Christoph Meinel

Demarcation Debates Lavoisier in Germany

During the 1860's, German universities experienced the advent of a new generation of »palace laboratories,« workshops designed for the mass production of chemical knowledge on a scale never before seen. These laboratories testified to the transformation of the universities into centres of experimental research, and impressively underlined Germany's claim to leadership in the world of science., Berlin's Chemical Laboratory, in particular, marked the culmination of representation and functionality. Designed for August Wilhelm Hofmann upon his return from London, the huge building, close to the very centre of Prussian power, was one of the first of its kind to incorporate a rich sculptural programme dedicated to the history of science: a series of busts and portraits linking the lustre of tradition to chemistry's claims to modernity.[1] The distinguished personalities to be included in this gallery were chosen by a committee formed by the members of the physico-mathematical class of the Royal Prussian Academy of Sciences. On March 1st, 1866, the committee decided to decorate the entrance hall with life-sized busts of those unanimously held to be the most prominent living chemists of their time, namely Michael Faraday, Justus von Liebig and Friedrich Wöhler. More controversial was the choice of deceased chemists, whose portraits were to be placed in the 14 angles of the window arches alongside the front of the building. Eventually, and »not ... without a lengthy and animated discussion,«[2] a list was drawn up, led by Antoine Laurent Lavoisier and followed by three of his rivals for the discovery of oxygen: Karl Wilhelm Scheele, Henry Cavendish, and Joseph Priestley. Furthermore, the list also included John Dalton, Humphry Davy, Claude Louis Berthollet, Joseph Louis Gay-Lussac, Martin Heinrich Klaproth, Jöns Jacob

1 August Wilhelm Hofmann, *The Chemical Laboratories in Course of Erection in the Universities of Bonn and Berlin* (London: Clowes, 1866); see also Christoph Meinel, »Chemische Laboratorien: Funktion und Disposition,« *Berichte zur Wissenschaftsgeschichte*, 2000, 23:287–302.

2 Hofmann, *Laboratories*, p. 71.

aus: *Lavoisier in Perspective*, ed. by Marco Beretta (München: Deutsches Museum, 2005), S. 153-166

Berzelius, Eilhard Mitscherlich, Heinrich Rose, Leopold Gmelin and, finally, Charles Gerhardt and Auguste Laurent jointly arranged in the same medallion.[3]

The messages of this »ornamentation which cannot fail to produce effect upon the scientific spectator«[4] were threefold. Firstly, they drew a symbolic demarcation line between present-day chemistry and its history. The heroes of the past faced the road linking Berlin's *Friedrich-Wilhelms-Universität* and the Academy of Sciences, thus looking down at both the general and academic public passing by, whilst the chosen triumvirate of living chemists inside the building cheered at those now initiated. Secondly, the erection of life-sized busts of scientists still alive revealed a surprising degree of pride and self-consciousness amongst the chemical community. Thirdly, the arrangement of busts and medallions presented chemistry as an international, collective endeavour with a noble, though relatively short, history, with Lavoiser as its point of departure. This version of history, however, had been constructed with the inclusion of some names, and the omission of others. From Hofmann's report we learn of conflicting opinions behind the scenes, as a result of which Georg Ernst Stahl, the founder of the phlogiston theory, had been explicitly excluded from the list of candidates.

The aim of this paper is to investigate the way Lavoisier was used by German chemists and chemist-historians alike in defining the boundaries of their discipline during the nineteenth and early twentieth centuries. It is a paper on the uses of disciplinary history and on how the past is used for the aims of the present.

Disciplinary historiography as a genre emerged around 1800. At that time, the encyclopaedic notion of learning gave way to the formation of the modern system of scientific disciplines. This process was driven and maintained by the combined forces of specialisation, institutionalisation, and professionalisation. In this context, demarcation became a vital problem for the emerging scientific communities, and history proved to be a most useful tool in that regard. Master narratives, written by scientists for their students and colleagues, provided the emerging discipline with some kind of identity during a period of profound change. History bridged the widening gap between the humanities and the scientists' ahistorical mind, and dignified their past with a record of lasting achievements. For individual scientists, it linked their careers to the idea of progress, and provided a network of scientific ancestry in which one could find one's place as in a family-tree.

By examining how the figure of Lavoisier was positioned in these various reference systems, we shall see that historical truth was not the primary aim. More important issues were the identity of chemistry as a discipline and its rank within the academic hierarchy. For this purpose, Lavoisier's name was used as a boundary post to define chemical territory according to national, methodological, or moral divides.

3 A similar series of medallions was placed in the vestibule of Bonn's Chemical Institute in 1868; see Gisbert Knopp, »Das Gebäude des alten Chemischen Instituts der Universität Bonn,« *Jahrbuch der Rheinischen Denkmalpflege*, 1989, 33:193–224.

4 *Ibid*., p. 70.

Ancestry and modernity

This situation was already the case for the German reception of the new antiphlogistic chemistry during the late 1780s and early 1790s.[5] The traditional account of this debate as a conflict between nationalistic partisans of Stahl's phlogiston and the neutral defenders of Lavoisier's oxygen theory is but one side of the story. National rhetoric was applied whenever the political circumstances favoured its use, and as a consequence the new theory was often referred to as »French chemistry«, almost never as »Lavoisian chemistry«. By naming it »French« one could use the national stereotypes of an alleged French predilection for elegance and wordiness (as opposed to German plainness and simplicity) and for abstract theorising (as opposed to German empirical soundness). Arguments of this type conditioned the way the German chemical community responded to Lavoisier's new system, but they rarely went beyond mere clichés. More important reasons for rejecting the claims of the oxygen theory and the new nomenclature were loyalties to professional traditions, and those practices not adequately tackled by Lavoisier: for instance, in pharmacy, the chemistry of minerals and salts, and in affinity theory. As a consequence, the first German converts to Lavoisier's system were those who were the least bound to any of these traditions, and those who lived in more cosmopolitan centres, being therefore less susceptible to cultural nationalism. The decisive debate, however, on the reliability of Lavoisier's account of the reduction of mercury calx was centred about methodological, rather than cultural, issues: viz. the reproducibility and matter-of-factness of an experiment.

If we examine textbooks and journal articles of the time, Lavoisier, as a historical figure, doesn't seem to have been particularly well known. Thomas Kuhn's observation that scientific revolutions become invisible once the textbooks have been re-written, seems to be true for the revolutionaries as well. Following a tradition established by Carl Wilhelm Juch's *System der antiphlogistischen Chemie* (Nuremberg: Stein, 1803), the first German textbook of general chemistry to entirely adopt the new doctrine, Lavoisier's name was referred to primarily as a mere abbreviation for the turning point from pre-modern to »modern« or »scientific« (*wissenschaftliche*) chemistry. Other textbook authors divided the more recent history of their discipline into three subsequent periods: a speculative one (synonymous with phlogistic chemistry), an experimental one (concerned with the anomalies in the earlier system), and a quantitative or scientific one. It was also common practice to name each period after a key figure. Thus the »era of Stahl« was followed by the »era of Lavoisier«, etc.[6]

5 Karl Hufbauer, *The Formation of the German Chemical Community*, 1720–1795 (Berkeley: University of California Press, 1982); see also Alfred Nordmann's paper in the present volume.

6 E.g. Johann Andreas Buchner, *Grundriß der Chemie*, 3 vols (Nuremberg: Schrag, 1826–1836); for the textbook tradition see Bettina Haupt, *Deutschsprachige Chemielehrbücher, 1775–1850* (Stuttgart: Deutscher Apotheker-Verlag, 1987).

Most textbook authors, however, adopted the model of Jöns Jacob Berzelius, who, in his influential *Lehrbuch der Chemie* (Dresden: Arnold, 1825–1831), frankly declared that »the history of a science is not an essential part of that science.«[7] As a consequence, many chemistry textbooks of the first half of the nineteenth century renounced history altogether and presented their subject in a purely systematic or factual manner.

We must therefore turn to the contemporary history of chemistry books to get a more detailed picture. Historical narratives in the sciences seem to have been particularly successful in Germany, although the historical approach was a general trend of the time. Yet, within the country's competitive university system still dominated by humanistic values, the pressures towards discipline formation resulted in a greater demand for bridging the gap between the narrowing specialities, and an idea of *Wissenschaft* still dominated by historical and philological scholarship.

The first general history of chemistry ever published was Johann Friedrich Gmelin's three-volume *Geschichte der Chemie* (Göttingen: Rosenbusch, 1797–1799). Part of a series of 57 volumes on the history of the arts and sciences spanning from the Renaissance through to the eighteenth century, Gmelin's work is a late manifesto in Enlightenment thought, a monument to the accumulation of positive knowledge. Devoted to the factual, the useful and the idea of progress, Gmelin's focus is on substances and procedures. Cultural, biographical and theoretical aspects are reduced to a minimum. Quite a substantial proportion of the three volumes, viz. more than 40% (1040 pages), were devoted to the »Era of Lavoisier.« However, the role of the patron-saint of modern chemistry remained largely invisible in Gmelin's treatment. The personality of the French scientist is presented in a brief and conventional eulogy that makes Lavoisier's moral qualities the source for his breakthrough in science, but his achievements in chemistry are broken up into bits and pieces of factual information hidden in a jungle of footnotes and references.

Johann Bartholomäus Trommsdorff's *Versuch einer allgemeinen Geschichte der Chemie* (Erfurt: Hennings, 1806) follows an alternative path. Written for chemists and apothecaries, the work was explicitly aimed at improving the intellectual and social status of these emerging professions by linking their past to the history of civilisation (*Kulturgeschichte*) in general, and to the evolution of philosophical thought in particular.

Consequently, Trommsdorff's primary interest was in chemical theory as part of a more general view of the physical world, and for that very reason his historical account culminated in the work of Lavoisier, who is presented as the first scientist to achieve an at least partial re-integration of chemistry with physics. To reduce Lavoisier's merits to the mere refutation of the phlogiston theory, as was cus-

7 Jöns Jacob Berzelius, *Lehrbuch der Chemie*, transl. by Friedrich Wöhler (Dresden: Arnold, 1825), vol. I, p. XII.

tomary at the time, was completely unacceptable to Trommsdorff. Instead, he stressed the importance of methodology, the general system, language and terminology, and devoted some space to the notion of *calorique* as a genuinely Lavoisian boundary concept between chemistry and physics. From this point of view, the all-encompassing philosophies of nature proposed by Immanuel Kant and Friedrich Wilhelm Schelling – if properly combined with empirical laboratory research – were seen as a legitimate continuation of what Lavoisier was unable to complete during his lifetime.

Thus, the beginning of chemical historiography is marked by two competing models: Gmelin's conviction that, in terms of facts and procedures, chemistry had already reached such a degree of autonomy that it could easily do without reference to other sciences; and Trommsdorff's eagerness to raise the prestige of chemistry with reference to the more general methodologies of physics and natural philosophy. In both cases, the emphasis was on the status of chemistry as a science, and not so much on the work of Lavoisier.

Hermann Kopp's four-volume *Geschichte der Chemie* (Braunschweig: Vieweg, 1843–1847), the standard treatment of the subject over generations, combined the respective advantages of both these approaches by having first a chronologically arranged volume, then three additional volumes devoted to the mere factual side of chemistry, arranged according to techniques and substances. Throughout the first volume, the development of theory is the guiding principle, and periodisation is achieved by means of the respective aims of the chemistry. According to this criterion, Lavoisier marks the beginning of »the era of quantitative research.« Still writing under the impression of French superiority in matters of science, Kopp presents Lavoisier in a remarkably balanced way and discusses the entirety of his chemical, industrial, physical and physiological researches, placed in the context of his public and political career. He further highlights his precision, experimental skill, logical reasoning, inventiveness and intuition in the use of instruments, these being the primary ingredients of Kopp's portrait. Referring to Lavoisier's occasional failing in adequately quoting his sources and predecessors, Kopp stood up for his French hero by pointing to the difference between an isolated discovery and the creation of a new system, to the difference between the first roots of an idea and its final working out into a theory. »No chemist,« Kopp concluded in his chapter on Lavoisier, »has ever added so much to the accumulated knowledge of the past, no one has ever fertilised a science, given to him by his predecessors, with such a refined and extended methodology.«[8]

This clearly went beyond the widespread use of Lavoisier as a mere boundary post to demarcate chemistry from its pre- or non-scientific predecessors. Based upon a thorough study of the primary sources, Kopp was as much a good historian and philologist as he was a good chemist, and his arguments in favour of Lavoisier's eminence were supported by careful reasoning about the nature of sci-

8 Hermann Kopp, *Geschichte der Chemie* (Braunschweig: Vieweg, 1843), vol. I, p. 313.

entific theories and about what counts as a discovery. However, Kopp was the last major German historian of the nineteenth century to unreservedly date the beginning of modern chemistry from Lavoisier.

Competing approaches

In the meantime, things had changed for science in Europe. After the Napoleonic period had come to an end, France was beginning to lose its former superiority in scientific matters. Her centralised system of higher education, once so efficient in breeding excellence, increasingly proved to be an impediment to further innovation. The formation of scientific disciplines and the establishment of research laboratories, for instance, was much more powerfully stimulated within the German universities. Their insistence on research, competitiveness and the unity of research and teaching, were instrumental in institutionalising laboratory science. Simultaneously, national scientific communities began to emerge as the new actors on the stage of European science. At the same time, the interest in chemistry shifted from mineral and inorganic to organic chemistry, and from the notion of elements and elementary composition to the notion of atoms and molecules. As a consequence of these shifts in focus and subject matter, the figure of Lavoisier lost its former position as a founding father – at least amongst German chemists.

Justus Liebig, a key figure in the transformation and re-orientation of German (and British) chemistry, exemplifies this shift of attention in a somewhat extreme form. His *Chemische Briefe* of 1844, the international chemical best-seller of the century, gives little credit to the French impact on modern chemistry, despite the fact that Liebig himself had received much of his formative initiation to chemical science in the laboratories of Joseph-Louis Gay-Lussac and Louis Jacques Thenard in Paris. In the first edition of the *Chemische Briefe*, history is confined to a brief sketch in the first letter. In it, Henry Cavendish and Joseph Priestley are the only authorities mentioned with regard to the origins of chemistry – it is as if Lavoisier's name had never occurred to Liebig: »Like a seed from a ripe fruit, so did chemistry split from physics as an autonomous science sixty years previously; its new calendar began with Cavendish and Priestley.«[9] For the third German edition, a few more letters on historical subjects were added, largely based on Kopp's account. Here, finally, Lavoisier's name re-appears, but on an equal footing with Cavendish, Watt and Black.[10] This strange absence of Lavoisier in Liebig's treatment might even explain the curious fact that the publisher of the sixth and last German edition of 1878 may have felt obliged to add Lavoisier's name to the abstract of the

9 Justus Liebig, *Chemische Briefe* (Heidelberg: Winter, 1844), p. 6.
10 Justus Liebig, *Chemische Briefe*, 3rd ed. (Heidelberg: Winter, 1851), third letter.

first letter, although in the referred text the French chemist is not mentioned at all.[11]

Nationalist prejudices were clearly alien to Liebig. Thus, the explanation for the shift of attention must be looked for elsewhere. Liebig's fierce competition with the school of Dumas may be part of the answer, for Jean-Baptiste Dumas' *Leçons sur la philosophie chimique* (Paris: Ébrard, 1837) was to become the most influential source for the mythical deification of Lavoisier in France.[12] Consequently, Liebig's omission of Lavoisier would make a fool of Dumas. But there were other reasons as well. Above all, the key problems tackled in chemistry at the time could no longer be subsumed under a Lavoisian framework. Neither atomism nor the various theories of valency, isomerism or the idea of molecular structure were rooted in the heritage that stemmed from Lavoisier's work. Furthermore, one of Lavoisier's primary achievements, the re-integration of chemistry into physics, so highly valued by Trommsdorff in the first decade of the nineteenth century, was now seen as being of ambiguous merit, for ever since then chemistry had been much more successful than physics in terms of discipline formation and public support. Status has always mattered in academia, and it would have been unwise therefore to choose a less powerful field as the point of reference.

In addition, the target of demarcation debates in science had changed since the 1830s. Instead of distinguishing scientific chemistry from its eighteenth-century precursors; a more important task was to separate it from the methods and notions favoured by the *Naturphilosophie* of German Romanticism. To draw a clear line between experimental science and the adepts of Friedrich Wilhelm Schelling, it may have been wiser to date the origin of modern chemistry from some time after the Romantic movement.

Theoretically-minded chemistry textbooks of the second half of the nineteenth century chose John Dalton and Amedeo Avogadro as their point of departure if they shared the atomist concept of matter, as did Lothar Meyer's *Die modernen Theorien der Chemie* (Breslau: Maruschke & Berendt, 1872); otherwise, they preferred Jean-Baptiste Dumas, Auguste Laurent and Charles Gerhardt to be the true founding-fathers of chemistry if they wished to adhere to the unitarian, anti-atomist camp, as in Albrecht Rau's *Die Theorien der modernen Chemie* (Braunschweig: Vieweg, 1879). Alfred Ladenburg's *Vorträge über die Entwicklungsgeschichte der Chemie von Lavoisier bis zur Gegenwart* (Heidelberg: Winter, 1869) is a historical survey that combines both approaches: his account, however, only pays lip-service

11 Justus von Liebig, *Chemische Briefe*, ed. Georg von Liebig (Heidelberg: Winter, 1878; reprint Darmstadt: Wissenschaftliche Buchgesellschaft, 1967), p. XVII.

12 Bernadette Bensaude-Vincent, »A founder myth in the history of sciences? The Lavoisier case,« in: Loren Graham, Wolf Lepenies, Peter Weingart, eds., *Functions and Uses of Disciplinary Histories*, vol. 7 of *Sociology of the Sciences* (Dordrecht: Reidel, 1983), , 53–78; Bernadette Bensaude-Vincent, »Une mythologie révolutionnaire dans la chimie française,« Annals of Science 1983, 40:189–196; Bernadette Bensaude-Vincent, *Lavoisier: mémoires d'une révolution* (Paris: Flammarion, 1993), pp. 363–417.

to Lavoisier as the creator of modern chemistry, and the few pages devoted to his work have little weight compared to the much more detailed treatment of nineteenth-century atomism, electrochemistry, valence and type theories.

National claims

So far, except for the brief outburst of nationalism at the time when Lavoisier's chemistry, revolutionary ideas and French troops almost simultaneously spread throughout Europe, chemical genealogies had been remarkably European. During the late 1860s, however, this pattern began to change. The formation of national chemical communities and organisations, the emergence of the nation-state and increasing competition on the European market set a new tune. Chemistry, still the most successful of all sciences in terms of institutionalisation and commercial success, was often seen as a measure of a nation's claim to power. In that regard, the rise of the German university system in general, and the success of German chemistry in particular, was seen as a challenge to other nations. At the occasion of a report on the German research laboratories delivered to the French minister of education in 1868, Adolphe Wurtz warned, »Il s'agit là d'un intérêt de première ordre, de l'avenir de la chimie en France. Cette science est française, et Dieu ne plaise que notre pays s'y laisse devancer.«[13]

Many reform initiatives in late nineteenth-century French chemistry, as well as their shortcomings, can indeed be seen as reactions to what was happening on the other side of the Rhine.[14] This is the historical context for the notorious opening sentence of Adolphe Wurtz's Dictionnaire de chimie pure et appliquée (Paris: Hachette, 1868): »La chimie est une science française: elle fut constituée par Lavoisier, d'immortelle mémoire.«[15]

On the eve of the Franco-Prussian War, hardly another phrase could have caused a similar uproar among the chemists of Europe, and, once ignited, the fire was impossible to extinguish. Following a brief controversy in the *Bulletin de la Société Chimique de Paris*,[16] Jacob Volhard published a long historical article in

13 Adolphe Wurtz, 8 April 1868, quoted in Harry W. Paul, *The Sorcerer's Apprentice: The French Scientist's Image of German Science, 1840–1919* (Gainesville: University of Florida Press, 1972), p. 8.

14 Ulrike Fell, *Disziplin, Profession und Nation: Die Ideologie der Chemie in Frankreich vom Zweiten Kaiserreich bis in die Zwischenkriegszeit* (Leipzig: Leipziger Universitätsverlag, 2000).

15 Wurtz's historical introduction was soon printed as a monograph: *Histoire des doctrines chimiques depuis Lavoisier jusqu'à nos jours* (Paris: Hachette, 1868). In the preface to the German edition of Adolphe Wurtz, *Geschichte der Chemischen Theorien seit Lavoisier bis auf unsere Zeit* (Berlin: Oppenheim, 1870), the translator Alphons Oppenheim summarises the controversy, supports Wurtz's view by referring to British authorities and modifies the introductory opening phrase to: »Die Chemie, als Wissenschaft, ist durch die unsterblichen Arbeiten Lavoisier's begründet worden.« See also Alan J. Rocke, »History and science, history of science: Adolphe Wurtz and the renovation of the academic profession in France,« *Ambix*, 1994, 41:20–32.

16 Rudolf Fittig, »Adolphe Wurtz,« *Bulletin de la Société Chimique de Paris*, 1869, 1:276–277.

order to prove that Lavoisier was no chemist at all, and his friend Hermann Kolbe took sides with a pamphlet on the backwardness of chemistry in France.[17] The answer came in the form of a declaration of protest signed by the Russian Chemical Society and published in a St. Petersburg newspaper.[18] Simultaneously, the Society decided to ban the use of German, which had been its usual language for publications up to then, and switched to Russian instead. The war between France and the German states that had begun in July, 1870 was fought not on the battlefield alone, but deeply restructured the entirety of scientific communication in Europe.[19]

As soon as the war was over, Hermann Kopp made a first attempt at settling the controversy by presenting the question of the origins of chemistry and Lavoisier's role in it a more balanced way. In his *Die Entwickelung der Chemie in der neueren Zeit* (München: Oldenbourg, 1873) Kopp conceded to Lavoisier the claim to be the founder of scientific chemistry – provided a clearly defined notion of »science« (*Wissenschaft*) was applied, and provided also that the notion of »founder« was not meant as a creation *ex nihilo*. After all, Kopp was one of the very few chemist-historians of the time intimately familiar with the recent advances in historical methodology. Only one concession was made to the critics of the French foundermyth: in Kopp's interpretation Lavoisier's scholarly etiquette was much less rigid than his research methodology; but achievement in positive science should not be judged on the basis of moral conduct.

Kopp's attempt at a reconciliation was essentially a voice crying out in the wilderness. Soon, none other than Wilhelm Ostwald took the debate back to where it had been a generation before. Ostwald's *Leitlinien der Chemie* (Leipzig: Akademische Verlagsgesellschaft, 1906) portrays Lavoisier as someone whose impact had greatly been exaggerated by chemists and historians alike. According to Ostwald, the core of Lavoisier's reform, the new theory of combustion, had been pre-existent in the phlogiston theory, and all Lavoisier had to do was to turn the latter upside down. If there were any legitimate claim for Lavoisier as creator of a new discipline, it would not be chemistry, but »energetics« – Ostwald's own vision of a new science based on the notion of energy and encompassing almost everything from physics to sociology.[20] Thus, in a clever reassessment of fatherhood,

17 Jakob Volhard, »Die Begründung der Chemie durch Lavoisier,« *Journal für praktische Chemie*, new series, 1870, 2:1–47; Hermann Kolbe, »Über den Zustand der Chemie in Frankreich,« *Journal für praktische Chemie*, new series, 1870, 2:173–183. The title of Kolbe's article refers to Liebig's seminal pamphlet of 1840 on the state of chemistry in Prussia.

18 *St. Petersburger Zeitung*, 1870, No. 271. The declaration is dated 22 Sept. / 4 October 1870 and was signed by N. Zinin, A. Butlerow, D. Mendeleew and A. Engelhardt; see Christoph Meinel, »Nationalismus und Internationalismus in der Chemie des 19. Jahrhunderts,« in *Perspektiven der Pharmaziegeschichte. Festschrift für Rudolf Schmitz*, ed. Peter Dilg (Graz: Akademische Druck- und Verlagsanstalt, 1983), 225–242.

19 Christoph Meinel, »Structural Changes in International Scientific Communication: The Case of Chemistry,« in *Atti del V Convegno Nazionale di Storia e Fondamenti della Chimica*, ed. Gianlorenzo Marino, *Rendinconti della Accademia Nazionale delle Scienze detta dei XL*, ser. 5, vol. 17, part 2/2 (Roma: 1993), 47–61.

20 Wilhelm Ostwald, *Leitlinien der Chemie* (Leipzig: Akademische Verlagsgesellschaft, 1906), pp.

Ostwald transferred the prestige connected with Lavoisier's name from chemistry to energetics, which he considered the most fundamental of all sciences, whilst at the same time, he implicitly used the French predecessor to enhance his own prestige – a giant on the shoulders of another giant.

Needless to say, the readers on the other side of the Rhine were upset when the French translation of Ostwald's *Leitlinien* appeared in print on the eve of World War I.[21] Pierre Duhem, a respected physicist and historian of science, countered it in a pamphlet entitled *La chimie est-elle une science française?* (Paris: Hermann, 1916). There, Duhem admitted that Lavoisier's revolution did have its roots in the achievements of his predecessors, but that it nevertheless was a real revolution. And he went on to argue that no German claim to achievement in chemistry was supported by historical evidence; even at present only a single German, August Wilhelm Hofmann, could be said to be of any significance in that science; and as far as the past was concerned, even the phlogiston theory was not of German origin but was rather the work of Guillaume-François Rouelle and Pierre Joseph Macquer. These two Frenchmen, Duhem claimed, rescued Stahl's confused ideas, hidden under a mishmash of obscure, useless and erroneous information, in order to reduce them to the simplicity and clarity of the French *esprit géométrique*.[22]

Thus, in the late nineteenth century the image of Lavoisier was used in a new way. It was no longer required to divide modern chemistry from its predecessors, because the methodological standards of this science had long been universally accepted and both the status and success of the discipline were beyond any doubt. Now Lavoisier's name was used to demarcate French chemistry from German chemistry, and since this was difficult to do on scientific grounds alone, moral issues were raised and national characters created out of the worn-out stereotypes by which selfness and otherness had been constructed in Europe for centuries. The notorious *Aufruf an die Kulturwelt* of 1914, signed by 93 German scientists and intellectuals in defence of their country's declaration of war, was but a continuation of that same debate.[23]

21–22.

21 Wilhelm Ostwald, *L'Évolution d'une science: la chimie* (Paris: Flammarion, 1909); subsequent editions came out in 1910, 1911, and 1914.

22 Pierre Duhem, *La chimie est-elle une science française?* (Paris: Hermann, 1916); see also Pierre Duhem, *German Science: Some Reflections on German Science: German Science and German Virtues* (La Salle/Illinois: Open Court, 1991).

23 Andreas Kleinert, »Von der Science allemande zur Deutschen Physik: Nationalismus und moderne Naturwissenschaft in Frankreich und Deutschland zwischen 1914 und 1940,« *Francia*, 1978, 6:509–525.

Chemistry vs. physics

In the meantime, the chemical pros and cons in the Lavoisier case had taken a more subtle course. Ernst von Meyer's *Geschichte der Chemie* (Leipzig: Veit, 1888), for instance, maintains the French scientist as the watershed between the older and the modern history of chemistry, but by way of compensation for this concession, the work reinforced two recent trends in German chemical historiography: a positive re-assessment of the importance of iatrochemistry and of Paracelsus in particular, combined with a virtual rehabilitation of the phlogiston theory. According to this view, chemists such as Stahl, Markgraf, Rouelle, Macquer, Black, Cavendish, Priestley, Scheele and Bergman gave chemistry its first (though limited) theory and methodology. More importantly, these chemists created the modern research programme with chemical analysis as the primary aim. Therefore, chemistry was a true science and could boast of eminent researchers long before Lavoisier. The latter's contribution was a mere refutation of erroneous prejudices, combined with the masterly application of scientific principles to subsume chemical processes under a unified theory. The facts, however, had been already established by the phlogistic school, and Lavoisier himself had little to add in terms of new chemical observations. For Meyer, as for Volhard a generation earlier – both of them close allies of Kolbe – Lavoisier was basically a physicist with little interest in what really mattered in chemistry: viz. the properties of substances.[24]

Meyer's re-assessment of Lavoisier was not intended to diminish his scientific achievements. The key argument was to assume an intrinsic difference between physics and chemistry, the former being about mass, forces and measurement, whereas the latter was defined as the science of the properties and reactions of material bodies. Again, demarcation was the issue at stake, but in this case not demarcation from foreign traditions, but the divide between chemistry and physics with regard to their respective subject matter. But why had such a distinction become necessary? Didn't the recent history of chemistry provide the ultimate example of a success story? And wasn't German chemistry in particular at the peak of its power and public esteem, as so impressively demonstrated by the success of the German dyestuffs industry?

Towards the end of the nineteenth century, there were signs of a widespread feeling that chemistry was about to loose its former position. Scientific and economic success had not necessarily led to public esteem and political influence. In the universities, the careers in experimental and theoretical physics attracted much wider attention. So far as the scientific basis of chemistry was concerned, the atomic debates, a number of anomalies triggered by the periodic system, and the discovery of radioactivity weakened its very foundations and key notions for decades.

24 Ernst von Meyer, *Geschichte der Chemie von den ältesten Zeiten bis zur Gegenwart*, 3rd ed. (Leipzig: Veit, 1906), 139–154.

With Roentgen's discovery of the x-rays in 1895, public attention definitively shifted to physics, and the spectacular rise of atomic and quantum physics strengthened this trend through most of the twentieth century. The question of reductionism – i.e. whether or not it is possible to reduce chemistry, and ultimately all sciences, to one of the two alternative physical world views: mechanics or thermodynamics – was clearly more than a mere philosophical issue: it equally mattered for the question of which science could properly claim to be the most fundamental one – and hence the one to receive the biggest share in terms of public support.

Based on Ernst von Meyer's distinction between physics as the science of masses, forces and measurement, and of chemistry as the science of materials and their properties, a new line of argument was proposed. In accordance with the prevailing pragmatism of the time, the practical, empirical and quality-oriented aspects of chemistry were given priority over theoretical and mathematical approaches. A good chemist was thus seen as someone who almost intuitively knew the substances by their behaviour and properties. Whilst the physicists knew by measuring and calculating, chemists knew by touching, smelling and seeing. It was substance and process that mattered in chemistry. As a consequence, the discovery of a new element, the synthesis of a new compound, the working out of a new type of reaction, was more highly valued within the chemical reward system than the formulation of a new theory. For theories come and go: the facts, however, i.e. the substances, remain.

In that regard, Lavoisier had little to hope for. His failure to undisputedly discover any new substance was added to the features of his public image. No salt, no organic compound bears his name. How much more durable seemed scientific fame if one's name was linked to it by posterity as in, let say, Glauber's salt or the Fehling reaction!

> No new body, no new phenomenon of nature was discovered by Lavoisier, and the processes established by him were but the necessary consequences of work preceding his own. His immortal achievement was to give a new meaning to the body of science, the members of which already existed.[25]

It was easy for twentieth-century chemists to ridicule Lavoisier's oxygen theory of acidity or his view on the elementary nature of *calorique*, and to criticise premature generalisations based on the antiphlogistic system. As far as the progress of chemistry was concerned, Lavoisier could thus be reduced to a missing link, a *Zwischenglied*, between the achievements of his predecessors and his great followers. This is how Lavoisier was presented in Paul Walden's *Drei Jahrtausende Chemie* (Berlin: Limpert, 1944).[26]

25 Paul Walden, *Drei Jahrtausende Chemie* (Berlin: Limpert, 1944), p. 159.
26 Walden, *Drei Jahrtausende*, pp. 150–159.

Völkische demarcations

Walden's book stands as a culmination of another, even more alarming development. In 1935, the author, a former pupil of Ostwald's and a new member of the ruling National Socialist Party, had published an article entitled »National pathways of modern chemistry.«[27] In it, Walden asked for specifically Germanic approaches to chemical research, as expected on the basis of race and environment. Humility towards nature, simplicity in describing her, profound experimentation, restraint from speculation and attachment to one's ethnic group (*Volksgemeinschaft*) were the alleged features of the Germanic chemist. As a consequence, the genealogy of chemistry had to be re-written and new heroes of the past had to enter onto the stage: Joachim Jungius, Johann Joachim Becher, Johan Baptista van Helmont and, above all, Paracelsus and Daniel Sennert stood for a morphologic and holistic, rather than mechanical and analytic, approach to the realm of materials and substances.

Borrowing from Goethe's morphology and modern Gestalt psychology, Rembert Ramsauer, Carl Lothar Wolf and Conrad Weygand proposed, in the 1940s, the chimera of a *»Deutsche Chemie«* as a holistic, intuitive (*gestalthaft schauende*) teaching of materials (*Lehre vom Stoff*),[28] and an alternative to the analytical, abstract and mechanistic approach of the Western tradition. Referring to Wurtz's enthronement of Lavoisier as the founding father of chemistry, Weygand conceded that,

> Chemistry, insofar it was a Western science in the sense of the late eighteenth and early nineteenth centuries, may have been co-founded by Lavoisier. However, chemistry as the teaching of material (*Lehre vom Stoff*), which we may call the German [chemistry], was not founded by Lavoisier. The earliest occidental teaching of material in the holistic sense is the German spagyrical teaching of Paracelsus.[29]

Fortunately, the spokesmen of *Deutsche Chemie* did not receive the kind of support they had hoped for in their attempt at merging chemistry and Nazi ideology. Nevertheless, most historical works of the time favoured the practical, craft-like aspects of early modern chemistry, and authors such as Rudolf Glauber, Johann Kunckel and Georg Ernst Stahl played a major role in these treatments. Accordingly, Lavoisier's contribution to the history of chemistry was marginalised

27 Paul Walden, »Nationale Wege der modernen Chemie,« *Chemiker-Zeitung*, 1935, 59:2–3.

28 Conrad Weygand, *Deutsche Chemie als Lehre vom Stoff* (Halle: Niemeyer, 1942); see also Martin Bechstedt, »Gestalthafte Atomlehre: Zur ‚Deutschen Chemie' im NS-Staat,« in *Naturwissenschaft, Technik und NS-Ideologie: Beiträge zur Wissenschaftsgeschichte des Dritten Reichs*, ed. Herbert Mehrtens and Steffen Richter (Frankfurt: Suhrkamp, 1980), 142–165; Markus Vonderau, *»Deutsche Chemie«: Der Versuch einer deutschartigen, ganzheitlich-gestalthaft schauenden Naturwissenschaft während der Zeit des Nationalsozialismus* (PhD dissertation, Marburg, 1994).

29 Weygand, *Deutsche Chemie*, p. 62.

to the extent that, in 1944, Paul Walden's *Drei Jahrtausende Chemie* devotes only four out of three hundred pages to the French scientist.

Epilogue

In September 2003, in a solemn ceremony, the bust of Antoine Laurent Lavoisier was inaugurated in the hall of fame of the *Deutsches Museum* in Munich. It was the first time a non-German scientist was honoured in this peculiar way, and at a place which is far from self-evident. For when the Ehrensaal was inaugurated in 1925, it was devoted to *deutschem Wesen und deutschem Geist*, to praise the achievements of »German energy and vigour, German thoroughness and depth of thought, German perseverance and industriousness.«[30] In its strange blend of belated rehabilitation and post-modern alienation, the 2003 arrival of Lavoisier's bust in this national scientific Pantheon – in a museum originally meant as the very embodiment of German supremacy in science and technology, and guarded by a statue of Chancellor Bismarck on the bridge crossing the river Isar – can be seen as a fair tribute to the international character of science, but at the same time it points to the fact that history is not just events and figures of the past, but a construction of likeness and difference which each generation has to build anew according to its changing self-images and requirements. The vicissitudes of Lavoisier's image in Germany reflect not so much the historical Antoine Laurent Lavoisier, but rather the way German chemists perceived themselves and their science in the vicissitudes of German and European history.

30 Walther von Dyck, »Der Ehrensaal des Deutschen Museums,« in: Conrad Matschoss (ed.), *Das Deutsche Museum: Geschichte, Aufgaben, Ziele* (Berlin: VDI-Verlag, 1925), pp. 19–37, on p. 20.