Organic Chemistry: Fifty Years of the James Flack Norris Award	
------	--------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------

**Preface.** The symposium on which this book is based came about because one of us (Tom Strom) became increasingly concerned about the status of his chosen discipline, physical organic chemistry. With the recent flowering of organic synthesis, physical organic chemistry seemed to be shrinking or perhaps it was just being absorbed into the tool kit of the synthetic chemist. The only Nobel Prize that can be reasonably attributed to a physical organic chemist is the 1994 award to George Olah, although Jeffrey I. Seeman has recently made a strong case that R. B. Woodward was actually a physical organic chemist in disguise (Seeman, J. I., R. B. Woodward, A Great Physical Organic Chemist. *J. Phys. Org. Chem.* **2014**, 27, 708–721.). However, it is clear that Woodward’s 1965 Nobel Prize was awarded because of his prowess in synthetic chemistry. Tom decided to arrange a symposium for the ACS History Division that examined the history and fundamentals of

physical organic chemistry. He asked his friend Jeffrey Seeman to be co-organizer. In examining themes for such a symposium, Seeman noted that 2014 would see the awarding of the 50<sup>th</sup> James Flack Norris Award in Physical Organic Chemistry. It became clear that the research carried out by the winners of this award, sponsored by the ACS Northeastern Section, gave insight into the fundamentals of the discipline. Jeff and Tom decided on a two stage symposium: presentations by early winners of the award and a panel discussion by recent award winners on the topic, "Whither Physical Organic Chemistry." The symposium then came together rather quickly and was scheduled for the March, 2014, ACS National Meeting in Dallas, TX. James Flack Norris was an early physical organic chemist, before the discipline received its name. His picture is on the cover of this book, and Arthur Greenberg led off the symposium with a talk on Norris. Then came talks from Norris Award winners Ned Arnett, Ronald Breslow, Andrew Streitwieser, John Brauman, Paul Schleyer, Kendall Houk, and Michael Wasielewski. The participants for the closing panel discussion were John Baldwin, Ned Porter, Matthew Platz, Hans Reich, John Roberts, and Michael Wasielewski. ACS Books was very interested in issuing a volume on this historical symposium. Co-organizer Jeff Seeman was unable to continue as a co-editor because of the press of other activities. Tom asked his long-time friend and chemical historian Vera Mainz to co-edit the volume, and she graciously agreed to do so. Greenberg, Arnett, Breslow, Streitwieser, and Schleyer agreed to submit book chapters, but Brauman, Houk, and Wasielewski were unable to do so. However, Norris Award winners Ken Wiberg, Keith Ingold, and Wes Borden, who were unable to participate in the original symposium, agreed to submit chapters on their work.

The steady progress toward completion of this volume ended abruptly with the death of Paul Schleyer in November, 2014. In his last message to us on Nov.19, he said he would try to finish his chapter the very next week. He died just two days later. Paul was 84 years old, but he was still strongly involved in quantum chemistry research and had a great deal left to give to chemistry and also to the history of chemistry. Your editors were faced with the problem of transforming his oral presentation, which we had on tape, into a written chapter. Also, we felt that this volume should not only contain a chapter by Paul, but a chapter **about** Paul. Eventually we were able to persuade Andy Streitwieser to provide such a chapter. Fortunately, Andy was able to obtain Paul's unfinished memoir, which he had started but never completed for Jeff Seeman's series of books by renowned organic chemists. We thank Paul's widow Inge for permission to use this material. Consequently, Paul Schleyer is represented in two chapters in this volume. With the precedent of having a chapter about a deceased Norris Award winner in the volume, we asked ACS Books for permission to have two more chapters about deceased winners. This permission was given. Therefore, the book was completed with a chapter on William Doering written by Ron Magid and Maitland Jones and a chapter on Glen A. Russell written by Kathleen Trahanovsky and E. Thomas Strom.

Our first words of thanks must go to the authors of our book chapters. We are grateful for the sharing of their recollections and research with the readers of this book. For financial support of the original symposium, we want to thank the ACS History of Chemistry Division, ACS President Tom Barton, and the Northeastern ACS Section. The ACS Division of Organic Chemistry was also a sponsor of the original symposium. We also thank the HIST Program Chair Seth Rasmussen for his assistance in arranging the symposium. We appreciate the important work done by Jeff Seeman in obtaining the original group of speakers. We thank the many reviewers of these chapters for their comments and corrections. For their invaluable assistance in completing this volume, we thank Tim Marney, Bob Hauserman, Arlene Furman, Lindsey Watson, and Tara Urban of ACS Books. Someday someone will write a history of physical organic chemistry. This

volume, with its contributions by so many noted physical organic chemists, will be an invaluable starting point for such a history.

E. Thomas Strom

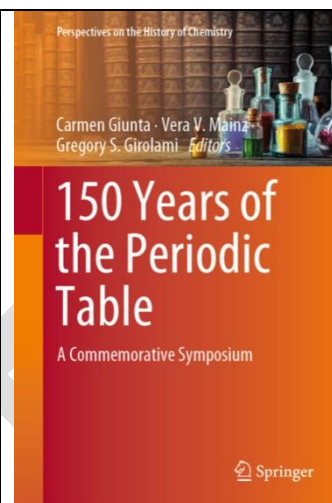
Vera V. Mainz

2021

Springer  
Perspectives on the  
History of  
Chemistry Series

Carmen J. Giunta, Vera  
V. Mainz and Gregory  
S. Girolami

150 Years of the  
Periodic Table: A  
Commemorative  
Symposium



### Excerpt from the Editors' Introduction

The declaration by UNESCO of 2019 as the International Year of the Periodic Table sparked celebrations and renewed study of this icon of science. Activities included exhibitions, symposia, and publications—including the present volume.

The periodic table has been described as an icon of science, one that all scientists and students of science encounter at some point in their careers. The table's profile, its arrangement of orderly but unequal rows and columns of boxes, is a distinctive design that often appears in unexpected places in popular culture. How the periodic table came to be constructed is a fascinating story that rewards serious study and warrants celebration. We think you will find that the following book contains fascinating and occasionally surprising new insights into that story.

Vera Mainz, Gregory Girolami, and Carmen Giunta, the editors of this volume, began planning a symposium to commemorate the 150th anniversary of Mendeleev's table in the summer of 2017. ... The symposium program spanned three half-day sessions. The first session treated classifiers of elements who preceded Mendeleev or were contemporaries of his. Most of the second session dealt with developments in the periodic system in the nineteenth century after the publication of Mendeleev's first table. The final session treated topics mainly from the twentieth century and beyond. ... Most of the symposium speakers graciously agreed to contribute to the present volume.

### Contents

#### 1 Editors' Introduction

Carmen J. Giunta, Vera V. Mainz and Gregory S. Girolami

#### Part I Mendeleev and his Predecessors

#### 2 Dmitri Mendeleev and the Periodic System: Philosophy, Periodicity, and Predictions

Ann E. Robinson

#### 3 The Trouble with Triads

William B. Jensen

4 Josiah Parsons Cooke, the Natural Philosophy of Sir John F.W. Herschel and the Rational Chemistry of the Elements  
Ronald Brashear and Gary Patterson

5 *Vis tellurique* of Alexandre-Émile Béguyer de Chancourtois  
Carmen J. Giunta

6 Periodicity in Britain: The Periodic Tables of Odling and Newlands  
Carmen J. Giunta, Vera V. Mainz and Julianna Poole-Sawyer

7 Gustavus Hinrichs and his Charts of the Elements  
Gregory S. Girolami

8 The Periodic Table of the Elements and Lothar Meyer  
Gisela Boeck

9 Translation of §§ 91-94 of Lothar Meyer's *Modernen Theorien* (1864)  
Vera V. Mainz

#### Part II Discoveries of Elements: Successes and Challenges

10 Discovery of Three Elements Predicted by Mendeleev's Table: Gallium, Scandium, and Germanium  
Mary Virginia Orna and Marco Fontani

11 The Rare Earths, A Challenge to Mendeleev, No Less Today  
Simon A. Cotton

12 The History (and Pre-History) of the Discovery and Chemistry of the Noble Gases  
Jay A. Labinger

13 Element Discovery and the Birth of the Atomic Age  
Kit Chapman

14 Mary Elvira Weeks and *Discovery of the Elements*  
Vera V. Mainz

#### Part III The Periodic Table from Other Perspectives

15 Astronomy Meets the Periodic Table, Or, How Much Is There of What, and Why?  
Virginia Trimble

16 The Impact of Twentieth Century Physics on the Periodic Table and Some Remaining Questions in the Twenty-first Century  
Eric R. Scerri

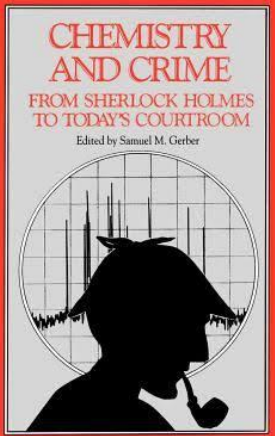
17 An Essay on Periodic Tables  
Pekka Pyykkö

18 The Periodic Table at 150: A Philatelic Celebration  
Daniel Rabinovich



100  
101  
102  
103

IV. ENTERTAINMENT AND DIVERSION

Date	Publisher	Editor(s)/Title	Cover Image
1983	American Chemical Society	Samuel M. Gerber  Chemistry and Crime: From Sherlock Holmes to Today's Courtroom	

**Preface.** Holmesians are committed to maintaining the myth that Sherlock Holmes was not a myth. Arthur Conan Doyle’s writing are full of ideas on forensic chemistry; articles have been written on Holmes’ chemical contributions; moreover, Watson himself said that Holmes’ knowledge of chemistry was profound.

Natalie Foster of Lehigh University, who has a keen interest in detective fiction, and I thought it would be a great idea to have a symposium on Chemistry in Crime – Fact and Fiction. We incorporated the fictional and forensic parts and noted, in many cases, a relationship between the two. The first three chapters clearly demonstrate this connection. The remaining chapters present descriptions of modern techniques in various sub disciplines of forensic science.

I want to thank all the contributors and members of the American Chemical Society Books Department, especially Suzanne B. Roethel, Janet S. Dodd, Paula M. Bérard and Anne G. Bigler.

A special debt of gratitude is due to Richard Saferstein of the New Jersey State Police.

Samuel M. Gerber

Table of Contents

1. Medical School Influences on the Fiction of Arthur Conan Doyle - 3  
*Ely Liebow*
2. Strong Poison: Chemistry in the Works of Dorothy L. Sayers - 17  
*Natalie Foster*
3. A Study in Scarlet: Blood Identification in 1875 - 31  
*Samuel M. Gerber*
4. Forensic Science: Winds of Change - 39  
*Richard Saferstein*
5. Chemistry and the Challenge of Crime - 45  
*Peter R. De Forest, Nicholas Petraco and Lawrence Kobilinsky*
6. The Elemental Comparisons of Bullet-Lead Evidence Specimens - 65  
*Vincent P. Guinn*
7. Blood Analysis: Case Histories - 79  
*Frances M. Gdowski*

8. Bloodstain Analysis: Serological and Electrophoretic Techniques - 87

*Lawrence Kobilinsky*

9. Does the Crime Laboratory Have the Answers? Four Cities Compared - 97

*Joseph L. Peterson*

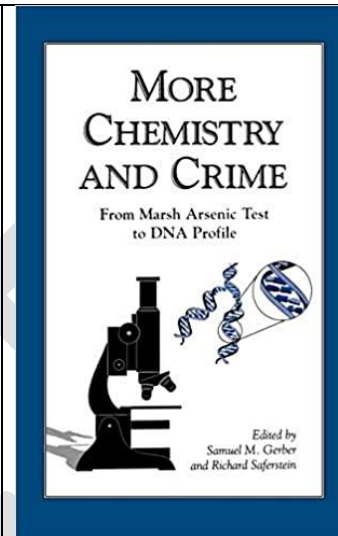
Index - 129

1997

American Chemical  
Society

Samuel M. Gerber and  
Richard Saferstein

More Chemistry and  
Crime: From Marsh  
Arsenic Test to DNA  
Profile



**Preface.** This sequel to the best-selling *Chemistry and Crime* presents the development of major forensic methods and their basis in academic science. It covers forensic disciplines and techniques such as detection of arsenic, forensic toxicology, dust analysis, examination of arson evidence, and DNA typing. It also illustrates the use of forensic science testimony for courtroom cases and provides a history of DNA applications by one of the leading practitioners, David H. Bing. A review of the field by the late Ralph Turner provides an historical perspective of forensic science. The book also includes an entertaining discussion of forensic science in detective fiction by S.M. Gerber.

#### Table of Contents

Preface – ix

Dedication – xi

1. Historical Perspectives in Forensic Science - 1

*Ralph F. Turner*

2. Forensic Biology: A Walk Through History - 13

*Robert C. Shaler*

3. DNA Typing Methods for Forensic Analyses – 33

*David H. Bing*

4. Forensic Dust Analysis - 59

*Nicholas Petraco*

5. Laboratory Examination of Arson Evidence – 85

*Charles R. Midkiff, Jr.*

6. The Microscope in Forensic Science: Forensic Microscopy in the 1890s and the Development of the Comparison Microscope - 107

*David A. Stoney and Paul M. Dougherty*

7. Milestones of Forensic Toxicology - 137

*Marina Stajic*

8. The Search for Arsenic – 149

*Robert H. Goldsmith*

9. The Forensic Expert Witness in the Courtroom: History and Development – 169

*Jay Siegel*

10. Forensic Science in Detective Fiction – 191

*Samuel M. Gerber*

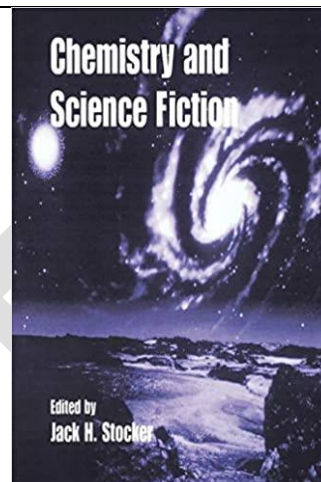
Index - 199

1998

American Chemical  
Society

Jack H. Stocker

Chemistry and Science  
Fiction



**Preface.** In 1992, at the Spring Meeting of the American Chemical Society in San Francisco, the History of Chemistry Division offered a symposium entitled “Chemistry and Science Fiction.” Scheduled in a rather small room accommodating perhaps 35 people, the first two talks were presented to an overflowing, standing-room only audience while additional would-be attendees languished outside. Transferred to a much larger room, seating perhaps 100, even that capacity was taxed with a number of standees for the rest of the day’s symposium. This book is an outgrowth of that highly successful symposium. For various reasons, some presentations could not be included, while some chapters reflect augmented presentations, and several chapters have been added. The difficulty in establishing clear boundaries for the science fiction genre is discussed in the first chapter of this book. Suffice it to say here that eligibility for inclusion in the symposium was deliberately set as broadly as possible and an occasional entry may raise an eyebrow or two. We can only request the tolerance of the reader who is quite certain his or her narrower definition of the first is a more accurate one.

The real difficulties came, however, with the “chemistry” part of the title. This is partly because stories are not textbooks, and the chemistry component may be a single large one (for instance, establishing that the nonsurvival of a planet colony is due to the trace concentration of beryllium in its soil, as appears in a novelette by Isaac Asimov) or several smaller ones (such as occurs in stories like the *Andromeda Strain* by Michael Crichton). Chemistry is not one of the sciences dominating the field of science fiction; quite likely physics, with its gadgets, laws, and grandiose concepts, view with the social sciences, with their corresponding utopias, dystopias, and alien cultures, for that honor. The biological sciences follow a short distance behind. It can be suggested that perhaps the two most widely chemistry-oriented contributions lie in the biochemical and materials science domains. Examples of both of these areas are reflected in the following chapters. A lengthy listing of suggestions for further reading, often accompanied by supportive commentary, is provided in the book’s concluding section.

An additional comment or two on what this book does and does not intend to do would be in order. While a number of authors enjoy pointing out and sharing with the reader examples of chemical bloopers, some of which are quite colossal, it was not the primary purpose of either the symposium or this book to take a totally analytical stance and

critique that science fiction field. Rather, the goals were to share an enthusiasm, to make a few recommendations, and to persuade a few readers to stretch their minds and think in some unorthodox categories.

Jack H. Stocker

Table of Contents

Preface – vii

Some (Extra-Terrestrial) Acknowledgments – ix

Contributors – xi

Introduction – xix

*James Gunn*

1. A Science Fiction Primer for the Uninitiated – 3

*Jack H. Stocker*

2. Science in Science Fiction: A Writer's Perspective – 21

*Connie Willis*

3. The Search for a Definition of Mankind: H. G. Wells and his Predecessors - 35

*Ben B. Chastain*

4. Planetary Chemistry in 100 Years of Science Fiction- 53

*Mark A. Nanny*

5. Beryllium, Thiotimoline and Pâté de Fois Gras: Chemistry in the Science Fiction of Isaac Asimov – 77

*Ben B. Chastain*

6. The Improbable Properties of Imipolex G: Chemistry and Materials Science in Thomas Pynchon's *Gravity's Rainbow* – 91

*Carl Trimble*

7. Sherlock Holmes: The Eccentric Chemist -105

*James F. O'Brien*

8. The Right Environment: Using Real Chemistry as a Basis for Science Fiction – 127

*Harry E. Pence*

9. On the Covers of Science Fiction Magazines – 137

*Jack H. Stocker*

10. Where No One Has Gone Before: Chemistry in *Star Trek* – 157

*Natalie Foster*

11. Chemistry in TV Science Fiction: *Star Trek* and *Dr. Who* - 173

*Penny A. Chaloner*

12. The Endochronic Properties of Resublimated Thiotimoline – 205

*Isaac Asimov*

13. Pâté de Fois Gras – 211

*Isaac Asimov*

14. Temporal Chirality: The Burgenstock Communication – 227

*Michael J. S. Dewar*

15. Science Fiction: A Classroom Resource – 233

*Jack H. Stocker*

16. Using Science Fiction to Help Teach Science: A Survey of Chemists and Physicists – 241

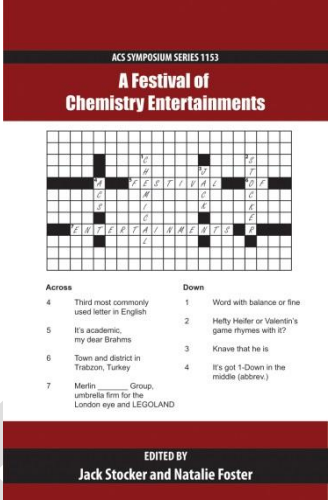
*Clarence J. Murphy, Mary Ann Mogus and Patricia M. Crotty*

17. Space, Time and Education – 251

*John E. Arnold*

Appendix: Recommendations for Further Reading – 269

Index - 285

2013	<a href="#">ACS Symposium Series Volume 1153</a>	Jack H. Stocker and Natalie Foster  A Festival of Chemistry Entertainments	
------	--------------------------------------------------	----------------------------------------------------------------------------------------	------------------------------------------------------------------------------------

**Preface.** This collection seeks to perform an act of magic. Imagine the iconic clip of a muscular man hitting a gong at the beginning of a J. Arthur Rank film to announce to viewers that they are entering a different realm. The sound of the gong signals that you are being transported away from the everyday into the world of movies. Elements of chemical whimsy can have the same effect when you encounter them amidst the serious business of science.

Suppose you're looking up articles on iron carbonyls, and you note with pleasure that one of the articles is written by someone named Steel. While browsing a table of contents, you see an article on FAKE molecular orbitals; that is obviously intriguing. You look into it and find out that FAKE is an acronym for Fast Accurate Kinetic Energy. The first is a case of whimsy by accident; the second is whimsy by design. Between these two is a middle ground, illustrated in a paper by Harry B. Gray and a visiting scientist in his laboratory, Zvi Dori. Those attuned to whimsy will immediately recognize that this is a paper by Dori and Gray (Dorian Gray). That sort of thing is the subject of these chapters. Once you become attuned to looking for whimsy, finding it leaves you with a sense of delight that makes the days chores a little less.

This book is a festival of whimsy. At the sound of the gong, enter the festival, and celebrate.

In Chapter 1, Bill Carroll pays homage to Ken Reese, purveyor of whimsy for us for many years on a weekly basis in the form of 'Newscripts' in *Chemical and Engineering News*. For many of us, the back page of *C&EN* was the front page, as we turned to Ken Reese's column first for items that would inform and entertain us.

Chapter 2 is the story of what whimsy lurks in the records of Chemical Abstracts Service. Most people think of CAS as being a somber, very serious, and most unlikely place to find delightfully and sometimes quite wicked and witty thoughts about matters. As an example, some years ago Chem Abstracts issued a book of drawings as a molecular coloring book. One of the illustrations was adamantane, but an adamantane that had been compressed flat in 2 dimensions, creating an interesting pattern of shapes. Not content to suggest only that people color in the shapes, the book's creators instructed the artist to color the forms in such a way that no two adjacent shapes have the same color. This article contains unexpected facts and records found in the deep data mines of CAS.

On three occasions the physician Howard Shapiro, accompanied by his acoustic guitar, sang his paper at ACS meetings. Chapter 3 presents the lyrics along with explanatory notes for several of Howard's musical renditions. References are provided to



YouTube links so you may actually hear the music in addition to reading the lyrics and the stories behind them.

Mary Virginia Orna is a chemist and internationally renowned expert in medieval dyes and pigments; she is also an expert constructor of crossword puzzles. Virginia, who has had puzzles accepted by publications as diverse as CHEMTECH and *The Sunday New York Times*, walks us through the design and completion of chemically based puzzles in Chapter 4. She also answers some of the frequently-asked questions from puzzle-solvers about the art and science of teasing our brains with crosswords.

The world is full of pranks by authors, editors, and even groups of people involved in the production of journals. In Chapter 5, Natalie Foster offers a collection of humorous entries into the chemical literature that include animals as co-authors, jokes that have become part of the folklore of chemistry, and an entire issue of a flagship journal that was devoted to humor.

The American Chemical Society in its machinations is a totally human endeavor that is not immune to humor. Former ACS President Mary L. Good concentrates on politics in Chapter 6, which is more thoughtful than humorous, although her description of Linus Pauling's appearance at the 100th Anniversary of the ACS certainly qualifies as whimsical. The goings-on in the ACS over many decades are a thought-provoking description of what we have done in the past and may provide insight about what we may do in the future.

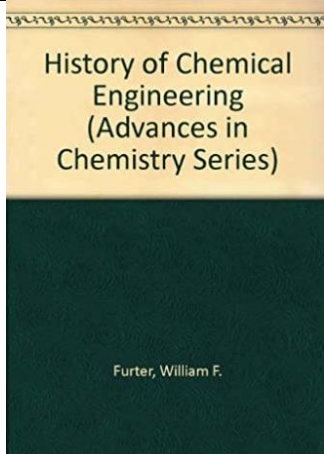
Chapter 7, the final chapter, is pure Jack, as he mops up the topic of whimsy in chemistry with a potpourri of items from his vast library. Much of Jack's accumulated memorabilia was lost in Hurricane Katrina, but the memory lives on in the literature and folklore of our discipline. As Jack sounds the gong at the end of his chapter, you will be returned to the serious but hopefully not somber world. As you read and watch and study in the future, may you continue to hear the sound of the gong and capture the whimsy.

Jack Stocker

Natalie Foster

104  
105  
106

## V. SUBDISCIPLINES

Date	Publisher	Editor(s)/Title	Cover Image
1980	<a href="#">ACS Advances in Chemistry Series</a> <a href="#">Volume 190</a>	William F. Furter  History of Chemical Engineering	

**Preface (Abbreviated).** With the publication of this book, the American Chemical Society honors chemical engineering on the occasion of what can be considered, for lack of a precise date, the approximate Centennial of its origin as a distinct profession.

The central theme of the book is the historical identification and development of chemical engineering as a profession in its own right, distinct not only from all other forms

of engineering, but particularly from all forms of chemistry including applied chemistry and industrial chemistry.

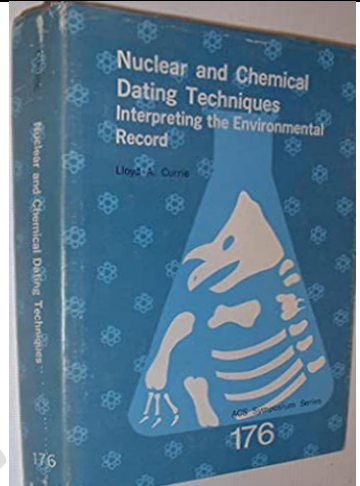
The volume's twenty-two chapters widely represent both industry and education, and originate in the United States, Canada, Britain, Germany, Japan, Italy, and India. The first chapter, written by F. J. Van Antwerpen, Secretary and Executive Director Emeritus of the American Institute of Chemical Engineers, was the keynote paper of the symposium on which the book is based. Several chapters concentrate on the early emergence of chemical engineering as distinct from chemistry, while others are concerned with more recent developments where chemical engineering has occupied a particularly high profile, as in the case of nuclear energy. Other chapters offer anecdotal and biographical insights into key figures in the history of the profession, and one deals with problems of professional identity. The final chapter, by D. F. Othmer, examines important aspects of the future of chemical engineering.

Earlier reference was made to the lack of any generally agreed date for marking the emergence of chemical engineering as a distinct profession. The reason is that chemical engineering has not one, but two main roots, that developed along differing time schedules. One root was primarily chemical and of mainly European origin, while the other was primarily physical and of mainly North American origin. The former root is characterized by the industrial chemistry approach, which achieved its principal development during the mid-nineteenth century and in which chemists and mechanical engineers teamed to manufacture chemicals on a large scale. The latter is characterized by the unit operations approach, which underwent its major development in the United States during the early part of the twentieth century and in which M.I.T. played a preeminent role. A very important point is that the two concepts fused from the outset in the United States, but did not begin to converge until relatively recently in Europe. The major significance of this factor on the overall history and development of the profession is demonstrated in several chapters.

The first public recognition of the chemical engineer seems to have been made in 1880 when an attempt was made to found a Society of Chemical Engineers in London. The initial attempt was unsuccessful, but provides a date which is as good as any other for establishing the point of origin of chemical engineering as a unique profession. However even the British claims of origin are disputable.

Chemical engineering is the fourth most universally popular form of engineering, after civil, electrical, and mechanical. These are known as the "big four" of engineering, and there is neither a consistent nor close fifth. Chemical engineering, at the forefront of scientific advancement not only in the applications of the chemical sciences but also in a much broader range of related fields, must ensure that it does not lose the momentum of the first century of its development to what could be a developing loss of its professional identity.

William F. Furter

1982	<a href="#">ACS Symposium Series Volume 176</a>	Lloyd A. Currie  Nuclear and Chemical Dating Techniques. Interpreting the Environmental Record	
------	-------------------------------------------------	------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------

**Preface.** When I was invited to plan a symposium on nuclear dating, it immediately occurred to me to invite my former professor, Bill Libby, to present the keynote lecture. Libby's impact on the field had been enormous, with basic contributions ranging from cosmic ray physics to the history of modern man. His discovery of the first cosmogenic nuclide in nature followed by his development of the method of radiocarbon dating resulted in Libby's being awarded the Nobel Prize in Chemistry in 1960. Since publication of his classic volume on the subject (*Radiocarbon Dating*, University of Chicago Press, 1952), biennial or triennial International Radiocarbon Conferences have taken place—the first in Andover, Massachusetts in 1954, and the most recent in Bern and Heidelberg in 1979. (These last proceedings are published in *Radiocarbon*, Volume 22, Numbers 2 and 3, 1980.)

Although Libby initially agreed to speak at the symposium, he was unable to attend for reasons of health, and Professor H. Oeschger kindly agreed to present the keynote. Following the meeting I informed Libby of my intention to dedicate this volume to him. He was pleased and graciously submitted the historical perspective that appears at the beginning of the volume. Libby passed on in September of 1980. We shall miss him, but we shall continue to be inspired by his enthusiasm, his insight, and his breadth of interest and knowledge.

The initial title for the symposium has had a twofold expansion, to incorporate *chemical* dating techniques and *interpretation* (or modeling). The relevance of chemical dating is clear when one considers the three kinds of geophysical "clocks"—those depending on (a) the rates of nuclear transformations, (b) the rates of chemical transformations or transport, and (c) natural cycles or accumulation processes (e.g., tree rings, ocean sediment). Also, the chemical properties of the nuclear species themselves are crucial in our approach to and the applicability of nuclear dating schemes, as Libby noted in his remarks with reference to  $^{14}\text{C}$  and  $^{187}\text{Re}$ .

With respect to interpretation, the existence of alternative dating techniques has made clear the necessity for and the difficulty of this step. That is, nature seldom provides ideal dating systems with fixed injection rates, negligible losses, and constant temperature. As a result, simple dates based upon observed isotopic ratios and nuclear half-lives, for example, frequently require cautious interpretation before they can serve as accurate measures of age; and in the absence of adequate models, alternative dating techniques will give discrepant results. The subject of this volume thus transcends dating. As put by H. Oeschger in his keynote lecture, a simple date (or observed radioisotope concentration) is but one factor to be considered in interpreting the current or past state of the environmental system. An adequate representation (model) of the system is required, as are sufficient isotopic and physicochemical data to yield reliable estimates for the parameters of the

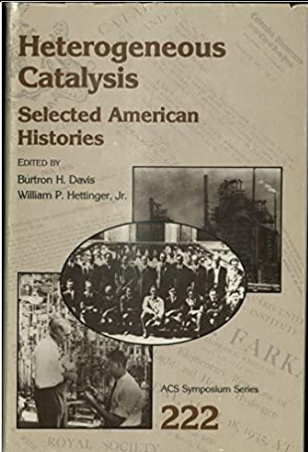
model. Thus, there is a dualism in that an accurate age cannot generally be deduced without a suitable environmental model, but simple dates help us to construct such models and to learn more about the state of the system than simply its age.

Isotopic and chemical patterns used in conjunction with absolute correlative dating techniques are also providing extremely interesting insights into the nature of geophysical or archaeological systems at various points in time. Such patterns may reflect physicochemically induced fractionation or composition variations indicative of natural or human activities. Some of the examples explored herein include: production and carbon cycle perturbations, mixing of hydrological reservoirs, the history of climate, variations and sources of atmospheric dust, sources of ancient organic matter, an extraterrestrial cause of the Cretaceous extinction, and the identification of manufacturing sources in an ancient culture. Geophysical modeling, chemical pattern recognition, and time series analysis make important contributions to such investigations; and one important outcome is chronological refinement.

A principal reason for organizing the symposium at this particular time was the recent occurrence of significant advances in dating techniques. Enormous improvements have taken place in minimizing chemical contamination, and in both the measurement of extremely small differences in isotopic ratios, and the separation and measurement of tiny quantities of inorganic and very similar organic species. Important progress is taking place in the measurement of very small quantities of long-lived radionuclides by means of direct high-energy (accelerator) ion counting, high-sensitivity microprobe and noble gas mass spectrometry, and ultralow-level counting. Among the most important benefits from these advances will be the ability to date samples that are quite rare or difficult to obtain (deep ice cores, precious artifacts, cometary dust, etc.) and an increase in the reliability or information content of the dates through high spatial, temporal, or chemical resolution. (The ability to date less than a milligram of carbon, for example, makes it interesting to determine the radiocarbon age of individual amino acids in bone.)

Progress in the application of a multiplicity of advanced dating techniques to a given problem together with sophisticated modeling promises to give us reliable information on the state and age of the system under consideration, as well as some extra degrees of freedom for model verification. When applied to natural archives, such studies can provide vital insight concerning the present and past states of the environmental (geophysical) system; of critical importance may be information on the relative influence of man's activities and natural events on environmental contamination and climate. Finally, questions involving the history and prehistory of man and the evolution and extinction of life are in many respects the most interesting to examine with these techniques, and they are certainly among the most challenging.

The efforts of all authors, reviewers, and other symposium participants are gratefully acknowledged. Special thanks are due Vic Viola, Juan Carlos Lerman, and Chet Langway for their assistance with the meeting. Credit for their excellent work in preparing the manuscripts for publication goes to Joy Shoemaker and Teresa Sperow of the Text Editing Facility of the Center for Analytical Chemistry, National Bureau of Standards.  
Lloyd A. Currie

1983	<a href="#">ACS Symposium Series Volume 222</a>	Burtron H. Davis and William P. Hettinger, Jr.  Heterogeneous Catalysis: Selected American Histories	
------	-------------------------------------------------	------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------

**Preface (Abbreviated).** Heterogeneous catalysis spans a broad range of scientific disciplines including such seemingly unrelated topics as solid state physics, materials sintering, and organic reaction mechanisms. While much of the early work in catalysis was a result of academic curiosity, the need for improved performance in industrial applications had a strong influence in focusing the many research disciplines onto heterogeneous catalysis.

During the 1800s much of the research in catalysis occurred in Europe and heterogeneous catalysis did not become firmly established in the United States until the 1920s. Because extensive activity in this area has produced an enormous amount of literature documenting many important advances, only a limited number of benchmark works and scientists could be included in a symposium even if the coverage was limited to U.S. contributions.

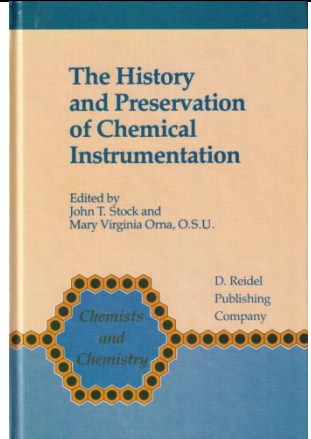
This seems an appropriate time to pause and survey the nearly 50 years of progress in U.S. heterogeneous catalysis research. In this volume, some of the U.S. pioneers from the 1920s and 1930s provide a personal view of their work, and, in addition, several experts provide a personal, historical account of a research area or pioneer. Much of this early research had an Edisonian character. The unique, creative personality of the investigator or unanticipated events were, in many cases, important features leading to a major advance. Frequently, these facets of science are not recorded in detail.

Advances in instrumentation have also occurred, so that present day investigators can obtain a detailed structure of a catalyst surface layer. Information can also be obtained about the concentration and chemical state of chemisorbed species. Therefore, even though Edisonian approaches will remain an important aspect of this research, we are entering a new era of research in heterogeneous catalysis.

Nearly all of the papers presented at the Las Vegas symposium are included in this book. In addition, some early researchers who were unable to attend the meeting have made written contributions. Our intention is to convey to you many fascinating aspects of catalysis and its broad scope, ranging all the way from alchemy to Edisonian research to high technology, and to provide insight into those most unusual, stimulating, and intellectual pioneers that gave it life. We are especially grateful to Dr. Robert Burwell for providing, in the very limited space allotted to him, such an outstanding and stimulating view of some events in European catalytic history prior to the 1920 period.

Burtron H. Davis  
William P. Hettinger, Jr.



1986	D. Reidel Publishing Company, Dordrecht	John T. Stock and Mary Virginia Orna  The History and Preservation of Chemical Instrumentation	
------	-----------------------------------------	------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------

**Introduction.** The development of chemistry, like that of other fields of science and technology, has depended greatly upon the availability of instruments. Accordingly, the study of the history of instrumentation is a major area in any survey of the progress in this science. Recognizing this fact, the Division of the History of Chemistry of the American Chemical Society organized and held a very successful symposium on the history of chemical instrumentation during the Washington, DC National Meeting in 1979.

Remarks, both formal and informal, made during this symposium stressed points that soon become obvious to anyone who looks at the ancestry of present-day instruments. In some cases, the total history is measured in years, rather than in centuries. Chemical instrumentation, by no means confined to the laboratory, is vital in industry. There is a natural tendency to discard an item of any kind when a newer version is acquired. Often, “to discard” means “to scrap.” If an item scrapped is an instrument that is unique – sometimes the last of its kind – we have a permanent artefactual gap in the history of science.

These points, together with the ever-growing importance and development of the tools of the chemist, led to Divisions of the History of Chemistry and of Analytical Chemistry to the joint organization of a more extensive symposium that formed part of the ACS National Meeting in Chicago in 1985. The inclusion of the word “and preservation” in the title stresses the importance of thinking and inquiring before scrapping. Only by the co-operation of all scientists and technologists can we hope to minimize or, hopefully, avoid losses like those of the past.

The eighteen papers in the symposium deal with instruments ranging from the very simple to the highly complex, with histories long, medium, or short. Some of the authors have not only first-hand knowledge of the history of a particular type of instrument, but have also contributed to the making of this history.

These facts, together with the many favorable comments received during and after the symposium, strengthened our resolve that the accounts presented should be placed on permanent record in a single collection. The Editors intend this book to be a tribute to instrument makers, whether of today or times past. The progress of science has, does and will depend upon their skill and ingenuity.

John T. Stock  
Mary Virginia Orna

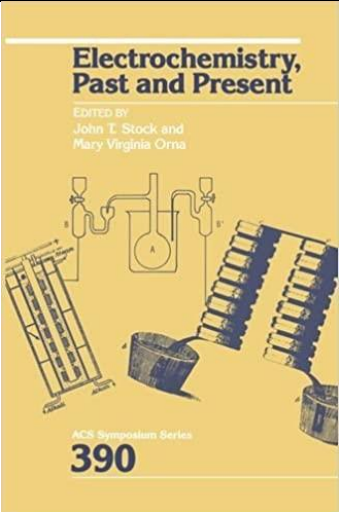
#### TABLE OF CONTENTS

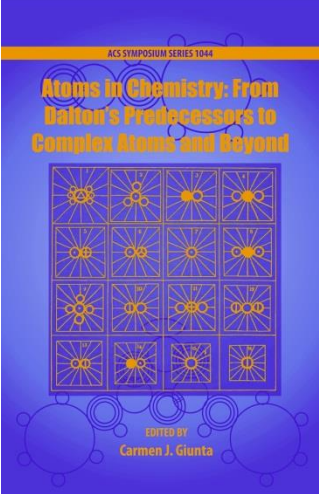
INTRODUCTION

vii

JOHN K. TAYLOR / The Impact of Instrumentation on

Analytical Chemistry	1
WILBUR KAYE / Rise and Fall of Specifications as Indicators of Instrument Performance	11
PAUL A. WILKS / The Origins of Commercial Infrared Spectrometers	27
MELVYN C. USSELMAN / The Reflective Goniometer and Its Impact on Chemical Theory	33
M. EUGENE RUDD / D.B. Brace's Measurement of Double Refraction Due to Ether Drift	41
DUANE H. JAECKS / Developments in 18th Century Optics and Early Instrumentation	51
WILLIAM J. ANGELOTTI / The History of Optical Emission Techniques for the Industrial User	67
C. EUGENE BENNETT / My Remembrance of Gas Chromatography	79
HAMISH SMALL / A Personal History of the Conception and Early Development of Ion Chromatography	97
GERALD L. HAWK / The Next Step in Laboratory Automation - Robotics	109
WILLIAM B. JENSEN / The Development of Blowpipe Analysis	123
WALTER J. BLAEDEL / The Practical Aspects of Collecting, Preserving, and Exhibiting Analytical Balances	151
WILLIAM J. READ / Renovation and Repair of Scientific Instruments	157
A. D. MORRISON-LOW / Kemp & Co., Laboratory Suppliers	163
DAVID J. BOULLIN / Mechanical Control of Gaslight: An Account of Clockwork Mechanisms Used for Operating Gaslights	187
WILLIAM J. READ / The Development of Scientific Instruments Relating to Negretti & Zambra, Instrument Makers, England, 1850-1985	211
JOHN BURNETT / The Use of New Materials in the Manufacture of Scientific Instruments, C.1880-C.1920	217
JOHN T. STOCK / Historic Instruments: Survival or Disappearance?	239
NAME INDEX	249
SUBJECT INDEX	255

1989	<a href="#">ACS Symposium Series Volume 390</a>	John T. Stock and Mary Virginia Orna  Electrochemistry Past and Present	
<p><b>Preface.</b> Nicholson and Carlyle recognized hydrogen and oxygen as products of the electrolysis of water in 1800. From this small beginning, the use of electrochemistry has grown tremendously, both in magnitude and in diversity. Electrochemistry affects everyone. Small stores carry arrays of that indispensable device, the battery. At one time, aluminum cost nearly as much as silver. Today fused-salt electrolysis produces the metal so cheaply that household items made from aluminum can be cheerfully discarded when damaged. Our health is less likely to suffer because of rapidly developing electrochemical approaches to the control of pollution.</p> <p>Chemists have at their disposal many preparative and investigative techniques that are based on electrochemistry. The symposium on which this book is based presented not only the basic history of electrochemistry, but also its growth to a major branch of science and technology. <i>Electrochemistry, Past and Present</i> captures the major events and technologies of classical and fundamental electrochemistry, electrosynthesis, electroanalytical chemistry, industrial electrochemistry, electrode systems, and pH measurement. This volume contains an overview of the field, organized under the general headings of Foundations of Electrochemistry, Organic and Biochemical Electrochemistry, Electroanalytical Chemistry, and Industrial Electrochemistry.</p> <p><i>Electrochemistry, Past and Present</i> is a unique collection that will educate and engage the interested reader. An equivalent background understanding of electrochemistry could only otherwise be gleaned by many days of persistent searching through the primary literature.</p> <p>John T. Stock Mary Virginia Orna</p>			

2010	<a href="#">ACS Symposium Series Volume 1044</a>	Carmen J. Giunta  Atoms in Chemistry: From Dalton's Predecessors to Complex Atoms and Beyond	
------	--------------------------------------------------	----------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------

**Introduction.** This volume contains presentations from a symposium titled “200 Years of Atoms in Chemistry: From Dalton’s Atoms to Nanotechnology,” held at the 236th national meeting of ACS in Philadelphia in August 2008. The occasion was the 200th anniversary of the publication of John Dalton’s *A New System of Chemical Philosophy*.

Dalton’s theory of the atom is generally considered to be what made the atom a scientifically fruitful concept in chemistry. To be sure, by Dalton’s time the atom had already had a two-millennium history as a philosophical idea, and corpuscular thought had long been viable in natural philosophy (that is, in what we would today call physics).

John Dalton (1766-1844) lived and worked most of his life in Manchester, and he was a mainstay of that city’s Literary and Philosophical Society. He had a life-long interest in the earth’s atmosphere. Indeed, it was this interest that led him to study gases, out of which study grew his atomic hypothesis. His experiments on gases also led to a result now known as Dalton’s law of partial pressures. Dalton’s name is also linked to color blindness, sometimes called daltonism, a condition he described from firsthand experience.

The laws of definite and multiple proportions are also associated with Dalton, for they can be explained by his atomic hypothesis. The law of definite proportions or of constant composition had previously been proposed in the work of Jeremias Richter and Joseph-Louis Proust. The law of multiple proportions came to be regarded as an empirical law quite independent of its relation to the atomic hypothesis or perhaps as an empirical law that inspired the atomic hypothesis; however, in Dalton’s mind it was a testable prediction which followed from the atomic hypothesis.

Dalton’s 1808 *New System* contains a detailed and mature presentation of his atomic theory. It is not, however, the first published statement of his atomic ideas or the first table of his atomic weights. A “Table of the relative weights of the ultimate particles of gaseous and other bodies” was published in 1805 after having been read in 1803. Thomas Thomson’s account of Dalton’s theory also preceded the publication of Dalton’s book—with Dalton’s permission.

Thus, 2008 was perhaps an arbitrary year to celebrate 200 years of Dalton’s theory, but as good a year as any. The Symposium Series volume appears in 2010, which is 200 years after the publication of Part II of Dalton’s *New System*. Readers interested in learning more about Dalton’s life and work are directed to Arnold Thackray’s *John Dalton: Critical Assessments of his Life and Science* (Harvard University Press, 1972) which remains authoritative even after nearly four decades.

As originally envisioned, the symposium was to examine episodes in the evolution of the concept of the atom, particularly in chemistry, from Dalton’s day to our own. Clearly, many of Dalton’s beliefs about atoms are not shared by 21st-century scientists. For

example, the existence of isotopes contradicts Dalton's statement that "the ultimate particles of all homogeneous bodies are perfectly alike in weight, figure, &c." Other properties long attributed to atoms, such as indivisibility and permanence have also been discarded over the course of the intervening two centuries.

One property that remains in the current concept of atom is discreteness. If anything, evidence for the particulate nature of matter has continued to accumulate over that time, notwithstanding the fact that particles can display wavelike phenomena such as diffraction and regardless of their ultimate nature (quarks? multidimensional strings? something else?).

Images that resolve discrete atoms and molecules became available in the 1980s, with the invention of scanning tunneling microscopy (STM). Its inventors, Gerd Binnig and Heinrich Rohrer, submitted their first paper on STM in fall 1981. Five years later, they were awarded the Nobel Prize in physics. Before long, other scientists at IBM turned an STM into a device that could pick up and place individual atoms, in effect turning atoms into individual "bricks" in nanofabricated structures.

STM was the first of a class of techniques known as scanning probe microscopy. Atomic force microscopy (AFM), invented later in the 1980s, is currently the most widely used of these techniques. Both STM and AFM depend on probes with atomically sharp tips; these probes are maneuvered over the surface of the sample to be imaged, maintaining atom-scale distances between the probe and sample. Both techniques are capable of picking up atoms individually and placing them precisely on surfaces.

Scanning probe microscopy and manipulation lie at the intersection of 21st-century nanotechnology and 19th-century Daltonian atomism. Never mind the fact that the devices depend on quantum mechanical forces: the devices also require atomic-scale engineering to make sharp tips and to steer the probes closely over sample surfaces. But more importantly, they make visible individual discrete atoms and are capable of manipulating them. As originally conceived, the symposium would have had a presentation on applications of atomism to nanotechnology to bring the coverage up to the present—or even the future. Alas, that presentation never materialized, but hints of what it might have covered remain in the introduction of this volume to give a sense of the sweep of the topic and its continued relevance to current science.

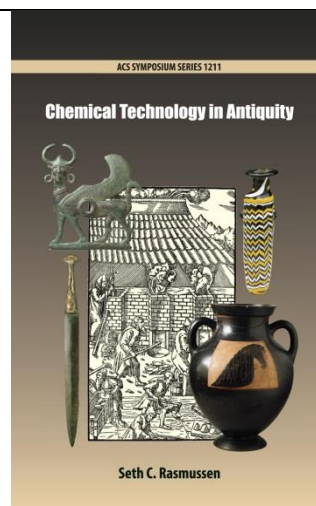
Carmen J. Giunta

2015

[ACS Symposium Series Volume 1211](#)

Seth C. Rasmussen

Chemical Technology in Antiquity



**Preface.** Chemistry is intimately involved in the development of the oldest known civilizations, resulting in a range of chemical technologies that not only continue to be part of modern civilized societies, but are so commonplace that it would be hard to imagine life without them. Such chemical technology has a very long and rich history, in some cases

dating back to as early as 20,000 BCE. My own interest in the early history of these technologies began with a desire to understand the factors behind the late application of glass to chemical apparatus (i.e., chemical glassware), which did not become a mainstay of the chemical laboratory until nearly 4000 years after the initial synthetic production of glass (Rasmussen, S. C. *Advances in 13th Century Glass Manufacturing and Their Effect on Chemical Progress. Bull. Hist. Chem.* **2008**, *33*, 28–34, Rasmussen, S. C. *How Glass Changed the World. The History and Chemistry of Glass from Antiquity to the 13th Century*; SpringerBriefs in Molecular Science: History of Chemistry; Springer: Heidelberg, 2012.) This of course soon led to a general interest in the history and chemistry of early glass (Rasmussen, *How Glass...*). As the history of glass is deeply entwined with the corresponding histories of metallurgy, ceramics, and alcohol (Rasmussen, *How Glass...*; Rasmussen, S. C. *The Quest for Aqua Vitae. The History and Chemistry of Alcohol from Antiquity to the Middle Ages*; SpringerBriefs in Molecular Science: History of Chemistry; Springer: Heidelberg, 2014.), I soon found that I had developed a deep, general interest in the broad range of early chemical technologies utilized throughout antiquity, as well as how these early technologies impacted later scientific pursuits.

A number of books are currently available that cover the history and chemistry of some of the individual topics included here, particularly that of glass(see above), pottery and ceramics (Cooper, E. *Ten Thousand Years of Pottery*, 4th ed.; University of Pennsylvania Press: Philadelphia, 2010; Rice, P. M. *Pottery Analysis: A Sourcebook*, 2nd ed.; University Of Chicago Press: Chicago, 2015.), metals and metallurgy (O'Brien, W. *Prehistoric Copper Mining in Europe: 5500-500 BC*; Oxford University Press: Oxford, 2015.), or various fermented beverages (Rasmussen, *The Quest...*; Hornsey, I. S. *A History of Beer and Brewing*; Royal Society of Chemistry: London, 2003.). However, sources presenting a broader scope of early chemical technology, especially those covering the number of topics contained in the current volume, are somewhat rare. The best of such works include Partington's *Origins and Development of Applied Chemistry* (Longmans Green, London, 1935), Forbes' multi-volume series *Studies in Ancient Technology* (E. J. Brill, Leiden), or the five-volume series, *A History of Technology*, edited by Singer et al. (Clarendon Press, Oxford). All of these, however, are out-of-print and are no longer representative of our current knowledge of the history of these technologies. Although there are a couple more recent examples of this broad approach, including Joseph Lambert's *Traces of the Past: Unraveling the Secrets of Archaeology through Chemistry* (Addison-Wesley, Reading, MA, 1997), it was felt that a new volume presenting updated histories of a collection of early chemical technologies would be a welcome addition for chemists, historians, chemical archaeologists, and general educated readers interested in the development of some of mankind's earliest and most common technologies.

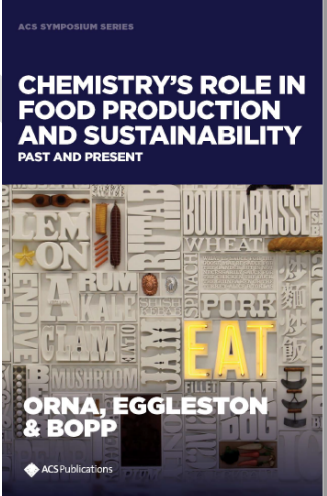
This current volume aims to present the discovery, development, and early history of a range of such chemical technologies and is based on the popular symposium, *Chemical Technology in Antiquity*, held March 23, 2015, at the 249th National Meeting of the American Chemical Society (ACS) in Denver, Colorado. The symposium was held as part of the programming of the ACS Division of the History of Chemistry (HIST) and was co-sponsored by the Multidisciplinary Program Planning Group (MPPG) as part of the meeting's thematic program "Chemistry of Natural Resources," as well as by the ACS Divisions of Analytical Chemistry (ANYL), Chemical Education (CHED), Inorganic Chemistry (INOR), and Organic Chemistry (ORGN). During the organization of both the original symposium and the current volume, I had two primary goals. The first was to include a number of smaller subjects often ignored in the presentation of early chemical technology, while a secondary goal was to use this venue as a way to bring some younger members of the HIST division into active historical research roles. The outcome of this



second goal was especially satisfying as the new authors included are all current or former students from North Dakota State University (NDSU) who were introduced to the history of chemistry via my own activities in the field. As a consequence, the resulting volume contains a core of the most significant and well-researched examples of early chemical technology written by established authorities on these topics, including chapters by Mary Virginia Orna on mineral pigments (Chapter 2), Nicholas Zumbulyadis on pottery (Chapter 3), Vera Mainz on metals and alloys (Chapter 5), and Zvi Koren on organic dyes (Chapter 7), as well as my own chapters on early fermented beverages and glass (Chapter 4 and Chapter 10). This core of traditional topics is then supplemented by less frequently covered topics by new authors, including chapters by Christopher Heth (NDSU Ph.D. 2010) on leather and tanning (Chapter 6), Narayanaganesh Balasubramanian (NDSU Ph.D. 2012) on oils and perfumes (Chapter 8), and my current graduate student Kristine Konkol doing the bulk of the work on a chapter on soap (Chapter 9).

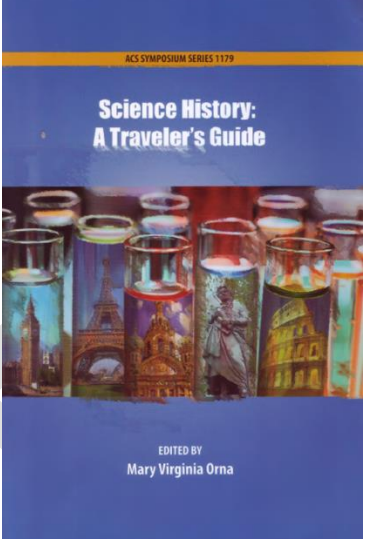
While this volume is in no way a complete coverage of the full range of chemical technologies practiced during antiquity, I hope that it provides a feel and appreciation for both the deep history involved with these topics, as well as the complexity of the chemical processes that were being utilized at such a very early time period. In conclusion, I want to thank all of the authors involved, as well as everyone who contributed to this volume as reviewers. While the initial idea of this volume and the responsibility of its editing were mine, the quality and success of the final product is most certainly due to a collective group effort.

Seth C. Rasmussen

2019	<a href="#">ACS Symposium Series Volume 1314</a>	<p>Mary Virginia Orna, Gillian Eggleston and Alvin F. Bopp</p> <p>Chemistry's Role in Food Production and Sustainability: Past and Present</p>	
------	--------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------

**Introduction.** This volume extensively explores food science chemistry, a topic often overlooked in chemistry curricula at all levels. Food was a natural focus for the 255th National Meeting of the American Chemical Society in New Orleans, Louisiana, since the meeting theme was “Nexus of Food, Energy, and Water.” This was also an appropriate topic for the location, given that New Orleans is a historic center of fine dining but also a victim of a series of environmental disasters that threatened the very availability of signature foodstuffs for which the city is famous. Thus, this volume was broadly outlined to cover not only the dining table, past and present, but also the water table and all the environmental forces that impinged upon it. Virtually every aspect of food production and the factors that affect it are represented in this volume.

Mary Virginia Orna  
Gillian Eggleston  
Alvin F. Bopp

Date	Publisher	Editor(s)/Title	Title
2014	<a href="#">ACS Symposium Series Volume 1179</a>	Mary Virginia Orna  Science History: A Traveler's Guide	

**Introduction.** When Paul and Brenda Cohen began their book (Cohen, P. S.; Cohen, B. H. *America's Scientific Treasures: A Travel Companion*; American Chemical Society: Washington, D.C., 1998; p v; this book has been expanded (2020) into a 2<sup>nd</sup> edition by Brenda and her son, Steve Cohen.) with these words, “Why write a book on travel to places with scientific content?” and then proceeded to outline their reasons, this struck a chord in my wandering soul. For many years, I had been aware of their regular column in the *Journal of College Science Teaching* (Column title found in various issues: *Finding Science Past and Present.*), and for perhaps just as long, I knew of John Wotiz’s legendary “forced marches” across the face of Europe, Iron Curtain notwithstanding (John H. Wotiz, interview by Herbert T. Pratt at Newcastle, Delaware, and Washington, D.C., 7, 8, and 10 August 2000; Philadelphia: Chemical Heritage Foundation (now Science History Institute), Oral History Transcript # 0197.). And I, too, was a scientific traveler of a sort, having organized and taught for more than a decade an undergraduate course called “History of Science and Mathematics” that included a two-week travel component to England and Scotland in alternate years. During that decade, I became acquainted, through the good graces of John T. Stock (1911-2005), an ACS Division of the History of Chemistry colleague from the University of Connecticut (and a native Londoner), with many of the “movers and shakers” in the history of science, and particularly the history of chemistry, in the U.K.: Robert G. W. Anderson, former Director of the Royal Scottish Museum and of the British Museum; Peter J. T. Morris of the London Science Museum who knows scientific London like the back of his hand; and Frank A. J. L. James, prolific author and incomparable Faraday scholar at the Royal Institution.

In the late 1990s, as the popularity of my course waned among my undergraduate students, for a variety of reasons that included a decline in funding and changes in curriculum requirements, my tours to the U.K. gained adherents among faculty and other ACS colleagues from around the country. Word of mouth is a powerful communicator, and soon I had a mailing list of almost 100 potential and past participants who were eager to get out on the road but with a themed and structured program that provided intellectual stimulation – and not all of them were chemists or even scientists! So almost another decade passed when, in 2009, I decided it was time to “go public” and inform the ACS world of these tours which had, in the meantime, branched out to the European continent. Among the speakers that I had lined up for a symposium at the Salt Lake City ACS

meeting in the spring of 2009 were a person who had participated in a John Wotiz tour, some who had participated in my own tours, some who had organized and participated in the Science History Tours run by Yvonne Twomey and Lee Marek, an Israeli, Zvi Koren, who proposed an archaeological study tour of Israel, and a “flight of fancy” tour to some almost improbable sites by Carmen Giunta, presently Editor of the *Bulletin for the History of Chemistry*. With such a stellar cast, it is no wonder that the ACS invited me to organize the talks into an ACS Symposium Series volume.

So what is different about this volume? The Cohens’s book is targeted scientific travel. It devotes at least one or 2 pages to over 250 scientific treasures in the United States, to sites as eclectically diverse as the National Museum of Roller Skating in Lincoln, NE and the Fermi National Accelerator Laboratory in Batavia, IL. Their criteria for including each site as a “treasure” were: the content and completeness of the collection had to be special, the site had to provide an educational component, and the presentation of the exhibits had to be beyond the ordinary. Could my Symposium Series volume live up to these expectations? The more I thought about it, the more I realized that this volume would have to be different, and yet complementary to the Cohens’s goals.

First of all, my study tours had as one of its goals learning science through travel to sites where the science actually happened, a privilege available only since the latter part of the past century. Another goal was to describe how such travel can interface with the professional goals of chemists in academe, industry, and other areas of endeavor. In accomplishing these goals in detailing places of scientific interest throughout Europe, Israel, and other non-European venues, I realized that the book could provide its readers with the following insights:

Visits to places important in the history of science can provide teachers with interesting experiences to use in broadening their science curricula.

Emphasis on the chemistry background of each of the sites would be helpful to chemistry teachers and other chemists alike.

The scientific and technological developments of other cultures, the materials they used, the extent of international commerce in goods and crafts can impact on our own understanding of how science is taught and practiced in the USA.

Even vicarious visits to faraway places of scientific interest can enrich the homebound or those unable to travel.

It would be possible to plan a scientifically-oriented visit to a place not necessarily associated with science.

It would be possible to plan a scientifically-oriented visit to well-known scientific sites armed with information not necessarily available on the internet or in guidebooks.

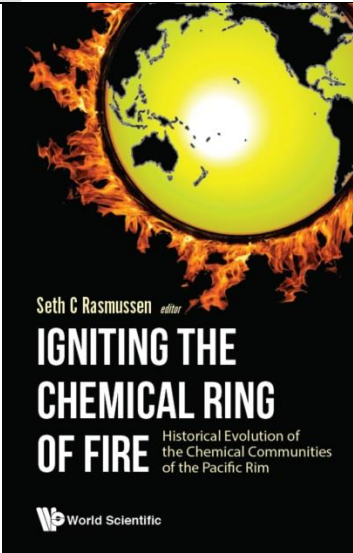
While the book is broadly scientific and treats areas other than chemistry, where appropriate, chemistry is the highlighted science. The book is also organized on the “base city” principle whenever possible: certain cities are hubs from which the traveler can branch out to other venues of interest. This is certainly true of London, Paris, Stockholm, and to a certain extent Prague and Vienna. The first part of this book is an overview, first by way of this chapter, and secondly, by way of the incomparable narrative of a John Wotiz tour by Leigh Wilson. The second part of the book consists of four chapters on the sites in the British Isles: London and environs, including Oxford, the Royal Institution, Cambridge and Scotland. The third part of the book contains eight chapters on sites in continental Europe moving from north to south and then west to east. The final two chapters take us beyond European science to encompass the archaeology of Israel and fanciful journeys to far-flung Asia, Africa, and North and South America. The

bibliography at the end of this chapter, while it concentrates on Europe, also includes references to sites in the United States and elsewhere.

The authors of the various chapters, including many already mentioned, have first-hand knowledge and in many instances, professional expertise, with respect to the history of the sites. Having lived in Rome for the past 5 years (which partially explains the delay in publishing this volume), I have visited the scientific venues in Italy many times and have also become an associate member of the History Section of the Italian Chemical Society. Marco Fontani, a colleague in the Italian Chemical Society and co-author of *The Lost Elements* (Fontani, M.; Costa, M.; Orna, M. V. *The Lost Elements: The Periodic Table's Shadow Side*; Oxford University Press: New York, 2015.), writes knowledgeably and lovingly of science in Florence, the city of his birth. Leigh Wilson gives us a first-hand experience of what it was like to travel on one of John Wotiz's legendary forays into the Communist bloc, complete with tales of aggressive guard dogs (and guards)!

Gary Patterson, Chief Bibliophile of the Bolton Society, treats us to some of the treasures to be found at the Fitzwilliam and Whipple Museums in Cambridge. Jan Hayes, Roger Rea, and David Katz delight us with their insights into the scientific joys of southern Germany, Eastern Europe, and Copenhagen, respectively. Roland Adunka, Founding Director of the Auer von Welsbach Museum, beckons us to the wonderful little town of Althofen where one can enjoy Alpine views, medieval castles and cathedrals, and unique industrial sites along with a visit to his museum, which documents the incredible accomplishments of the nobleman and chemist who laid claim to discovering four elements. Jim and Jenny Marshall take us on a rollicking adventure through Sweden, Finland, and Norway (and a smidgen of Germany) to seemingly inaccessible sites, some marked with only a mailbox, in their search for the original mines and laboratories where many of 30-some-odd elements were discovered. Hang onto your seats as we take off – you are in for a special treat!

Mary Virginia Orna

2018	World Science Publishers, Singapore	Seth C. Rasmussen  Igniting the Chemical Ring of Fire: Historical Evolution of the Chemical Communities of the Pacific Rim	
------	-------------------------------------	----------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------

**Preface.** The current volume evolved out of an idea for a historical symposium proposed by the American Chemical Society's Division of the History of Chemistry (HIST) for the *International Chemical Congress of the Pacific Basin Societies 2015*, more commonly known as *Pacifichem*. This initial idea developed into the symposium "Historical Evolution of the Chemical Community in the Countries of the Pacific Rim," which was an international collaboration between the historical communities of the United States, Canada, Japan, and Australia. The symposium was co-organized by Gary Patterson (USA), Trevor Levere (Canada), Yasu Furukawa (Japan), and Ian Rae (Australia), with myself

acting as the corresponding symposium organizer to shepherd the project to its conclusion. The symposium was held toward the end of the conference in Honolulu, Hawaii, on December 19 and 20, and consisted of 10 speakers. The topics focused largely on the four organizing countries, but speakers covered histories of China and Korea as well.

It was shortly before the start of Pacifichem that Merlin Fox of World Scientific Publishing reached out to me about the potential of developing a volume from the symposium. He was inspired by the recently published Royal Society of Chemistry volume *Creating Networks in Chemistry: The Founding and Early History of Chemical Societies in Europe* (Nielsen, A. N.; Strbanova, S. Eds. *Creating Networks in Chemistry: The Founding and Early History of Chemical Societies in Europe*; Royal Society of Chemistry: London, 2008.) and felt that a related volume on the communities of the Pacific Rim would be a worthwhile addition to the historical literature. Considering that such a volume would be the first of its kind, the symposium speakers all agreed, but it was quite clear that the limited scope covered in the Pacifichem symposium would need to be expanded in order to properly develop a meaningful volume on the subject. As such, the organizers began working to recruit additional authors in order to expand the chemical communities included.

As with most such projects, the topics included are completely dependent on the number of authors willing to devote the time to the project. Of course, a critical factor in this process is the extent that the author may have already compiled research and background sources on the topic in question. Unfortunately, as the histories of many of these communities have yet to be formally told, it was often difficult to find authors willing to cover these tasks. Nevertheless, the original ten talks were ultimately expanded to 15 chapters, which covered the histories of 10 countries. In the process, countries representing four of the six regions of the Pacific Rim have been included, although it must be recognized that we were unable to include histories for any of the countries of either Central or South America. However, as this volume represents the first collection of histories of countries of the Pacific Rim, it is hoped that this initial volume can act as a seed for more extensive works.

Finally, it is with some sadness that I need to recognize the passing of two of our colleagues during the organization of the original symposium and the preparation of this final volume. The first of these is Mel Usselman (1946–2015), who was one of the original invited speakers for Canada who had agreed to give a talk entitled “Evolution of the University of Western Ontario’s Chemistry Department in the 1950s into a research intensive department.” Unfortunately, Mel passed away on March 23, 2015 (Rocke, A. In Memoriam. Mel Usselman. *Newsletter of the History of Science Society*, **2015**, *44*, 20–21.), nine months before the symposium’s occurrence and thus was not included in the 10 speakers of the final program. A short overview of his life and work was included in the introductory remarks of the symposium, however, and it is no doubt that he was with us in spirit that day.

Unknown to most of us at the time, a second colleague would also soon be leaving us. One of the invited speakers of Japan, Masanori Kaji (1956–2016), fully participated in the Pacifichem symposium and gave a very nice talk entitled “The transformation of organic chemistry in Japan: from Majima Riko to the third international symposium on the chemistry of natural products.” Throughout the symposium, he seemed to relish meeting new colleagues and was very supportive of the idea of the current volume. So much so that he agreed not only to contribute his presented talk on Japan, but to also prepare a chapter on Taiwan for the book. However, what most of us did not know was that he had been diagnosed with pancreatic cancer just a couple of months prior to the symposium and was not expected to live long. In the months following the symposium, he sent the promised

chapter on Taiwan, but passed away on July 18, 2016 (Furukawa, Y.; Homburg, E.; Zaitseva, E. Éloge: Masanori Kaji (1956–2016). [www.euchems.eu/wp-content/uploads/2015/06/Masanori-Kaji-obituary.pdf](http://www.euchems.eu/wp-content/uploads/2015/06/Masanori-Kaji-obituary.pdf) (accessed December 30, 2016).) before he could complete his chapter on Japan to be based on his original symposium talk. Kaji will be sorely missed, but we are glad that his contributions to the history of science were able to be represented in this volume.

In conclusion, I want to thank all the authors involved, as well as everyone that contributed to this volume as reviewers. While the responsibility of the construction and editing of this volume was mine, the quality and success of the final product is most certainly due to a collective group effort.

Seth C. Rasmussen

*Preface xi*

*About the Editor xv*

Chapter 1 Introduction: The Pacific Rim — From Early Chemical Technology to Independent Local Chemical Communities 1

*Seth C. Rasmussen*

**AUSTRALIA 15**

Chapter 2 Vehicles for the Discussion of Chemistry in Early 19th Century Sydney 17

*Anthony T. Baker*

Chapter 3 Australian Chemists Crossing the Pacific to the Promised Land 43

*Ian D. Rae*

**CANADA 73**

Chapter 4 Chemistry in Canada: 1720–2017 75

*Thomas Tidwell*

**CHINA 95**

Chapter 5 History of the Modern Chemistry Doctoral Program in Mainland China 97

*Vera V. Mainz*

**JAPAN 137**

Chapter 6 International Relations of the Japanese Chemical Community 139

*Yoshiyuki Kikuchi*

Chapter 7 Gen-itsu Kita and the Kyoto School's Formation 157

*Yasu Furukawa*

**KOREA 169**

Chapter 8 A Short Story of Chemistry in South Korea 171

*Choon H. Do*

Chapter 9 A History of the Korean Chemical Society 207

*Gary Patterson*

**NEW ZEALAND 233**

Chapter 10 The Development of Chemistry in New Zealand 235

*Brian Halton*

**RUSSIA 307**

Chapter 11 High Creativity, Historical Invisibility: The Growth of Chemistry in Russia 309

*David E. Lewis*

**TAIWAN 355**

Chapter 12 Development of the Natural Products Chemistry by Tetsuo Nozoe in Taiwan 357

*Masanori Kaji*

**UNITED STATES 369**

Chapter 13 Impact of the 1862 Morrill Land-Grant College Act on Chemistry Education in the United States 371

*Roger Ego*

Chapter 14 The Professionalization of American Chemistry: How the German Ph.D. Model Crossed the Atlantic 387

*Ned D. Heindel, Jeffrey L. Sturchio, and James J. Bohning*



**VIETNAM 427**

Chapter 15 History of Vietnamese Chemistry from Decolonization to the 21st Century 429

*Pham Thi Ngoc Mai, Nguyen Thi Anh Huong, Pham Tien Duc, Hoang Quoc Anh, and Ta Thi Thao*  
Index 447

110

111

112

113

114

It is hoped that this catalogue of HIST publications whets your appetite for a more complete read of some of these volumes. Many of them are unique in their content and execution. This is a body of literature that deserves to be better known as a font of information for the curious and a source of reference for the scholar.

DRAFT