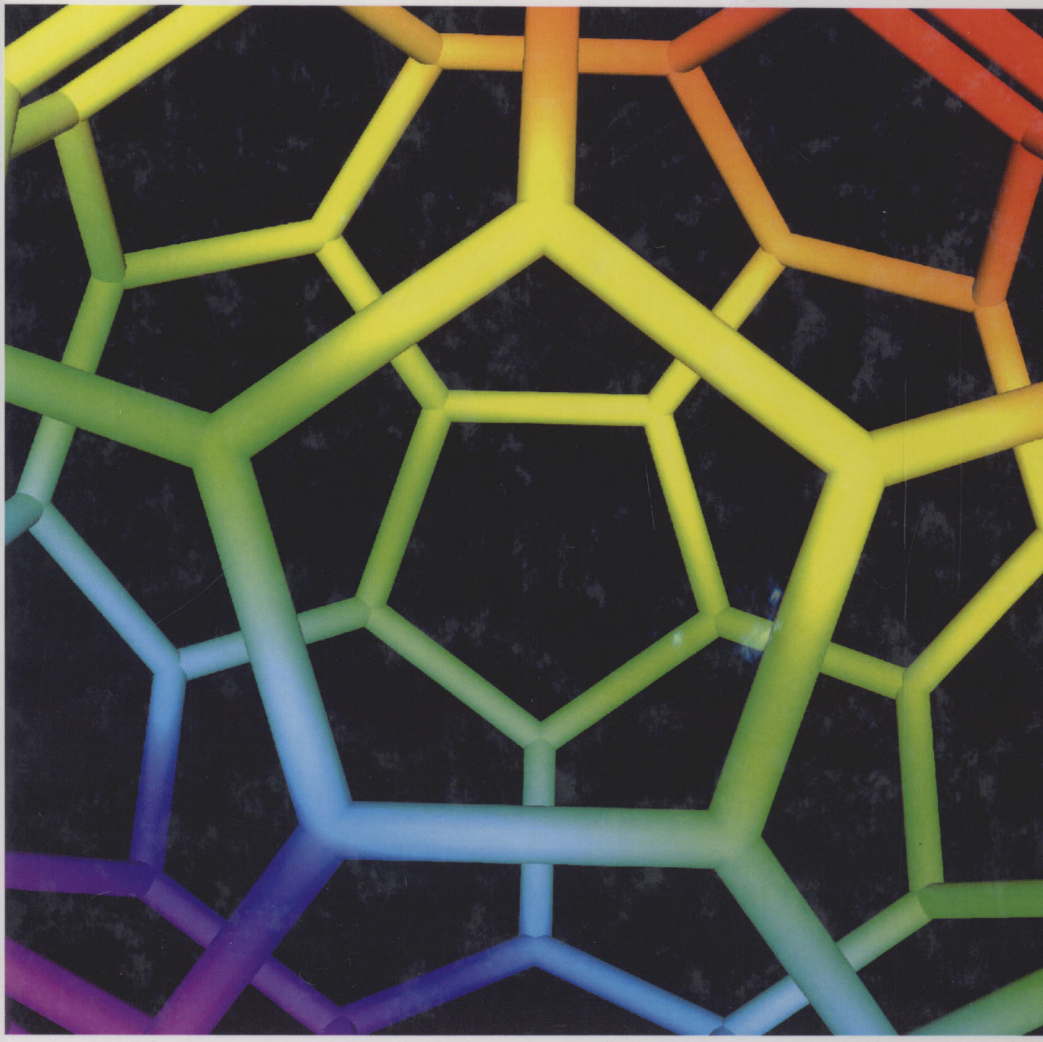
Edited by Colin A. Russell and Gerrylynn K. Roberts

Chemical History

Reviews of the Recent Literature



RSC Publishing

Chemical History
Reviews of the Recent Literature

Edited by

Colin A. Russell and Gerrylynn K. Roberts
The Open University, Milton Keynes, UK

RSC Publishing

Cover image Courtesy of David R Roberts

ISBN 0-85404-464-7

A catalogue record for this book is available from the British Library

Published by The Royal Society of Chemistry,
Thomas Graham House, Science Park, Milton Road,
Cambridge CB4 0WF, UK

Registered Charity Number 207890

For further information see our web site at www.rsc.org

Typeset by Macmillan India Ltd, Bangalore, India
Printed by Biddles Ltd, King's Lynn, Norfolk, UK

Chemical History
Reviews of the Recent Literature

Dedication

Dedicated to the memory of

Dr W. A. ("Bill") Smeaton
1925–2001

much valued friend and
eminent co-worker in the history of chemistry

Preface

This volume is the natural successor to *Recent Developments in the History of Chemistry*,[1] edited by one of us, published in 1985. Its primary intention was to familiarize newcomers to the history of chemistry with some of the more important developments over the previous twenty years or so. We had specially in mind the large number of chemistry teachers who were at that time expecting to introduce at least a small amount of historical material into their curricula. While they might have been familiar with some of the older standard histories, or with historical introductions in school textbooks, they had no means of discovering the large amount of recent historical research or of sharing in its excitement. The original impetus came from a meeting of the Historical Group of the Royal Society of Chemistry though the actual work was given to the History of Chemistry Research Group at the Open University. Most of the writing, and all the editing, was undertaken by members of that Group, though we were glad to include several chapters from distinguished scholars beyond our ranks. The text was keyed in to what is now an ancient computer and was, we are told, the first book to be published by the Royal Society of Chemistry entirely from camera-ready copy.

We believe this publication is timely, not simply because it bestrides a convenient gap of twenty years since the previous volume. This is a moment when chemistry is being challenged as never before in modern times. Some of the reasons are undoubtedly located in history, and historical studies can offer highly relevant insights. In addition, they can be valuable in humanizing the task of chemistry teachers and, when judiciously used, can increase the appeal of the subject as a whole. The present President of the Royal Society of Chemistry has recently urged the need for a better perception of chemistry by the public and Government, and for better communication by chemists.[2] We hope this book may make a modest contribution to both those ends.

The original intention for the previous volume was that each chapter should both provide a literature update and at the same time tell a connected story. In the event that was possible for only a few chapters, largely because of the kind of material that emerged. Because we were writing chiefly for chemists, we had no compunction in using an unashamedly chemical framework for the book, as is also true for the present volume. It soon became evident that other needs were being incidentally met, and we were very glad that practising chemists not in teaching, as well as historians of science in general, found the book of some value. We hope this may continue to be the case.

Chemical History: Reviews of the Recent Literature continues many of these practices, and we have adopted a similar (though not identical) chapter plan. Once again, most authors are or have been full-time members of the same History of Chemistry

Research Group, though we are glad to welcome several others, including three newcomers to the project. The period covered is about the same, *i.e.* the twenty years since the appearance of *Recent Devlopments in the History of Chemistry*. We have kept to this limit fairly strictly but on some occasions have referred to publications before 1985 where there were special reasons to do so. This is especially true of Chapter 5 (on physical organic chemistry); since the previous volume had no chapter on that topic, the author had a more extended brief. Furthermore, owing to the unusually long period of gestation for this work, terminal dates vary slightly from chapter to chapter.

Another difference from the first volume is that we have had the use of a computerized literature search programme organized by the Royal Society of Chemistry Search Services and involving a world-wide scan *via Chemical Abstracts*. It has thrown up large numbers of papers and articles, and very occasionally books, which would never have come to our attention otherwise. We have to say that it has not been possible to check all the originals in Russian, Japanese and Chinese and one or two less common languages. In all other cases the originals have been thoroughly examined. English translations have been provided of all foreign language titles, where the text language is other than English, French or German. We have indicated that for the benefit for readers who might find the information helpful before ordering material by Inter Library Loan.

It has been our practice to use, as far as possible, Royal Society of Chemistry conventions in citing literature. Thus, initials rather than first names are employed and standard journal abbreviations are used. One exception to frequent scientific practice is that, in most cases, titles of papers and articles are added. We find that this custom from the historical literature has much to commend it in the present context.

Finally, as editors we wish to thank all our contributors for their work, for their patience in sometimes waiting interminably for editorial comment, and for their cooperation at all times. We specially wish to record our appreciation of the work of Alec Campbell (1917–1999); Chapter 3 reflects his deep engagement with the chemical literature to the time of his death. We are very grateful to the Open University for travel support, for a most generous use of Inter Library Loans and for funding for several years the considerable costs of the computerized literature survey. To individual members of the Library staff our gratitude is immense.

Colin A. Russell
Gerrylynn K. Roberts
May 2005

References

1. C. A. Russell, ed., *Recent Developments in the History of Chemistry*, Royal Society of Chemistry, London, 1985.
2. S. Campbell, *RSC News*, August, 2004.

Table of Contents

CHAPTER 1

Getting to Know History of Chemistry

COLIN A. RUSSELL AND GERRYLYNN K. ROBERTS

History of Chemistry Research Group, The Open University

1.1 Trends in History of Chemistry Literature

In the twenty or so years between the appearance of this volume and that of its predecessor,[1] the history of chemistry may be said to have undergone something of a sea-change. Partly, of course, this reflects changing fashions or 'trends', as it might be more polite to call them, within the history of science itself. A strong tendency to provide exclusively social explanations for scientific events was already under fire in the 1980s and the extreme form of sociological reductionism observable in the 1960s is now rarely seen. Instead, we have a much broader approach, with a widespread recognition that, while science undoubtedly is a social phenomenon, it is certainly much more than that. Hence respect is given to all kinds of interpretative schemes, including also those that take seriously the internal structures of scientific theory and practice.

Some of the most impressive work in the history of chemistry over the last twenty years has been performed by people who are, or have been, chemists by profession. This is a remarkable swing of the pendulum. Such efforts should not necessarily be consigned to the dustbin of 'Whiggishness' (where all history is read from the standpoint of the present day and seen as an almost inevitable progress to the current situation of triumph and success). Some contributions by workers active in chemical research demonstrate a quite sophisticated approach to history (even their own). These stand in the tradition of 19th-century historians of science who, contrary to popular belief, were not in their dotage and were very alert to events that proved unfavourable to their own approach to chemistry.[2] For a critique of the rather dated view that there is something inferior about history written by professional chemists, it would be hard to recommend anything more appropriate than a brief essay on 'Historians of chemistry' in a book by the eminent biochemist Joseph Fruton.[3] Another writer facing this issue is R. W. Cahn, author of a history of materials

science,[4] a closely related field to chemistry. Examining the question as to whether 'it is acceptable for someone trained as a scientist' to write the history of a science, he comments on historical treatments of his own science, which have all been written by working scientists. His conclusion represents a substantial body of opinion: it is 'far better to be read by other scientists, who may on the whole be assumed to be in favour of science as a vocation'.[5] Today, controversy between self-styled 'historians of chemistry' and those they dubbed 'chemist-historians' has been subsumed in an alliance in which the latter hold a distinguished place. It is striking how frequently those who write as chemists use well-developed techniques of historical research, bringing fresh insights as they look back on their own subject. So let us see how in practice the history of chemistry has altered in character during the last couple of decades.

In the first place, *historical interest appears to have shifted from the classical to the modern period*, and especially to the very recent past. Thus a new historical interest in physical organic chemistry is so considerable that Chapter 5 is devoted to it alone. There must be several reasons for this stress on 20th-century developments and it is tempting to speculate. It could be argued, for example, that there is little new to learn about classical branches of chemistry and that the subject is virtually exhausted. However, some major incursions in the last few years have demonstrated the fallacy of such a view, for in fact the development of (say) organic chemistry has been far more complex than most of us have realized until quite recently. In its institutional aspects, there is much to be learned about the design and construction of laboratories and about the growth and decline of individual schools all over Europe. However, it takes time for these perceptions to take root.

Another explanation for the retreat to modernity may well lie in the need for contemporary chemists to gain public acceptance at a time when, partly for environmental reasons, the whole of chemistry is in some state of disrepute.[6] One way to win favourable public attention is to display recent research in the best light, and that may sometimes be accomplished by retailing a story of gradual progress until the present enlightenment has arrived. This would help to explain the large number of references in this volume to work by chemists on the history of their own branch of study. The remarkable recent emphasis on fullerenes may not be unconnected with the award of the 1996 Nobel Prize in chemistry to (and subsequent Knighthood of) Harold Kroto and (in Britain at least) with political mileage to be gained by such publicity.

Furthermore, the emergence of oral history as a systematic technique of historical investigation may have favoured interest in the history of contemporary chemistry. Properly handled interviews of practitioners of chemistry of the recent past can provide a rich repository of historical source material on the informal and affective aspects of doing science, which seldom enter the written record.[7,8] A study of the origins of the Krebs cycle is a powerful example of the potential of oral history.[9] The specialist history of chemistry centre, the Chemical Heritage Foundation in Philadelphia, has undertaken a systematic programme of chemical oral histories.[10]

A second feature of the current literature is a *strong emphasis on chemical biography*. Biographical writing in general has acquired a new vogue, even eclipsing the novel in some quarters. History of science is no exception,[11] though the number of major biographies of important chemical figures is relatively small. However, there are plenty of essays on a smaller scale that describe the lives of lesser mortals; and

there are some that attempt two-page coverage of chemical giants. Such ambitious cameos are not necessarily to be derided. They may well convey to a newcomer far more vivid impressions than lengthy tomes replete with footnotes could hope to do. Indeed, the professional historian may have something to learn from them in terms of communication skills and even content.

A sub-set of chemical biography is of course that written by the subjects themselves. The current efflorescence of autobiographical writing by chemists may well be a further reflection of their desire to portray their science in a good light and so help in its general promotion. The most conspicuous array of autobiographies is the large number published in the American Chemical Society series "Profiles, Pathways and Dreams: Autobiographies of Eminent Chemists", a milestone in preserving our knowledge of many of the greatest figures in the subject. Edited by J. I. Seeman, whose portrait is curiously the first one encountered in every volume, they are rather variable in quality and interest, and most do not approach the level of discerning analysis that historians of science have come to expect. Yet they are most valuable as primary sources, and doubtless will be used as such in the future by new generations of grateful historians.

A third characteristic of many of the works cited in this book is the *strong emphasis on obviously useful chemistry.* This, of course, is what one might expect from a strategy of popularization through history. Many people believe that environmental attacks on the subject may best be met with positive statements as to the positive good imparted by chemical research and application. There is therefore much activity in the history of medical chemistry (Chapter 8) and also of industrial chemistry. However, utilitarian aspects also appear as the history of all kinds of other topics is recounted. Often this is entirely justified by the facts, but sometimes one may wonder how far the treatment is determined by considerations of public image or even public and private funding. In such cases it is wise to adopt an attitude of judicious scepticism. A concern for the image of chemistry is indeed one reason why chemists are interested in the history of their subject.[12] As chemistry becomes ever more specialized and in danger of losing its core identity, so history becomes a way of reasserting that identity.[13,14]

We are now in a position to examine a whole battery of scholarly approaches available to modern students of the history of chemistry. There is no shortage of material!

1.2 General Histories of Chemistry

For a general overview of the history of chemistry the obvious place to start is the numerous books that may be called general histories of the subject. The daunting nature of the task has not inhibited occasional attempts to chronicle the whole of history of chemistry for nearly two centuries. As the subject gets bigger, the technicalities become more complex and the history gets longer, authors of such works are faced with a project of exponentially increasing difficulty. Yet, in the last twenty years, no fewer than six major efforts have been made to supply up-to-date histories of chemistry. Before mentioning these, it may be helpful to glance back at the situation in the quarter century before 1985.

The 1960s saw seven brave efforts to 'tell the whole story', as one publisher put it. First there were two books in series dealing with scientific discovery in general. Neither offered footnotes or even bibliography, though one provided a simple but clear text[15] and the other compensated with lavish illustration.[16] On a different scale, and of immense academic value, was a trio of works that received attention in the first volume but must certainly be noticed here. From the USA came a magisterial work by Aaron Ihde that has recently been reprinted,[17] and another by Henry Leicester.[18] Even more ambitious was the four-volume *History of Chemistry* by J. R. Partington, published in London and probably the most valuable single tool ever provided for historians of chemistry.[19] Attacked by a few on the grounds that it offered facts rather than interpretations (which is certainly true), it nevertheless presents such a staggering wealth of material that it is hard to see how it can be eclipsed. Certainly none of the six more recent histories comes anywhere near it for detail of information, nor do they attempt or claim to do so. Unlike them, however, it may be hard to acquire copies (it is long out of print), it cannot be read as a consecutive narrative, and it offers no synthesis of the historical data.

Then, in the 1990s, came a veritable explosion of general histories of chemistry. Each has its merits and its limitations and the following account will inevitably reflect the predispositions of the present authors. For that reason, readers are specially referred to independent reviews, particularly those in *Ambix*, volume 40.

First, a book originally in French provides a healthy antidote to Anglocentricity and offers an excellent treatment of such figures as Berthollet, Gay-Lussac and (of course) Lavoisier.[20] It will appeal particularly to historians seeking a fresh approach to their subject. The same may also be true of a book by David Knight, whose title conveys a more accurate flavour of its contents than does its sub-title[21]. Various characteristics of chemistry are described in a very roughly chronological order (occult, mechanical, independent, fundamental and so on, to finish with a subject that is teachable, reduced and finally a service science). It has been criticized (by a French reviewer!) as being too British in emphasis but commended as a good introduction for non-chemists. It is clearly intended to be read within the context of the humanities.

An almost polar opposite to Knight's work is one whose title might have conveyed the impression of being rather similar. Entitled *The Historical Development of Chemical Concepts*, and written by a distinguished Polish chemist,[22] it conveys chemical insights with accuracy, but it sits as lightly to recent historical scholarship in the West as the previous author does to developments in 20th-century chemistry. Chemists will find it challenging, and many readers will learn much that is new about the development of chemistry in Poland.

Three other books, in different ways, will serve as good introductions to beginners. A text by John Hudson[23] is explicitly aimed at chemistry teachers and provides a straightforward internalistic account of the growth of chemistry with little regard to the social or even the biographical dimensions of the subject. Some will regret a tendency to old-fashioned positivism, though within its chosen limitations it is clearly successful. A more catholic treatment awaits the reader in Bill Brock's ambitious *Fontana History of Chemistry*, appearing at almost the same time.[24] Here is a rather longer account (744 pages), organized on a series of themes derived from important chemical texts, and displaying insights from the social history of science

as well as a courageous effort to interpret historically quite modern developments. Graced with a lengthy bibliographical essay it must be one of the best introductions for a beginner who intends to prosecute the subject with due seriousness. Yet a book from America, which offers a general history of chemistry at a fairly popular level, may well turn out to be the best for an absolute beginner.[25]

It is thus apparent that the 'best' general history of chemistry depends largely on the intended readership. Without in any way limiting the scope of these six volumes it is possible to summarize the single most appropriate choice for a given *clientèle* as follows:

Newcomers	*Cobb and Goldschmidt*[25]
Chemistry teachers	*Hudson*[23]
Chemists	*Mierzecki*[22]
Humanities scholars	*Knight*[21]
Historians of chemistry	*Bensaude-Vincent / Stengers*[20]
General use	*Brock*[24]

Prices vary enormously, the volume by Mierzecki being approximately ten times as expensive as that by Brock.

Finally, several older histories of chemistry have recently appeared as reprints. One is a classic from 1866 and 1869, the famous *Histoire de la chimie* of Ferdinand Hoefer, reprinted in 1980.[26] Another is the Clows' classic of 1952, *The Chemical Revolution*.[27] It does not deal with the Lavoisierian transformation of chemistry (as might have been expected) but with the revolutionary changes in applied chemistry that made the Industrial Revolution possible.

1.3 Other General Works

In addition to complete histories of the science, several other types of general works may be noted. First, there are several volumes of *collected essays* that deal, mainly or exclusively, with the history of chemistry. An example of these is the published proceedings of the 'Symposium on Alchemy, Chemistry and Pharmacy', held during the International Congress of History of Science at Liège in 1997.[28] There is also a volume of essays on the history of chemistry in the multi-volume Italian publication, *Storia della scienza*.[29] The five-year European Science Foundation Programme, 'The Evolution of Chemistry in Europe, 1789–1939',[30] which was launched in 1993, has resulted in a number of collections of essays: on Lavoisier,[31] on aspects of the chemical industry,[32–35] on chemical textbooks,[36] and on chemical education and institutions.[37–39]

Furthermore, there is a series of reprints of original papers that in some cases originated well before 1985. They are usually unedited, often with the original pagination. Nevertheless, the Variorum series, in particular, provides a useful way to access and store such material. A collection by Allen Debus relates mainly to chemistry in its early phases[40] and is a highly authoritative introduction to such matters. Debus has also recently edited a collection of 'classic' articles on alchemy and early chemistry reprinted from *Ambix*, the Journal of the Society for the History of Alchemy and Chemistry.[41] Another volume in the Variorum series relates to a later period and

reflects the author's well-known interest in the triple relationships between chemistry, ideas of nature, and society in the century or so following the French Revolution.[42] A third, by John Brooke, displays his concern for the history of ideas within chemistry, almost entirely within the 19th century.[43]

Secondly, there are *books that cover the history of chemistry in particular places*. The development of chemical science in modern China is the theme of one recent book that is probably the only source in the West of such information.[44] Setting a new trail in analysis of national trends was the multi-authored book *Chemistry in America 1876–1976*.[45] This presented a vast mass of empirical data about most conceivable aspects of American chemistry: vocational, professional, educational and industrial. Like the *History of Chemistry* by Partington, to which it bears a curious resemblance in its fact-collecting skills and deadpan presentation, it is unlikely to be replaced for a long time. As will be seen in subsequent chapters there are many smaller studies available of aspects of chemistry in individual countries or regions. One of general interest is a discussion on chemistry in 19th-century Baden,[46] while another localizes chemistry to Essex and East London.[47]

Thirdly, several books have appeared in the last two decades taking a *single chemical theme* and charting its development over, sometimes, many centuries. A recent example concerns itself with the role of language in chemical change and particularly focuses on the work of Lavoisier.[48] A broader treatment of the same theme comes in a discussion on the language of chemistry from the beginnings of alchemy to c.1800.[49] Just before 1985 came a book of similar genre engaging with the interpretation of form, notably in mineralogy, crystallography, and its wider relationships with chemistry.[50] On a smaller scale there is a paper on the aether in late 19th-century chemistry.[51] Other examples will be encountered in chapters dealing with the individual branches of chemistry, such as organic and inorganic.

A fourth kind of work is the *period study*: Chemistry in general is considered within a restricted time-span. A collection of essays dealing with the rather wide theme of law and order in 18th-century chemistry has appeared.[52] A book about chemistry in Britain from 1760 to 1820 includes an examination of chemistry in the Scottish Enlightenment, the rise of pneumatic chemistry, the work of Priestley and Davy, and a study of the London chemical community.[53] Despite possible unfamiliarity with the author's sociological emphasis, chemists will find useful material on the way their subject interacted with the culture of that critical period. A work of a very different kind traces the changing relationship between chemistry and physics and, largely avoiding the social history of science, presents an ingenious and well-researched synthesis of ideas in the two sciences.[54] The author, Mary Jo Nye, has also written another book that, by its intriguing sub-title, implies a triple concern with a period (1800–1850), a theme of chemical change (dynamics of matter) and a social dimension (dynamics of disciplines).[55] An unusual paper covers a specific period and place in a study of chauvinism in 19th-century European chemistry.[56]

A different kind of general treatment relates to *source materials*. It is very important, though often quite difficult, to know just what is available in the secondary literature. The best historical works have either full literary references in footnotes, or separate bibliographies or both. To some extent, it is hoped that the present book will meet that need, but other assistance is available. For example, a book published in