

PRESIDENTIAL ADDRESS

‘Rude and Disgraceful Beginnings’: A View of History of Chemistry from the Nineteenth Century

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In a conference devoted to the history of science and its publics it might momentarily be supposed that this phrase has been intended to refer to our subject in its earlier, less enlightened period. That a few historians of science today do indeed regard their predecessors in a less than flattering light is, perhaps unfortunately, all too true. Moreover, this chauvinistic impression would be reinforced if I were to declare (as I now do) that it is an earlier phase of the subject that constitutes my theme for this paper. However, the intention is not to pillory, but to understand, earlier historians of science—possibly to learn from them. And the pejorative words of this title are not mine, but theirs; and they apply not to even earlier writers of history but to those whose work many centuries ago may be said to have marked one of the origins of a modern science. They refer, of course, to the alchemists whose famous activities have engendered a mixture of shame, embarrassment and curiosity in those who may be considered their intellectual descendants, the chemists of today.

It would be possible, in the present day, to examine the way in which alchemy has been treated in historiography just as others have discussed it in the context of literature¹ and iconography.² This would, at the very least, have something to tell us about changing attitudes in history of science. But it is a shade too specialized for an Address like this and also limiting for another reason. Partly because of the ‘rude and disgraceful beginnings’ of the subject writers of chemical history often commence their labours in the post-alchemical field, thereby excluding themselves from such a discussion. On the other hand, to cast our net so widely as to include all former historians of science would be a self-defeating exercise in compression, even assuming it were possible (which in my case it is emphatically not). As a middle way I propose to focus on one branch of science (chemistry) and one period (the nineteenth century). In posing the question

1 J. Read, ‘Alchemy and literature’, *Proc. Chem. Soc.*, (1957), pp. 138–143, and many other sources.

2 J. Read, ‘Alchemy and art’, *Proc. Chem. Soc.*, (1958), pp. 162–166; C.R. Hill, ‘The iconography of the laboratory’, *Ambix*, (1975), 22, 102–110.

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'how did nineteenth century writers on chemical history see their task?' we may glean a few insights into Victorian chemistry on the way and perhaps see our own endeavours in a larger context.

It may, of course, be objected that chemistry is not typical of science as a whole (which is true in some respects) and therefore not relevant to a general view of science (which would not appear to follow from the premiss). With more truth it could now be argued that historical studies in chemistry are less important than they once were. This, however, needs to be seen in the context of specialist studies as a whole, and depends to some extent on which indicators are used: numbers and percentages of papers, or of doctoral students. Although comparable figures are not available for the previous century a qualitative impression is one of very considerable interest and activity in the history of chemical science, and that is my chief justification.³

In the nineteenth century and well into our own it used to be the habit to introduce chemical compounds to students under the headings: Occurrence—Preparation—Properties—Uses. Not all occurred naturally, nor did all have known uses, but it was a valuable framework for individuals and whole classes of substances. For more than symbolic reasons it will also be appropriate for the present survey of historico-chemical literature.

1. OCCURRENCE

What nineteenth century histories of chemistry can be identified and who were their authors? Professional historians of chemistry or any other science did not exist and these people are often called the 'chemist-historians'. On any basis, the first off the mark was that notable breeder of research chemists and university reformer, Thomas Thomson, Professor of Chemistry in Glasgow, defender of John Dalton and author of *The History of Chemistry* of 1830–1831.⁴ Equally important was his textbook *A System of Chemistry*,⁵ which first appeared in 1802 and was shot through with historical insights and emphases. His influence in Britain was considerable, though as a historian he was overshadowed on the continent by two other figures. First, the little-known Ferdinand Hoefer published his two-volume *Histoire de la Chimie* in 1842–1843 (thereby inhibiting the notable French chemist Chevreul from producing his own *magnum opus* on the subject but stimulating him to develop and expand his own historical insight in a series of articles).⁶ This was immediately followed by the massive four

3 History of chemistry did not start in the nineteenth century, though that period saw a major efflorescence of the subject. See A.G. Debus, 'An Elizabethan history of medical chemistry', *Ann. Sci.*, (1962) 18, 1–29; 'The history of chemistry and the history of science', *Ambix*, (1971), 18, 169–177. A paper on 'Heroes and hero-worship: history of chemistry in the nineteenth century' was given by Dr Nicholas Fisher at a BSHS Symposium on problems and perspectives in the history of chemistry in April 1979 at Leicester. A post-circulated typescript included a specific request that the paper be neither cited nor quoted; it has not been used in the preparation of this Address.

4 T. Thomson, *The History of Chemistry*, London, 1830.

5 T. Thomson, *A System of Chemistry*, Edinburgh, 1802 (4 vols), 1804 (4 vols), 1807 (5 vols) and later editions.

6 J.C.F. Hoefer, *Histoire de la Chimie*, Paris, 1842 (2 vols). See G. Sarton, 'Hoefer and Chevreul', *Bull. Hist. Med.*, (1940), 8, 419–445; H. Metzger, 'Eugène Chevreul, historien de la chimie', *Archeion*, (1932), 14, 6–11.



Figure 1. H. Kopp. (Reproduced by kind courtesy of The Royal Society of Chemistry.)

volume *Geschichte der Chemie*⁷ of Hermann Kopp of 1843–1847,⁷ then a youthful professor at Giessen. In the next forty years three other major historical works flowed from his pen.⁸ Many a subsequent historian of chemistry has confessed that Kopp was his starting-point.

The 1860s witnessed a relative flood of historico-chemical writing, perhaps reflecting the new spirit of optimism abroad in the post-Karlsruhe era of agreed atomic weights,

⁷ H. Kopp, *Geschichte der Chemie*, Brunswick, 1844–1847 (4 vols).

⁸ H. Kopp, *Beiträge zur Geschichte der Chemie*, Brunswick, 1869–1875; *Die Entwicklung der Chemie in der neueren Zeit*, Munich, 1873; *Die Alchemie in älterer und neuerer Zeit*, Heidelberg, 1886.



Figure 2. A. Ladenburg. (Reproduced by kind courtesy of The Royal Society of Chemistry.)

valency and structure. In 1866–1869 a second edition of Hoefer's history appeared (two volumes). Adolph Wurtz, a founder of the Société Chimique de Paris and Professor of Chemistry in the Sorbonne, achieved a new kind of fame by his *Histoire des Doctrines Chimiques depuis Lavoisier jusqu' à nos Jours* of 1869, with an almost instantaneous translation in English.⁹ Meanwhile, a young German chemist in Heidelberg, Albert

⁹ A. Wurtz, *Histoire des Doctrines Chimiques depuis Lavoisier jusqu' à nos Jours*, Paris, 1869; *A History of Chemical Theory from the Age of Lavoisier to the present time*, tr. H. Watts, London, 1869.

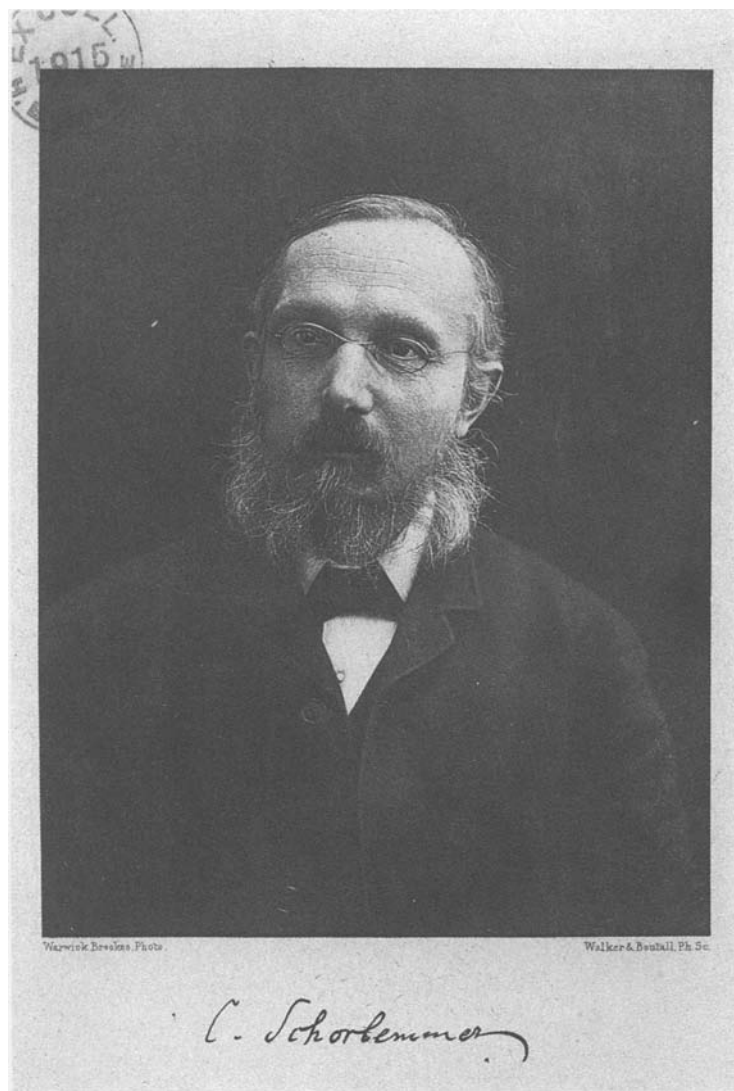


Figure 3. C. Schorlemmer. (Reproduced by kind courtesy of The Royal Society of Chemistry.)

Ladenburg, made 1869 a bumper year with his *Vorträge über die Entwicklungsgeschichte der Chemie*; this went through several editions and appeared in English translation in 1905.¹⁰ Ladenburg was to make important contributions to organic chemistry, not least in the synthesis of coniine alkaloids and in his famous ‘prism’ structure for

¹⁰ A. Ladenburg, *Vorträge über die Entwicklungsgeschichte der Chemie von Lavoisier bis zur Gegenwart*, Brunswick, 1879; 2nd edn, 1907; *Lectures on the History of the Development of Chemistry since the Time of Lavoisier*, tr. L. Dobbin, Edinburgh, 1905.

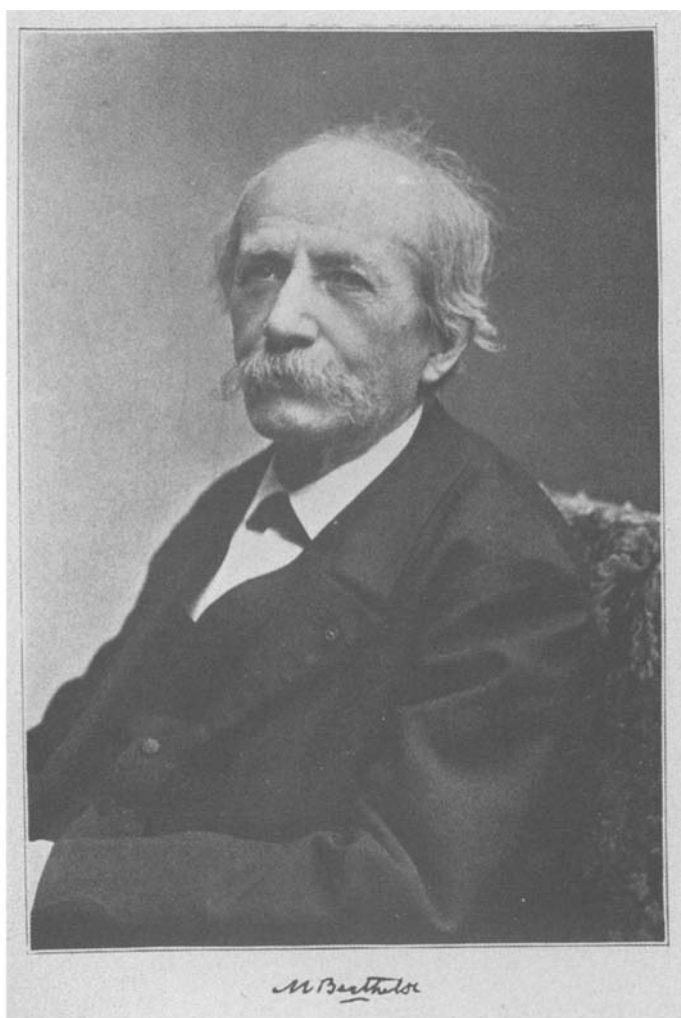


Figure 4. M. Berthelot. (Reproduced by kind courtesy of The Royal Society of Chemistry.)

benzene that has only recently been established for a transient valence isomer. He was working on benzene and the history of chemistry at the same time.

In 1879 the first history of organic chemistry appeared, written by the first incumbent of a British chair in that subject, Carl Schorlemmer, of Owens College, Manchester. It was he who first clarified the nature of the alkane series of hydrocarbons [paraffins]. His predecessor, Edward Frankland, had incorrectly inferred two different species with (for instance) the formula C_2H_6 ; Schorlemmer's end to the confusion removed a great hindrance to the development of organic chemical theory in the 1860s. A friend of Engels and Marx, he belonged to the German Social-Democratic Party, and that would have precluded tenure of any chair in Germany in the later years of the century. His



Figure 5. T.E. Thorpe. (Reproduced by kind courtesy of The Royal Society of Chemistry.)

book *The Rise and Development of Organic Chemistry* was translated into German and appeared as a second English edition in 1894.¹¹ An unpublished manuscript history of chemistry as a whole was discovered after his death.

As the century drew to a close other histories appeared, some continuing the more

11 C. Schorlemmer, *The Rise and Development of Organic Chemistry*, Manchester, 1879; 2nd edn, London, 1894; *Der Ursprung und die Entwicklung der organischen Chemie*, Brunswick, 1889.

specialist emphasis of Schorlemmer. In 1885 Marcellin Berthelot produced *Les Origines de l'Alchimie*, in 1887–1888 his *Collection des anciens Alchimistes Grecs*, in 1889 his *Introduction à l'Étude de la Chimie des Anciens et du Moyen Age*, in 1890 *La Revolution Chimique, Lavoisier*, and three years later his three-volume *Histoire des Sciences. La Chimie au Moyen Age*.¹² Berthelot was one of the great chemists of his day, as was Friedrich Wilhelm Ostwald who shared some of his philosophical attitudes. Ostwald wrote his *Elektrochemie, ihre Geschichte und Lehre* in 1896,¹³ although his book on the history of chemistry, *Der Werdegang einer Wissenschaft*, had to wait until the new century (1909).¹⁴ Nor should one forget Ernst von Meyer, of Leipzig and later Dresden, whose *Geschichte der Chemie* first appeared in 1889.¹⁵ In Britain, Pattison Muir, Praelector in Chemistry at Gonville and Caius College, Cambridge, added *Chemists* to the gallery of 'Heroes of Science' in 1883, supplementing this book with *The Story of Chemical Elements* in 1897.¹⁶ William Tilden's *Short History of Chemistry* appeared in 1899,¹⁷ with more substantial works in the new century from both Tilden and Muir.¹⁸ T. E. Thorpe entitled his Presidential Address to the Chemical Society 'On the progress of chemistry in Great Britain and Ireland in the nineteenth century',¹⁹ reaching a wider public with his *Essays in Historical Chemistry*²⁰ and other incursions into chemical biography, together with a small two-volume *History of Chemistry* in the new century.²¹

2. PREPARATION

Even that does not quite exhaust the list, but it is long enough. Fortunately, it is possible to go beyond a mere catalogue of names and to ask what kind of people these men were and whether any general statements can be made about them. Indeed, one generalization is already in common circulation, and has been widely repeated. It is that historians of chemistry of previous generations, including the nineteenth century, were often retired chemists spending their declining years rewriting the history of their subject so as to paint their own endeavours in the best possible light. They knew nothing of historical analysis, were chiefly concerned with compilation of lists of curious facts,

12 M. Berthelot, *Les Origines de l'Alchimie*, Paris, 1885; *Collection des anciens Alchimistes Grecs*, Paris, 1887–1888 (3 vols); *Introduction à l'Étude de la Chimie des Anciens et du Moyen Age*, Paris, 1889; *La Revolution Chimique, Lavoisier*, Paris, 1890; *Histoire des Sciences. La Chimie au Moyen Age*, Paris, 1893 (3 vols).

13 W. Ostwald, *Elektrochemie, ihre Geschichte und Lehre*, Leipzig, 1896.

14 W. Ostwald, *Der Werdegang einer Wissenschaft*, Leipzig, 1909; *L'Évolution d'une Science, la Chimie*, tr. M. Dufour, Paris, 1919.

15 E. von Meyer, *Geschichte der Chemie, von den ältesten Zeiten bis zur Gegenwart*, Leipzig, 1889, 1891 and 1905; *A History of Chemistry from Earliest Times to the Present Day*, tr. G. McGowan, London, 1891, 1898 and 1906.

16 M.M. Pattison Muir, *Heroes of Science: Chemists*, London, 1883; *The Story of Chemical Elements*, London, 1897.

17 W. Tilden, *A Short History of the Progress of Scientific Chemistry in our own Times*, London, 1899.

18 W. Tilden, *The Progress of Scientific Chemistry in our own Times*, London, 1913; *Chemical Discovery and Invention in the Twentieth Century*, London, 1916; *Famous Chemists, the Men and their Work*, London, 1921.

19 T.E. Thorpe, Presidential Address, *J. Chem. Soc.*, (1900), 77, pp. 555–586 (562–586).

20 T.E. Thorpe, *Essays in Historical Chemistry*, London, 1894.

21 T.E. Thorpe, *History of Chemistry*, London, 1909–1910 (2 vols).

often failed to distinguish between good and bad evidence, were only concerned with what their generation regarded as successful science, ignored the blind alleys and cul-de-sacs of chemical enquiry, and (in short) represented the very quintessence of Whiggism. Such a view I call 'the dotage theory'. Let us see if it bears any relation to the facts.

Author	Dates	Book dates	Age
T. Thomson	1773–1852	1830	57
J.C.F. Hoefer	1811–1878	1842+	31+
A. Wurtz	1817–1884	1868	51
H. Kopp	1817–1892	1843–1847	26+
M. Berthelot	1827–1907	1885 (Alchemy)	58
		1892 (Middle Ages)	65
C. Schorlemmer	1834–1892	1879	45
C. Graebe	1841–1927	1920	79
A. Ladenburg	1842–1911	1869	27
W.A. Tilden	1842–1926	1899 (Short Hist.)	57
		1913 (Prog. Sci. Ch.)	71
T.E. Thorpe	1845–1925	1894 (Essays)	49
E. von Meyer	1847–1916	1889	42
M.M.P. Muir	1848–1931	1883 (Heroes)	35
		1897 (Elements)	49
W. Ostwald	1853–1932	1896 (Electrochem.)	43
		1909 (Hist. Chem.)	56
G.W.A. Kahlbaum	1853–1905	1897+	44+
P. Walden	1863–1957	1941	78
T.M. Lowry	1874–1936	1911	37
P. Diergart	1875–1943	1909	34
J.R. Partington	1886–1965	1935 (App. Chem.)	49
		1937 (Short Hist.)	51
		1961+ (4 vol.)	75+
E. Farber	1892–1969	1931 (Hist. Dev.)	39
		1952 (Evol. Chem.)	60

Figure 6. The Dotage Theory.

This chart lists the main figures just mentioned, together with their successors in the present century. Several things are immediately apparent. First, there are several authors well into old age, of whom the organic chemists Graebe and Walden appear to have started their historical endeavours well after their distinguished chemical careers were over. Though not completely true (for Walden had written on the history of solution when he was a mere forty-seven²²) it is largely correct, and Graebe admits that only after he retired from teaching did he develop his predilection for history of chemistry.²³ Perhaps here is the origin of the dotage legend, for the rest of the data

22 P. Walden, 'Die Lösungstheorie in ihrer geschichtlichen Aufeinanderfolge', *Samml. chem. u. chem.-techn. Vorträge*, (1910), 15, 277.

23 C. Graebe, *Geschichte der organischen Chemie*, Berlin, 1920, p. iii.

indicates that that is exactly what it is. To be sure Partington was long retired when his monumental four-volume *History of Chemistry* began to appear, but his *Origins and Development of Applied Chemistry*²⁴ had appeared over a quarter of a century earlier. Similarly, neither Tilden nor Farber waited for retirement to produce their first historical work. Nor did Berthelot, whose magisterial work on alchemy was conducted while he was at the height of his powers and actually preceded his work on thermochemistry, his discovery of iron carbonyl and much else. Thomson had been writing historically for over twenty years before his *History* was published and Hoefler, although fifty-five when the second edition of his book appeared, was only thirty-one for the first edition. Of the rest most were youngish men, while Kopp, perhaps the most influential of them all, was a mere stripling of twenty-six when he first went into print.

That most of the major chemist-historians of the last two centuries wrote important historical work well before their dotage seems incontrovertible. But age, by itself, is only one consideration. Another is the provenance of their studies, and here it seems likely that many began in the same kind of way as historians of other sciences in the last century. We are told, for instance, that J. C. Poggendorf had 'for many years' delivered lectures on the history of physics at the University of Berlin, and out of these his *Geschichte der Physik* was posthumously produced for publication.²⁵ Many years later a similar course of lectures at Northwestern University, Illinois, led to the publication of Henry Crew's *The Rise of Modern Physics*, just as his colleague William Lacy had previously done with his lectures on the history of biology.²⁶ In chemistry such lectures may have been popular expositions, like those of T. E. Thorpe to working men in Manchester²⁷ or of Tilden to a similar audience in London.²⁸ Or they may have been delivered to university classes, either as part of an undergraduate course or as an optional extra—sometimes it is hard to tell which. Two examples must suffice, both around 1900.

James Campbell Brown (1843–1910), a pupil of Tyndall and Hofmann, was Professor of Chemistry at Liverpool at the turn of the century. The Public Analyst for the city, he was a founding member of both the Society of Chemical Industry and the Society of Public Analysts. His *History of Chemistry from the Earliest Times to the Present Day* was published posthumously²⁹ on the basis of lectures delivered as 'a labour of love' and illustrated with 'lantern slides' as part of his chemical course.³⁰ At that time the University College of Liverpool was plagued by low numbers and low entry standards³¹ and historical lectures may have been seen as an alternative to laboratory work. The other example [for which I am indebted to Dr W. A. Smeaton] is

24 J.R. Partington, *Origins and Development of Applied Chemistry*, London, 1935.

25 W. Barentin, Foreword to J. C. Poggendorf, *Geschichte der Physik*, Leipzig, 1879.

26 H. Crew, *The Rise of Modern Physics*, 2nd edn, London, 1935, p. ix.

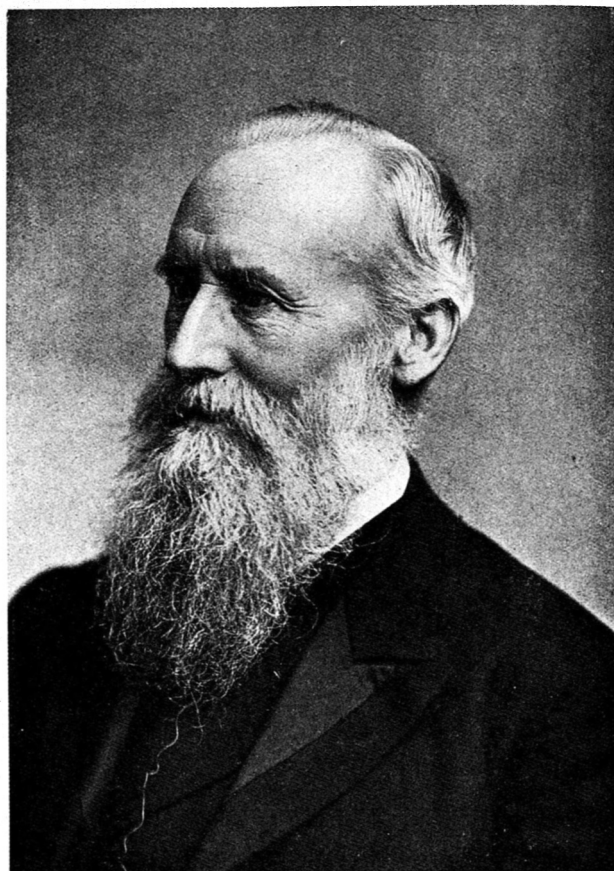
27 E.g., T.E. Thorpe, 'Cavendish and his discoveries', in *Science Lectures for the People*, Manchester, 1875–1876, pp. 89–103.

28 W. Tilden (1899), p. v.

29 J.C. Brown, *History of Chemistry from the Earliest Times to the Present Day*, London, 1913.

30 *Ibid.*, p. v.

31 Only thirty chemistry graduates had been produced in the ten years since its foundation in 1890: G.W. Roderick and M.D. Stephens, *Scientific and Technical Education in the Nineteenth Century*, Newton Abbot, 1972, p. 68.



J.C. BROWN, M.D.

Figure 7. J.C. Brown.

that of William Ramsay who, in 1900–1901, gave a course on history of chemistry to third-year students at University College, London. However, it was only in the final term, and at 9 a.m. on Saturdays!³² Perhaps it was poor attendance that caused the course to be withdrawn shortly afterwards. If any lesson is to be drawn from these melancholy events it is possibly that history of science is no substitute for science teaching for less able students, and that, like anything else, it suffers from exposure at

³² Information from Dr W.A. Smeaton; these lectures were probably one ingredient of Ramsay's *Essays Biographical and Chemical*, London, 1908.

unsocial hours. Of other, more successful, attempts to include history in chemistry courses we shall take notice later.

Not all the great histories of chemistry originated as lecture courses. Many were the outcome of research conducted between spells of experimental work, others as an essentially spare time activity, and a few as a long-anticipated luxury of retirement years. In the last category were doubtless several that never saw the light of day, such as the sadly incomplete manuscript of Schorlemmer's history of the whole science.³³ Others again must be recognized as the chief literary activity of authors whose experimental chemical activity was negligible. Men like Hoefer were to produce considerable works of historical scholarship long before history of science was professionalized in anything like the modern sense.

And we must not forget another class of writers. These were the many chemists who did not aspire to writing whole histories of their subject but nevertheless wrote impressively on either individual biography or on special episodes in chemical history. A notable example of the latter authors is Henry Roscoe, who wrote both a biography of John Dalton and (with Harden) *A New View of the Origin of Dalton's Atomic Theory*.³⁴ Nor must the multitude of lesser men be forgotten whose textbooks of chemistry were liberally sprinkled with allusions to past events in the subject, real or supposed. From such diverse origins did the nineteenth century treatments of chemical history arise. Equally diverse were the characteristics they displayed.

3. PROPERTIES

Far from being monolithic expressions of Whiggism or of anything else the nineteenth century histories of chemistry are at least as different from one another as from any of our own time. They differ in the extent to which they represent original research or rely on other secondary sources. Many acknowledge their indebtedness to Kopp, especially, and some are patently derivative for almost all their material. Others, like the works of Thomson and Berthelot, display a familiarity with original sources that many a modern might profitably emulate. However, Thomson emerged from his alchemical studies to remark ruefully 'that the information gained by such a perusal will very seldom repay the trouble', and regretted time spent with Paracelsus, 'this prince of quacks and imposters'.³⁵ Most obviously there are differences in the extent of historical coverage, many attempting comprehensive coverage but others focusing on specific areas of chemistry (as Schorlemmer or Roscoe and Harden) or more recent times (as the spate of studies on the departing century around 1900). In all cases there are exact parallels in other sciences.³⁶ Yet without exception all the works contain three elements, and it is the ratio of these to one another as well as their separate treatment that

33 On this see *DNB* and *DSB*.

34 H.E. Roscoe, *John Dalton and the Rise of Modern Chemistry*, London, 1895; H.E. Roscoe and P. Harden, *A New View of the Origin of Dalton's Atomic Theory*, London, 1896.

35 Thomson (1830), pp. ii and iv.

36 Thus in astronomy there were specialist studies such as R. Grant, *History of Physical Astronomy*, London, 1852; and Agnes M. Clerke, *A Popular History of Astronomy during the Nineteenth Century*, London, 1893.

constitutes some of the most revealing characteristics of both the author and his work. These are discoveries, concepts and people. Some of the most useful histories of chemistry have these so well blended together that it is impossible to argue for a special emphasis on one rather than another. Outstanding examples of such eirenic treatments are furnished by Thomson, Meyer and Ladenburg. Other accounts, still of great value, are distinctively slanted in one of the three directions.

3.1 Discoveries

The pragmatic, empirical spirit of chemistry is well displayed in the title of a book appearing well into the twentieth century but redolent of the values of Victorian chemical history: *Chemical Discovery and Invention in the Twentieth Century* by Sir William Tilden (1917). Relatively light on theory, it is dedicated to showing that chemistry is a useful science for which industry ought to be prepared to make better provision.³⁷ (This was also a time when Government was glad enough for chemists to run munition factories but otherwise treating them with scandalous neglect.³⁸) Introducing an earlier book in 1899, Tilden declared his intention 'to trace the course of discovery in chemistry' in the Victorian period.³⁹

A few other histories centred on discoveries but the tendency is far more common in chemistry textbooks. One of the most famous textbooks in English was *Inorganic Chemistry* by Frankland and Japp,⁴⁰ in which all major compounds were introduced by a section on 'history', thus adding a new category to occurrence, preparation, properties and uses. They set a pattern for generations of textbooks on elementary chemistry where such historical synopses, often in very small print, were quite sufficient to minimize historical interest in those who read them. This formalization of history did not appear in Frankland's earlier books and appears to reflect a growing interest in chemistry's past as well as Frankland's inveterate tendency to systematize for didactic purposes. However, 'discovery' was not the major *Leitmotiv* of Victorian chemical historiography.

3.2 Concepts

The history of chemical ideas was a favourite theme of these chemist-historians. But it must not be imagined that most of them wished merely to chronicle minute fluctuations of ideas within their own limited sphere of chemical understanding, still less that they wanted to mobilize contemporary opinion in breathless admiration at their own latest intellectual achievement. These were often men of wide and general culture, and they saw the history of chemistry as part of a much wider history of ideas. A good example is Justus von Liebig.

37 W.A. Tilden, *Chemical Discovery and Invention in the Twentieth Century*, London, 1917.

38 G.K. Roberts in C.A. Russell, N.G. Coley and G.K. Roberts, *Chemists by Profession*, Milton Keynes, 1977, pp. 212–213.

39 W.A. Tilden (1899), p. 16.

40 E. Frankland and F.R. Japp, *Inorganic Chemistry*, London, 1884.

The third edition of Liebig's *Familiar Letters on Chemistry* (1851) contains several chapters on the history of the subject. He confesses a debt to Kopp but also to several general historians and observes 'the history of science fills a page in the history of the human mind'. Parting company from those who despise chemistry's humble origins, he complains of 'the very ludicrous and excessive estimation of ourselves' which leads us to despise the age of alchemy and which springs from a 'prevailing ignorance of chemistry, and especially of its history'. If that were not enough he goes on to ascribe a contempt for the theory of phlogiston as a result of 'ignorance of the history of science'.⁴¹ In other words he wants to use history to exalt the past, not the present, so turning the conventional caricature of a chemist-historian on its head.

In a similar way Ladenburg argues the value of a history that 'is no longer a mere enumeration of isolated facts in chronological order' but one that 'embraces the development of the human mind and of human civilisation'. Darwinians and even their opponents must surely see the importance of historical studies. But it is history of science, even more than history of philosophy, that can help us to understand the history of the development of the human intellect. He instances several specific advantages of such an enterprise: it can help us to understand the present; it displays 'the mutability of opinions'; it undermines a blind faith in authority; and it stresses the importance of theories as compared with mere observations.⁴²

Examples can be multiplied of this high valuation of the history of science, and thus of the treatment of chemical concepts (as opposed to mere discoveries). It was said of Ostwald's historico-chemical studies in the late nineteenth century that 'he became more and more convinced that in the history of science the general laws of historical phenomena can be more readily grasped than in the entangled web of universal history'.⁴³

This general dedication to intellectual history was sometimes associated with a clearly displayed philosophy of life. The values of positivism are not far below the surface of Ostwald's exposition, for instance. He deals with Berzelius' electrochemical theory largely in terms of equivalents, announcing that 'equivalent and combining weights are nothing more than the magnitudes of the capacity for chemical energy', and complains that in the development of isomerism theories 'chemists have got themselves more and more into the habit of regarding the atoms as real'.⁴⁴ Even more pronounced was the ideological stance of Schorlemmer.

Schorlemmer's history of chemistry was deeply indebted to Kopp, as he gladly admitted, but he went far beyond his teacher in developing a history of science based on Marxism. Indeed his recent biographer, Karl Heinig, asserts that here was the beginning of Marxist historiography of science. Thoroughly disenchanted with the empiricist legacy of *Naturphilosophie*, Schorlemmer adopted the standpoint of dialectical materialism, concerning himself with 'the basic laws of scientific development, the

41 J. von Liebig, *Familiar Letters on Chemistry*, London, 1851, pp. 25, 42 and 46 (italics mine).

42 A. Ladenburg (1905), pp. 1–4.

43 M. Dufour in Preface to W. Ostwald, *L'Évolution d'une Science: la Chimie*, tr. M. Dufour, Paris, 1919, p. 2.

44 *Ibid.*, p. 85.

context in which the individual sciences relate to one another, theoretical questions about the role of hypotheses and theories, and the connection between Theory and Praxis'.⁴⁵ He held a dynamic view of chemical change, holding that even for molecules 'everything is in an eternal flux' as Heraclitus had said.⁴⁶ He was fortunate in finding organic chemistry just then embracing dynamic concepts (as in tautomerism) and therefore ideal for his exegesis. And the Hegelian notion of quality emerging from quantity was able to account for the incremental effect of successive CH₂ additions in building up homologous series,⁴⁷ an argument later used by Engels.⁴⁸ In 1892 Engels wrote a highly appreciative obituary notice for him.⁴⁹

Schorlemmer's history of organic chemistry is undoubtedly a major achievement, and it does highlight the importance of conceptual analysis in history as in science. Yet if it be compared with its predecessors—even with Thomson half a century earlier—its methodology does not seem to be so very different. Nor, in fact, does it have much to say about economic or political factors. What it does accomplish is the establishment of a historiography that takes into account the dynamic processes and distinctive features of the new organic chemistry. And it was a means to an end. 'For Schorlemmer the history of science was an unconditional necessity for understanding science itself'.⁵⁰

This conviction, together with his high evaluation of a conceptual history of chemistry, was shared by many of his successors. Pattison Muir is chiefly remembered for his historical writing, and that of a conceptual kind. It was said of him that 'as behoved his Scottish birth [he] was more a metaphysician than a typical man of test tubes and reagent bottles'.⁵¹ When his *magnum opus* did appear, early in the new century, it was appropriately called *A History of Chemical Laws and Theories*.⁵² Not for nothing had he been secretary of the Cambridge Philosophical Society. But there still remains a third emphasis in nineteenth century chemical history.

3.3 People

When T. E. Thorpe wrote the Memorial Lecture for his former master Kopp he announced 'The history of an epoch is the history of its leading men'.⁵³ Such opinions may not have been held by Kopp but they were firmly believed by his obituarist. Thorpe excelled at chemical biography, and made it the basis of his later *History of Chemistry*.²¹ His *Essays in Historical Chemistry*²⁰ consisted of a selective series of biographical studies, culled from a variety of sources. Its approach is typical of much history of chemistry at the end of the Victorian era including, of course, many single-volume

45 K. Heinig, *Carl Schorlemmer, Chemiker und Kommunist ersten ranges*, Leipzig, 1979, p. 53.

46 Schorlemmer (1894), p. 184.

47 Schorlemmer (1894), p. 142.

48 F. Engels, *Herrn Eugen Dühring's Umwälzung der Wissenschaft*, Zurich, 1886, 1878, p. 104.

49 *Vorwärts Berliner Volksblatt*, 3 July, 1892.

50 Heinig, p. 55.

51 R.S. Morrell, *J. Chem. Soc.*, (1932), p. 1334.

52 M.M. Pattison Muir, *A History of Chemical Laws and Theories*, London, 1907.

53 T.E. Thorpe, *Memorial Lectures of the Chemical Society, 1893–1900*, London, 1901, p. 776.

biographies of great chemists. This tendency was not unique to Britain. Of the continental writers one of the most prolific was the G. W. A. Kahlbaum of Basle. In addition to his eight-volume *Monographien* he wrote about Paracelsus, Schönbein, Wöhler and others and edited several volumes of their letters.⁵⁴

4. USES

In asking for what uses the history of chemistry was intended we inevitably raise the most important underlying question of the dominant ideologies. At the risk of oversimplification we can perhaps identify three separate approaches.

4.1 Patriotic

At both a national and local level patriotism was a powerful force in European culture, and even history of science was pressed into its service. Chemistry recognized its international bonds, as the Memorial Lectures of the Chemical Society testify, but at moments of stress or provocation nationalism may be seen to have determined historical writing to a considerable extent. Writing in the aftermath of the 1848 revolutions Liebig complained of the fallacious view that chemical knowledge began with 'the French school' of Lavoisier.⁵⁵ When, in 1869, Franco-German relations reached a new low point, Wurtz introduced his history of chemistry with the words 'Chemistry is a French science; it was founded by Lavoisier of immortal memory',⁵⁶ a remark that called from Thorpe the riposte 'Chemistry is an English Science, its founder was Cavendish of immortal memory!'⁵⁷ One is reminded of the comments of Berzelius on Turner's *Elements of Chemistry* in 1827: 'What damned nonsense, written in an impertinent style, oblivious to everything which has not been done in England by Englishmen . . . in spite of the fact that the man has been studying under Stromeyer!'⁵⁸ But then, he was suffering badly from gout.

Nor must such partisan uses of the history of science be regarded solely as the propensity of historians. A history of science in Germany was actually commissioned by King Maximilian II of Bavaria to exalt his country's honour.⁵⁹ And patriotism is not restricted to German monarchs: at a much more local level the civic pride of Manchester may be seen in the intense veneration of Dalton's memory, as shown by Roscoe's biography of him.³⁴ In conjunction with Schorlemmer, Roscoe wrote a textbook of inorganic chemistry with a frontispiece portrait of Dalton and a long

54 G.W.A. Kahlbaum, *Monographien aus der Geschichte der Chemie*, Leipzig, 1897–1904, (8 vols); *Theophrastus Paracelsus*, Basle, 1894; *Christian Friedrich Schönbein*, 1799–1868, Leipzig, 1879–1901 (3 vols); (ed. with Darbyshire) *The Letters of Faraday and Schönbein*, London, 1899; (ed. with E. Thon) *Justus Liebig und Christian Friedrich Schönbein. Briefwechsel 1853–1868*, Leipzig, 1900, etc.

55 Liebig, p. 26.

56 A. Wurtz, *Histoire des Doctrines Chimiques depuis Lavoisier jusqu'à nos Jours*, Paris, 1869, p. xx.

57 T.E. Thorpe, (1875/1876), p. 103.

58 J.J. Berzelius, Letter to Wöhler, 10 July, 1829, in O. Wallach (ed.), *Briefwechsel zwischen J. Berzelius und F. Wöhler*, Leipzig, 1901, vol. i, p. 267.

59 J. von Sachs, *Histoire de la Botanique du XVI^e Siècle à 1860*, tr. H. de Varigny, Paris, 1892, p. xi.

historical introduction that specially relates the rise of Daltonian atomism.⁶⁰ It is not hard to think of modern histories of chemistry with an overtly nationalistic function. Looking back on the previous century one may well be grateful for such endeavours, and perhaps think more kindly (though no less critically) of their latter-day equivalents.

4.2 Didactic

That history of chemistry has been used as a vehicle for ideological purposes is obvious for the cases of Ostwald (positivism) and Schorlemmer (dialectical materialism). The latter's biographer remarked that his book was 'really much more than a history of organic chemistry. It is a history of human thought isolated in concrete form in the example of the development of one science'.⁶¹ It might also be inferred that history of chemistry was considered to be an agent of humanism or atheism since Thorpe's *History of Chemistry* was 'issued for the Rationalist Press Association, Limited'.⁶² But there is the counter-example of the 'Heroes of Science' series, which included Pattison Muir's essay on chemists, which was issued by the Society for the Promotion of Christian Knowledge (who also published *Our Secret Friends and Foes* by the agnostic Percy Frankland⁶³). All that this seems to show is that history of chemistry was seen as a marketable commodity at a time when science was enjoying greater popularity than ever before.

There was, however, another form of didacticism that pervaded late Victorian thought and that is endemic in some (but by no means all) histories of chemistry at the turn of the century. This was the triumphalist belief in progress unlimited. In chemical historiography it is visible at an almost ludicrous level in *The Story of Chemistry*, by a young research worker in Sir William Ramsay's laboratory, Harold W. Picton. From mysticism chemistry has progressed from 'the childhood of truth' to 'the conflict with error' and thence to 'the triumph of truth' and the broad daylight of modern science.⁶³ Even Roscoe commended 'this little book' in a Preface. In the same spirit 'heroes of science' are paraded as in a Roman triumph, 'progress' is on everyone's lips and all is well with the chemical world. It is hard to avoid the impression that this is a particularly English phenomenon. If so, Herbert Spencer must bear some of the responsibility, but so also must Queen Victoria. Her Diamond Jubilee, coming so near the end of a century of unparalleled industrial and imperial progress, cried out for celebration and the chemists were not slow to respond. It was for that very reason that Roscoe launched his 'Century of Science' series that included his own life of Dalton, and biographies of other scientists including the chemists Liebig and Davy.⁶⁴

Not all of this plunged to Pictonian depths of Whiggishness but there is enough to provide a nucleus for the dotage myth referred to at the beginning. However, given a predisposition for Whig-hunting (if I may be allowed the term), modern historians can

60 H.E. Roscoe and C. Schorlemmer, *A Treatise on Chemistry*, vol. i, 'The non-metallic elements', 2nd edn, London, 1878, pp. 3–40.

61 Heinig, p. 56.

62 P.F. Frankland, *Our Secret Friends and Foes*, London, 1894.

63 H.W. Picton, *The Story of Chemistry*, London, 1889.

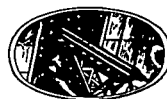
64 W.A. Shenstone, *Justus von Liebig: His Life and Work*; T.E. Thorpe, *Humphry Davy, Poet and Philosopher*, London, 1901 and 1896, respectively.



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Figure 8. Contents pages of Picton's *The Story of Chemistry*.

find plenty more evidence elsewhere if they so desire. Much of this 'evidence' I believe to be misunderstood and capable of an entirely different interpretation. Let me offer two examples. At one point in his *Familiar Letters* Liebig compares scientific and political progress, seeing both as a three-phase sequence. An apparent gift to the Whig-hunters this analogy turns out to imply not that we are living in the last days of all-conquering science, but simply that we must soon address ourselves to the third and most sophisticated method of analysis, the quantitative. After concentrating on *substance*, and then on *ideas* we call in *mathematics* which, 'with aid of numbers, completes the work'.⁶⁵ My second example is from Thomson, whose description of alchemy provides the title of this Address: 'rude and disgraceful beginnings'.⁶⁶ Yet repeatedly the term 'disgrace' is applied not to ignorance and credulity but to duplicity and deception. It is not intellectual but moral (or at least ethical) categories that are involved in his denunciations. Neither Liebig nor Thomson, nor for that matter many of their contemporaries and successors, held to an inexorability of chemical progress and neither can be accused of that modern heresy, Whig historiography.

65 Liebig, p. 54.

66 Thomson (1830), p. 2.

The one conviction shared by every one of the nineteenth-century historians of chemistry is that (like every other science) it has progressed. Its progress has sometimes been in an almost linear fashion, sometimes by fits and starts. That they wrote from the standpoint of their own day is no less true of them than it is of us. As some unlikely defenders of a (modified) Whig historiography have recently written there *is* sometimes a case to be made for writing about the past from the standpoint of the present. Only then can we communicate effectively to our scientific contemporaries, and only then can we demonstrate the continuity of ideas. 'Our purpose in doing so is not to demonstrate our superiority over our predecessors, but to learn from their mistakes and successes'.⁶⁷ And, of course, to condemn our predecessors as being more Whiggish, and thus less enlightened, than ourselves is to adopt the most Whiggish stance of all. It may be that some modern historians are doing unconsciously exactly what they imagine these chemist-historians were up to: highlighting the achievements of the present generation with its new professionalism at the expense of their forebears.

4.3 Pedagogic

One final application of the history of chemistry in the previous century remains to be mentioned. So far as can be ascertained every one of our chemist-historians felt passionately that history was part of chemistry, and that it was of value in communicating the rest of the science. In fact the nineteenth century witnessed two opposing tendencies on the part of the chemist-historians.

The older tendency, long predating 1800, was to treat modern and earlier chemistry as an integrated whole, much as Priestley had done in his *History and Present State of Electricity*⁶⁸ or his *History and Present State of Discoveries relating to Vision, Light and Colours*.⁶⁹ For chemistry, Boerhaave, Black and others had done the same.³ As Debus reminds us, when William Henry proposed to omit this standard feature from a new textbook in 1819⁷⁰ he felt it necessary to explain why. Thomas Thomson had no such scruples and made clear why the history was included:

The object of this work is to exhibit as complete a view as possible of the present state of chemistry; and to trace at the same time its gradual progress from its first rude dawnings as a science, to the improved state which it has now attained. By thus blending the history with the science, the facts will be more easily remembered, as well as better understood; and we shall at the same time pay that tribute of respect to which the illustrious improvers of it are justly entitled.⁷¹

In the century ahead others were made to emulate Thomson in this objective. At the same time the history of chemistry began to be administered to chemical students in a rather different way, as a separate course of lectures or in separate books (as Thomson's own *History of Chemistry*). This differentiation of the subject may reflect

67 J.D. Barrow and F.J. Tipler, *The Anthropic Cosmological Principle*, Oxford, 1986, pp. 10–11.

68 J. Priestley, *The History and Present State of Electricity*, London, 1767.

69 J. Priestley, *The History and Present State of Discoveries relating to Vision, Light and Colours*, London, 1772.

70 W. Henry, *The Elements of Experimental Chemistry*, Philadelphia, 1819, vol. i, p. ix.

71 T. Thomson (1820), vol. i, pp. 9–10.

the growing interest in history generally and a wish to give it a more prominent role still in scientific education. Thus we find Kopp adding the subject to his list of lecture courses at Giessen in about 1841,⁷² and Ladenburg making it the topic of his first course of lectures at Heidelberg in about 1868.⁷³ By 1904 E. von Meyer could write of 'frequent courses of lectures on the history of chemistry' then being delivered in German colleges and universities.⁷⁴ Six years later a course on the history of organic chemistry was given by Norman Collie to research students in that subject at University College, London. And, as we have seen, many of these courses were eventually transformed into books.

Meanwhile that other tradition of an integrated historico-chemical approach showed unmistakable signs of withering, though it continued in an attenuated form until World War II. The famous textbook of Frankland and Japp,⁴⁰ though setting a trend by formally installing 'history' as a desirable category of knowledge about each individual substance, seems to have accelerated the dehistoricisation of chemistry. By screening off the history, so to speak, their treatment effectively questioned its relevance. By greatly compressing it they reduced its interest and appeal. And by failing to relate one discovery to any other they evacuated it of any real significance. It is interesting to recall that their index does not include any historical names except the very few who are noticed in connection with the development of theory. Thus Dalton and Mendeléeef may be located, but not Priestley, Cavendish or Davy. Many years later this very approach, with its 'snippets' of history, was to receive severe treatment in the context of school teaching.⁷⁵

The demise of chemical history in chemistry textbooks doubtless owed much to two other considerations. One was the rapidly increasing volume of chemical facts and theories to be absorbed at every academic level. The other was the growth of faculty psychology and the attendant rise of heurism, when chemistry by discovery in the here and now was so much more to be desired than gaining second-hand knowledge about other people's discoveries in the remote past.⁷⁶ It is only in our own day that the value of the integrated historico-chemical approach urged so long ago by Thomson is re-appearing as a viable possibility in certain educational situations. It is not hard to speculate on the reasons. In his day, as in ours, science was far less popular than it was to become in late Victorian Britain; both early Romantic and latter-day environmentalist lobbies have rebelled against the soullessness of a dehumanized science; and a separation of science from its history was not demanded (as then) by an explosive growth of science or (as now) by a professionalization of its history. For all these reasons, and doubtless for others, the opportunities for integrating historical insights and material within a scientific curriculum are greater today than for many years past. To take the case of physics, it has been possible for a recent writer to assert that 'we now have enough concrete evidence showing that the historical approach does have

72 T.E. Thorpe (1901), p. 778.

73 F.S. Kipping, Ladenburg Memorial Lecture, *J. Chem. Soc.* (1913), 103, 1871–1895 (1874).

74 E. von Meyer (1906), p. xiv [dated October, 1904].

75 E.W. Jenkins, *From Armstrong to Nuffield*, London, 1979, p. 70.

76 W.H. Brock (ed.), *H.E. Armstrong and the Teaching of Science 1880–1930*, Cambridge, 1973.



Figure 9. At the British Association Meeting, Manchester, 1887: back row (l. to r.): J.A. Wislicenus, G. Quincke, H.E. Schunck, C. Schorlemmer, J.P. Joule; front row (l. to r.): L. Meyer, D.I. Mendeléev, H.E. Roscoe.

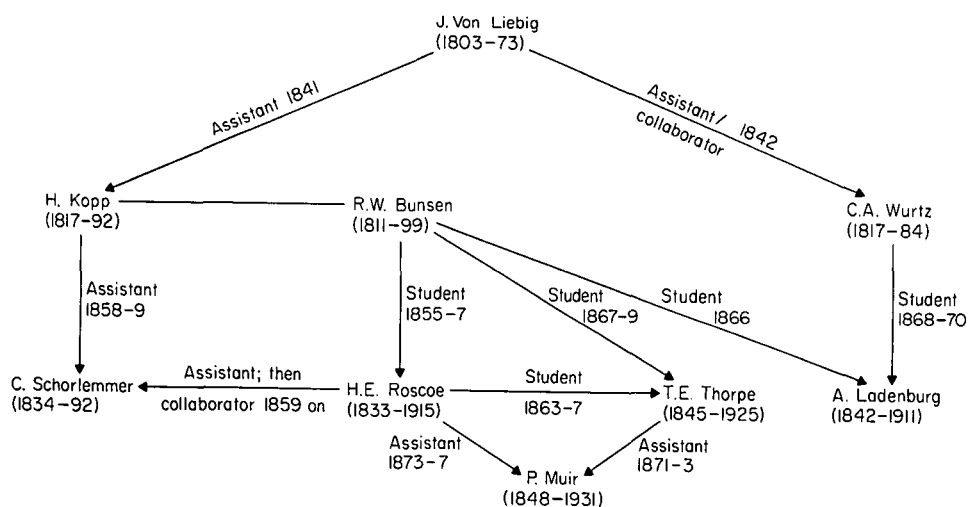


Figure 10. History of Chemistry Networks.

an impact on students, without interfering with their learning of the technical content of science'.⁷⁷ And if the opportunities are immense then the resources are greater than ever before. Let me therefore comment finally on one other aspect of the work of the nineteenth century chemist-historians.

Hardly any of the major figures in nineteenth century chemical historiography worked in isolation from others sympathetic to his enterprise. There was a network of communication in nineteenth century science about which we still have much to learn. But it is certain that it included the chemist-historians. A few of the more obvious links are sketched in Fig. 10. One example must suffice, Henry Roscoe. He had been, like Kopp, a pupil of Bunsen; his assistant Schorlemmer (a former pupil of Kopp) became his colleague and co-author; one of his pupils was Thorpe, under whom Pattison Muir had worked before studying under Roscoe. And Thorpe himself had encountered Kopp at Heidelberg and was to write his Memorial Lecture.

Among the immense resources available to us today is the modern history of science network, of which this Society is just one constituent. In an era of unparalleled opportunity it is our responsibility and privilege to serve the community of science at least as well as did the chemist-historians of the nineteenth century.

77 S.G. Brush, 'History of science and science education', *Scientific Literacy Papers* (1987), 1, 75–85 (82).