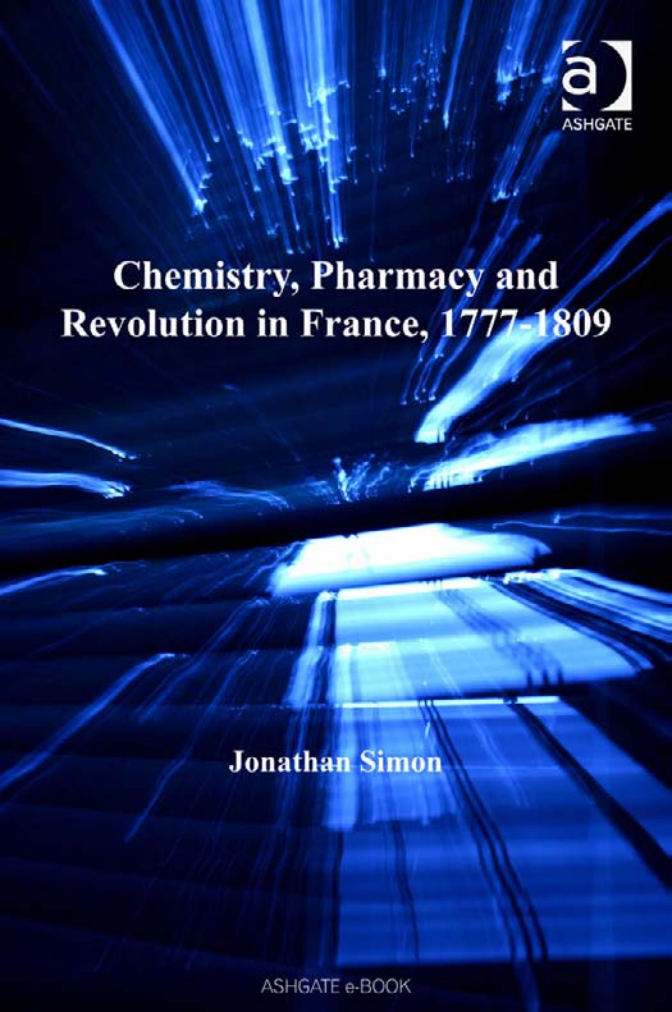
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Chemistry, Pharmacy and Revolution in France, 1777-1809
Jonathan Simon
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CHEMISTRY, PHARMACY AND REVOLUTION IN FRANCE, 1777-1809

This book explores the history of pharmacy in France and its relationship to the discipline of chemistry as it emerged at the beginning of the nineteenth century. It argues that an appreciation of the history of pharmacy is essential to a full understanding of the constitution of modern science, in particular the discipline of chemistry. As such, it provides a novel interpretation of the chemical revolution (c.1770-1789) that will, no doubt, generate much debate on the place of the chemical arts in this story, a question that has hitherto lacked sufficient scholarly reflection. Furthermore, the book situates this analysis within the broader context of the French Revolution, arguing that an intimate and direct link can be drawn between the political upheavals and our vision of the chemical revolution.

The story of the chemical revolution has usually been told by focusing on the small group of French chemists who championed Lavoisier's oxygen theory, or else his opponents. Such a perspective emphasises competing theories and interpretations of critical experiments, but neglects the challenging issue of who could be understood as practising chemistry in the eighteenth century. In contrast, this study traces the tradition of pharmacy as a professional pursuit that relied on chemical techniques to prepare medicines, and shows how one of the central elements of the chemical revolution was the more or less conscious disassociation of the new chemistry from this ancient chemical art.

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Published by

Ashgate Publishing Limited
Gower House
Croft Road
Aldershot
Hants GU11 3HR
England

Ashgate Publishing Company
Suite 420
101 Cherry Street
Burlington
Vermont, 05401-4405
USA

Ashgate website: http://www.ashgate.com

British Library Cataloguing in Publication Data
Simon, Jonathan
Chemistry, Pharmacy and Revolution in France, 1777-1809. — (Science, Technology and Culture, 1700-1945)
1. Pharmacy — France — History — 18th century. 2. Chemistry — France — History 18th century. 3. Science and state — France — History — 18th century. 4. France — History — Revolution, 1789-1799. I. Title.
615.l'0944'09033

US Library of Congress Cataloging in Publication Data
Simon, Jonathan
Chemistry, Pharmacy and Revolution in France, 1777-1809/ by Jonathan Simon.
p. cm. — (Science, Technology and Culture, 1700-1945)
Includes bibliographical references.
l. Pharmacy — France — History — 18th century. 2. Chemistry — France — History — 18th century. 3. France — History — Revolution, 1789-1799. I. Title. II. Series.
RS67.F8S56 2005
615'.1094409033—dc22 2005004152

ISBN 0 7546 5044 8

Printed and bound in Great Britain by TJ International Ltd, Padstow, Cornwall

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Chapter 1

Introduction:
Pharmacy and the Chemical Revolution

In some sense, pharmacy is as old as humanity itself. People have always made use of plant leaves, roots, and minerals to treat the diseases that have evolved along with them. Although modern scientific pharmacy, based on chemistry, toxicology, physiology, and a range of other sciences is a twentieth-century invention, it nevertheless started along this distinctive scientific course at least a century earlier. In France, the last decades of the eighteenth, and the first of the nineteenth proved crucial in setting the pace for modern European pharmacy. Traditionally referred to as apothecaries, the members of the Parisian guild experienced a profoundly significant event in 1777, as with the founding of the *Collège de pharmacie* they officially became pharmacists. This change in name was not, however, as decisive for the future of French pharmacy as subsequent developments in French chemistry and politics. The revolutions that would follow around the turn of the century would change the status of pharmacy, reform pharmaceutical education and provide a radically new horizon for pharmaceutical scientific ambition. The French Revolution was largely responsible for the crucial institutional changes that would transform a traditional guild structure into a state-run organization, but there was also a scientific revolution – the chemical revolution, associated with the name of Lavoisier – in the offing that would result in an equally dramatic change in how pharmacists perceived themselves and their art. This book covers these two revolutions, exploring the effects that they had on both pharmacy and chemistry in France.

The nature of the chemical revolution has become a key issue in the history of eighteenth-century chemistry, and this introduction will provide an opportunity not only to raise this central issue, but also to situate my own approach in relation to prior historical projects. Much of what this books aims to achieve will not be readily understandable to the non-specialist reader without reference to this introductory material, as I address issues that have built up over several decades of historical and philosophical work. Although relatively young as professional disciplines, both the history and the philosophy of science are more deeply immersed in preconceptions concerning their subject matter than many of their older academic neighbours, with the concept of 'revolution' acting as a vehicle for a great many of these prejudices. All the same, I intend this work to be accessible to anyone with a working knowledge of eighteenth-century French history, whether or

not they are in the field of the history and philosophy of science. Stepping back, it becomes clear how an issue of unquestioned centrality for someone immersed in the field needs to be justified to those untouched by such concerns. Familiarity with disciplinary pre-occupations breeds a certain degree of complacency, and what were originally provisional explanatory conjectures can easily become congealed into inflexible positions and periodizations that constitute the almost invisible tools of the trade. Nevertheless, the revisionist needs to be equally careful not to throw the baby out with the bathwater; while on the one hand it is clear that what seems a compelling historical approach may have only acquired this status through constant repetition, on the other, such an approach might appear irrelevant simply because its relevance no longer needs to be made explicit.

I want to introduce the central issues addressed by this book by means of two preliminary questions. First, how can the history of pharmacy help our understanding of the development of chemistry in general and the episode of the chemical revolution in particular? Second, what is the relationship between the French and chemical revolutions? Concerning the first question, what I argue here is that examining the place of pharmacy gives the historian an illuminating perspective on the formation of chemistry as an independent science. The founding twentieth-century histories of chemistry have tended to take a well-delimited late-nineteenth-century discipline as their subject and from there to embark on a search for its origins.[1] This tactic brings with it not only the danger of projecting a contemporary scientific identity onto a markedly different socio-cultural context, but also raises the associated problem that any field not seen to have contributed directly to the development of modern chemistry is dismissed from consideration. Examining another field that has been (more or less intimately) allied to chemistry throughout its history, but one that is not identical with this science, allows us to present a more critical view of the identity of chemistry as a discipline.

Bernadette Bensaude-Vincent and Isabelle Stengers's history of chemistry has explicitly taken this very theme of identity as its organizing principle, tracing the changing self-conception of the discipline from the seventeenth into the twentieth century.[2] Instead of asking how chemists have conceived their own discipline, however, there is an alternative way of revealing disciplinary identity, and this involves looking at what areas chemists have excluded from their science. The changing features of what is taken to lie outside chemistry tell us much about what constitutes the science itself, just as the geographical definition of a country can be obtained from the borders it shares with all its neighbours, a sort of definition by exclusion. What is particularly interesting about pharmacy from this perspective is

[1] See Partington, *A Short History of Chemistry,* London: Macmillan, 1937. Already by the 1960s when Aaron Ihde came to write his own *History of Chemistry* (New York: Harper & Row, 1964) there was more sensitivity to the novelty of eighteenth-century chemistry, and he takes a more circumspect (and less hagiographic) view of its origins.

[2] Bensaude-Vincent, Bernadette & Isabelle Stengers, *Histoire de la chimie,* Paris: La Découverte, 1993.

that at some time during the eighteenth century, it became *the* discipline from which chemists sought to distance themselves. Therefore, looking at the developing relationship between pharmacy and chemistry in this period tells us as much about the identity of the second as the first.

Furthermore, I will argue that a relational understanding of chemistry informed by this study of pharmacy can offer a more interesting interpretation of the chemical revolution, one that goes beyond seeing it as simply a change in theory. Here, I will take the opportunity to consider a few of the wide variety of positions that have already been adopted with respect to this event, and briefly review some of the debates that have resulted. These debates, for better or for worse, have defined the historical terrain of the chemical revolution as it lies at present.

As far as the second question is concerned – the relationship between the French and the chemical revolutions – it is beyond the scope of my work to review the historiography of the French Revolution, as this itself constitutes an extensive and particularly contentious area of historical scholarship. Instead, I will limit myself to suggesting some important points of contact between this central event in modern history and my treatment of the chemical revolution through pharmacy. Before I move on to these two questions, however, I want to start with some thoughts on the history of pharmacy, as it is a subject that generally falls outside the mainstream of the history of science, and it is worthwhile considering why this is the case. I will then briefly consider the role of disciplines in the history of science before passing on to the chemical and finally the French Revolution.

The history of pharmacy and the history of science

Although now widely considered an inadequate approach to understanding the history of science, the traditional tactic has been to recount a grand narrative that turns around the Scientific Revolution. This monumental event was classically understood as an intellectual revolution during which the great thinkers of the seventeenth century, relying on empirical observations, challenged medieval traditions, and finished by founding modern experimental science. At the heart of this story lie the replacement of the Ptolemaic Earth-centred universe with the Copernican sun-centred system, and the determination of the Newtonian laws of motion. With celestial and terrestrial mechanics very much to the fore, the temptation for historians of science who wanted to include chemistry in this vision of the Scientific Revolution was to search the science's past for the likes of Copernicus, Galileo and, of course, Newton. These architects of modern mechanics found their chemical equivalents partly in Robert Boyle, partly in John Dalton, but most fully in Antoine-Laurent Lavoisier. Just as the former group had thrown off the shackles of Aristotelian views of motion, and put a formalized universal mechanics in its place, the latter group rejected the Aristotelian understanding of

matter, and replaced the four ancient elements with a substantially correct, experimentally based notion of chemical elements.[3]

Something that usually passes unnoticed is that the historical figures who have come to dominate the history of chemistry were quite untypical of practicing chemists between the mid-seventeenth and the early nineteenth century. The majority of those engaged with chemistry were physicians or pharmacists, who had a direct professional interest in the medical uses of chemistry. Furthermore, the lack of interest these founding fathers showed in pharmacy (Dalton and Lavoisier in particular) is reflected in the writings of Lavoisier's biographers, such as Douglas McKie and Henry Guerlac, who became the most important historians of the chemical revolution in the post-war period.

In general, the scientists who have come to dominate the history of chemistry are those who have been seen to devise progressive chemical theories. Nevertheless, the search for novel theories as the only proper subject for the history of science has at least two detrimental side-effects. First, the focus on such scientists and their work obscures other scientists who, often due to the pressure of their professional commitments, put less energy into formulating these theoretical perspectives, but were nevertheless significant players in the development of a science.[4] Second, tracing the filiation of theories ignores the importance of institutional and disciplinary shifts, and more importantly it leaves aside practical innovations particularly important in an experimentally based science like chemistry.

This preoccupation with theory has to a large extent carried over from general histories of science into the equivalent historical treatments of chemistry, the best known of which also tend to focus on the development of modern chemical theory, and thus have little to say about pharmacy as a professional tradition in chemistry.[5] As I will argue in Chapter 3, the separation between chemistry and pharmacy, at least in seventeenth-century France, is an artificial one; moreover, it is one that distorts the historical perspective on the development of both chemistry as an independent discipline and pharmacy as a dependent one. Moreover, as Chapter 5 will make clear, failing to take these disciplinary shifts into account makes it

[3] Robert Siegfried has recently returned to this history of a revolution in the conception of chemical composition brought about by Lavoisier and Dalton. See, Robert Siegfried, *From Elements to Atoms: A History of Chemical Composition,* Philadelphia: American Philosophical Society, 2002.

[4] In the history of chemistry, one such figure, Étienne-François Geoffroy, has enjoyed considerable attention recently, particularly in the work by Ursula Klein and Alistair Duncan.

[5] One notable feature of Partington's four-volume *A History of Chemistry,* for example, is that he writes a lot about pharmacists, but offers no vision of the development of pharmacy. Of course, he discusses the importance of iatrochemistry in the sixteenth and early seventeenth centuries, but as the seventeenth century advances, medical chemistry drops out of consideration. By the end of the seventeenth century, he insists on taking an interest in pharmacists only as they fit into the development of chemistry.

difficult to understand the development of scientific pharmacy in the nineteenth century.

Disciplines in science

I have already suggested several times that I adopt a disciplinary approach to the chemical revolution, but without explaining what I mean by the word discipline. In general, it is a term that is widely used but rarely defined. A discipline, like the more commonly used sociological category of profession, means different things to different people and is easier to recognize than to define. Nevertheless, we can say that the word clearly carries the connotation of an area of specialization that has order and cohesion imposed on it, either from within or without. Furthermore, the association of 'disciplining' with the control and regulation of people's lives and bodies, coeval with the rise of modern industrial society is difficult to avoid, particularly following the widespread influence of Michel Foucault on social theory.' The parallels between political and scientific institutions suggest the use of political theory to understand the latter. Robert Kohler explicitly takes up this political angle when he offers the following general definition of a discipline:

> Disciplines are political institutions that demarcate areas of academic territory, allocate the privileges and responsibilities of expertise, and structure claims on resources.[7]

Here, I will be pursuing this political approach, but from a different perspective. In line with Benedict Anderson's anthropological treatment of the phenomenon of nationalism, I want to emphasize the role that a discipline plays as a unit of identification. As such, it remains a multivalent term, in part pointing to membership in professional groups, and in part to an identity constructed around shared commitments and beliefs, at once less material and more egalitarian. This is how Anderson defines the nation in his influential *Imagined Communities:*

> In an anthropological spirit, then, I propose the following definition of the nation: it is an imagined political community — and imagined as both inherently limited and sovereign.[8]

[6] See Michel Foucault, *Discipline and Punish: The Birth of the Prison,* New York: Vintage, 1979, and *Madness and Civilization: A History of Insanity in the Age of Reason,* New York: Vintage, 1988. Of more direct relevance to this period is his *Birth of the Clinic: An Archaeology of Medical Perception,* New York: Vintage, 1975, in which the centrality of clinical experience is established at the time of the French Revolution, through an institutional disciplining of pathology.

[7] Robert E. Kohler, *From Medical Chemistry to Biochemistry: The Making of a Biomedical Discipline,* Cambridge: Cambridge University Press, 1982, p. 1.

[8] Benedict Anderson, *Imagined Communities,* New York: Verso, 1991, pp. 5-6.

In the same spirit, I would like to think about a scientific discipline as an imagined scientific community, which is imagined as bounded and exclusively competent over its self-determined area of expertise. As Anderson stresses, the fact that a community is imagined does not mean that it is imaginary, and the division between pharmacy and chemistry is no less real for being conceived and constructed in a particular historical context. Thus, I want to argue, the disciplinary division took place and two separate disciplines came into being when chemists and pharmacists recognized themselves as distinct from one another, simultaneously defining the borders of their own community and those of the other.

Compared to those developing in the eighteenth century, more recent scientific disciplines are relatively easy to identify. Again, drawing on theories of nationalism, Mary Jo Nye in her treatment of nineteenth-century French chemistry has offered six elements for establishing a discipline: genealogy, a core literature, codified rituals, a physical homeland, recognition from the outside and a shared set of scientific values.[9] Similarly, sociologists of science use key indicators to specify a particular discipline or sub discipline; schools of research, specialized journals and academic departments to name but three. In the present case, however, it is harder to pick out such clear markers for a particular discipline, because, at the end of the eighteenth century, discipline-building was not a refined art, and borders were neither as jealously guarded nor as clearly delimited as they are today. Taking the example of the journals that I will be examining in the present study, we can see this problem more clearly. While the *Annales de chimie* and the *Bulletin de pharmacie* provide clues to the diverging disciplinary identity of chemistry and pharmacy, there was, as we shall see, considerable overlap in their contents. Even if pharmacy was not the principal focus of the *Annales,* it continued to find a place in this journal even after the *Bulletin* had started to provide a specialized venue for scientific pharmacy. Furthermore, this was a period when there was no standard professional path for a scientist to take. Indeed, as I argue, one of the reasons that chemistry could establish itself independently of pharmacy was the rise of teaching opportunities in chemistry provided by Napoleonic educational reform. With the formation of the elements of the Imperial University, the discipline could develop beyond the restricted space of the Royal Academy of Sciences and later the Academy of Sciences at the *Institut.* The establishment of a community of chemistry teachers outside the medical sphere was a vital element in the development of modern chemistry in France.[10]

[9] Mary Jo Nye, *From Chemical Philosophy to Theoretical Chemistry: Dynamics of Matter and Dynamics of Disciplines 1800-1950,* Berkeley: University of California Press, 1993.

[10] For more detailed treatments of the development of scientific careers in the eighteenth century, see Roger Hahn, 'Scientific Careers in Eighteenth-century France', and Maurice Crosland, 'The Development of a Professional Career in Science in France', both

The disciplinary approach has come into favour in the history of science over the last twenty-five years, with several monographs detailing the rise of scientific disciplines. Such studies regularly take the end of the eighteenth century as their starting-point.[11] The publication most closely related to my project is Karl Hufbauer's work on the rise of the German chemical community around the time of the chemical revolution, but noone has seen fit to apply this approach to the parallel community in France.[12] In the area of French chemistry, even those who talk of disciplines tend to consider the term almost exclusively as it relates to theoretical commitment. While Hufbauer analysed the German chemical community around Crell's journal and the sources of financial support for chemistry in Germany, Arthur Donovan has taken the vaguely defined methodological approach of experimental physics to provide the model for understanding Lavoisier's chemistry as a novel disciplinary development. Nevertheless, Donovan's version of what constitutes a disciplinary interpretation of the chemical revolution, although it does have a certain appeal, is considerably narrower than the one I advocate here.[13]

Without a more thoroughgoing disciplinary approach it is hard to recognize important transformations that were taking place in chemistry at this time. An excessively narrow focus on the switch of allegiance from phlogiston to oxygen, or other satellite issues that turn around the figure of Lavoisier obscures important changes in the population of chemists, and how the growing constituency of exclusively philosophical chemists conceived their science. Some might express doubts as to whether the kind of approach I am proposing here can help us understand the chemical revolution. After all, the rise of chemistry as a philosophical pursuit, increasingly independent of its practical applications, was a

in *The Emergence of Science in Western Europe,* Ed. M. Crosland, New York: Science History Publications, 1976.

[11] Rudolf Stichweh's *Zur Entstehung des modernen Systems wissenschaftlicher Disziplinen: Physik in Deutschland 1740-1890,* Frankfurt am Main: Suhrkamp Verlag, 1984, takes as its subject the rise of physics as an institutionalized discipline and so touches on chemistry as well. Paul Farber offers a narrower study in *The Emergence of Ornithology as a Scientific Discipline 1760-1850,* Dordrecht: D. Reidel, 1982. Loren Graham has edited a volume dedicated to disciplinary histories: *Functions and Uses of Disciplinary Histories,* Dordrecht: D. Reidel, 1983.

[12] Karl Hufbauer, *The Formation of the German Chemical Community (1720-1795),* Berkeley: University of California Press, 1982.

[13] The original inspiration for the interest in chemistry's relation to physics in Lavoisier's work was Henry Guerlac's article 'Chemistry as a Branch of Physics: Laplace's Collaboration with Lavoisier', *Historical Studies in the Physical Sciences, 7* (1976): 193-276. Donovan offered his view in 'Lavoisier and Origins of Modern Chemistry' in *The Chemical Revolution: Essays in Reinterpretation,* Ed. A. Donovan, *Osiris* 2nd ser., Vol. 4, 1988: 214-31. Carleton Perrin presented a point-by-point rebuff to Donovan's article and an earlier one by Evan Melhado in C. E. Perrin, 'Chemistry as Peer of Physics: A Response to Donovan and Melhado on Lavoisier', *Isis* 81 (1990): 259-70. Donovan and Melhado published short defences of their positions in the subsequent pages.

gradual and non-linear process that took place across the eighteenth century, and cannot be tied down to any single revolutionary moment, while there does seem to have been a coincidence of events at the end of the eighteenth century in France that together constitute what is usually seen as *the* chemical revolution. In this book, I end up in a sense reaffirming the existence of such a revolution around the figure of Lavoisier. Nevertheless, I want to emphasize certain features of this revolution that are not dealt with in traditional intellectual histories of the event. First, Lavoisier and his school clearly represent the culmination of the rise of philosophical chemistry as an independent discipline, and this will be a key theme in this book, particularly in Chapters 3 and 5. Second, I want to affirm the importance of Lavoisier's innovation in developing his system of chemistry. He offered a radically new vision of chemistry as a science divorced from the traditional concerns of pharmacy, a vision that was powerfully conveyed by his 1789 *Élements of Chemistry*. Furthermore, the system was integrated into a new language for chemistry, presented in the jointly authored *Method of Chemical Nomenclature* of 1787. Finally, the sudden social transformations brought about by the French Revolution allowed the institutional reorganization of French chemistry and its associated arts, reflecting the realignments that had taken place in other social and intellectual spheres. These were not, however, independent occurrences, rather they were intimately interlinked and our understanding of each one influences our perception of the others.

Looking at pharmacy allows us to see all three levels of transformation – theoretical, social and institutional – operating together. Nevertheless, from the point of view of the professional pharmacist, the French Revolution brought about the most striking changes. In just over a decade, the traditional guild control of pharmacy was dissolved, while the ultimate, if not the day-to-day, responsibility for the profession was assumed by the state. This switch from a guild- to a state-controlled institutional system provided reforming government agents with a unique opportunity to integrate Lavoisier's revolutionary chemistry into the pharmaceutical curriculum relatively soon after it had been developed.[14] Furthermore, this institutional transformation is reflected in a change in pharmacy's primary concerns. Pharmacists switched from a pre-revolutionary preoccupation with their institutional position to a growing concern about the scientific status of the art. It is this change in the profession's preoccupations that I want to convey through the comparison of two ceremonies that forms the core of the next chapter. The first occasion represents the zenith of the Parisian pharmacists' power as a guild, the founding of the *Collège de pharmacie* in 1777, while the second catches the community twenty years later, in a state of uncertainty, suspended between guild

[14] Jan Goldstein describes the importance of these models for the institution of science in the first chapter of her *Console and Classify*. She argues that the wider transformation of medicine from a corporate to a statist model (by way of an extended period of *laissez-faire* governance) allowed psychiatry to make a bid for disciplinary independence. See Jan Goldstein, *Console and Classify,* Cambridge: Cambridge University Press, 1987.

and state control. Antoine-François de Fourcroy, one of Lavoisier's collaborators, and a well-placed advocate of the new chemistry took this opportunity to underline the importance of the pharmacists' relationship to chemistry in determining their future.

Subsequent to the French and chemical revolutions, the elite Parisian pharmacists found that they had simultaneously been promoted and relegated with respect to their status. While they retained a certain amount of institutional prestige, in their capacity as civil servants as well as members of the *Institut,* they were already being overshadowed in both these public arenas by those chemists who followed the path blazed by Lavoisier. Although, as we shall see, the new pharmacists realized some outstanding scientific successes while integrating parts of the new chemistry into traditional pharmaceutical analytical practices, in the end they could not compete with the achievements and mounting prestige of the dominant science of chemistry. Overall, the profession of pharmacy began to take on quite a different complexion under Napoleonic rule. The transformation was both scientific and institutional, with changes in one of the areas informing changes in the other. Furthermore, all these changes contributed to the meaning of the chemical revolution as a historical event.

The argument that pharmacy has an important place in the history of science depends, therefore, on challenging two prejudicial attitudes within the field. First, a bias towards theoretical developments as being the only interesting subject of the history of science. Second, a lack of sensitivity with respect to the importance of disciplinary divisions in the context of eighteenth-century chemistry. In a broader context, both these attitudes have been vigorously challenged in the last few decades, so the time seems ripe for a reappraisal of pharmacy's place in the history of science.

Reconsidering the chemical revolution

One of my central aims in this book is to indicate the ways in which taking the history of pharmacy into account might change our view of the chemical revolution itself. As with most historical categorizations, the meaning of the chemical revolution has not remained stable, rather it has been contested by a number of historians, and has shifted accordingly. Nevertheless, unlike many other historical debates, disputes about the chemical revolution operate around an assumed orthodoxy that serves to locate all the various dissenting positions as deviations from an apparent norm. Although it does not originate here, this standard history is best exemplified in the account of the chemical revolution offered by Thomas Kuhn in his influential *The Structure of Scientific Revolutions* (henceforth, *Structure).* It was this work that brought the canonical version of the chemical revolution its widest public exposure. While Kuhn himself was a historian of science, *Structure* was primarily a contribution to the philosophy of science, proposing a general model for scientific revolutions, of which the chemical revolution was just one

example. The model of scientific revolution that Kuhn proposed was very clearly articulated around theory change, and suggested a fairly straightforward picture of how, in passing through a revolution, a community of scientists changes allegiance from one theory to another. A theory determines a paradigm in any science and the usual work of scientists – so-called normal science – remains within the conceptual structure determined by this paradigm. At some point, the dominant theory enters into a crisis and is replaced by another theory which brings with it a new paradigm. It is not difficult to see how the canonical version of the chemical revolution fits into this model. Stahl's phlogiston theory/paradigm was replaced by Lavoisier's oxygen theory/paradigm, with the discovery of gases and their participation in reactions (in particular combustion) supplying the precipitating crisis. Kuhn reproduced a picture of the chemical revolution very similar to that presented by his Harvard professor – James Bryant Conant – a dozen years earlier.[15] Since the publication of *Structure,* Kuhn's schematized version of the chemical revolution has become the philosophical standard against which both historians and philosophers of science have measured their own interpretations.

Those familiar with the breadth of Kuhn's historical work will know that he was considerably more circumspect than my brief summary of his position suggests. Indeed, he directly addressed the issue of disciplines in a 1969 postscript which accompanied the second edition of *Structure.* In responding to complaints about vagueness in his use of the term 'paradigm', he stressed the importance of a disciplinary community which could be defined through the identification of a shared paradigm. He acknowledged that this position carried with it the threat of circularity – the paradigm defines the community which in turn serves to define the paradigm as the community's shared theoretical (and practical) commitment. In order to escape this definitional circularity, Kuhn granted priority to the sociological investigation of communities:

> Scientific communities can and should be isolated without prior recourse to paradigms; the latter can then be discovered by scrutinizing the behaviour of a given community's members. [16]

The approach I take in this book is likewise to try and determine the boundaries of pharmacy and chemistry as they were understood by the actors in this history, rather than assuming that either is characterized by one particular theory-based

[15] In his forward to *The Overthrow of the Phlogiston Theory,* Conant thanks Kuhn, among others, for unspecified assistance (James Bryant Conant, *The Overthrow of the Phlogiston Theory: The Chemical Revolution of 1775-1789,* Cambridge: Harvard University Press, 1950, p. 10). Steve Fuller has argued for the importance of Kuhn's involvement in teaching Conant's course for the development of his thinking on science. See Steve Fuller, *Thomas Kuhn: a philosophical history for our times,* Chicago IL: University of Chicago Press, 2000.

[16] Thomas S. Kuhn, *The Structure of Scientific Revolutions,* Chicago IL: University of Chicago Press (2nd edn), 1970, p. 176.

paradigm. This is particularly important around the time of the chemical revolution, a time when the two communities were still in the process of defining themselves as distinct. Indeed, allegiance to the oxygen theory was not the exclusive characteristic of the members of either community. Therefore, despite the fact that prominent pharmacists such as Baum& and Demachy did resist Lavoisier's new chemistry, ultimately it was not the oxygen theory that divided the two communities in the nineteenth century, even though it did play a vitally important role in locating their relative positions in French society. The divergent professional interests and analytical traditions of the two communities were just as important as the rise of the new chemistry in determining the disciplinary identities of modern French chemistry and pharmacy.[17]

There is a paradox associated with the popularity of *Structure* and *its* effect on the history of chemistry. While Kuhn's work disseminated a clear picture of the chemical revolution to a large audience, it seems to have had almost no normative impact on historians specializing in eighteenth-century chemistry. Although it is cited in almost every review article as providing the canonical account of the event, there have been few in the historical community who have wanted to defend this picture. Kuhn's account of the chemical revolution was, by contrast, picked up by philosophers of science, who used his version of the event in order to argue for their preferred methodologies of science:[18] Therefore, although he brought the history of the chemical revolution to its widest audience, Kuhn's lasting impact on the history of chemistry community seems to have been to provide a clear version of this event for historians to attack. Dressed up in the language of paradigms and scientific revolution, Kuhn drew his philosophical lessons from a Lavoisier-centered vision of the chemical revolution.

At almost the same time that Conant was using Lavoisier's conceptual revolution in order to promote science to non-scientists, a very different view of what constituted the chemical revolution was being proposed in Britain. In 1952, Archibald and Nan Clow published the results of their extensive research into the chemistry deployed during the Industrial Revolution in Britain, producing a book entitled, quite simply, *The Chemical Revolution.* This historical *tour de force* was a

[17] I take differences in analytical traditions to cover the subjects and the methods of analysis. The new chemistry focused its analytical attention on the mineral realm and treated the organic substances from this perspective, while pharmaceutical chemistry took a different approach to organic matter. See Chapter 5, below.

[18] Examples of this kind of philosophical approach are provided by Paul Thagard in his 'The conceptual structure of the chemical revolution' and by Alan Musgrave in 'Why did Oxygen Supplant Phlogiston? Research Programmes in the Chemical Revolution.' The first article argues for a computational theory of concept change, while the second seeks to explain the event in terms of Imre Lakatos's 'methodology of scientific research programmes'. Lakatos's model of scientific change owes a great deal to Kuhn's *The Structure* and is presented most fully in the posthumous 1978 collection edited by John Worrall and Gregory Currie.

Marxist-inspired work that made only passing reference to Lavoisier and his chemical revolution, partly for geographical reasons, but mainly due to the book's focus on the nascent chemistry industry. Concentrating almost exclusively on Scotland and the North of England, the Clows detailed the rise of modern industrial chemical manufacture from the production of salt at the beginning of the eighteenth century to the growth of the nineteenth-century tar industries associated with lighting the large industrial cities. The Clows' chemical revolution mirrored the industrial revolution and involved the gradual improvement of techniques for the manufacture of chemicals rather than tracing any grand changes in theory. The approach pioneered by the Clows has been followed up intermittently, but has certainly never threatened to displace the orthodox understanding of the cheinical revolution supplied by Lavoisier's biographers.[19] Nevertheless, this alternative view of the chemical revolution has persisted in the background of the discussions of the history of eighteenth-century chemistry that followed.

Returning to more traditional intellectual history, there have also been historians within the tradition of Lavoisier studies who sought to challenge the standard picture introduced by his nineteenth-century biographers. The most prominent figure in this field before the Second World War was Hélène Metzger, a sophisticated and wide-ranging historian of chemistry who adopted a more philosophical approach to her subject matter than had her predecessors. Writing in the 1920s, she challenged the heroic account of Lavoisier's single-handed making of modern chemistry around the oxygen theory, even before this picture of the chemical revolution had settled into orthodoxy.[20] As a general principle, Metzger consistently championed evolution against the picture of revolution in science, and so when she came to examine Lavoisier, she aimed to reinsert him into an intellectual context that minimized his originality.[21] Stepping back from a narrow focus on the fall of phlogiston, she looked at the wider picture of the succession of theories of matter since the seventeenth century. Therefore, when she did directly address Lavoisier's contributions she drew attention away from his combustion experiments in order to concentrate on his metaphysical approach to matter. From this broader perspective, she found that Lavoisier's views had much in common with the Stahlian theory that they replaced. Metzger even went as far as to claim that Lavoisier's oxygen theory had retained phlogiston in the form of caloric.

[19] John Smith applied the Clows' style of industrial chemical history to France in his 1979 book, *The Origins and Early Development of the Heavy Chemical Industry in France,* Oxford: Clarendon Press, 1979.

[20] A number of different views on Metzger's history can be read in the collection edited by Gad Freudenthal, *Etudes sur/Studies on Hélene Metzger.* This work includes a fascinating biography written by the editor.

[21] See the introduction in Hélène Metzger, *Les Doctrines chimiques en France du début du XVII^e^ a la fin du XVIII^e^ Siècle* (2nd edn), Paris: Albert Blanchard, 1969 (1st edn 1923), in particular, p. 9.

This broader, philosophical analysis of the history of chemistry as the history of theories of matter effectively sidelined the issues that had been so central to Lavoisier scholars, and provided an alternative view of the development of chemistry across a longer period of time. The same general approach was pursued by Arnold Thackray and Robert Schofield, working in the 1960s, who together traced the path of Newtonian thought across the eighteenth century.[22] On the one hand, Schofield took on the fate of mechanism in Britain, and came to the conclusion that in this light Lavoisier's revolution represented a retrograde rejection of mechanization. On the other hand, Thackray adopted a wider European approach and deflected attention away from Lavoisier, whom he characterized as avoiding the philosophical problem of the nature of matter by means of his diplomatic positivism, instead bringing Guyton de Morveau and Berthollet to the fore as the key Newtonian chemists in late eighteenth-century France.

Another theme in the historiography of chemistry taken up in the 1960s was the hunt for a more detailed understanding of the practice of eighteenth-century chemistry, with the aim of bringing to light the chemical operations that lay behind the chemists' theorizing. The late Frederic Holmes was a leader in this field, and, deploying a painstaking methodology, worked both sides of the revolution/evolution controversy. Based on his detailed investigation of Lavoisier's experimental work on organic matter and the animal economy, he painted a picture of a brilliant although hesitant investigator who revolutionized the contemporary understanding of respiration and organic composition.[23] On the other side of the debate, Holmes has stressed the continuity of several important chemical analytical traditions that has been obscured by excessive focus on combustion in the historiography of the chemical revolution.[24]

More recent studies of science have been increasingly informed by sociological concerns, with a great deal of interest in the question of how local knowledge is promoted to the status of universal scientific fact.[25] The resulting studies have,

[22] This covered both the introduction of a Newtonian conception of forces into chemistry and the mechanical, material side of Newton's scientific view. Arnold Thackray, *Atoms and powers, an essay on Newtonian matter-theory and the development of chemistry,* Cambridge, MA: Harvard University Press, 1970. Robert E. Schofield, *Mechanism and materialism; British natural philosophy in an age of reason,* Princeton, N.J.: Princeton University Press, 1970.

[23] Frederic L. Holmes, *Lavoisier and the Chemistry of Life. An exploration of scientific creativity,* Madison: University of Wisconsin Press, 1985.

[24] Frederic L. Holmes, 'Analysis by Fire and Solvent Extractions: The Metamorphosis of a Tradition', *Isis* 62 (1971): 129-48.

[25] The problem of reconciling local production of knowledge in a laboratory with the public and open ideology of science has been a prevalent concern in science studies since the mid-1980s. The old dichotomy of internal versus external histories of science has fallen out of favour with most researchers in this field, and the local/global dichotomy seems to have taken its place. For a discussion of what happened to the internal/external debate in the history of science, see Steven Shapin, 'Discipline and Bounding: The History and Sociology

however, tended to approach the chemical revolution only tangentially if at all. One exception is the work of Lissa Roberts, a sociologist of science who has brought new considerations to bear on the chemical revolution. In particular, she has stressed the importance of laboratory instruments and language, expanding Holmes's demand to look more closely at chemical practice as well as theory to include these 'instruments' of persuasion and discipline-formation. Indeed, following Condillac's logic, she has claimed that the way the new chemistry ordered the world through its new nomenclature to a great degree determined the way the world was to be understood.[26] The ordering of the world also served to order the discipline, and Roberts notes that Lavoisier turned away from the traditional artisanal mode of presenting chemical knowledge in a set of untheorized tables, and instead used linguistic reform to order chemistry around his theory and promote it from an art to a science.[27] I will be raising these themes myself in Chapter 3, stressing the importance of theory in establishing chemistry as an independent discipline. To round off this review of the historiography of the chemical revolution, I want to mention John McEvoy's appeal for a multivalent approach that looks beyond the confines of theory change.[28] Although I do not want to pursue all the avenues of research that he proposes, I do believe that such a multi-level approach is needed in order to capture what is a complex historical

of Science as seen through the Externalism-Internalism debate', *History of Science* 30 (1992): 333-69. Jan Golinski has taken the lead in examining the problem of making local knowledge public in the area of eighteenth-century chemistry, *Science and Public Culture.* Cambridge: Cambridge University Press, 1992. Together with John Christie, he also offers some interesting views on where the history of chemistry needs to go after the internal/external debate. J. R. R. Christie and J. V. Golinski, 'The Spreading of the Word: New Directions in the Historiography of Chemistry 1600-1800', *History of Science* 20 (1982): 235-66.

[26] Lissa Roberts, 'The Word and the World: The Significance of Naming the Calorimeter', *Isis,* 82 (1991): 199-222.

[27] Lissa Roberts, 'Setting the Table: The Disciplinary Development of Eighteenth-Century Chemistry as Read through the Changing Structure of its Tables' in *The Literary Structure of Scientific Argument,* Ed. Peter Dear, Philadelphia: University of Pennsylvania Press, 1991.

[28] John McEvoy, 'Continuity and Discontinuity in the Chemical Revolution', *The Chemical Revolution: Essays in Reinterpretation.* Ed. Arthur Donovan, Philadelphia: History of Science Society, 1988,195-213. There are many other overviews of the chemical revolution that have been published in the last decades: Frederic L. Holmes, 'The Boundaries of Lavoisier's Chemical Revolution', *Revue d'Histoire des Sciences* 48 (1995), 9-48; Maurice Crosland, 'Chemistry and the Chemical Revolution' in *The Ferment of Knowledge: Studies in the Historiography of Eighteenth-Century Science,* Eds G. S. Rousseau and Roy Porter, Cambridge: Cambridge University Press, 1980; Evan M. Melhado, 'Toward an Understanding of the Chemical Revolution', *Knowledge and Society: Studies in the Sociology of Science Past and Present* 8 (1989): 123-37. John McEvoy, 'The Chemical Revolution in Context', *The Eighteenth Century: Theory and Interpretation* 33 (1992): 198-216.

event. Indeed, the understanding of the chemical revolution as theory change covers only a small part of the whole, and not the part that has had the greatest long-term impact.

The view of the chemical revolution that I am advocating here is, as I suggested at the end of the last section, a three-level one – theoretical, social and institutional – all interlinked and to a certain extent interdefinitional. At the level of theory, I would agree that Lavoisier introduced a recognizably new chemistry that integrated the recently characterized gases into a chemical system for the first time. I would also side with those historians who emphasize the importance of the reformed language of chemistry in the institution of Lavoisier's new theory. It is the distinctive analytical aims of the new chemistry that are particularly important from my perspective, and, with the theoretical focus falling on the explanation of combustion in its various guises, these have hitherto been left to one side.

At the social level, I want to suggest that the chemical revolution represents the culmination of a slower process that removed chemistry from the sphere of the practical arts and placed it firmly among the high sciences. Whether chemistry became the equal of experimental physics or even mathematical physics is of less significance than the fact that it was successfully deracinated. Chemistry's removal from its more mundane artisanal connections met with widespread approval, as its too-close connection to pharmacy was recognized as holding it back. The end of chemistry's confusion with pharmacy was more important than the possible commingling with any part of physics that Donovan has suggested, although these may be aspects of the same phenomenon. Finally, on the institutional level, the French Revolution served to collapse the theoretical and social shifts, by institutionalizing the new chemists' understanding of the proper hierarchy. This becomes particularly evident if we consider the structure and content of science education that was put into place under Napoleon Bonaparte. Indeed, the introduction of the institutional hierarchy that established chemistry as the dominant science and pharmacy as the subservient art will form a central theme for this book.

The French and chemical revolutions

What was the relationship between the chemical revolution and the French Revolution? Despite the historical proximity of these two events, the question of their connection is rarely addressed. The chemical revolution finds no place in histories of the French Revolution, and the most common role for the political event in histories of science has been as the frenzied executioner of Antoine Lavoisier, the father of modern chemistry. Any biography of this great scientist-administrator is obliged to include a description of Lavoisier's perfunctory trial,

and his trip to the guillotine, where he died minutes after his father-in-law.[29] The drama of this event, and the lessons concerning the relationship between politics and science that can be drawn from it, are too tempting for historians to pass over in silence?' Nevertheless, although the death of Lavoisier has sparked consideration of the place of science in the French Revolution,[31] and even the role of the French Revolution in shaping scientists' views of their science,[32] it has not prompted much consideration of the possible causal relationship between the scientific revolution in chemistry and the political revolution that took France from a monarchy to a republic and then to an empire.

Two reasons conspire to keep this larger discussion at bay. The first is the enduring division between internal and external history of science, and the classic philosophical dichotomies associated with this divide.[33] According to this view, the

[29] Jean-Pierre Poirier, *Lavoisier,* Paris: Pygmalion, 1993, 395-414; Arthur Donovan, *Antoine Lavoisier: science, administration, and revolution,* Oxford: Blackwell, 1993; Douglas McKie, *Antoine Lavoisier: scientist, economist, social reformer,* New York: Schuman, 1952. David Knight explicitly uses the execution of Lavoisier in order to link the two revolutions together: '[T]hat Lavoisier's career should have been brought to an end by the guillotine in the Terror intertwines the novel French and chemical revolutions.' David Knight, *Ideas in Chemistry: a History of the Science.* New Brunswick, N.J.: Rutgers University Press, 1992, p. 68. Berthelot is considerably more lyrical in pointing out the tragic irony: L'intérêt qui s'attache à l'oeuvre de Lavoisier est rendu plus grand encore et plus poignant par sa destinée personnelle. Après avoir passé dix années a établis les bases expérimentales de sa doctrine, après avoir lutté quinze ans pour renverser les préjugés des anciennes doctrines, après avoir rendu tant de services a son pays et à l'humanité et jeté tant de gloire sur la France par ses découvertes, alors qu'il semblait appelé à terminer sa vie comme Newton, dans l'apothéose du triomphe, entouré du respect et de l'admiration de ses contemporains; a ce moment même, Lavoisier se trouva soudain enveloppé, sans l'avoir provoqué, dans la tempête révolutionnaire, dépouillé de ses places et de sa fortune, conduit enfin à l'échafaud.' Marcellin Berthelot, *La revolution chimique : Lavoisier,* Paris: Félix Alcan, 1890, pp. 4-5.

[30] Bernadette Bensaude-Vincent, *Lavoisier : mémoires d'une révolution,* Paris: Flammarion, 1993, 343-362, and Poirier, *Lavoisier.*

[31] For example, see Charles Coulston Gillispie 'The *Encyclopédie* and the Jacobin philosophy of science: a study in ideas and consequences', L. Pearce Williams 'The Politics of Science in the French Revolution', and the responses to these papers by Henry Bertram Hill and Henry Guerlac, in *Critical Problems in the History of Science,* Ed. Marshall Clagett, Madison: University of Wisconsin Press, 1959.

[32] Dorinda Outram, 'The Ordeal of Vocation: The Paris Academy of Sciences and the Terror, 1793-95', *History of Science* 21 (1983): 251-73.

[33] In particular, objectivity versus subjectivity. For a quick review of the internal versus the external history of science, see Thomas Kuhn's essay 'The History of Science', in Thomas Kuhn, *The Essential Tension,* Chicago: University of Chicago Press, 1977, and Imre Lakatos, 'History of Science and its Rational Reconstructions' in *The Methodology of Scientific Research Programmes,* Eds John Worrall and Gregory Currie, Cambridge: Cambridge University Press, 1978.

development of science is to be explained by the rational progress through successive theories based on experimental evidence. Second, and more straightforwardly, the chronology of this pair of revolutions serves to drive a wedge between them. The sequence of events, combined with a common-sense view of their relative impact, seems to rule out the very possibility of any causal interaction between these two events. In fact, Maurice Crosland has proclaimed the futility of any such project, offering in its place the more anodyne alternative of a shared heritage:

> No-one would want to argue a cause and effect connection between the two revolutions [the French Revolution and the chemical revolution] but it might be reasonable to argue along the lines of a common context.[34]

What are the reasons for Crosland's dismissal of any causal relationship between the two revolutions? First, the French Revolution was a momentous event on the contemporary political scene, while the chemical revolution was a transformative episode in a relatively underdeveloped science, directly affecting relatively few people. Therefore, the most promising route for an argument that one revolution caused the other would seem to lie in positing the French Revolution as the cause of the chemical revolution. Such an attempt immediately runs into problems of chronology, as, on the one hand, the canonical starting date for the French Revolution is 14 July 1789, while on the other hand the close of the chemical revolution is usually taken to be announced by the publication of Lavoisier's masterful textbook, the *Traité Élémentaire de Chimie,* also in 1789. So, if the chemical revolution was over before the French Revolution began, then the historian who wishes to pursue the possibility of cause and effect, seems to be left with the option of seeking out the influences of the former on the latter.

Nevertheless, looking from the other side of the question is not much more promising. Could the chemical revolution have influenced the course of the French Revolution? Several possibilities suggest themselves in response to this question, but none seems to offer any explanatory prospects. On the practical side, the exploration of the newly-discovered gases gave rise to hydrogen balloons, which served as observation posts for the French *aérostiers* during several important battles of the revolutionary period. Moreover, Guyton de Morveau, one of the other leading figures of the chemical revolution, was intimately involved with the development and deployment of these hydrogen balloons. It would, however, be hard to argue that these balloons were a significant addition to the French army, even in their most notable engagement (the battle of Fleurus in 1792). Military balloons, and more particularly the founding of a balloon school at Meudon,[35]

[34] Maurice Crosland, 'Lavoisier, the Two French Revolutions and "The Imperial Despotism of Oxygen"', *Ambix* 42, 1995.

[35] The National Convention decreed the opening of the *École d 'aérostation* at Meudon, on 2 April 1794.

constituted a visible symbol of the government's commitment to innovation (scientific among other forms), but served little other purpose. In fact, gunpowder represented a much more important opportunity for the practical application of chemistry than balloons. If Lavoisier's claims to have improved French gunpowder are to be believed, this was a significant contribution of chemistry to the defence of the French republic, but only after the French Revolution itself.

What about the fall-back position of a common cultural cause for the two revolutions? There is no doubt something important to be said about the role of Enlightenment views in stimulating both the scientific and the political revolution. A positive view of science, particularly practical science, exhibited most clearly in Diderot and d'Alembert's Encyclopedic project, made it more acceptable for the bourgeoisie (including both men and women) to take an interest in these sciences. As I will argue in Chapter 3, this was an important influence in the rise of an independent philosophical chemistry. Furthermore, the Enlightenment, as a set of values, played some part in establishing a political culture that challenged the absolutism which had been characteristic of France at least since the time of Louis XIV.[36] Although this cultural history is very appealing, and has been persuasively presented by several notable historians, I believe that we can locate a more tangible relationship between the French and chemical revolutions than this nebulous cultural common cause.[37]

My aim is to revive one of the options ruled out above, albeit in a revised form. Rather than suggest that the French Revolution caused the chemical revolution, I want to argue that the political event was constitutive of the scientific revolution. This requires broadening the concept of the chemical revolution beyond its traditional limits, and insisting on its being a negotiable historical construct, rather than a brute historical fact waiting to be laid bare by the appropriate research. The chemical revolution is still open to interpretation, and I believe that any adequate interpretation must take the institutional effects of the French Revolution into account.

In order to make the connection between the political and scientific revolutions clearer, I use Chapters 4 and 5 to emphasize the point that the French Revolution dramatically changed the institutional topography of France and that this in turn had a profound effect on the ways in which Lavoisier's chemistry was adopted and disseminated. I will only be examining the effect of these events on pharmacy here, but I believe that analyses of any one of the chemical arts would reveal the ways in which the new chemistry was established widely and relatively quickly thanks to the changes (chiefly in the sphere of education) brought about under the First Republic and the Napoleonic Empire. The introduction of a clear professional identity for both the academic chemist and the scientific pharmacist served to locate

[36] See, Thomas Broman 'The Habermasian Public Sphere and "Science in the Enlightenment"', *History of Science,* 26 (1998): 123-149.

[37] For example, Roger Chartier, *The Cultural Origins of the French Revolution,* Durham NC: Duke University Press, 1991.

the disciplines in social space, and thus facilitated the construction of a Lavoisier-centred view of the chemical revolution from these fixed points. In this fashion, the French Revolution contributed not only to the crystallization of Lavoisier's work as a sudden break with the past, but it also made him appear as a more typical chemist than he actually was.

Finally, broadening the chemical revolution to include social and institutional transformations, as well as purely theoretical innovation, allows us not only to understand the historical event more adequately, but also to share out the credit for the founding of modern French chemistry in France. The reformers who followed in his wake, I will argue, contributed in ways that would turn out to be just as important for the chemical revolution as Lavoisier's innovations.

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Chapter 2

From Artisan to Scientist

The Creation and Rise of the French Pharmacist

From the editors of the Bulletin of Pharmacy
to the honourable secretary of the Paris Society of Pharmacy.

The important tasks to which we are going to dedicate ourselves do not allow us to waste our time at the meetings of your society; we request that you inform your colleagues of our intention of no longer being included in your directory; it is henceforth impossible that observer-pharmacists moulded by the principles they drew from the great masters' lessons; now that they have versed themselves in the natural methods and philosophical systems and have established friendships with the greatest chemists and physicists of Europe, can walk alongside these pharmacists who are nothing but more or less skilled manipulators, devoid of the knowledge that illuminates their art; In fact, sir, isn't it disheartening for us to see ourselves disdained by chemists who only occupy themselves with theory, we who made ourselves so commendable through so many useful works, who illuminated an ungrateful science with the enlightening flame of our genius; and will be regarded as parrots. ....

We have the honour of greeting you

Signed Parmentier, Cadet, Planche, Boullay, Boudet and Destouches [1]

The Paris Society of Pharmacy had this letter scrupulously copied into its ledgers. The text looks rather incongruous squeezed between the society's monotonous administrative proceedings and the accounts of its interminable struggles against charlatans operating in France's capital city. Perhaps the clearest message that the society received from this letter was the threatened defection of six of its members,

[1] From folio 12, register 49 in the archive of the Bibliothèque Interuniversitaire at the Faculty of Pharmacy in Paris (BIUP). The letter is transcribed into the register with the underlining in the original. No date is given for the letter, and so it is difficult to establish one with precision. The document before this one is from September 1805, and the one after from October 1814. The Bulletin started in January 1809, and I would place the letter around this date because Vauquelin, an unlikely target for this letter, was president of the Society in 1808. If Cadet de Gassicourt signed it, it must have been before he was called up to join Napoleon in Germany as *pharmacien de l'empereur* on 24 March 1809.

including Napoleon's personal pharmacist, as well as his chief military pharmacist.[2] For the purposes of my argument, however, it is the denunciation accompanying the threat of resignation that is of most interest. The statement that pharmacists (and apothecaries before them) were nothing more than 'manipulators' of chemical products was an unusual accusation for pharmacists to level at their own colleagues, and it must have come as a shock for the society. The editors of the newly-constituted *Bulletin de pharmacie* distinguish themselves from the benighted practitioners of an ancient, but (according to this letter at least) far from venerable art, by referring to themselves as 'observer-pharmacists'. The men who chose this title represented a new scientific vanguard of pharmacy, destined to succeed what they regarded as an ailing, uninformed empirical art. Important to their sense of difference from other pharmacists were the intimate links these observer-pharmacists claimed to have with the chemists, and their professed commitment to natural methods and philosophical systems. These key phrases were meant not only to associate their authors with an optimistic Enlightenment view of progress through the sciences, but also, more particularly, they were intended to forge a direct link with the founders of the victorious chemical system that emerged in France at the end of the eighteenth century around the figure of Antoine-Laurent Lavoisier. The authors of the letter were clearly seeking legitimacy for their view of pharmacy (as intimately connected to the sciences, if not a science itself) beyond the confines of a society whose purpose was the administration of pharmacy in Paris, a society they threatened to abandon in order to pursue their vision of a modern pharmacy. In the end, I will argue, it would be these observer-pharmacists, announcing their existence in this letter who would lead French pharmacy into the nineteenth century as a science, informed and legitimated by the new chemistry. In the course of assuming the scientific mantle, pharmacy would change its relationship with chemistry, eventually orienting itself towards the new chemistry and its characteristic analytical perspective. It was in this transformation that a new pharmaceutical chemistry would find its defmition in the nineteenth century.

The letter's explicit attack on the worth of pharmacy as practiced by most members of the Society of Pharmacy represents the last stage in a profound transformation which French pharmacy had undergone over the last decades of the eighteenth century and which seems to have been resolved only during the first decades of the nineteenth. The authors of the letter have highlighted the remarkable effect that the chemical revolution had had on the community of pharmacists. Formerly, in seventeenth- and early eighteenth-century France, chemistry and pharmacy had been associated to the point of being indistinguishable. Over the course of the eighteenth century, however, a new *philosophical* chemistry had developed that was increasingly divorced from pharmacy. Having realized its full potential as an independent science with the ground-breaking work of Lavoisier and

[2] Parmentier held the title *premier pharmacien des armées* and Cadet de Gassicourt that of *pharmacien de l'empereur.*

his colleagues at the end of the eighteenth century, the new chemistry now demanded to be heard on its own terms.

The great success of Lavoisier's new chemistry, a science that did not concern itself with pharmacy, necessarily raised questions about what relationship, if any, pharmacy could be considered to bear to the science of chemistry. The answers that came from inside this community of philosophical chemists tended to demote pharmacy, characterizing it as merely a chemical art. Nevertheless, certain of these chemists (Antoine-François de Fourcroy in particular, as we shall see in what follows) held out a hope for pharmacy's scientific redemption if it abandoned its old artisanal identity and aligned itself with the new chemistry. The complex nature of this historical episode seems to have eluded most historians of chemistry, who tend to perpetuate Lavoisier's view of pharmacy's irrelevance to late eighteenth-century chemistry. Nevertheless, adopting Lavoisier's perspective blinds us to the interesting and unusual situation in which the pharmacists found themselves at the time of the chemical revolution. They were now confronted with an apparently brand-new scientific discipline which, although traditionally an integral part of pharmacy itself, had become a competitor, and a competitor with a decided edge. Paradoxically, at the beginning of the nineteenth century, this new chemistry was not a source of pride and unity amongst the profession that had spawned it, but instead served to throw the value of pharmacy into question and to divide pharmacists against one another.

Divisions within the community of pharmacists were certainly nothing new. As with any guild, much of the history of the French apothecaries is taken up with defining and defending their rights and duties not only from assaults by neighbouring professions, but from internal disruption as well. [3] Up until this time, however, any disputes within the body of apothecaries had typically been over issues of institutional privilege. For example, the rank-and-file members of the guild of apothecaries resented the status enjoyed by the *apothicaires privilégiés,* who, through their attachment to the crown, the army or monastic orders escaped the control of the guild and operated autonomously until 1777. In Napoleonic France, however, the divisive issue had become the scientific status of pharmacy, and views on the future orientation of the profession differed accordingly. Should pharmacy continue with its traditional approaches and preparations, or should it look to the new science of chemistry as underwriting the future credibility of the art?

In order to frame this problematic, I use two sets of speeches that, when placed side by side, show the extent to which the context of pharmacy changed in the wake of the French and chemical revolutions. These are two formal occasions involving two quite different official bodies, and yet the purpose of both was to represent the

[3] As an example of an external dispute, Robert Scagliola cites the persistent struggle between the *corporation des sauciers-moutardiers-vinaigriers-distillateurs* created by Louis XII in 1514 and the Parisian apothecaries. Robert Scagliola. *Les Apothicaires de Paris et les distillateurs,* Clermont-Ferrand, 1943.

interests of Parisian pharmacists. The first group of speeches took place in 1777 to celebrate the newly founded *Collège de pharmacie,* and the second was a single speech before the *Société litre des pharmaciens.* This second event took place in 1797, twenty years after the first; this pair of dates straddles both the chemical revolution (narrowly understood as the introduction of Lavoisier's new chemical theory) and the French Revolution, and thus it would be surprising if pharmacy had undergone no changes at all to reflect these important transformations in both French science and society. The first speech reveals Parisian pharmacy at its eighteenth-century zenith, under the protection of the king, and challenging the supremacy of the powerful faculty of medicine in Paris, while the second captures the profession at a time of uncertainty. In the preceding decade, all its privileges had been called into question, and its future now depended on the unpredictable young Republic of France. Indeed, the distance that pharmacy had travelled in the course of these two decades becomes clear when we place these two sets of speeches side by side. Before these can be properly understood, however, I need to fill in the institutional history which serves as a background to these events, for without this context it is difficult to appreciate their full significance.

Pharmacy: the journey mapped out from 1777 to 1803

From the Middle Ages, the French apothecary had operated under the guidance of centralized administrative institutions, becoming a free trade for only a matter of days during the most radical phase of the French Revolution. Following its incorporation under Charles VIII in 1484 as the guild of *apothicaires-épiciers,* each provincial guild oversaw and legislated for the profession within its local area. The entry of apprentices into the field was regulated by the guild responsible for the district, which normally demanded a four-year apprenticeship. The family of a prospective apprentice would usually negotiate a contract for their son with a local practicing apothecary, an agreement that would cost the family between 50 and 200 livres.[4] Therefore, leaving aside any other qualifications that might be required, the price of an apprenticeship limited the profession to the sons of elite artisans or the local bourgeois. After successfully completing his apprenticeship, the next stage for the candidate was to become a journeyman. Now under the supervision of the national network of guilds, the journeyman would travel around France working in paid positions with various apothecaries and building up the practical experience necessary for becoming a apothecary. After this three-year tour of France, the journeyman graduated to the status of qualified apothecary by passing an exam, again administered by his local guild. The apothecary could now set up his own

[4] These figures are from Georges Dilleman, Henri Bonnemain, and André Boucherle, *La Pharmacie française; ses origines, son histoire, son évolution,* Paris: Tec & Doc, 1992, who estimate the value of 200 livres in 1992 to be around 26000 francs (2600 pounds).

officine,[5] subject to limitations imposed by the guild, and could hope to achieve a higher qualification – the *maîtrise* — on submission of a *chef d'oeuvre.* The examination of the *chef d'oeuvre* was also administered by the local guild, which effectively levelled supplementary charges on the student for all these tests that he had to take. In addition to composing strict ordinances governing who could set up an *officine* and where, the guild also took responsibility for regular inspections of any such premises, and the officers of the guild took such responsibilities very seriously.

Although the guild's control was widespread, it was not total. A parallel series of qualifications existed side by side with the guild-system. The privileged apothecaries *(apothicaires privilégiés),* who included those appointed *apothicaire royal* by the king, and the sons of master-apothecaries, were exempt from the qualifying examinations administered by the guild, and could open their *officines* and practice as apothecaries without the guild's approval.[6] The fact that these groups escaped the control of the guild would remain an irritation for ordinary apothecaries until, in 1777, their privileged counterparts (in Paris at least) were drawn into the unifying *Collège de pharmacie.* Vestigial privileges were only comprehensively removed, however, by the French Revolution itself.

The end of the eighteenth century saw the first legislative challenges to the dominance of the guild system in France. Liberal economic thinkers regarded the guild administration of professions as a means of indirect regulation, and the physiocrats famously demonized them as an unnecessary restraint on free trade. Although successive French governments were reluctant to attack such a well established system, on 5 February 1776 the physiocrat Turgot, Louis XVI's first chief minister, attempted to suppress the guilds in France. Deemed too important a profession to be practiced unsupervised, the apothecaries (along with the printers and the goldsmiths) received a special dispensation exempting them from this legislation. Necker replaced Turgot after the latter's resignation in May 1776, and the anti-guild policy was discontinued. Although the apothecaries had been fortunate enough to escape any ill effects of Turgot's move against the guilds, these were clearly difficult times, with the very attempt to eliminate it signalling a rising

[5] The word *officine* is difficult to translate, as it refers both to the pharmacy where the apothecary dispensed medicines and the associated laboratory where he prepared what he was going to sell.

[6] 'Les apothicaires privilégiés de Paris sous l'Ancien régime.' in *Bulletin de la société d'histoire de la pharmacie,* 16 (1917), p.267, drawing on a book by E.-H. Guitard.

There were five types of privilege:

(i) suivant-la-Cour'

(ii) de la famille royale

(iii) des maisons royales et de l'arm&

(iv) des couvents et du premier médecin

(v) gagnant-maîtrise'.

antipathy to the traditional guild structure within contemporary economic thought, and possibly a similar feeling on the part of the ruling elite itself.

Only a year after presiding over his chief minister's initiative to abolish guilds altogether in France, Louis XVI backed the opposite approach, albeit on a smaller scale, with respect to pharmacy. By signing the separation of the apothecary from the spicer into law on 25 April 1777, he was effectively creating a new guild. This separation was natural in a certain sense, and was certainly in line with the apothecaries' view of their position in the field of medical practice. The legal division of labour was that doctors alone were allowed to prescribe medicines, and apothecaries in turn were the only ones allowed to fill them. The spicers were supposed to restrict their activity to supplying the so-called 'simples', the basic ingredients that were combined into the 'compound' medicines by the apothecaries. Contravention of these privileges was, it seems, the exception that continually proved the rule, with doctors filling prescriptions, apothecaries informally prescribing their own medicines, and spicers regularly selling medicines. Thus, the apothecaries saw the division of the guild as an important opportunity for establishing their exclusive rights that were already inscribed in the law. Beyond the simple fact of separation, however, the Parisian apothecaries were granted new rights, a new institution and a new name. They found a new home in the *Collège de pharmacie de Paris,* established on the site of the former *Jardin des apothicaires,* on the rue d'Arbalètre, a site that comprised all the buildings of the old guild of *apothicaires-épiciers.* The physical institution was, therefore, only new in name, although now the spicers had been removed from the buildings. In addition, the *apothicaires* were now to be known as *pharmaciens,* so it is quite literally true to say that on this day in 1777 the pharmacist, if not pharmacy, was born in France.

The pharmacists were granted the important monopoly over making salts and 'any other preparations intended to be taken internally as medicaments'. This precision served to clarify the pharmacists' position with respect both to doctors who might want to prepare medications themselves, and enterprising spicers who hoped to move beyond their official role of supplying the simple medicines in bulk. Furthermore, all differentiation of rank within the College was dissolved, drawing the privileged apothecaries under the same administration as the ordinary pharmacists. Although this would not serve to eradicate the exemptions such pharmacists had enjoyed, it at least brought them under the supervision of the *Collège.* This was an important step towards uniting all practicing Parisian pharmacists within a single community operating under the watchful eye of a single administrative body.

In 1780, the *Collège de pharmacie* received *lettres patentes* from the King granting the college the right to teach pharmacy publicly, a right formerly monopolized by the powerful Faculty of Medicine at the University of Paris. This represented a considerable victory for the pharmacists over the doctors. The turf war between the Faculty of Medicine and the Parisian apothecaries had flared up

again and again over the years,[7] and the granting of this right to teach was a welcome sign of the king's favour.

In its course, the French Revolution would realize Turgot's plan of sweeping away most of the guild restrictions that operated in pre-revolutionary France. The d'Allarde law (2-17 March 1791), which took effect on 1 April 1791, was the legal instrument by which the National Assembly suppressed all associations of workers and all qualifications for working in trades. In line with its views on the freedom of the citizen from traditional occupational restraints, combined with the country's pressing need for cash, any citizen could pursue whatever trade he desired on payment of an appropriate fee. Just as in Turgot's time, however, this move to undo all traditional commercial associations was not unmitigated. Due to the representations of the *Comité de salubrith* headed by Joseph-Ignace Guillotin, the National Assembly backed down with respect to pharmacy and two weeks later, on 14 April 1791, they reinstated limits on the exercise of pharmacy, limits back-dated to cover the intervening period. This left the *Collège de pharmacie* in the strange position of having dissolved itself in order to be in conformity with the d'Allarde law, yet still existing as the body administering pharmacy in Paris.

The opportunity to re-form as an official group came in 1796, when the Convention granted citizens the right to constitute 'free societies'. On 20 March 1796, the remnants of the former *Collège de pharmacie* became the *Société libre des pharmaciens.* Reflecting the continuity that the change in name sought to disguise, this new body of citizens took up residence in the former home of the *Collège* and assumed the same right to teach courses that it had exercised in its previous incarnation before the revolution. The society formed the *École gratuite de pharmacie* specifically to teach its courses, and this time the Paris Faculty of Medicine was not there to protest, having been dissolved along with the *Académie des Sciences* in 1793. The society's charter of 16 Thermidor IV (3 August 1796) guaranteed public lectures and prizes, with its commitment to teaching outlined in article XVIII:

> Every year, four free public courses shall be given at the School of Pharmacy; to wit, one in Chemistry, one in Pharmacy, a third in Natural History, and a fourth in Botany.[8]

The School of Pharmacy was effectively a survivor from the pre-revolutionary *ancien régime* and joined the ranks of a significant number of reformed educational

[7] For example, the printing of Philippe Guibert's *Médecin charitable* was intended to ruin the apothecaries' trade by giving the public instructions concerning how to prepare the most important medicines. See Kremers and Urdang, *History of Pharmacy,* p.62.

[8] Jacques de Mari, *La Société libre des pharmaciens de Paris (1796-1803),* Grenoble: Prudhomme & C[ie], 1944, p. 23. 11 sera fait, chaque année quatre cours publics et gratuits dans *l'Ecole de Pharmacie,* savoir un de Chymie, un de Pharmacie, un troisième d'Histoire naturelle, et un quatrième de Botanique.'

establishments that emerged from the French Revolution, including the *École Polytechnique* and the *École des Mines.*

The history of pharmacy I have just presented covers the twenty years spanned by the two speeches examined below. But, before presenting these events, I would like to consider the fate of the pharmacists as they moved into the nineteenth century. The institutional transformation of pharmacy under Napoleon is even more important for its scientific development than the events of the French Revolution itself. The *Société libre des pharmaciens* remained the representative body for Parisian pharmacists during the next seven years. After this, the discipline underwent its most significant and comprehensive reform. The law of 21 Germinal year 11 (11 April 1803) placed pharmacy within a system of state administration and education. The projected plan for medical education in the Republic envisioned the founding of six schools of pharmacy attached to six medical schools in Paris, Montpellier, Strasbourg, Mainz, Genoa and Turin, although in the end only the first three cities had their own (French) schools of pharmacy. The schools would serve to draw pharmacists into formal education as a supplement to the traditional pattern of apprenticeship. Attendance at one of these official schools of pharmacy was rewarded through a new system of qualifications. There would now be two classes of pharmacist; first, the pharmacist who was examined in one of the schools, who could set up his *officine* anywhere in France, second, the pharmacist who was examined by a local jury, who could operate only in the particular area in which he had qualified.[9]

This Napoleonic legislation, which I shall examine in more detail in Chapter 4, placed emphasis on the registration and education of pharmacists by the state, reducing the autonomy of the vestiges of the guild structure that survived the Revolution. Nevertheless, the heirs of the guilds in the nineteenth century still effectively controlled many aspects of the life of the pharmacist, their training in particular. The major effects of the law were, therefore, to raise the level of the state's involvement in pharmacy and also to promote the role of formal education in the training of future generations of pharmacists in France. Apart from absorption into the imperial university in 1809, the educational model for French pharmacy would remain substantially the same throughout the nineteenth, and into the twentieth century.

I want now to return to the task of giving an impression of the distance that pharmacy travelled over the lifetime of the College of Pharmacy, the almost twenty years from 1777 to 1796. As I said, I will do this by offering a comparison of two inaugural ceremonies. The first took place in the summer of 1777, and celebrates the royal founding of the *College de pharmacie de Paris,* while the second, from

[9] Law reproduced in Alfred de Beauchamp, *Médecine et pharmacie, projets de lois,* Paris, 1888. Vol. 28 of *Enquêtes et documents relatifs a l'enseignement supérieur:* 600 ff. See Articles 23, 24 and 27 for the degrees of qualification. Health officers *(officiers de santé)* could also administer medicine, although they could not hold an officine. For more on the health officer see Chapter 4 below.

the winter of 1797, commemorates the coming together of a group of free citizens in the Republic of France to form the *Société libre des pharmaciens.*

Founding the *College de pharmacie de Paris*

The inauguration of the *Collège de pharmacie de Paris* that took place over the course of two days in the summer of 1777 was a suitably impressive affair, illustrating the elevated social goals that the Parisian pharmacists had set themselves under the reign of Louis XVI. Although certainly aware that they should not risk an open confrontation with the Paris physicians, they were leaning hard on the privileges of the Faculty of Medicine at the University of Paris, using the King as protection. In a letter addressed to Antoine Baumé, a *doyen* of the new establishinent, Bougguez, an apothecary practicing in Aurillac (Auvergne), gives us some idea of the status the *Collège* hoped to attain. Before asking for clarification on some details concerning the *Collège,* Bougguez waxes lyrical on the significance of the King's intervention.

> The King, through his declaration of 25 April, has just raised your guild up into a College, and has cut pharmacy loose from the spicers. It seems to me that the King wants to accord certain privileges to this science, and in confining the pharmacists within the bounds from which they never should have strayed, he wants them to enjoy the same prerogatives as the surgeons. Without doubt all the true apothecaries of the kingdom will bend their efforts to perfecting this art and to meriting the profitable days of this law. Do I not have the good fortune to be a member of your illustrious company, and to accompany you in demonstrating to our generous monarch that which this profession has deserved for a long time; to escape from the class of arts and crafts. [10]

Bougguez's message is quite clear; through the act of founding the *Collège,* pharmacy was at the very least aspiring to raise its status from being just another artisanal skill — one of the arts — to that of a liberal art. The newly defined bounds of pharmacy are recognized as being its proper limits, implying that this liberal profession was always present, only it had previously been trapped in an unworthy partnership with the guild of spicers, an association that disguised the true worth of

[10] Archives of the Faculté de Pharmacie, Paris: Registre 10, letter of 22 June 1777: 'Le Roy par sa declaration du 25 avril, vient d'ériger votre communauté en Collège, et de desunir la pharmacie de l'epicerie, il me semble que le Roy veut accorder a cette science des privileges qui en restraignant le pharmacien dans les bornes dont il n'auroit jamais deu sortir, veut qu'il jouisse des memes prerogatives que le chirurgien. Sans doute que tout ce qu'il y a de vrais apoticaires dans le Royaume fairont leurs effors pour perfectionner cet art, et pour meriter des jours du benefice de cette loi que n'ai je le bonneur, Monsieur d'être membre de votre illustre compagnie pour concourir avec vous a prouver au monarque bienfaisant que cette proffession meritoit depuis longtems de sortir de la clace des ars et metiers.'

the pharmacist. Bougguez's use of the term 'science' is also suggestive, even though the French word does not have the specific connotations of its English cognate. The implication might even be taken to be that a science is not practiced in a guild, but in an Academy! Indeed, we should bear in mind that in April 1731 the king had founded a Parisian academy for the surgeons. This act was followed up by a declaration in 1743 that required the Paris master surgeons to hold a degree from the university and banned them from any degrading work as barber-surgeons, thus providing a clear model for the apothecaries in terms of social ascension.[11] On an even more elevated social level, the apothecaries might have had their sights set on the Royal Academy of Sciences, which itself counted a number of apothecaries among its members.[12] As a pale reflection of this national scientific institution, an academy of apothecaries in the form of the College of Pharmacy could serve its own royal patron by performing functions parallel to those the Royal Academy of Sciences performed for the crown.

This tentative claim concerning the pharmacists' ambition for their representative body is supported by the central role of the college's patron, Jean-Charles-Pierre Lenoir, *Conseiller d'Etat* and Lieutenant-General of Police, who was also the chief representative of the king at the college's ceremonies[13] The relationship between Lenoir and the *Collège de pharmacie* was a symbiotic one, and seems to have exhibited many features of a patron's relationship with a private academy, if not a royal one. The college provided Lenoir with a source of scientific expertise, allowing him to by-pass the rather more haughty (and overworked) experts of the Royal Academy of Sciences.[14] In return, Lenoir supplied the college with political support at court, as well as sometimes offering the physical means of enforcing order in their courses. There was, however, an important dissimilarity between the *Collège de pharmacie* and the Royal Academy of Sciences; at no point did the college receive funding from the royal coffers, relying instead on annual dues paid by the members according to a sliding scale based on seniority.[15]

[11] See Toby Gelfand, 'Monarchical Profession' in the Old Regime: Surgeons, Ordinary Practitioners, and Medical Professionalization in Eighteenth-Century France', in G. L. Geison (Ed.), *Professions and the French State, 1700-1900,* Philadelphia: University of Pennsylvania Press, 1984, particularly pp. 161-3.

[12] For a history of this august French institution see Roger Hahn *Anatomy of a Scientific Institution.* Berkeley: University of California Press, 1971.

[13] Lenoir's full title was *Lieutenant général de police de la ville, prévôtê et vicomté de Paris.* Although technically not a very high rank, the position brought a lot of power and prestige with it. See Alan Williams, *The Police of Paris,* Baton Rouge: Louisiana State University Press, 1979.

[14] In 1781, at Lenoir's request, a committee was formed by the *Collège* to report on a paper entitled 'Observations sur]'usage de l'etain '. The model being adopted seems to be that of the *Academie Royale des Sciences,* a body whose expertise Lenoir wanted to make use of as well. See Williams *The Police of Paris,* p. 136

[15] The fact that the *Collège* supported itself would become an article of particular pride when the time came to form the *Societé libre des pharmaciens.* The pharmacists considered

The special political relationship between Lenoir and the *Collège de pharmacie* is acknowledged in painfully demeaning terms by Demachy at the end of his speech. Lenoir, he says, is more than just the college's patron, he is 'a true father to whom we owe our existence, the feelings he has for his new family are those of adoption'.[16] While it is difficult to assess the exact nature and extent of the relationship that existed between Lenoir and the *Collège de pharmacie,* it is important not underestimate it: [17] Thus, the context of political patronage in *ancien régime* France forms an essential background to the inauguration of the *Collège de pharmacie* in Paris.

The first part of the opening ceremony took place on 30 June 1777, on the premises of the new College. The guest of honour was neither a pharmacist, nor any sort of natural philosopher, but rather an officer of the king: Lenoir, *Conseiller d'État* and Lieutenant-General of Police. Four *Apothicaires du Corps du Roy* were also mentioned as honoured witnesses to the ceremony. They were now, in principle at least, pharmacists on a par with the other members of the *Collège,* but, as we can infer from their being specially mentioned, they retained the privileged social status that they had received by virtue of their royal appointment. [18]

The whole ceremony proceeded according to a formula heavily weighted on the side of the king and his government. After Lenoir's short introduction, his secretary read out the relevant edict proclaimed by the *Conseil d'État.* Lenoir then spoke again to name the officers of the new *Collège de pharmacie,* whom he had personally appointed in accordance with a right specified in the royal edict.[19]From the outset, therefore, Lenoir was asserting at least symbolic control over this nominally independent professional body, a royal influence that would pass away in the course of the French Revolution.

Only after all these legislative proclamations had been completed was a representative of the *College* allowed a few final words. This closing speech was delivered by Trevez, who had been pronounced *premier Prévôt* of the *Collège* just

themselves less compromised in terms of republican values because they had not been financially supported by the king. The Royal Academy of Sciences, on the other hand, was funded entirely by the crown.

[16] '...un vrai père a qui nous devons notre existence; il a pour sa nouvelle famille les sentiments de l'adoption;...' Speech by De Machy introducing the inaugural course offered by the *Collège de Pharmacie de Paris,* 16 July, 1777. Reproduced in Paul Dorveaux, 'Procès-verbaux des délibérations du Collège de pharmacie de Paris', *Revue d'histoire de la pharmacie* 92 (1935), p. 246.

[17] Although an important and powerful figure on the pharmaceutical scene, Lenoir did not presume to dictate the functioning of the guild in its traditional role of regulating Parisian pharmacy.

[18] These privileged pharmacists were not yet required to submit themselves to the qualification examinations administered by the College.

[19] Again, following the model of the Royal Academy of Sciences, the college proposed the candidates, and these proposals were approved by Lenoir, who officially made the appointment.

moments earlier. The flattering tone of this concluding speech, addressed directly to the *Conseiller d 'Etat,* reflects the political importance of Lenoir's support as well as the considerable power he represented:

> SIR,
> An epoch which must forever be remembered in the annals of Pharmacy, your presence amongst us, the kind words which we have just heard, all conspire this day to evoke feelings that demand a more brilliant speaker. [20]

Trevez was, however, quite brilliant enough as a speaker to convey several important themes. With the arrival of explicit royal protection and such a powerful patron as Lenoir, alternative justifications for defending the privileges of pharmacists became available. Traditionally, the apothecary had justified his existence in terms of the social utility of the profession; the qualified medical doctor drew up a prescription in accordance with the diagnosis, and the apothecary supplied the prescribed medication. The new pharmacist, however, could go further than the apothecary and assert a right to exist independently of his role as the doctor's amanuensis. Moreover, the separation of the activity froin the spicers provided a perfect scapegoat for past indignity, an unhappy association that had served to disguise the true value of pharmacy. The happy conjuncture of 1777 would allow the pharmacist to assume his veritable status. Pharmacy as a profession could be claimed to be associated with certain rights of its own, foremost among these the right to be recognized, not just as a service, but as an honourable social station in life:

> The domain of Pharmacy, better defended against the businesses of merchants [the *marchand-épiciers]* will no longer see itself fall prey to their abuses, doubly at fault in exposing the public to the greatest mischief at the same time as they deprive the Pharmacist of the fruits of his position.[21]

But what role, if any, did chemistry play in the new situation of the pharmacist? The clues from this first inauguration day are sparse, chemistry itself was mentioned only once, and then simply as the adjective *chimiques'* qualifying the compositions that needed to be known by the candidates for entry into the college: knowledge of 'the application of these principles [of the pharmaceutical art] to

[20] Speech by Trevez at the inaugural session of the *Collége de pharmacie de Paris,* 30 June 1777. Reproduced in Paul Dorveaux, 'Procès-verbaux des delibérations du Collège de pharmacie de Paris', *Revue d'histoire de la pharmacie* 90 (1935), p. 118, 'Monsieur, une epoque à jamais mémorable dans les fastes de la Pharmacie, votre présence au milieu de nous, les paroles de bonté que nous venons d'entendre, tout est fait en ce jour pour des sentiments qui demanderoient un plus brillant interprète.'

[21] Ibid., p. 119, 'Le domaine de la Pharmacie, mieux défendu contre les entreprises marchandes, ne se verra plus en proie a des ravages qui doublement coupables exposoient le public aux plus grands malheurs en même temps qu'ils frustroient le Pharmacien des fruits de son &at.'

Galenic as well as chemical compositions'.[22] In this ceremony, dominated by official edicts and expressions of gratitude for the founding of the *College,* any discussion of chemistry would have been out of place.

The opening day of the *Collège de pharmacie* was followed a month later by the inauguration of the courses that formed the core of the college's educational mission.[23] This supplementary ceremony was an occasion in which chemistry assumed a much higher profile. Indeed, the inaugural lesson was in chemistry, taught by Mitouart, and presented, according to the report, straight after the preliminary speeches, on 16 July 1777. Lenoir was again present, this time along with a whole battery of high-ranking royal officials: M. Joly de Fleury, *avocat général,* M. de Villeveau, *Maître des Requêtes* and M. Moreau, *Procureur du Roy.* On this day, however, despite the number of dignitaries present, it was the turn of the pharmacists' to speak; first M. Habert in his capacity as *apothicaire du Corps du Roy* and perpetual honorary provost, followed by Trevez, and finally M. Demachy, a demonstrator for the course in botany and natural history. The order in which these men spoke further reflects the centrality of the king's agents in the position of the new *Collège.* The *apothicaire du Corps du Roy* was being given the privilege of opening the proceedings, which shows a temporary acceptance of a contested status within the *Collège.* Indeed, the special rights these *apothicaires royaux* enjoyed were the source of disputes that would continue until the question was resolved once and for all with the radical reforms of the French Revolution. Nevertheless, this exceptional celebratory event provided an opportunity to indulge in the rhetoric of professional equality, a moment of sodality within the newly formed group. It was a time for all the college's members to celebrate their definitive separation from their rivals, the *épiciers.* In line with this ecumenical spirit, the privileged pharmacists could welcome the enforced healing of rifts between the different orders of apothecaries, rifts that had only deepened and matured over the centuries. Habert, indeed, was the first to turn his speech to such irenic ends:

> Consider with me ... how minor considerations of self-esteem, of rivalry, of opinion, and of fame, tend to divide men who are travelling the same route, and you will understand the respectability of a union that can only be founded on profound and reciprocal respect. I conclude from this that any differences of opinion that could be born among you cannot give rise to anything but honest

[22] From the *Extrait des registres du conseil d'etat,* read by Collot, Le Noir's secretary. Ibid., p.117, Tapplication des principes [de l'art pharmaceutique] aux compositions tant galéniques que chimiques'.

[23] As a consequence of the monopoly that the Paris Faculty of Medicine had over teaching such courses, the college's courses were not formally allowed to be offered publicly until after the edict of 1780.

> disagreement, decent and always useful for the progress of the sciences that give rise to your glory and happiness.[24]

The other two echo the sentiment, although these ordinary members of the *Collège* cannot equal the magnanimity of the *apothicaire royal.* It is interesting to note the reference Habert makes to the maintenance of honest and moderate behaviour for the sake of advancing the sciences. The vision of this kind of gentlemanly conduct in the interest of scientific progress seems designed to call to mind the ideals of the societies of savants – the Academies – rather than the guilds of which the *Collège* is really just an incarnation. Indeed, the aspirations of the pharmacists are close to the surface throughout these ceremonies.

What exactly are the sciences that will be furthered by this new *Collège?* All three speeches touch on this subject, revealing interestingly different perspectives. It might at first seem surprising that the 'science' involved in pharmacy should be dealt with at all in front of an audience of courtiers and pharmacists, as there is no clear need to broach this subject. This situation stands in sharp contrast to the circumstances of Fourcroy's speech of twenty years later, which will be presented next. Fourcroy's was the speech of a 'chemist' addressing 'pharmacists' who, he feared, remained for the most part unconvinced of their need to embrace the new science; thus, the goals are clearer in this post-revolutionary situation. What is particularly important about the formation of the *Collège de pharmacie,* by contrast, is a social reorientation. The law of 1777 allowed the apothecaries to make a crucial move away from their past within a guild, where, although they remained relatively autonomous, defending their professional interests was a constant struggle, and towards a position, temporary as it would turn out, more closely under the wing of court patronage. The need to talk of science and chemistry did, however, itself serve a role in establishing the credibility of the pharmacists. To be scientific, to work for the furtherance of the sciences, was at one and the same time to reaffirm the utility of the profession and to align it with the desirable status associated with the sciences.

There are two senses of utility at work here. The first is perhaps the most evident, and that is the utility of pharmacy for the population at large, what we might term an external utility. The pharmacist as the benevolent supplier of life-

[24] Speech by Habert introducing the inaugural course offered by the *Collège de pharmacie de Paris,* 16 July 1777. Paul Dorveaux, 'Procès-verbaux des délibérations du Collège de pharmacie de Paris', *Revue d'histoire de la pharmacie* 91 (1935), p. 182, 'Considerés avec moi combien les petits intérets d'amour propre, de rivalitez, d'opinions et de renommée tendent a diviser des hommes qui courent la même carrière et vous sentirés combien est respectable une union qui ne peut être fond& que sur une estime profonde et réciproque. Je conclurai de la que les différences d'opinions qui pourront naître parmi vous, ne doivent former que des disputes honnêtes, décentes et toujours utiles au progrès des sciences qui font votre gloire et votre bonheur.'

giving medicines was a common image throughout the profession's long history.[25] The second utility being championed here is an internal one, that is to say the utility for the profession itself. This particular argument around utility is first hinted at by Habert:

> Sirs, let us try to make ourselves deserving of new benefits through our indefatigable zeal to extend the progress of Chemistry, Pharmacy and Natural History the furthest possible.[26]

Trevez strikes more or less the same note, choosing to put the case of utility more forcefully, and so making the connection between the external and internal utility clearer. For Trevez it is science, understood as a profound knowledge of nature, that has always distinguished the apothecary from the crowd of humanity, and the establishment of the *Collège de pharmacie* (with the consequent distance placed between themselves and the trade of the spicers) is simply an overdue recognition of this. The modest pharmacist, dedicated first and foremost to knowledge of medicines has never actively courted royal patronage, but gratefully accepts what is, in fact, simply a recognition of the value of useful knowledge:

> Too long lost in the crowd of citizens who practice the mercantile arts and professions, with whom this capital city abounds, we have not, until now, sought to raise ourselves above our estate and to distinguish ourselves from the other professions except by our profound study of nature, and by our assiduous care in rendering it more and more useful and curative for humanity.[27]

The utility of pharmacy to the population of Paris is well established, but the time has come to demand more recognition for the profession, and this is precisely the promise of the *Collège.*

It was left to Demachy, the most junior speaker, and yet already a well-known chemist, to give by far the longest speech and to talk at the greatest length about the science involved in pharmacy. His speech ranged far and wide, giving a condensed history of pharmacy before offering an acknowledgement of the king's generosity. He went on to make a rather favourable comparison of pharmacy with surgery, a comparison that Bougguez also raised in his letter, and one that might well have

[25] There is even an iconographic tradition of representing Jesus as pharmacist, although it is less common than the image of Jesus as physician.

[26] Ibid., p.182, 'Tachons, Messieurs, de mériter de nouveaux bienfaits par un zèle infatiguable à porter au plus loin les progrès de la Chymie, de la Pharmacie et de l'Histoire naturelle.'

[27] Ibid., p.183, (speech by Trevez) 'Trop longtemps confondus dans la foule des citoyens qui exercent des Professions et des arts mercantiles dont cette capitale abonde, nous n'avions cherché jusqu'a présent à nous élever au dessus de notre Etat et à nous distinguer des autres professions que par l'étude approfondie de la nature, et par nos soins assidus a la rendre de plus en plus utile et salutaire à l'humanité.'

caused consternation in the professional bodies of both surgery and medicine had they been aware of it.

Demachy's assessment of the improved status of the college over the guild, however, is simply a preamble to his predictions concerning the future of pharmacy, and it is in this vein that he makes the rather striking claim that 'chemistry is pharmacy's fate... '.[28] From the perspective of this book, these are prophetic words indeed, but it would be an anachronistic reading that assigned too clear a premonition of the future to this phrase. No one could possibly have foreseen the sequence of events that would form the nineteenth-century profession of pharmacy. By 1777, Lavoisier was already starting on the path of research that would eventually lead to the development of his oxygen theory that would supersede all others in the realm of philosophical chemistry, announcing a new independence for this discipline. In fact, I will argue in the next two chapters that the first truly independent discipline of chemistry, in the sense of being a science fully detached from pharmacy, formed itself around Lavoisier, both the individual and his new oxygen theory. Even when Lavoisier's theory was claiming converts throughout the chemical community, Demachy remained a staunch defender of the phlogiston theory he had worked so hard to publicize in France. It should also be borne in mind that Demachy was a pharmacist, out of place in the world of the new chemistry. Furthermore, the professional world of the Parisian pharmacist would change even more dramatically with the coming of the French Revolution in 1789, and he would no longer be able to face the future with the confidence provided by the founding of the *Collège de pharmacie.*

Nor should we forget that Demachy's chemistry is still very much integrated into the pursuit of pharmacy, providing the essential analytical tools for the pharmacist to be able to ply his trade. What then does he mean when he claims that chemistry is pharmacy's fate? Demachy hoped that pharmacy's grounding in chemistry would allow it to distance itself from the base commercialism of a professional trade. Where the shopkeeper is simply interested in selling his wares, the pharmacist was obliged to know their intimate nature:

> Chemistry is [pharmacy's] fate, without this science there cannot be a single well executed pharmaceutical preparation, the Galenic art has always been its [pharmacy's] domain. [Pharmacy] is going to move (back) into the full-bloom of its apogee, we will no longer see surreptitious, greedy individuals or indiscreet patrons nurturing the trespassing opportunists who, up until now, have basely destroyed our heritage; no more will the enlightened artist be confused with the uneducated shopkeeper in the [struggle for the] trust of the public. The pharmacist will cultivate [the knowledge of] botany and natural history, which are of the utmost importance to him. How can he compound his preparations wisely if he does not know the nature of the things which he has to put in them.[29]

[28] 'La chimie est son lot ...': for reference see following footnote.

[29] Speech by Demachy introducing the inaugural course offered by the *College de Pharmacie de Paris,* 16 July, 1777. Dorveaux, Procès-verbaux des délibérations du Collège

With the benefit of hindsight, and in particular after we have examined the speech that Fourcroy would give twenty years later, we can see the threat latent in Demachy's speech. Indeed, it would prove impossible for pharmacy to keep chemistry as a tame handmaiden, as this science was already on the point of rising up and subjugating its master. Demachy was a pharmacist arguing for the importance of chemistry in aiding pharmacy, while two decades later Fourcroy was a chemist insisting on its dominance.

Looking at the last line of Demachy's explanation we see that chemistry (along with botany and natural history) enables the pharmacist to know the true nature of the medicines he prepares. This claim still relies on a traditional sense of pharmaceutical analysis, one that would be put aside in Lavoisier's chemistry. In pharmacy, chemistry had always involved the analysis of the compound substances used as medicaments into the simples of pharmacy. These simples, however, were neither the chemical elements of today nor even those presented by Lavoisier in his *Élements of Chemistry* of 1789, they were the simple constituents of which inorganic compounds and elements formed only a small, although growing, part. It was this version of analytical chemistry that the chemistry course offered by the *Collège de pharmacie de Paris* in 1777 was meant to teach the aspiring pharmacists: an understanding of medicaments through their analysis into simples.

On 21 July, only five days after this second round of speeches, the provosts of the *Collège de pharmacie* met to take a vote. The question was whether or not to accede to Demachy's request and allow the publication of his speech, which he wanted to have circulated along with the rest of the proceedings from the two days of inaugural ceremonies. The vote was unanimous: nothing would be circulated, and this decision was dutifully registered in the records of the *Collège de pharmacie:*

> … that the Provosts would beg of M. de Machy in no way to disseminate his speech, and, concerning the printing of this speech and of the minutes [of the ceremonies] the committee formally opposes it, signed,
>
> VASSOU, ROUELLE, TREVEZ, SIMONNET, BAYEN, CHARLARD, GILLET, BECQUERET, DELACOUR, TASSART.[30]

de Pharmacie de Paris', *Revue d'histoire de la pharmacie* 92 (1935), p. 245 'La chimie est son lot, sans cette science il n'est pas une seule composition pharmaceutique bien dirigée, l'art galénique fut de tout temps son partage, elle va rentrer dans la plénitude de sa jouissance, on ne verra plus d'obscurs particuliers cupides ou indiscrets protecteurs caresser les envahisseurs entreprenants qui jusqu'a ce jour ont indignement dévasté son patrimoine; on ne confondra plus pour établir la confiance publique l'artiste &laké avec le commerçant sans études; le pharmacien cultivera la botanique et l'histoire naturelle, ces connoissances lui sont d'une premiére nécessité ; comment feroit-il avec intelligence ses préparations, s'il ignorait la nature des choses qu'il doit y faire entrer.'

[30] 21 juillet 1777, *Contre la publication du discours de M de Machy* in Dorveaux 'Procès-verbaux des délibérations du Collège de Pharmacie de Paris', *Revue d'histoire de la*

There are a number of possible reasons for this reaction. Two which immediately suggest themselves are shame and fear. Shame at the numerous humiliating outpourings of gratitude that had characterized the event; currying political favour might well have been a necessity without being a source of pride. A more likely motive, however, would have been fear. Fear that the status pretended to by the *Collège de pharmacie* would draw strong reactions from the surgeons, the Faculty of Medicine or perhaps from some other guild or academy. After all, the *Collège* had not yet received formal permission for the courses that were so openly promoted at this event. Whatever the reason, the outcome is incontestable, and the proceedings of these ceremonies would remain unpublished for another century and a half. This would not be the case for the next speech I will be examining, which was presented twenty years later in very different circumstances.

Fourcroy and the *Société libre des pharmaciens de Paris*

In contrast to the opening ceremony of the *College de pharmacie,* Antoine-François de Fourcroy's speech to the *Société libre des pharmaciens de Paris* was printed by the society's own printer and distributed to all its members. The second event took place in the depths of winter, on the 5 January 1797 (16 nivôse , year 5 of the Republic) and finds the pharmacists in quite a different political climate. Gone are the royal officials who formed the focus of the first ceremony, the king himself having been executed four years earlier. Centre stage, we find Citizen Fourcroy, a scientist in the service of the Republic of France, the new site of political power. It was under Fourcroy's watchful eye, not Lenoir's, that the *Société* established itself, and within a decade all of French pharmacy would operate under regulations composed by his hand.

None of the people, pharmacists or otherwise, who featured in the ceremonies of 1777 reappear in this second event: it is Citizen Fourcroy who delivers the speech, Citizen Trusson, director of the society, who gives a short obsequious response, and then Citizens Morelot and Bouillon-Lagrange, as secretaries of the society, who enter into the records both Fourcroy's speech and his honorary election to membership of the society. Although the *Collège de pharmacie de Paris* and the *Société libre des pharmaciens de Paris* did have some members in common, the leadership had been entirely renewed in the intervening twenty years, spurred primarily by the revolution.[31] In his speech, Fourcroy lobbied for a similar kind of radical transformation in pharmacy itself, and as the title of his intervention

pharmacie 92 (1935), pp. 247-8, 'que Messieurs les Prévots prieroient M. de Machy de ne point répandre son discours par la voie de la communication, et qu'a l'égard de l'impression de ce dicours ainsi que du procès-verbal, le comité s'y opposoit formellement, et ont signé.'

[31] Of the nineteen appointees in 1777 (excluding teaching appointments) only eight were members of the *Société libre des pharmaciens* in 1796, and none served as its officers.

— A Discourse on the Union of Chemistry with Pharmacy[32] — suggests, the future of pharmacy was to be tied intimately to that of chemistry. He does not, however, share the traditional vision of chemistry as an integral part of pharmacy. In brief, Fourcroy offers an apology for the subordinate position that he feels pharmacy must ultimately take with respect to the new French science of chemistry. This position is understandable enough from Fourcroy's point of view; after all, he was one of the authors of the *Méthode de nomenclature chimique* published ten years earlier, which codified a reformed chemical language tailored to the new science. His intimate association with Lavoisier — the architect of the new chemistry — further cemented Fourcroy's commitment to a vision of chemistry as a philosophical science quite independent of pharmacy, a development I will explore in more detail in the next chapter.

Fourcroy's speech is divided into three parts; a historical review of the subject, a summary of the present situation and a look towards the future, unwittingly repeating the structure found in Demachy's speech twenty years earlier. Although Fourcroy avoids the latter's cloying excess of flattery (not surprisingly, after all, it was he who was being courted by the pharmacists not vice versa), his published speech repeats the verbose style characteristic of his other publications. The strategy employed in the construction of the speech is fairly straightforward, and serves to drive home a heartfelt sentiment: the need to open the *officines* to chemistry in two senses. First, pharmacists need to accept the superiority of the new chemistry (including, of course, its new language) in order that they might benefit from its entry into their profession. Second, for the sake of the science of chemistry, pharmacists should render up their secrets, in particular those of their technical expertise, which they had tended to keep hidden in the interests of the 'business' of pharmacy. This second injunction demanded that pharmacists pay the price for being considered scientists, forsaking their guild past and playing by the rules of openness associated with the physical sciences.

The message is, however, driven home in a variety of forms, and to this end each of the sections — past, present and future — exercises a different strategy. The first turns history on its head, reading pharmacy's own long history as merely the unconscious period of labour preceding the birth of a new science, a science that casts its parent into the shade. The idea is that the pharmacist should feel both humbled and proud before this magnificent history; humbled by chemistry's transcendence while remaining proud to have been a part of its origins. Fourcroy's historiographical prejudice is clearly inscribed in his teleological reading of the history. For him, the history of pharmacy finds its scientific interest only in the birth of chemistry, a theme that comes up time and again in his historical exegesis. We should of course bear in mind that Fourcroy was never a practicing pharmacist, although his trajectory touched on pharmacy at several points. Despite his being in a sense an outsider, the pantheon offered in his historical dredging of pharmacy's past is very close to that offered by Demachy twenty years earlier, when the

[32] Discours sur l'union de la Chimie et la Pharmacie.

pharmacist gave an overview of his own profession's history. The list includes Lefevre, Glaser, Beguin, Charas, Geoffroy and Lemery, all figures we will return to in Chapter 3. Fourcroy also offers explicit recognition that these men were pharmacists, except that now the categorization is supplemented with the understanding that they were not simply pharmacists, but also proto-chemists. The problem with which Fourcroy is immediately confronted is how to make the separation between the practices that count as chemistry and those that count as pharmacy. His implicit solution is to assume, in the very formulation of the problem, that such a distinction has, in principle at least, always existed. The separation becomes historically feasible only once one knows what 'chemistry' looks like, and this image of chemistry is based on the theory-dominated science that emerged from the chemical revolution. Once the true nature of chemistry — as distinct from pharmacy — has been clarified, it becomes much easier to see the seeds of their separation when looking back. Thus, rather than seeing the identity of chemistry and pharmacy in the past, Fourcroy chooses to describe this history as one of a happy union:

> So, indicating only those who have the greatest claim to engage our interest, you see following the works of Lefevre, Glaser, Beguin, Lemort, and Rouviere, those of Charas, Boulduc, Geoffroy, Lemery, and, pursuing our course right up to the period of one or the other Rouelle, masters to us all, you will recognize Chemistry as being inseparable from Pharmacy, profiting from all its light, genuinely illuminating itself by the fire of its furnaces, and existing, in a manner of speaking, entirely on the basis of its experiments, as a product of its conceptions.[33]

While Fourcroy argues that chemistry is fully integrated into pharmacy, this history leads inevitably to the independence of the science. Thus, one of his goals in this speech is to make chemistry visible as an independent science, even when it is considered to be part of pharmacy. The best way to do this is to base his historical interpretation on the premise that the two were always quite distinct, and then trace the history backwards with the object of teasing them apart at each successive historical moment. Fourcroy ends up settling on an avian metaphor to describe chemistry's separation from the medical arts, with the science taking flight and soaring heavenwards, and he himself ends up taking this metaphor to great heights. It becomes unnecessary to insist on the image of the sorry, ugly profession left

[33] A. F. Fourcroy, *Discours prononcé a la société libre des pharmaciens,* Paris, 1797, p. 11, 'Alors, pour ne vous tracer que ceux qui ont le plus de droit à notre intérêt, aux travaux des Lefevre, des Glazer, des Beguin, des Lemort, des Rouviere, vous verriez succéder ceux des Charas, des Boulduc, des Geoffroy, des Lemery, et précipitant votre course jusqu'au temps de l'un et l'autre Rouelle, nos maîtres à tous, vous reconnaîtrez la Chimie inséparable de la Pharmacie, profitant de toutes ses lumières, s'allumant véritablement au feu de ses fourneaux, et vivant, en quelque sorte, toute entière du fond de ses expériences comme du produit de ses conceptions.' The following series of quotations are all from the same source, and the page number follows the quotation in square brackets.

behind when chemistry, the burgeoning offspring, quits its nest to take up residence in the home of its equally exalted cousin, 'experimental physics':

> ... Chemistry, taking its highest flight, and achieving a sort of divorce from its original mother, seems to abandon the laboratories of Pharmacy and [be] transported into the cabinets of experimental Physics ... [34]

This vision of chemistry successful and free of pharmacy takes Fourcroy up to the present and constitutes the second section of the speech, which fmally gives way to a different closing strategy. In the final section, Fourcroy paints a picture of the terrible end pharmacy faces if it does not take into account all that chemistry has opened up to the eyes of the savants. In contrast to Demachy's vision of the future, chemistry, in this case the new chemistry, is no longer necessarily the fate of pharmacy. In Fourcroy's view, chemistry is now pharmacy's mature offspring which, come of age, has outgrown any reliance on its original mother and instead overshadows her in terms of status and potential. The corollary of this new science's enviable success is that the original art has become a jealous parent attempting to smother its brilliant offspring out of a fear of being eclipsed. The attempt is both ill advised and in vain, as pharmacy can only hope to raise itself up by an alliance with chemistry, and has anyway already been eclipsed:

> In taking a foolhardy leap and passing beyond the useful art of preparing medications and towards the sublime mission of explaining Nature's most important phenomena [chemistry] seems to have abandoned its origins to blend itself into physics; although we have witnessed it renounce its wet-nurse's breast, we should not pretend that this has happened without some fault on the part of [pharmacy]. How many prejudices had to be fought in order to maintain this ancient alliance & to block the deplorable divorce that menaced them! What courage, what conviction did the young chemists need in order to stay faithful to [the subject] when even their masters kept clear of the study of chemistry? Were not Scheele's sublime discoveries a subject for reproach on the part of two consecutive masters? How many pharmacists who have excessively neglected the cultivation of chemistry, have insisted on the same sacrifice, or the [holding of the] same opinion on the part of their students?[35]

[34] .... la Chimie portant son vol plus haut, et faisant une sorte de divorce avec sa première mère, vous paroütroit quitter les laboratoires de Pharmacie, et transport& dans les cabinets de Physique expérimentale , ...' [12].

[35] 'Si lorsque, prenant un vol plus hardi et passant de l'art utile de faire des préparations médicamenteuses a la mission sublime d'expliquer les plus grands phénomènes de la nature, elle a paru abandonner sa première origine pour se confondre avec la Physique, si on l'a vu renoncer au sein de sa nourrice, ne dissimulons pas que celle-ci n'a pas eté sans quelques torts a son egard. Combien de préjugés n'a-t-il pas fallu combattre pour maintenir cette ancienne alliance, & pour empêcher le facheux divorce dont elles ont éte menacées! Quel courage, quelle ardeur n'a-t-il pas fallu aux jeunes Chimistes que leurs maitres même éloignoient de l' étude de la Chimie, pour lui rester fidèles. Les sublimes découvertes de Schèele n'ont-elles pas été un sujet de reproche de la part de deux de ses maîtres

Thus, at their greatest degree of separation from one another, it is theory that reveals the distance dividing chemistry from pharmacy. On the other hand, as Fourcroy so eloquently recalls, it is the material practices and chemical substances held in common that tend to unite the disciplines, with chemistry illuminating itself in the light of the apothecary's furnace. Nevertheless, Fourcroy demands that the pharmacists cede to the forces of 'the sublime mission' and accept the victorious new chemistry, a duty which he sees some of them resisting. He rounds on any such resistance, and threatens the desuetude of their art if the pharmacists fail to embrace the new chemistry:

> Were there not those who wished to banish it [chemistry] as a dangerous study that would turn them from the true path they had to follow with the aim of attaining the veritable goal of pharmacy; if a similar prejudice were to become more general, more widespread, that would put an end to the ancient renown of pharmacy, disinherited of its ancient right to create and to perfect Chemistry, we would soon see it reduced on the one side to the isolated techniques of a narrow art, on the other to commercial speculation ... [36]

According to Fourcroy, the goals of pharmacy, which in Demachy's view embraced chemistry, represent an obstacle to its relationship with the new science. The art of preparing medicines and the commerce of selling them serve to distance pharmacy from chemistry and hence threaten the decline of the profession's status. Clearly, pharmacists would have a difficult path to follow if they wanted to retain the traditional association with chemistry that had brought them so much credit. The vision of being excluded from sharing in the prestige of the science of chemistry is calculated to strike fear into the status-hungry pharmacists' hearts, but this is not the close of the speech. The pessimistic vision is only the setting for a final generous offer from the spokesman for the new science.

The act of magnanimity we saw twenty years earlier is here repeated in a completely different register by Fourcroy. Whereas before the royal apothecaries offered equality to their fellow members of the college, here it is a new breed of chemist who performs the same redemptive act before the pharmacists. To this end Fourcroy puts away the stick of guilt and turns to the carrot of a future union between chemistry and pharmacy; the future promised in the very title of the speech:

successivement. Combien de Pharmaciens qui avoient trop négligé la culture de la Chimie, n'ont-ils pas exigé le même sacrifice ou la même opinion de la part de leurs élèves.' [17-18]

[36] 'N'a-t-on pas voulu la bannir comme une étude dangereuse, qui détourne de la véritable route qu'on doit suivre, du but qu'il faut atteindre dans la Pharmacie; si un pareil préjugé devenoit plus général et plus répandu, c'en seroit fait de l'antique illustration de la Pharmacie; deshéritée de ses droits anciens à la création et au perfectionnement de la Chimie, on la verroit bientôt réduite d'une part aux seules manipulations d'un art borné, et de l'autre aux spéculations commerciales

> What benefit is not given to pharmacy by the light of chemistry? What advantage can we not draw from it every day, for the preparation of nitric, nitrous, muriatic, sulphurous, and ammoniacal acids?[37]

Naturally enough, Fourcroy uses the new nomenclature developed initially by Guyton de Morveau and published in its definitive form in the jointly-authored *Méthode de nomenclature chimique* of 1787, a work featuring Fourcroy as one of the co-authors.[38] Therefore these new terms for common chemicals are presumably words that the more dynamic pharmacists who have followed the advances of chemistry would be at home with. On the other hand, not all the audience would feel so comfortable with these names, after all, Fourcroy does feel the need repeatedly to encourage the pharmacists to acquaint themselves with the new chemistry, whose writings provide the initiation into this new nomenclature.

Fourcroy does not, however, confme himself to using the new nomenclature, and the way in which he shifts between the old, the new and the as yet unlegislated gives us important clues concerning the problems the new chemistry faced in its task of refashioning pharmacy in its image. It is 1797, the new systematic nomenclature has been in circulation for fifteen years, and the definitive *Méthode* for ten. Fourcroy himself is perfectly at home with the new nomenclature, and we can be certain that the shifts between the old and the new are not entirely accidental. Nevertheless, he chooses to begin his speech using this old nomenclature:

> In particular, you would find in this list taken from the times about which I am speaking, *pourpre minéral, or fulminant, turbith minéral,* the various *précipités mercuriels, minium, colcothar, antimoine diaphorétique, beurre d'antimoine, magisteres sulfureux & métalliques, fleurs, teintures, terres, alcalis caustiques,* and many other preparations which were supplied as much as materials useful for the chemists as they were as heroic medicaments for doctors ... [39]

Formerly *colcothar,* now *oxide de fer rouge,* likewise *beurre d'antimoine* is now *muriate d'antimoine sublimé;* the translations are available in the *Méthode de*

[37] 'Quel bienfait [est] rendu à la Pharmacie par les lumières de la Chimie? Quel avantage n'en tirons-nous pas chaque jour pour la préparation des acides nitrique et nitreux, muriatique, sulfureux, de l'ammoniaque ?' [24].

[38] The authors of this book were Louis-Bernard Guyton de Morveau, Antoine-Laurent Lavoisier, Claude-Louis Berthollet and Antoine-François de Fourcroy.

[39] 'Vous auriez spécialement, dans cette liste aux temps dont je parle, le pourpre minéral, l'or fulminant, le turbith minéral, les divers précipités mercuriels, le minium, le colcothar, l'antimoine diaphorétique, le beurre d'antimoine, les magisteres sulfureux et métalliques, les fleurs, les teintures, les terres, les alcalis caustiques, et tant d'autres prèparations qui ont fourni autant de matériaux utiles aux chimistes, que de médicamens héroïques aux médecins;' [10]. To avoid confusion, I have not translated the old French nomenclature that Fourcroy employs for the chemicals.

nomenclature chimique that included a dictionary for this very purpose. In describing their history to them, Fourcroy has chosen to use the traditional chemical vocabulary. Perhaps using a language that more of his audience is liable to understand is intended to make the pharmacists feel at ease? Fourcroy is not, however, so liberal when the time comes to talk about the revolution achieved by Scheele and the pneumatic chemists:

> It is thus while [chemistry] experienced a revolution in France, which seemed increasingly to distance it from the laboratories of pharmacy, and which was to transform it, that it remained faithful to one of its favourites, solely concerned with the preparation of medications. [Chemistry] inspired Scheele, right in the midst of his pharmaceutical work, to make his immortal discoveries concerning arsenic, oxalic acid, manganese, molybdenum, tungsten, spath fluor, prussic acid, milk, gallstones; it informed him through these same furnaces by the side of receptacles in which he prepared infusions, medicines, electuaries, syrups ... [40]

History plays a strange trick on the modern reader of this passage – the part of the first list that is rendered into the new nomenclature sounds more familiar to the modern chemist than the word that is not: spath fluor. It is, however, more important to notice the strange archaic sound of the second list. Anyone who lived his professional life under the instruction of an eighteenth-century pharmacopoeia would, however, have exactly the opposite problem. For him, the 'electuaries' and 'syrups' constituted the majority of the daily work in the *officine,* and, despite the popularity of antimony products as medicaments, animal and vegetable extracts would continue to dominate the French pharmacopoeia for the next century and beyond.

This reflection finds support in another part of Fourcroy's speech where he talks about the opportunities for analysis opened up by discoveries in the New World. Here, he suggests that the pharmacists should turn their attention to just this kind of analytical work:

[40] est ainsi que pendant qu'elle éprouvoit en France une révolution qui sembloit l'éloigner de plus en plus des laboratoires de Pharmacie, et qui devoit la faire changer de face, elle restoit fidèle a un de ses plus chers favoris, uniquement occupé de la préparation des médicamens; elle inspiroit à Schèele, au milieu même de ses travaux pharmaceutiques, des découvertes immortelles sur l'arsénic , l'acide oxalique, le manganèse, le molybdène, le tungstène, le spath fluor, l'acide prussique, le lait, la pierre de la vessie; elle lui dictoit sur les mêmes fourneaux à doté des vases on il préparoit les apozèmes, les médecines, les électuaires, les syrops, ...' [13-14]. Note the laboured distinction that Fourcroy draws between chemistry and pharmacy in the work of Scheele.

> From which other men can we rather hope for knowledge of the principles of opium, this heroic medicament that contributes so much to the philosopher's meditations, the principles of ipecacuanha, camphor, aloes, scammony, resinous gum, arnica, saffron, hemlock ... [41]

He has no special names for any of these vegetable substances, nor for the thousands of others that the pharmacists used in their everyday business. As I will show in the following chapters, the art of analysis understood as a traditional chemical practice of pharmacists does not accord with the revolutionary analytical practice of the new chemistry that sought out the elementary constitution of matter. Furthermore, there is no available methodical nomenclature that can systematically name vegetable material according to elementary composition, and Guyton de Morveau's reforms based around the binoinial naming of inorganic compounds cannot possibly supply the principles for such a nomenclature. Part of the way in which pharmacy would constitute itself as a science involved developing its own, more systematic analyses in this area, employing methods and goals that combined pharmaceutical analytical traditions and approaches drawn from the new chemistry. The constitution of this particular discipline of pharmaceutical chemistry at the turn of the century will be the subject of Chapter 5.

Conclusion

In twenty years the pharmacists had moved from courting the favour of the Lieutenant-General of Police and *Conseiller d'État,* Jean-Charles-Pierre Lenoir, to courting Citizen Fourcroy, not only a member of the *Conseil d 'Anciens* and a former member of the *Comité de Salut Public,* but also co-founder of the *Annales de chimie* and co-author of the *Méthode de nomenclature chimique.* The deal struck with Lenoir involved the pharmacists sacrificing a certain amount of autonomy in return for a reaffirmation of their commercial monopoly and the coveted status that came with the title of *Collège.* Twenty years later, the existence of the corporate body of pharmacists was under real threat. Although it had managed to reform into an official body, it existed in a climate unsympathetic to the guild traditions from which it had emerged. The court of Louis XVI, the college's official protector for a dozen years, had been dissolved in a bloody purge, and the pharmacists now had to seek the support of a republican government. Fourcroy was the representative of this government, and so they had to treat him with all due respect. Unlike Lenoir, Fourcroy had definite plans for the future of pharmacy in France; he wanted to mould the chemical art into a scientifically informed profession operating under

[41] De quell autres hommes pourra-t'on espérer d'avantage pour la connaissance des principes de l'opium, ce médicament haroïque qui prête tant aux méditations du philosophe, de l'ipécacuanha, du camphré, de l'aloês, de la scammonée, des gommes résines, de l'arnica, du safran, de la cighe...' [33].

state control. Furthermore, less than six years later, Fourcroy would succeed in translating these ambitions into binding legislation.

Two revolutions had intervened between the events I have presented in this chapter; a revolution that had definitively reoriented chemistry away from its traditional associations with pharmacy, and a revolution that had changed the basis for the exercise of power in France. Previous theories and conceptions of chemistry were giving way to Lavoisier's new chemistry, and the absolute power of the throne had ceded to a succession of governments, all of which claimed to represent the will of the French people. The chemical revolution succeeded in taking chemistry out of pharmacy and setting it up on its own. The French Revolution had shaken up the institutional structure of France in such a way that it was now possible for Fourcroy to inaugurate a new state-administered profession of pharmacy. Pharmacy's prospects had changed dramatically over the course of two decades.

Each of the two commemorative events around which I have structured this chapter gave their participants the opportunity to touch on the science involved in pharmacy, although the subject was considerably more prominent in 1797 than it was twenty years earlier. On the first occasion, the scientific status of pharmacy, and particularly its use of chemistry (understood as the art of analysis in pharmacy) was deployed in order both to stress the public utility of the art and to convince Lenoir of the value of the expertise resident in the body of pharmacists. On the second occasion it was the pharmacists' turn to listen, and they heard a salutary tale about what could happen if pharmacy lost touch with chemistry. Chemistry had been substantially redefined since Demachy had confidently claimed it to be the fate of pharmacy twenty years earlier. What was perceived as a correlative part of the pharmacist's practice had become a formidably independent discipline which, at the end of the eighteenth century had to be actively reintegrated into the pharmacists' *officines,* on its own terms. One of the main means for introducing the new chemistry into pharmacy would be new schools for pharmacists. Where exclusive reliance on apprenticeship might have been a force retarding the entry of the new science into the profession, the state-run schools greatly facilitated the nineteenth-century ideal of a scientific education.

The educational system put in place at the turn of the century in France ensured that this reintegration would take place on the terms dictated by the new chemists, who were also key architects of educational reform, Fourcroy in particular. Whereas Demachy presented a rather unrigorous image of chemistry as an empirical science instantiated by pharmacists in the unexceptional practice of their art, Fourcroy conceived of a radical division between chemistry and pharmacy. By projecting this division backwards, he managed to describe a history in which such a division had always been immanent, a version of the development that too often informs our understanding of the history of chemistry. This disciplinary divide, however artificially it may have been introduced, has subsequently become firm to the point of seeming obvious.

The result of the disciplinary and political shifts outlined above was that, just at the peak of its rise in status, French pharmacy found itself suddenly subjugated to an independent discipline that seemed to appear from nowhere. What was particularly insidious about this event, however, was that unlike medicine, or the trade of the spice-merchant, this new science had never previously appeared as either an enemy or a competitor. The Oedipal imagery that Fourcroy was so keen on using to illustrate the history of chemistry and pharmacy is only justified in light of his own retrospective reconstruction of this history. The successful son (chemistry) only fully detached himself from the father (pharmacy) in the telling of history. Nevertheless, the resulting patricide (or at least subjugation of the father by the son) was no less real for the historically artificial distinction between the vanquished parent and the merciless offspring.

The next chapter will serve to fill in some details in the historical argument concerning the roots of modern chemistry in France, an argument that I have only been able to sketch out so far. To make the story clear means spreading a wider net than my focus at the end of the eighteenth century, and so I will trace the tradition of chemistry in pharmacy back to the end of the seventeenth century. This will also give me the opportunity to offer a more detailed picture of how this tradition was transformed under the influence of Lavoisier's chemistry. Chapters 4 and 5 will deal with the institutional changes so important in providing a suitable site for pharmacy, one that would allow it to establish a new identity as a scientific discipline. The closed, traditional nature of the pharmacy and its *officine* would have been imperfect ground for such a reorientation, despite the official end of the guilds in France.

In Chapter 5 I will return to the pharmacists' analytic practices as they developed at the beginning of the nineteenth century. I will also illustrate how the new chemistry was being taught in the new schools of pharmacy. In the end, we will see how Demachy's prediction was fulfilled; indeed, chemistry was to be the fate of pharmacy, but the new French chemistry, not the old.

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Chapter 3

From Pharmacy to 'Philosophical Chemistry'

Glaser, Lemery. Venel, Macquer and Lavoisier

> Chemistry, although the word itself is very old, has only existed, properly speaking, for half a century. It is no longer the art of drawing juices from plants, as its name suggests.
>
> Fourcroy, 1787[1]

Was Nicolas Lemery a chemist who practiced pharmacy or a pharmacist with an interest in chemistry? The same question can be asked of Guillaume-François Rouelle, Antoine Baum& and Nicolas Vauquelin, three other pharmacists who feature as prominent chemists in most histories of the field. The question is deceptively simple, but it would be foolhardy even to attempt to give a straightforward answer. My argument is precisely that to compartmentalize pharmacy and chemistry in the seventeenth or early eighteenth centuries is wrong-headed, as they neither represented a choice in terms of professional or personal identity nor covered distinct activities. While Lemery would no doubt agree that the words chemistry and pharmacy were not interchangeable and that they referred to different (although overlapping) aspects of his work, still chemistry would be implicated in his daily pharmaceutical business, and pharmacy would necessarily imply chemical operations. Their separation was artificial and unnecessary, as pharmacists were not importing outside knowledge or personnel to do their chemistry, nor were they dividing up their workspace and laboratory practices along these lines. Nevertheless, although I believe there is no answer to this question, raising it underlines the need to understand the shifting disciplinary status of pharmacy and chemistry across the eighteenth century. Furthermore, as I have already suggested, understanding the changing nature of either one will automatically help us understand the reconfiguration of the other. In this chapter I

[1] A. F. de Fourcroy, *Bibliothéque universelle des dames; principes de chimie,* Paris: Cuchet, 1787, p. x, 'la *Chimie,* dont la dénomination est fort ancienne, n'existe proprement parler, que depuis un demi siècle. Ce n'est plus l'art de retirer les sucs des plantes, comme son nom l'indiquoit.'

intend to outline these realignments, and to describe how they shaped the relationship between the two disciplines as they emerged at the end of the century.

If, as I have already suggested, chemistry became an independent theory-oriented scientific discipline by the beginning of the nineteenth century in France, the question remains of how this came about? This chapter will address precisely this issue, but I want to offer the broad outlines of the argument here to orient the reader in what follows. Starting from the observation that most of the men who populate the histories of French chemistry between 1650 and 1750 are not professional chemists (indeed, I would argue that there were no professional chemists before the nineteenth century), but were instead usually medical doctors or pharmacists, it is useful to consider why some of what they did does not count as medicine or pharmacy, but as chemistry. Indeed, although its interpretation may be, the category itself is not an imposition of the modern historian. The authors I will be looking at in this chapter, Glaser, Lemery and Macquer, all wrote treatises on chemistry despite making a living from a medical profession. My object here is not, therefore, to deny the existence of chemistry before opportunities existed to dedicate a working lifetime to the science, but rather it is to drive a wedge between a modern understanding of chemistry and its seventeenth- and early eighteenth-century counterpart. Before the middle of the eighteenth century, chemistry was indissolubly bound up with other endeavours, pharmacy featuring chief among them, while after the chemical revolution this was no longer the case.[2]

Indeed, chemistry's decisive move away from pharmacy seems to have come, in France at least, with the wide-ranging acceptance of the Stahlian theory in the middle of the eighteenth century. The question remains, however, why then? After all, the Stahlian theory was not the first chemical theory to have gained widespread acceptance. As we shall see, Cartesian mechanical philosophy had already been articulated in chemistry, but without the separation of the science of chemistry from the practice of pharmacy. The reason that the introduction of Stahlian theory brought with it such an important disciplinary shift was, I will argue, the changing nature of the audience for chemistry in the eighteenth century, a feature that is too often ignored in the history of chemistry.[3] I see the change as a process whereby at one and the same time chemistry was aligned with higher sciences, and the pool of talent from which chemists were recruited opened up, loosening the once-tight links between the science and its practical applications, with pharmacy leading the field. The emphasis on its philosophical nature attracted a wider audience to chemistry,

[2] This configuration favouring pharmacy applies to France in particular. For various reasons, it was metallurgy that had a comparable association with chemistry in the Scandinavian countries. For more on this see Theodore M. Porter, 'The Promotion of Mining and the Advancement of Science: the Chemical Revolution of Mineralogy', *Annals of Science,* 38 (1981): 543-70.

[3] Mi Gyung Kim has addressed this question to some extent in her recent book; Mi Gyung Kim, *Affinity, that Elusive Dream: A Genealogy of the Chemical Revolution,* Cambridge MA: MIT Press, 2003.

expanding its appeal beyond the traditional constituency of pharmacists and medical students. The new chemists attracted by a more philosophical science were to lead the chemical revolution through the introduction of theoretical, linguistic and institutional reform. The implicit opposition between philosophical and practical chemistry raises the opposition between the work of the head and that of the hand, in turn reflecting a traditional demarcation between art and science that was already recognized quite consciously in the seventeenth century. Thus, the pharmacist Nicolas LeFevre offers the following description of the distinction in his 1669 *Treatise on Chemistry:*

> The difference that exists between Art and Science can be deduced from the difference between their ends. Just as the only goal of science is contemplation, and its end, with which it must be satisfied and content, is simply knowledge, and nothing beyond, so the goal of an art is simply the operation, and it will not cease operating until it has carried out what it has proposed to do.[4]

Eighteenth-century philosophical chemistry would cloud this distinction in a sense. While privileging contemplation and knowledge, chemists still had to rely on experimental operations, albeit ones orientated towards philosophical questions and not simply commercial enterprise.

I have chosen Diderot and d'Alembert's *Encyclopedie* as the main text around which to structure this chapter, and this for a variety of reasons. First, published by subscription between 1751 and 1780, it has assumed a central place in the history of the Enlightenment, and is often cited as a significant cultural factor in precipitating the French Revolution itself. The fact that many of its articles (contributed by a large number of named and anonymous authors, associated with the loose-knit group of thinkers known as the *philosophes)* served for the expression of secular, innovative philosophical positions means that the text has assumed an important position in the history of French literature as well as politics. An advantage which follows from this status of the *Encyclopédie* is that there exists a large and informative literature on the work which places it in much-needed context. The analysis of texts in the history of science all too often lacks any such contextual support, devoid of information concerning the nature of the publishing enterprise behind the work as well as evidence concerning its ultimate readership. Another particularity of the *Encyclopédia* is that it gives an unusual view not just of chemistry, but of all the fields of learning that found their way into its volumes, allowing a nominated speaker to offer his opinion on what constituted the subject and where it stood. In his study of the publishing history of the *Encyclopédie,* Robert Darnton suggests that this approach reflects the constitution of expertise in a context of increased professionalization or at least specialization in French intellectual life. Of course, this view fits well with the argument I am making about the establishment of an independent science of chemistry across the eighteenth

[4] Nicolas Le Fevre, *Traité de la Chymie,* Paris, 1669, p. 8.

century, although, as we shall see, it does not work equally well with the two chemists chosen to contribute the articles on this field to the *Éncyclopédie.*[5]

Following my analysis of the treatment of chemistry in the *Encyclopédie,* I will turn to Macquer's *Élémens de chymie théorique,* a text contemporary with the early volumes of Diderot's enterprise, and I will close with an analysis of the work of Lavoisier and his collaborators. It was Lavoisier's chemistry, more than anything else, I will argue, that exemplified and justified the definitive split between this science and pharmacy, radically separating the two pursuits. While inconceivable at the beginning of the century, following Lavoisier's pioneering work in the practical, theoretical and disciplinary space of the science it became quite natural to think of reforming pharmacy through the application of chemistry. In the next chapter, we will see how it was Fourcroy who assumed this task of bringing the new chemistry to the pharmacists.

Before I take on the *Encyclopédie* and the chemical revolution that followed it, however, I need to present some essential background in seventeenth- and early eighteenth-century chemistry. My argument relies on a good understanding of the relationship between pharmacy and chemistry in France before it came to resemble the relationship we are accustomed to today. By exploring classic chemistry texts from the seventeenth and early part of the eighteenth centuries, I aim to show that the dominant understanding of chemistry was indistinguishable in many instances from pharmacy itself.

Nicolas Lemery – chemist or pharmacist?

Nicolas Lemery is representative of both the apothecary tradition in chemistry and the already-rising tide of 'philosophical chemistry', offering the latest in mechanistic corpuscular theory side by side with practical preparations and their medicinal uses. If we, as modern readers, take seriously the whole spectrum of his chemical work, Lemery appears a contradictory figure, with one foot in theoretical chemistry and the other in the unreflective empirical tradition of *materia medica.* I want to suggest, however, that any such contradiction is more apparent than real. Indeed, I want to argue that it is an artefact of a certain view of the history of chemistry, a version of history we will already find articulated in Venel's work for the *Encyclopédie* examined below. According to this view, little consideration is given to the pharmaceutical preparations and preoccupations that occupy so much of the seventeenth-century chemical corpus regularly reviewed in the history of chemistry.[6] Such an approach has led historians of chemistry to disguise the central

[5] Robert Darnton, *The Business of Enlightenment: A publishing History of the* Encyclopédie *1775-1800,* Cambridge, MA: Harvard University Press, 1979, pp. 518-9.

[6] This is less true than it used to be, with historians increasingly acknowledging the importance of the medical concerns of pharmacists. For example, see the recent history of

pharmaceutical concerns present in the work of these chemists. Partington, for example, has combed through Lemery's work to pick out those of his preparations he feels are of importance in the history of chemistry, an exercise that conveys only a hint of his work as a pharmacist.[7] This kind of distillation of seventeenth- and early eighteenth-century works on chemistry gives the reader of secondary texts a skewed vision of the work as a whole. In what follows I hope to redress the balance somewhat, although for those who cannot decide who is being the most tendentious in their presentation, the best solution is still to look at the original treatises.

Lemery's stature is incontestable. Although a seventeenth-century figure who lived only fifteen years of his life in the eighteenth, his books carried on being reprinted well after his death. His best-known work, the *Cours de chymie,* originally published in 1675 was still being reprinted as late as 1756. This continued interest in Lemery's work is all the more remarkable in an area like chemistry, which was the object of so much attention and innovation in the eighteenth century. Significantly, his pharmacopoeia was still being published in a revised form as the *Pharmacopée universelle* at the beginning of the nineteenth century.[8] The treatises on chemistry by Lemery, like those by Glaser and Lefebvre that preceded them represent a traditional pharmaceutical understanding of chemistry that was to decline across the eighteenth century. The republication of these books forms a bridge between the two traditions, that of practical pharmaceutical chemistry, and the new philosophical chemistry that came to dominate first the scientific and then the pharmaceutical landscape. Lemery's training as an apothecary also shows an attachment to a traditional form of chemical education which, although remaining common throughout the eighteenth century, was to supply a diminishing proportion of the major French chemists as the eighteenth passed into the nineteenth century.

Lemery's life and education was undeniably that of a pharmacist. At the age of fifteen he was apprenticed to his uncle, a local apothecary in his home town of Rouen. His mother, who had already been widowed for four years at this point, wanted to ensure the future of her son by introducing him to an honourable trade. After six years in this apprenticeship, Lemery made the journey to Paris, a standard stop on a journeyman's tour of France. Here, he studied with the famous Parisian apothecary Christophle Glaser. This arrangement, however, lasted for only two months, as, according to Fontenelle at least, Lemery found this eminent teacher unsuitable:

chemical composition by Robert Siegfried *From Elements to Atoms: A History of Chemical Composition,* Philadelphia: American Philosophical Society, 2002.

[7] J. R. Partington, *A History of Chemistry,* vol. III, New York: St Martin's Press, 1962: 28-41.

[8] The reforms of 1803 demanded a revised pharmacopeia, but its publication was delayed until 1818 *(Codex Medicamentarius sive Pharmacopoea Gallica, 1818,* Paris, 1818). The French translation appeared the following year.

> M. Glazer was a true Chymist *(un vrai Chimiste),* full of obscure ideas, possessive even of those ideas, and very unsociable. [9]

The implication is clearly that Glaser was too attached to the alchemical or hermetic tradition to be able to instruct the aspiring scientist correctly in the useful parts of chemistry, an opinion at variance with Glaser's own assessment of himself, as we shall see shortly. Nevertheless, Fontenelle's aim was probably more to attack the old ways of alchemy rather than to denounce Glaser in particular, an attitude that illustrates the mounting anti-alchemical sentiment in the eighteenth-century world of learning. It is interesting to note in passing, however, that Fontenelle characterizes a follower of the hermetic art by using exactly the same phrase– 'un vrai Chimiste' – that Macquer would use a quarter of a century later to characterize its opponents.

Following his short-lived association with Glaser, Lemery left Paris and toured around, studying in such places as Lyon, Geneva and Montpellier. Upon his return to Paris in 1972, he set himself up comfortably in the orbit of French royalty, buying the office of King's apothecary in 1674. Growing Catholic intolerance, culminating in the repeal of the Edict of Nantes in 1685, made life increasingly difficult for French Protestants, but Lemery was able to avoid the worst excesses of persecution by converting to Catholicism. This strategic change of faith allowed him to pursue a long and successful career.

Lemery's best known work, the *Cours de chymie* of 1675, was based on popular lectures he was giving to students of pharmacy and Parisian amateur scientists alike. These lectures not only supplied material for the book, they also provide valuable evidence concerning the rising popularity of chemistry, an important feature of French chemistry in the late seventeenth century, one that was to become even more evident as the eighteenth century progressed. It is clear from Fontenelle's description of Lemery's course that chemistry had already broadened its appeal beyond the traditional 'interested' audience of pharmacists, doctors or mineralogists. The public attending Lemery's lectures at the *Hotel de Condé* was not composed exclusively of aspiring artisans:

> His Laboratory was less a Room than a Cave, & almost a magical lair, illuminated solely by the glow of the furnaces; nevertheless the affluence of the crowd there was so great, that there was scarcely enough room for his operations. The most famous names were entered on the roster of his audience, Rohaut, Bernier, Auzout, Regis, Tournefort. Even Ladies swept up by the fad had the audacity to come and show themselves in these very learned gatherings. [10]

[9] Bernard Le Bovier de Fontenelle, *Éloges des académiciens,* Brussels: Culture & Civilisation, 1969 (first edn 1740), vol. I, p. 335.

[10] Fontenelle, *Éloges des académiciens* (1740), vol. I, p. 337, 'Son Laboratoire &oft moins une Chambre qu'une Cave, & presque un Antre Magique, éclairé de la seule lueur des fourneaux; cependant l'affluence du monde y étoit si grande, qu'a peine avoit-il de la place pour ses operations. Les noms les plus fameux entrent dans la liste de ses Auditeurs,

Interest in chemistry had evidently spread beyond those who needed the techniques of preparing chemicals to make a living. Although women could act as apothecaries at this time, they would not be expected to know how to prepare medicines. In accordance with laws dating back to the fifteenth century, the widow of a master apothecary was allowed to keep her husband's pharmacy open, but only on the condition that she employed a journeyman or another master apothecary to run the business. We may conclude, therefore, that the women who were attending Lemery's lectures were not going for a practical pharmaceutical instruction. In fact, Fontenelle does not even describe these members of the audience as 'women' *(femmes),* but rather as 'ladies' *(dames),* showing that already at the end of the seventeenth century chemistry was establishing a place for itself in the polite culture of Paris. It was this polite sector of bourgeois French society that would supply the greatest names of late eighteenth-century French chemistry, as well as the primary social site for the legitimation of this new science over the coming century. To accommodate his diverse audience, Lemery went as far as to offer a few preparations deliberately chosen for their curiosity value. One example of such an experiment was the philosophical tree *(Arbre de Diane* or *Arbre Philosophique)* a crystallization involving silver and mercury, of which he wrote that 'this operation has no use in Medicine, I described it solely for the Curious.'[11] There were not, however, very many of these curiosities included in his course.

As I said, Lemery's course of lectures was published as the *Course of Chymistry (Cours de chymie)* in 1675 and ran into eleven French editions under his own direction, before being produced in several posthumous editions extensively annotated by Théodore Baron. The work was also translated into Latin, English, German, Dutch, Italian and Spanish. Fontenelle famously commented that the book 'sold like a Work of Gallantry or Satire. The Editions followed each other almost yearly, without counting the great number of counterfeit Editions, honourable & pernicious for the Author.' [12] The success of this work would earn Lemery a significant position in the history of chemistry, but the book needs to be understood as a transitional work, bridging the gap between a philosophical chemistry dominated by theory and a more practical type of chemistry that supplied medical preparations. In fact, Lemery's preoccupation with philosophical questions grew as edition followed edition in the last quarter of the seventeenth century.

les Rohaut, les Bernier, les Auzout, les Regis, les Tournefort. Les Dames mêmes entraînées par la mode avoient l'audace de venir se montrer à des Assemblées si savantes.'

[11] Nicolas Lémery, *Cours de chymie,* Paris: D'Houry, 1756, p.90, 'Cette opération n'est de mil usage dans la Médecine, je la décris seulement pour les Curieux.'

[12] Fontenelle, *Éloges des académiciens* (1740) vol. I, p.340, 'II se vendit comme une Ouvrage de Galanterie ou de Satire. Les Editions se suivoient les unes les autres presque d'année en armée, sans compter un grand nombre d'Editions contre faites, honorables & pernicieuses pour l'Auteur.'

In the preface, Lemery committed himself to presenting chemistry clearly, freeing it from a tradition of obscurity particularly associated with alchemy:

> I strive to render myself intelligible, & to avoid obscure expressions which have served other Authors who have written of it before me. Most of the names which I employ are familiar, and I let no term of Art pass without subsequently explaining it in the Remarks.[13]

Lemery did not want to be taken for an obscurantist philosopher. Emboldened by the success of his work, he reaffirmed this opposition to the hermetic art more specifically in a later edition. Thus, in 1696 he endorsed the view that alchemy was best defined as 'an Art without art, of which the beginning is to lie, the middle is to labour, and the end is to beg'. [14] In these later editions, Lemery not only took a stand against the alchemical tradition, but also roundly condemned the most salient features of Paracelsian medical theory. He explicitly challenged the notion that sympathy existed between metals and planets, a view of which the first edition seemed to approve. Adopting a sceptical stance, Lemery concluded in the 1696 edition that no one knew whether or not the planets 'are of the same nature as the metals'. His methodological prejudices were clearly present, they were those of Descartes, as was the mechanistic ontology he promoted in his theoretical discussions. The chemical world was one of extension and movement, with only efficient causes acting on material bodies:

> In truth, the metals serve us in Medicine & we derive good remedies from them, as we will show in what follows, but their effects may be better explained through immediate causes than by those of the Stars. [15]

Lemery, therefore, accepted the formerly controversial metallic drugs introduced by the Paracelsians, but he chose to substitute a mechanical, corpuscular theory for the Paracelsian mysticism, first clandestinely, and later openly. Indeed, his use of physical mechanisms through contact to explain chemical phenomena has earned him a particular place in the history of chemistry.

Lemery was a disciple of Gassendi and Descartes, taking their version of the mechanical philosophy into chemistry in a thoroughly committed fashion, and

[13] Nicolas Lemery, *Cours de chymie* Paris: Lemery, 1675, preface. 'Je tasche de m'y rendre intelligible, & d'èviter les expressions obscures dont se sont servis les Auteurs qui en ont écrit avant moi. La plûpart des noms que j'employe sont familiers, & je ne laisse passer aucun terme de l'Art, que je ne l'explique ensuite dans les Remarques.'

[14] Nicolas Lemery, *Cours de chymie,* Paris: Michallet, 1696 (8th edn), p.89, je trouve qu'on a fort bien défini l'Alchymie : *Ars sine arte, cuius principium mentiri, medium laborare, & finis mendicare ;* Art sans Art, dont le commencement est de mentir, le milieu de travailler, & la fm de mendier.'

[15] Ibid, p.80, 'Les métaux a la vérité, nous servent de la Médecine, & nous en retirons de bons remedes, comme nous dirons dans la suite, mais leurs effets se peuvent mieux expliquer par des causes prochaines, que par celles des Astres.'

certainly it is impossible to read his *Course of Chymistry* without being struck by the imaginative corpuscular explanations he supplies for many of the phenomena under consideration. For example, Lemery offered a model corpuscular explanation of why *aqua regia* (a combination of nitric and hydrochloric acids used to dissolve gold) precipitates the gold it holds in solution when an alkali is added to the mixture. The explanation rested on the commonly held corpuscular assumption that acidic corpuscles were pointed, with points giving rise to the acidic taste as a result of the corpuscles pricking the tongue. In order to explain the initial dissolution of the gold by the acid, Lemery assumed that the particles of gold were porous, so that the points of the acid could stick into them and thus hold them in solution. The action of the alkali was to shake up the acid solution to such an extent that the gold was dislodged and precipitated out:

> I suppose that when the *aqua regia* acts on the gold in such a way that it dissolves the gold, the points which are responsible for the acid's strength are stuck into the particles of gold. But, because these little bodies are very hard, & consequently difficult to penetrate, the points only enter superficially, although far enough to suspend the particles of gold & to prevent them from precipitating; that is why, though you might add as much extra gold as you want, when each of these points has taken up what it can support it will not dissolve a grain more of it; it is also this suspension that renders the particles of gold imperceptible: but if you add some body which by its movement & figure can, by its shock, shake up the acids enough to break them, the particles of gold, being free will precipitate due to their own weight: this, I claim, is what the oil of tartar & the volatile spirits of alkali do.[16]

The theory certainly accounted for the chemical phenomena in a vivid and colourful way. Moreover, Lemery's uncompromising insistence on the materialist nature of his explanation did strike hard against the psychologizing tendencies of many seventeenth-century chemical theorists; the substances participating in chemical reactions were no longer considered to have their own appetites or desires, only extension and motion. It is not surprising, therefore, that Hélène

[16] Lemery, *Cours de chymie,* 1675, pp. 43-4, 'Je suppose que quand l'Eau Regale a agy sur l'or, ensorte qu'elle l'a dissout, les pointes qui faisoient sa force sont fichées dans les particules de l'or. Mais come ces petits corps sont fort durs, & par consequent difficiles estre penetrez, ces pointes ne sont entrées que superficiellement, & toutesfois assez avant pour suspendre les particules de l'or, & empescher qu'elles ne se precipitent; c'est pourquoy on y mettroit tant d'autre or qu'on voudroit, lorsque chacune de ces pointes a pris ce qu'elle pouvoit, qu'il ne s'en dissoudroit pas un grain d'avantage, & c'est même cette suspension qui rend les particules de l'or imperceptibles : mail si vous ajoustez quelque corps qui par son mouvement & par sa figure puisse, en choquant, ébranler assez les acides pour les rompre, les particules d'or étant en liberté se précipiteront par leur propre poids. C'est ce que je pré-tens que fait l'huile de Tartre & les Esprits volatils Alkalis.'

Metzger should have championed Nicolas Lemery as an unrecognized theoretical pioneer in the history of French chemistry.[17]

It is all too easy, however, to get carried away by Lemery's corpuscular explanations of chemical reactions and physical effects, and thereby skip the analysis of the overall content of his work. Historians of science too often take this as the only thing to say about Lemery, and focusing on this particular aspect of his work makes him look like a theoretical chemist producing a corpus close to that of Robert Boyle. The *Course of Chymistry,* however, was not a text that dealt primarily with the theory of chemistry, but was an eminently practical book, as is suggested by the full title of the work: *A Course of Chymistry containing the ways in which to perform the operations which are in use in Medicine, by means of an easy method.* The principal aim of the course was to give the reader information on how to prepare 'mixts' — mineral, vegetable and animal — and how to use these 'mixts' in the treatment of disease, and Lemery makes no attempt to disguise this. A preparation in the mineral realm will serve as an illustration of a typical entry in this book, one that can be fruitfully followed through the eighteenth century, the preparation of the various precipitates of mercury. Lemery starts with the red precipitate of mercury, a considerably easier preparation than the precipitate of mercury *per se:*

> *Red precipitate.*
>
> Take eight ounces of *Mercury* revived out of *Cinnabar,* dissolve it in a sufficient quantity of Spirit of *Niter,* which is nine or ten ounces; pour the dissolution into a viol or Matrass with a short Neck, set it on Sand, and evaporate all the moisture over a gentle heat, until there remains a white Mass; then drive the fire by little and little to the third Degree, and keep it in this condition till all your matter is turned Red, then take it off the fire, let the Viol cool, and break it to get your Precipitate, which weighs nine ounces.[18]

Here are a set of explicit practical instructions for carrying out a simple chemical experiment. In modem chemical language, we would describe it as a preparation of mercury oxide starting from the sulphide, and passing through the intermediary stage of pure mercury, and as such it would not be out of place in an introductory chemistry textbook. To leave the entry at this, however, would be to miss the point

[17] See Chapter 5 of Hélène Metzger, *Les Doctrines chimiques en France du début du XVIIe a la fin du XVIII Siècle ,* Paris: Presses universitaires de France, 1923.

[18] Lemery, *Cours de chymie,* 1675, p. 167, *Mercure precipité rouge.* Prenez huit onces de Mercure revivifié du Cinabre : Faites-le dissoudre dans une suffisante quantité d'Esprit de Nitre, qui est neuf ou dix onces : Versez la dissolution dans une Phiole ou dans un Matras à col court que vows placerez sur le sable, & ferez à feu moderé évaporer toute l'humidité, jusqu'à ce qu'il ne reste qu'une masse blanche : Poussez alors le feu peu a peu jusqu'au troisiéme degré, & l'entretenez en cét etat, jusques a ce que vostre matiere soit devenuë rouge, puis ostez le feu, laissez refroidir la Phiole, & la cassez pour avoir vostre Précipité qui sera au poids de neuf onces.' The translation is from Walter Harris's 1677 translation; *A Course of Chymistry,* London: Kettilby, 1677, p. 102.

of the preparation. For Lemery, the preparation of the red precipitate of mercury found its justification not in a theoretical explanation of what had taken place, but in its medical use as an escharotic, a corrosive agent that can eat away boils and ulcers on the skin:

> It is a good Escarotick, it eats proud flesh; it is used for the laying open of Chancres mixt with burnt Alom, Ægyptiacum, and the common Suppurative. Some do give it inwardly to four grains for to raise a Flux, but this is a dangerous undertaking, unless that Rectified Spirit of Wine be burnt two or three times upon it.[19]

As the whole entry on the red precipitate of mercury taken together suggests, Lemery's *Course of Chymistry* was at base a recipe book for those who wanted to prepare medicines in order to treat the sick. This also explains its continuing currency in the eighteenth-century, as there was a strong demand for such practical chemical instructions, both for the practicing apothecary and for the layman or woman who wanted to prepare their own medicines. Thèodore Baron, Lemery's posthumous editor, even added an index at the end that allowed the owner of the book to look up the right preparation as a function of the disease that needed to be treated. These kinds of do-it-yourself pharmaceutical recipes are clearly not what we would now take to be chemistry, yet for Lemery it formed the greatest part of the field as he understood it. The subsequent transformation away from preparations for practical, medicinal purposes, to preparations for their own sake, or for the sake of chemistry understood as a theory-governed science, was one of the decisive shifts that took place across the eighteenth century.

The distance that has been travelled between Lemery's chemistry and the modern circumscription of the field becomes clearer looking further into his *Course of Chymistry*. Its subject matter was not exclusively inorganic chemistry, or the chemistry of the mineral kingdom as it was understood then. All three kingdoms were represented, mineral, vegetable and animal. Although the majority of the book covered the preparations in the mineral kingdom – and this was a characteristic of these chemistry texts that set them apart from the typical pharmacopoeias – Lemery was quite uniform in his approach across the three kingdoms. The book was, so to speak, recipes all the way down. The entry for rhubarb, for example, in the section dealing with the vegetable kingdom, reads quite similarly to the entry for the red precipitate of mercury presented above. First, there was a natural history of the plant and then a suggestion of the treatment followed by the practical instructions for a preparation.

[19] Lemery, *Cours de chymie,* 1675, pp. 167-168, 'C'est un bon Escarrotique, il mange les chairs baveuses : On s'en sert pour ouvrir les Chancres, meslé avec de l'alun bruslé, de l'Ægyptiac, & du Supuratif. Quelques-uns en font prendre par la bouche jusqu'à quatre grains, pour exciter le Flux de bouche, mais cette pratique est dangereuse, a moins qu'on n'ait fait brûler dessus deux ou trois fois de l'Esprit-de-vin tres rectifié.'

> Slice six or eight ounces of good *Rhubarb,* and steep it twelve hours warm in a sufficient quantity of *Succory* Water, so as the Water may be four fmgers above the *Rhubarb ;* let it just boil, and pass the Liquor through a cloth; infuse the Residence in so much more Succory Water, as before, then strain the Infusion, and express it strongly : mix your Impregnations, or Tinctures, and let them settle ; filtrate them and consume the moisture in a glass Vessel, over a very gentle fire, until there remains a Matter that hath the consistence of thick honey, this is called *Extract of Rhubarb,* keep it in a Pot.
>
> The Dose is from ten Grains to two Scruples in Pills, or dissolved in Succory water for Diseases of the Liver and Spleen, it binds as it purges. [20]

These instructions, although formally very similar to the preparation for the red precipitate, would appear quite out of place in a twentieth-century chemistry book, as it does not illustrate a well-theorized transformation with clearly defined starting and end products. One would be much more likely to find these kinds of instructions in a modern cookbook than in even the most introductory set of chemistry experiments. Even before Lavoisier's revolution, such recipes were to be excluded from chemistry texts and demoted to handbooks and pharmacopoeia. This was part of the irresistible rise of chemistry above its lowly artisanal applications.

The aims of chemistry: Glaser and Lemery

I want here to make a short digression into the realm of chemical practice at the dawn of the eighteenth century. It is not intended to be an exhaustive history of the development of practical analytical chemistry, but rather an examination of how chemistry was practiced at that time based on two exemplary figures.[21] My aim is simply to back up my claim of how intimately chemistry was blended with pharmacy at this time, a relationship that began to fade from chemists' collective memory even as early as the nineteenth century, when a purified chemistry started to have good professional reasons to forget its artisanal past.

[20] Ibid., pp. 375-376, 'Concassez six ou huit onces de bonne Rhubarbe, & la faites tremper chaudement pendant douze heures dans une quantité suffisante d'eau de Chicorée, ensorte que l'eau surpasse la Rhubarbe de quatre doigts : Faites-luy prendre un boüillon, & passez la liqueur par une Estamine; faites tremper le marc dans encore autant d'eau de Chicorée comme devant; puis coulez l'infusion, & l'exprimez fortement : Meslez vos impregnations, ou teintures, & les laissez rassoir : Filtrez-les, & en faites consumer l'humidité dans un vaisseau de verre au feu de sable assez lent, jusqu'à ce qu'il vous reste une matiere qui ait la consistance de Miel épais, c'est ce qu'on appelle *Extrait de Rhubarbe;* lequel il faut le garder dans un pot. La dose est depuis dix grains juqu'à deux scrupules en Pilulles, ou dilayé dans l'eau de Chicorée pour les Maladies du Foye, & de la Ratte; il purge en resserrant.'

[21] A more complete overview is offered in F. L. Holmes, *Eighteenth-century chemistry as an investigative enterprise,* Berkeley: Office for History of Science and Technology, University of California at Berkeley, 1989.

What we must do, therefore, is follow John Eklund into the chemist's laboratory, at least as it is described to us in two classic chemistry texts.[22] I will be focusing exclusively on the chemistry textbooks written by Glaser and Lemery — master and apprentice, as we saw above. Although there is a great deal of overlap in the content of these two books, there are also significant differences that make the comparison worthwhile. Glaser provides a good introduction to seventeenth-century chemistry because he held to a traditional view of matter as composed of five principles, without the complicating features of Lemery's corpuscularianism. Thus, it is easier to see how Glaser's work in the laboratory fits or fails to fit with his professed compositional commitments. Further, Lemery largely took over Glaser's practical preparations for his own text, and although the theoretical gloss is somewhat different, this did not, as I suggested above, substantially alter the conception of the goals of chemistry.

Finally, examining these texts in their entirety suggests that the practical developments in chemistry were not accurately reflected in the relative theoretical stagnation of the discipline through much of the seventeenth century. I do not wish to pursue this point any further, however, as what interests me here is simply trying to understand what it was the French pharmacists were doing at the end of the seventeenth and beginning of eighteenth centuries. In particular, this means trying to understand their goals and the practical manipulations they employed to achieve these goals.

Christophle Glaser

Glaser started his 1663 *Treatise on Chymistry*[23] by dividing chemists into three categories, those who practiced 'high chemistry', followed by an intermediate category of chemists who deliberately disguised their discoveries in obscure jargon and finally the *souffleurs* or puffers *(blowfires* in the 1677 English translation[24]) 'who do not even deserve to receive the name Chymists.'[25] Glaser defined his own position in contrast to all three categories as the modest purveyor of the unadorned practical know-how that was chemistry:

[22] See the short, but compelling book by John Eklund, *The Incompleat Chymist,* Washington DC: Smithsonian Institution Press, 1975.

[23] Christophle Glaser, *Traité de la chymie,* Paris: Glaser, 1663. Like Lemery after him, Glaser published the first edition of his chemistry text himself. This is because the original intention in both cases was to provide a companion book for the courses the authors were teaching in Paris.

[24] Christopher Glaser, *The Compleat Chymist, or a New Treatise of Chymistry,* London: John Starkey, 1677. This translation was based on the fourth edition.

[25] Glaser, *Traité de la chymie,* Paris: Glaser, 1663, preface, p. 'D'autres en fin, qui ne meritent pas d'avoir le nom de Chymistes; mail plfttost de souffleurs ignorants....'. All these chemists can be seen as alchemists of one sort or another.

> … I purpose only in this little Treatise, to publish a short and easy method for the happy attainment of all the most necessary preparations of Chymistry. [26]

Glaser promised to be the honest broker for the practicing apothecary, sparing him the lofty but incomprehensible mysteries of high chemistry, while steering clear of the 'ridiculous work' of the ignorant puffers, and yet presenting this knowledge clearly, not just for the adepts.[27] Nevertheless, Glaser did not entirely forgo theory, and felt obliged to provide an introductory overview of the essential principles of his chemistry. According to him, there were five such principles, three active: Salt, Sulphur and Mercury, and two passive: Earth and Phlegm (or water). The active principles were not the same as the naturally occurring substances that shared their names; for one thing the principles could not be isolated, although their presence could be determined through characteristic signs. These were Paracelsus's *tria prima,* the three hypostatical principles introduced by the founding father of iatrochemistry at the beginning of the sixteenth century. Earth and phlegm were a later addition to the Paracelsian principles, which, however, could already be found in Etienne de Clave's 1646 *Cours de chimie,* and they served to disguise the active principles in nature. It was, therefore, of particular importance that the pharmacist learn how to remove them, as only the active principles, and not the passive ones carried a material's curative virtues. This then is how Glaser characterized the aim of chemistry:

> Chemistry is very extensive, having generally as its object and matter all the mixed bodies taken as much from the kingdom & family of vegetables as of animals & minerals; which it reduces to their active principles ... & purifies them & relieves them of the passive substances, ... which bind their hands & hold them in prison, [chemistry] augments their activity & renders them proper for executing that of which formerly they were incapable, even though they may have had that secret power.[28]

[26] Idem., 'Je me suis seulement proposé dans ce petit traité, de donner au public une methode brieve & aisée, pour venir heureusement à bout de toutes les plus necessaires preparations de la Chymie.' The English is from the 1677 translation.

[27] Considering this view he had of himself, Glaser makes a strange target for Fontenelle in his biography of Lemery.

[28] Ibid., p.7, 'La Chymie est d'une fort grand estenduë, ayant pour objet & matiere generalement tous les corps mixtes, pris tant du regne & famille des vegetaux, que des animaux & mineraux; les quels elle reduit en leurs principes actifs, qui sont du consentement de tous les Philosophes & artistes, le Sel, le Soulphre, & le Mercure; & en les purifiant, & desbarrassant des substances passives, à sçavoir de la Terre, & du Phlegme, qui leur lioyent les mains & les tenoient comme en prison, augmente leur activeté & les rend propres à executer ce dont au paravant ils estoyent incapables, quoy qu'ils en eussent une secrette puissance.'

The power of execution is the power to cure. Thus, the aim of chemistry as the pharmacist's art was to isolate the medically active part of any naturally-occurring substance – animal, vegetable or mineral – so that its curative virtue might be put to use. The ignorant pharmacist without any knowledge of chemistry could easily destroy or lose the active principle, or worse still 'introduce into the mixt, on which he is working, bad qualities while casting out the good.'[29] This goal of purification was not, however, going to be achieved by attempts to isolate any single one of the active principles, first because they always occurred in combination, and, more importantly, because the particular medical properties of any substance depended on its characteristic constitutive combination of principles. Therefore, analysis was not about determining the proportions of the ultimate elements. Instead, the analyses would only ever be down to the level of these medically useful combinations, the sum of which in turn constituted the *materia medico,* purified substances that ranged across all three kingdoms.

Beyond the principle of the active principles, however, Glaser's compositional theory seemed to play little role in a largely practical text, and the word 'principle' almost immediately found itself shifted metonymically from the Paracelsian ideal to the curative virtue itself. Hence, after explaining his theory of five principles, Glaser went on to describe some forty operations whereby *the principle* could be liberated from the mixt. This chapter was followed by one on the vessels used in the operations, one on furnaces, one on luting (the tricky task of connecting individual vessels and tubes together) and one on obtaining the various degrees of heat called for in the text. As in metallurgy, precise control over the degree of heat and the ability to maintain a certain temperature over a period of time were key techniques for a whole range of preparations used by the apothecary. With these chapters on laboratory hardware, Glaser had already left theory behind in order to give the reader vital practical background for what followed. What followed was a series of detailed recipes for preparing and purifying medically useful materials.

Just as in Lemery's book, which drew conspicuously on the work of his former master, Glaser's text was dominated by preparations in the mineral kingdom. This should not, however, be taken as a sign that chemistry in pharmacy was itself mainly the application of inorganic analytical techniques, an area that would later occupy Lavoisier to the exclusion of most animal and vegetable matter. The reason that the mineral realm accounted for so many pages relative to its counterparts in the vegetable and animal kingdoms was the generalizability of techniques in these other areas. Glaser stressed the uniformity of the parts of different plants, they all contained some combination of the following: roots, wood, bark, resins, gums (and other secretions), leaves, flowers, seeds and fruit.[30] Consequently, the same

[29] Ibid., p. 3 [the pharmacist ignorant of chemistry] le [le principe necessaire l'intention du Medecin] détruit ou le perd, en se reseruant le mauvais, ou bien introduit au mixte, sur lequel il travaille, des mauvaises quallitez en rejettant les bonnes.'

[30] This list is given on p. 288 of Glaser's 1668 edition of the *Traité de la Chymie,* in the introduction to the second section on vegetables: 'qui sont les racines, les Bois, les

techniques could serve to purify the active principles of, for example, all types of leaves no matter their origin, rendering them suitable for medical application. Thus only a few techniques needed to be described in full in the section on vegetable preparations, even though their application was in fact far more extensive than the more specific techniques deployed in the mineral realm. This relative paucity of specific vegetable analytical preparations indicates an interesting deficiency in both Glaser and Lemery's texts, a problem I will return to later.

On closer exainination, we see that even when working in the mineral kingdom, Glaser used his five principles only to characterize materials in the most general sense, and this tendency is even more obvious for analyses in the vegetable and animal kingdoms. He never analysed any substance, whether mineral, animal or vegetable, to its elements, because, as I have already pointed out above, the aim was to purify the active principle specific to the mixt under analysis.

To illustrate more clearly what this means, I want to look in detail at the example of tin as typical of the metals that Glaser dealt with in the first part of his work. Beyond the metals, this example can also usefully serve as a model for Glaser's aims in all the preparations he described in his book. Tin is, he claimed, a combination of salt, mercury, sulphur and earth, but its particular imperfection as a metal (the pharmacist's standard of perfection was gold) is due to the preponderance of sulphur and earth in its composition. Glaser drew on a Paracelsian tradition of sympathy and antipathy between the macrocosm of the universe and the microcosm of the human body in order to understand the particular medical virtues of tin. As we have already seen, this was the same view of the relation between the planets and the metals Lemery would explicitly reject some thirty years later.

> 'Tis called *Jupiter,* by reason of the affinity it hath with the *Jupiter* of the great World, and for that the Remedies made of it serve for the Diseases of the *Liver* and the *Matrix*.[31]

As I explained above, the reduction of tin to its principles would denature the metal, rendering it ineffective for the treatment of hysteria, as this medical property depended on the metal's sympathy with Jupiter, which in turn depended on the metal's characteristic constitution. Tin occurs naturally together with other materials, so the first step in any preparation was to separate and purify the tin through a standard procedure of smelting the ore to remove the impurities. Glaser did not subscribe to the medicinal use of tin in its metallic form, but instead described two tin derivatives, one to be taken internally as a medication, while the

escorces, les relines, les gommes & autres excroissances, les feüilles, les fleurs, les semences, & les fruits.'

[31] Glaser, *Traité de la chymie,* Paris: Jean d'Houry, 1668, p. 119, 'On l'appelle Jupiter, à cause du rapport qu'il a avec le Jupiter du grand monde, & à cause que les remedes qui s'en tirent, servent aux maladies du foye & de la matrice.' The English is from the 1677 translation.

other was intended for cosmetic use. The internal medicine was 'salt of Jupiter' *(sel de Jupiter)* which Glaser obtained by reacting purified tin with saltpeter and then distilled vinegar.[32] The resulting substance was, we are told, very effective against all manner of hysterical diseases. The preparation of magister of Jupiter *(magister de Jupiter)* was more straightforward. The tin was dissolved in spirit of niter,[33] and then the magister precipitated by the addition of excess water. The resulting white powder could be used as make-up, providing an elegantly pale complexion.

The practical goal that lay behind these preparations of tin was not only common to all the other metals dealt with in the treatise, it was also carried unchanged into the vegetable and animal kingdoms. The form of all the operations described in the book is the same: a naturally-occurring material was purified and then either used as it was or converted into another form. By itself, however, the book does not serve as a complete vademecum for the aspiring apothecary. This is particularly clear for the preparations in the vegetable and animal kingdoms. Here, Glaser only provided exemplary descriptions for the purification of a root or leaf, with the others to follow this pattern. The problem is that in order to know the dosage for any preparation not explicitly included here the pharmacist would have to look elsewhere. Hence, the text would have to be supplemented by a pharmacopoeia, as only these more comprehensive reference works would supply all the appropriate doses.

What I want to emphasize, however, is that the importance of chemistry for Glaser was in the practical preparations, as these allowed the formerly inactive mixts to become medically effective. Although Lemery would drop the association with planets and replace Paracelsian talk of sympathies with his corpuscular theory, the logic behind his chemical work remained the same. Like Glaser, Lemery believed that it was the characteristic constitution that determined the medical efficacy, and it was the work of chemistry to liberate the curative portion from its medically ineffective or counter-productive complement. The provenance of these mixts encompassed all three kingdoms, animal, vegetable and mineral:

> Chymistry is an Art that teaches how to separate the different substances which are found in Mixt Bodies: I mean by a Mixt Body those things that naturally grow and encrease such as Minerals, Vegetables, and Animals. Under the name of Minerals, I comprehend the Seven Metals, Minerals, Stones and earths; under Vegetables, I understand Plants, Gumms, Rosins, Fruits, the several sorts of Fungus, Seeds, Juyces, Flowers, Mosses, and whatsoever else comes from them. Among these also I reckon Manna, Honey, and those that are called imperfect Mixts. And under Animals I contain both the Animals themselves, and whatsoever belongs to them, as their parts and excrements.[34]

[32] Saltpeter can be identified with potassium nitrate, although the purity by modern standards is variable, and similarly distilled vinegar is more or less pure acetic acid.

[33] Nitric acid.

[34] Lemery, *Cours de Chymie,* 1675, pp. 2-3, 'La Chymie est un Art qui enseigne séparer les differentes Substances qui se rencontrent dans un Mixte; J'entends par Mixte, les

Thus, while the ultimate aim of such chemical analysis may well have been the determination of elementary composition, whether the four Aristotelian elements, the Paracelsian *tria prima,* or some others, the important medicinal role of analysis was separation and purification of different substances – even composite ones – that constituted the various mixts.

As I will show in the final chapter, even when it eventually adopted the new science of chemistry, pharmacy did not dispense with an overriding interest in medical efficacy. After all, the preparations themselves were the key to the pharmacist's livelihood, the very meaning of the profession. Nevertheless, pharmacy did not remain unaffected by the chemical revolution, rather, beginning in the eighteenth century there was a new understanding of what constituted chemistry and how pharmacy fitted in to this conception of the science. By moving on to the middle of the eighteenth century, we find ourselves in a world where the self-conception of an independent science of chemistry was already taking form. The emergence of what would be one of the two great physical sciences of the nineteenth century serves too often to blind the historian to the continuing importance of the tradition of pharmaceutical chemistry and the preparation of medicines in the perception of this emerging science.

Venel & the *Encyclopedie*

The *Encyclopédie* compiled by Diderot and d'Alembert sought to redefine the world of knowledge in eighteenth-century France. Originally conceived of as a translation of Chambers' *Cyclopedia,* under Diderot's direction it was fashioned into a passport to the world of Enlightenment learning for anyone who could afford its numerous volumes. The advertisement at the front of the quarto edition proclaims just such a goal – albeit retrospectively – the monopoly of the reader's bookshelves:

> The two writers who conceived the project of the *Encyclopedia* made it the library of the man of taste *(homme de gaût),* of the philosopher *(philosophe),* and of the intellectual *(savant).* This book frees us from having to read practically any other.[35]

choses qui croissent naturellement, a sçavoir les Minéraux, les Vegetaux, & les Animaux sous le nom de Mineraux; je comprends les Sept Metaux, les Mineraux, les Pierres , & les Terms. Sous les Vegetaux, les Plantes, les Gommes, les Resines, les Fruicts, les sortes de Fungus, les Semences, les Sucs, les Fleurs, les Mousses, & toutes les autres choses qui en viennent. Je mets aussi en ce rang le Manne, le Miel, & ce qu'on appelle Mixtes imparfaits; Et sous les Animaux les Animaux, & ce qui leur appartient, comme leurs parties & leur excrements.' Walter Harris's 1677 translation, pp. l-2.

35 Quoted from Robert Darnton's *The Business of Enlightenment: A publishing History of the* Encyclopédie *1775-1800,* Cambridge MA: Harvard University Press, 1979, p. 260, 'Les deux écrivains qui conçurent le projet de *l'Encyclopédie* en firent la bibliothèque de

The original (Paris) folio edition of the *Encyclopedia* was published between 1751 and 1765, with plates following between 1762 and 1772. The initial subscription price of 280 livres put the work out of the reach of the majority of Frenchmen, and the final cost of 980 livres, a price that does not even include the supplement, only served to exaggerate the elitism of this cultural *tour de force.* We need only consider Labrousse's estimate that skilled artisans could hope to make 15 livres a week, to see what a limited readership the original *Encyclopedia* was courting.[36] Nevertheless, the first edition's print run of four thousand copies proved a profitable venture for the small consortium that backed it.[37]

The third volume of the *Encyclopedia* was published in 1753, and it was here that the reader could find Gabriel-François Venel's thirty-five page disquisition on chemistry. The general heading of 'Chymie ou chimie' allowed Venel full range to inform his audience of how he perceived the present state of the discipline. The view that he gave is very revealing, but it would be wrong to consider it representative of establishment chemistry, if such a thing could be said to have existed at this time. It is important to remember that he himself was not a prominent figure in the world of chemistry. A medical doctor from the University of Montpellier, still in his late twenties, Venel was a relative newcomer to the Parisian scientific scene.[38] In 1741, he had defended his thesis 'A Dissertation on the thickness of the humors',[39] and since then had published nothing outside the *Encyclopedia.* Although he was appointed royal censor in the area of natural history, medicine and chemistry, this was only due to the influence of his patron, the powerful Duke of Orléans, coupled with the support of Malesherbes, the chief royal censor. Moreover, it is interesting to note that Venel was never elected to the Royal Academy of Sciences in Paris, not even as a corresponding member. Nevertheless, by the time the third volume of the *Encyclopedia* was written, Venel had supplanted another physician, Paul-Jacques Malouin, twenty-two years his senior and an *adjoint chimiste* at the Royal Academy of Sciences, as the principal writer for the articles concerning chemistry.

Due to the alphabetic organization of the *Encyclopedia,* it was Malouin who had contributed the definition of alchemy to the first volume. In this entry Malouin

l'homme de goût, du philosophe, et du savant. Ce livre nous dispense de lire presque tous les autres.'

[36] Labrousse, *Esquisse du mouvement des prix et des revenus en France au XVIIIe siècle* Paris, 1932. Quoted from Darnton, p. 275, f/n 66.

[37] Darnton estimates the profits from the first edition at between 1 3/4 and 2 1/2 million livres. Darnton, *The Business of Enlightenment,* 1979, p. 16.

[38] Born in 1723 in Tourbes, he moved to Paris around 1746. For more on his life see the entry in *The Dictionary of Scientific Biography,* written by W. A. Smeaton. For more context on Montpellier physicians and their relationship to the medical circles in Paris, see Elizabeth Williams, *A Cultural History of Medical Vitalism in Englightenment Montpellier,* Aldershot: Ashgate, 2003.

[39] *Dissertatio de humorum crassitudine,* Montpellier, 1741.

revealed how out of touch he was with contemporary sentiment against alchemy, particularly in the more progressive parts of the chemical community. At the same time, his sympathetic portrayal of alchemical learning, including the tradition of the mythically ancient hermetic knowledge, shows the modern reader that alchemy was still an extant intellectual force in the second half of the eighteenth century.[40] In fact, Malouin went so far as openly to criticize his peers in chemistry for the disdain with which they treated this venerable art:

> … chemistry makes use of the advantages that it has received from *alchemy: alchemy* is mistreated in the majority of chemistry books.[41]

It was perhaps due to his unguarded support of the ancients against the moderns that Malouin was squeezed out by Diderot in favour of the younger, and more progressive Venel. It is worth noting as well that Malouin had close ties to pharmacy, and published two books, both on pharmaceutical chemistry, continuing the tradition of Glaser and Lemery, which we examined above. Nor did the end of Malouin's collaboration on the *Encyclopedia* end his contributions to dictionaries, as he contributed entries on baking and milling for the *Descriptions des arts et métiers* published by the Royal Academy of Sciences between 1761 and 1783.

We can see the chemistry articles changing hands between Malouin and Venel in the course of the second and third volumes of the *Encyclopedia.* Malouin wrote 54 articles for the first volume, 18 for the second and only 6 for the third, and this was the sum total of his publication in the *Encyclopedia.* Meanwhile Venel's contribution started with the second volume where we find only 8 of his entries, while he is responsible for 75 entries in the third volume and 71 in the fourth. In total, Venel contributed some 770 entries to the 17 volumes of the *Encyclopedia,* ten times as many as his predecessor.[42] It is important not to read too much into Diderot's change of allegiance, however, as we do not know the circumstances in which Venel succeeded Malouin as the main contributor on chemistry and *materia*

[40] For an interesting discussion of the role of ancient knowledge in seventeenth-century science, see the classic paper by McGuire 'Newton and the Pipes of Pan' (1972). There is other evidence of continued interest in alchemical pursuits and the occult more generally continuing into the heart of the eighteenth century. As Daniel Mornet reminds us, *Lettres sur la Pierre philosophale, les génies, la magie ...* was first published in Paris in 1733 and went into a second edition in 1748; Daniel Mornet, 'Les Enseignements des Bibliothèques Privées (1750-1780)' in *Revue d'histoire littéraire de la France,* XVII[e] année (vol. 17), 1910, p. 490.

[41] Malouin in Denis Diderot and Jean d'Alembert (Eds) *Encyclopédie ou dictionnaire raisonné des sciences des arts et des métiers par une société de gens de lettres,* Paris: Panckoucke, 1751-1765, Vol. I, p. 248, ... la chimie use avec ingratitude des avantages qu'elle a reçûs de *l'alchimie : l'alchimie* est maltraité dans la plupart des livres de chimie.'

[42] These figures are from the author index offered by R. N. Schwab and W. E. Rex, 'Inventory of Diderot's *Encyclopédie,' Studies on Voltaire and the Eighteenth Century,* Vol. XCIII (1972).

medica for the project. In his thesis on chemistry in the *Encyclopedia,* Jean-Claude Guédon suggests that Malouin had neither the time nor the inclination to continue working on the *Encyclopedia,* not only because his own practice was flourishing, but also because the influence of his rival, G.-F. Rouelle, over the Encyclopedists was in the ascendant.[43] Venel was, like Rouelle, a follower of the chemist Georg Ernst Stahl, and therefore fitted in with the predilections of the editors and his fellow-contributors better than Malouin ever had. Whatever the reason, the fact is that Venel continued to work on the *Encyclopedia* despite his relatively junior status as a chemist.

Although Venel and the *Encyclopedia* provide a useful starting-point for assessing the state of French chemistry just prior to the chemical revolution, it is nevertheless, safer to take Pierre-Joseph Macquer as the voice of orthodox late eighteenth-century French chemistry. Macquer's *Élémens de chymie,* which we shall be considering in the next section, was a chemistry text read by other chemists and aspiring chemists, as here they could find a usable up-to-date treatment of the science. Venel, on the other hand, if read at all, would have been read by those members of French society who wanted to know what chemistry was without making any particular commitment to the science.[44] The *Encyclopedia* was supposed to be a source of universal knowledge, and the description of chemistry sat side by side with essays on a vast range of subjects. Perhaps to make chemistry more attractive to his bourgeois audience, Venel refers to an entry on 'Chemical Recreations', although, like many such internal references, the promised article never materialized in any of the later volumes.

Fully aware that he was competing for the attention of the *Encyclopedia's* audience, Venel took a clearly evangelical stance with respect to his subject matter. To this end, he offered a deeply contradictory vision of chemistry. It was a science that was both blooming and sorely neglected, enjoying its greatest triumphs and yet remaining unrecognized. Venel was summing up the state of the art for his readers, using the overview as a dual-purpose tool intended not only to invite initiates into a deserving and promising science, but also proudly to assert its independence and value as a science. These dual aims perhaps account for the contradictory rhetoric with which he laid out the state of the art. He starts by complaining that there were

[43] Jean-Claude Guédon, 'The Still Life of a Transition: Chemistry in the Encyclopedie', PhD Thesis, University of Wisconsin, 1974, p. 110. Guédon also points out that on the death of C.-J. Geoffroy (a pensionnaire in the Royal Academy) in 1752, Malouin was joined by Rouelle, who also became *associé.* Rouelle, a mere adjoint, caused quite a stir by ignoring the niceties of Academic tradition and putting himself forward for consideration as pensionnaire.

[44] I do not mean to imply that apothecaries did not own their own copies of the *Encyclopédie.* In a census of private libraries, Daniel Mornet found two apothecaries who owned the *Encyclopédie* (whether a complete or incomplete set is not specified). The point is that chemistry could not be learnt from the *Encyclopédie* as it could from Macquer's works, written for that purpose.

too few chemists and that those outside chemistry did not understand what it really was. The first misconception involved confusing chemists with 'puffers'. We have already come across this term in Glaser's treatise on chemistry, where he made it clear that it referred to those who vainly pursued the secret of transforming base metals into gold, a central alchemical quest. Venel followed this usage, employing the term 'puffer' as a derogatory reference to alchemy, an art which had been praised by Malouin as a superior ancient wisdom in the first volume of the same work. There was, according to Venel, another mistake that people were in the habit of making and that was to take chemistry for pharmacy, an error all the more disturbing as it was widespread:

> Others, and a lot more in number, limit the idea of *Chemistry* to its medicinal uses: these are they who ask of the product of an operation, what does it cure? They do not know *Chemistry* except through its remedies owed to it by practical Medicine, or at the very best by this route & through the hypotheses with which it has furnished the theoretical Medicine of the schools.[45]

Venel bemoans the common misconception that chemistry was the equivalent of chemical pharmacy. This misconception was holding chemistry back, and further justified Venel's efforts to promote it as an independent science in the pages of the *Encyclopedia.* While chemistry remained confused with the artisanal preparation of medicines what hope did it have of engaging the *philosophes* and savants who subscribed to the *Encyclopedia,* except as one of the many practical arts found in the kingdom of France? In order to be raised above the arts, chemistry had to make a claim to have philosophical interest, and such a claim could only rest on chemical theory not on chemical practice. Consequently, Venel dwelt predominantly on just such theoretical issues. He dedicated most of the opening section to attacking the formerly fashionable corpuscularian view of chemistry and to promoting an alternative, in his opinion more plausible, philosophical view of chemistry, one inspired by Stahl. He found the corpuscularians too reductive; the Cartesian program which he took to have worked successfully in the coarse-grained mechanical context of physics could not presume to apply its methods indiscriminately to the understanding of the interactions and properties of the constituents of matter, the *parties intégrantes* and their combination to form the subjects of chemistry. Venel's explicit aim was to present a version of chemistry that would be attractive to the *Encyclopedia's* readership, one based on a defensible theory of matter, but independent of physics:

[45] Diderot and d'Alembert (Eds), *Encyclopédie,* 1751-1765, 'Chymie', vol. III, p. 408, 'Quelques autres, en bien plus grand nombre, restreignent l'idée de la *Chimie à* ses usages medicinaux : ce sont ceux qui demandent du produit d'une opération, dequoi cela guérit-il? Ils ne connoissent la *Chimie* que par les remedes que lui doit la Medecine pratique, ou tout au plus par ce côté & par les hypotheses qu'elle a fournies à la Medecine théorique des écoles.'

> … we are going to try to present *Chemistry* from a point of view that might render it worthy of the interest of Philosophers *[Philosophes],* and to make them see that at least it might become something in their hands.[46]

To be an interesting science meant to be *philosophically* interesting. It is significant that while Venel started his article by complaining that the ignorant confuse pharmacy with chemistry, the subsequent argument has nothing to say about keeping the two distinct. What Venel went on to argue was that chemistry should be distinguished from physics and this line of argument assumed a theory-oriented conception of what constituted chemistry. The popular conception of chemistry might well have been one of more or less sophisticated artisans working with chemicals in a laboratory. This chemist in the laboratory could not, however, possibly be confused with Maupertuis working out his philosophical comparison of Cartesian and Newtonian physics, and yet it was precisely this latter image of the philosopher that Venel wanted to attach to the chemist. Consequently, although he paid lip-service to the importance of experimental work for cheinistry, Venel's presentation of the science was dominated by theory, because it was only the theory that could support the image of chemistry as truly philosophical. This reconception of chemistry as a philosophical science like physics, rather than a weakly-theorized art, was the 'revolution' that Venel hoped to spread to the unconverted in France. Furthermore, it was this revolution that would overthrow the negative image the public had of chemistry. Venel held up Newtonianism as the model for philosophical respectability that could be profitably imitated by chemistry, and claimed that the introduction of Stahlianism into France in 1723 had already brought about a revolution. Stahlian theory had, according to Venel:

> … effected the same revolution in our Chemistry that the reflections on attraction published by M. de Maupertuis in his discours sur les différentes figures des astres, effected in our Physics, allowing us to receive Newtonianism.[47]

Having set forth his program for the promotion of chemistry through its being rendered philosophical, Venel did return to the consideration of the practical arts associated with chemistry, and here he had to admit the crucial role of pharmacy in providing the practical base for any philosophical version of the science. This return from the high ground of theory to the lowly world of practical chemical manipulation had the effect, whether intended or not, of turning the history of

[46] Ibid., p. 410, ... nous allons tâcher de présenter la *Chimie* sous un point de vue qui puisse la rendre digne des regards des Philosophes, & leur faire appercevoir qu'au moins pourroit-elle devenir quelque chose entre leurs mains.'

[47] Ibid., p. 437, 'en 1723 le nouveau cours de *Chimie,* selon les principes de Newton & de Stahl, nous apporta le Stahlianisme, & fit la même révolution dans notre *Chimie,* que les réflexions sur l'attraction que publia M. de Maupertuis dans son discours sur les différentes figures des astres, ont opéré dans notre Physique, en nous faisant recevoir le Newtonianism.

chemistry on its head. Chemistry was presented as the theoretical trunk of a tree which had over time grown branches of practical utility, including pharmacy:

> Up until now, we have been looking at *Chemistry* as the general science of small bodies, as a vast source of natural knowledge; the particular application which has been made to different objects, has produced the divers branches of *Chemistry* & the different chemical arts. The two branches of *Chemistry* which have been cultivated most scientifically, & which have thus become the basis of the work, the true bedrock of the chemist-philosopher's *[chimiste philosophe]* experiments, at the same time as being the two most important chemical arts, are the art of preparing medicaments, *see* PHARMACY, & that of handling ores & purifying metals, either in large or in small quantities, *See* METALLURGY, & DOCIMASY.[48]

This is an inverted vision of the historical relationship between pharmacy and chemistry, presenting a pre-existent independent theoretical chemistry as the soil in which pharmacy and metallurgy had taken root. Nevertheless, this is the vision of chemistry that will come to dominate both the history of chemistry at the end of the eighteenth century and beyond. The untenability of this view as it applies to the history becomes clearer when Venel offers an overview of this very subject, a presentation that makes up over half the entry.

Venel resisted any temptation to dwell on the mythically ancient roots of chemistry and the lost wisdom of Hermes Trismegistus, locating the origins of the science in the fourth century. His dismissive treatment of the tradition of ancient wisdom which Malouin had supported in his presentation of alchemy is part of a greater struggle between the two men within the pages of the *Encyclopedia*. As Venel moved his history into more modern times, the first hero he offers the reader is Paracelsus, but it is not clear, as in so many other presentations of Paracelsus's life, what kind of a chemist he is supposed to be. Although clearly not a modern, Paracelsus drew praise from Venel as the founder of a tradition that succeeded in keeping chemistry alive *within* medicine through the sixteenth and seventeenth centuries:

> Whatever may be the real merit of Paracelsus, it is clear that we owe to him the propagation & the *perpetuity* of *Chemistry*. It is the taste for remedies prepared

[48] Ibid., p.420, 'Nous avons regardé jusqu'a présent la *Chimie* comme la science générale des petits corps, comme une vaste source de connoissances naturelles ; l'application particuliere qu'on en a faite à différens objets, a produit les diverses branches de la *Chimie* & les différens arts chimiques. Les deux branches de la *Chimie* qui ont été cultivées le plus scientifiquement, & qui sont devenues par-là la base du travail, le vrai fonds d'expériences du chimiste philosophe, en même tems qu'elles ont été les deux premiers arts chimiques, sont l'art de préparer les médicamens, *voyez* PHARMACIE, & celui de traiter les mines & de purifier les métaux, soit en grand soit en petit, *Voyez* MÉTALLURGIE, & DOCIMASIE.' The references in block capitals indicate an entry somewhere else in the Encyclopedia, an entry that may or may not exist

> with the help of *Chemistry* that Paracelsus in particular spread and accredited, [and he] introduced this art to the Doctors as an elementary study; which produced a considerable number of treatises of pharmaceutical & medical *Chemistry,* which were for a century, the classic & elementary books of *Chemistry, &* above all in as much as it was only the art of preparing the most agreeable, the most healthy, & the surest medicaments, as Beguin, one of the oldest disciples of Paracelsus defined it.[49]

Even Venel, a forthright champion of chemistry's independence is obliged to admit the inseparability of chemistry from pharmacy at the time of Paracelsus. Nevertheless he was also subscribing to just the kind of redemptive picture of philosophical chemistry he had earlier rejected in the form of the Mosaic inheritance. Venel mentioned that the claim that Moses and Alexander the Great were the original chemical authors had been discredited as the works formerly ascribed to them had been dated to the fifteenth century AD. He also made the much more general observation that the blind veneration of ancient wisdom does a disservice to the moderns whose science had truly progressed beyond what had been known in ancient times:

> ... we have given the ancients more credit than they deserve ... On every occasion we attribute our finesse to them, & we afterwards congratulate ourselves on having worked it out. We will find anything we want to look for in ancient fables.[50]

Despite this trenchant critique of the narrative of the redemption of wisdom, Venel's history of chemistry shared important features with this approach. He saw chemistry as having gone underground in the linkage made by Paracelsus between chemistry and medicine. The pristine science had previously been bound up with alchemy, and after Paracelsus it became hidden in pharmacy. Having set up this dynamic, it was only a matter of time before chemistry would break free, and, according to Venel, this happened in France with the introduction of Stahl's theory.

Before reaching Becher and Stahl, the flame of chemistry passed from Paracelsus to van Helmont and then to Glauber. The history here is still very much that of pharmaceutical chemistry, but this all changes with the arrival of Becher, who receives glowing praise from Venel:

[49] Ibid., p. 431, 'Quel que soit le mérite réel de Paracelse, il est évident que c'est a lui qu'est dûe la propagation & la *perpétuité* de la *Chimie.* C'est le goût pour les remedes préparés par les secours de la *Chimie,* que Paracelse a singulierement répandus & accrédités, qui a fait passer cet art chez les Medecins comme étude élémentaire ; ce qui a produit une quantité considérable de traités de *Chimie* pharmaceutique & medicinale, qui ont été pendant un siecle les livres élémentaires & classiques de la *Chimie, &* sur-tout tant qu'elle n'a été que l'art de préparer des médicamens plus agréables, plus salutaires, & plus sûrs, comme le définit Beguin, un des plus anciens disciples de Paracelse.'

[50] Ibid., p. 421, ... nous n'avons fait aux anciens plus d'honneur qu'ils n'en méritoient ... A tout moment nous leur prétons notre finesse, & nous nous félicitons en suite de l'avoir devinée. On trouvera dans les fables anciennes tout ce qu'on y cherchera.'

> [T]he true Hermes of *Philosophical Chemistry;* the father, the creator of the chemical dogma of this *Chemistry,* which I presented at the beginning of this article as the basis for the study of nature.[51]

It is ironic that Venel, the defender of the moderns against the ancients, should associate Becher with the greatest of all of the mythical founders of the true ancient alchemical art, Hermes Trismegistus.[52] After this epiphany in the person of Becher, Stahl comes as something of a disappointment due, it seems, to his inaccessible writing style. Nevertheless, Venel believed that Stahl's propagation of Becher's thought brought about a revolution in chemistry, a revolution spread to France by Stahl's disciples during the eighteenth century.

In casting an eye over the history of chemistry, Venel acknowledged that pharmaceutical chemistry was dominant in France throughout the seventeenth century. He recognized, as he put it, the important contributions that 'pharmaceutical and medicinal' chemistry had made to 'fundamental and elementary' chemistry, while explicitly rejecting the continued viability of this contingent relationship. For Venel, the pharmaceutical texts that had for so long functioned as introductions to chemistry had now become obsolete, and could serve only to introduce the student to the practical side of this science. Pharmacy could only supply facts and procedures that catered to the chemist's most basic needs. In brief, the unphilosophical pharmacist was no longer to be considered a chemist. And yet pharmacists were paraded before the reader as having made important contributions to chemistry: Beguin, Lefevre, Charas and Lemery. Indeed, Venel claimed that prior to this point in time Lemery's course of chemistry 'was the only truly classic & elementary [text] in France'. Quoting this passage in full provides a good summary of the crucial role Stahl or at least Stahlian theory played in Venel's historiography, as well as reminding us of the importance of Nicolas Lemery as a figure in French chemistry:

> Lemery, who seems to have known absolutely nothing of Stahl, gave us several chemical works at the beginning of the century, among which his *Chemistry* above all won him a considerable reputation, even with the Germans, who translated it despite their own wealth in this area. This work is indeed estimable due to the exactness of the operations, & the frequent & judicious observations of practical [skill]. He stands out from the crowd of pharmaceutical Chemists in which class we have placed him, by a certain semi-corpuscular theory, with which he has decorated or charged his operations. It [the *Course of Chemistry]* was the only

[51] Ibid., p. 434, ... le vrai Hermès de la *Chimie philosophique;* le pere, le créateur du dogme chimique de cette *Chimie,* que j'ai donné au commencement de cet article comme la base de l' étude de la nature.'

[52] For an appreciation of the importance of this figure before the Enlightenment, see Frances Yates, *Giordano Bruno and the Hermetic tradition,* London: Routledge and Kegan Paul, 1964.

> *Chemistry,* according to the principles of Newton & of Stahl, brought us Stahlianism, & effected the same revolution in our *Chemistry,* that the reflections on attraction published by M. de Maupertuis in his discours sur les différentes figures des astres, effected in our Physics, making us receive Newtonianism.[53]

Venel mentioned the operations that comprise most of Lemery's *Course of Chymistry,* but omitted their primary purpose which was, as I have shown above, to prepare medicines. This is just one example of an important elision of categories that operated in Venel's presentation of chemistry's past. While he accepted that Lemery's book was a chemistry text, which was quite natural considering its title, he also categorized Lemery as a pharmaceutical chemist, without any indication of how this might qualify his chemistry. Any divergence in the path between chemistry and pharmacy has been glossed over, and this is a constant feature of Venel's work in constructing a usable history for philosophical chemistry. Nor is this the last time we will come across this kind of historical sleight of hand.

The meagre helping of institutional history served up by Venel also suffers from its attempt to separate the inseparable. It does, however, provide us with some clues as to why chemistry struck out as an independent discipline only in the eighteenth century. Two very important elements are suggested by Venel; the source of the personnel for a chemical science independent of medicine, and the precipitating reason for the serious pursuit of the science. After reminding the reader that the first chairs of chemistry established in the seventeenth century were to be found in medical schools, he explains what has happened since then:

> It is only since the sciences have spread out by a sort of overflowing *[débordement],* that philosophical *Chemistry* has emerged from the bosom of Medicine, where even today there are the greatest number of artists, the true professionals *[gens du métier]:* the others (aside from the leading figures in the great chemical arts, a class which can supply only one or two Chemists for each nation) are, properly speaking, nothing other than amateurs.[54]

[53] *Encyclopédie,* vol. III, 1753, p. 437, 'Lemery, qui paroit absolument avoir ignoré Stahl, nous donna au commencement du siecle plusieurs ouvrages chimiques, entre lesquels sa *Chimie* lui a fait sur-tout une réputation considérable, même chez les Allemands, qui l'ont traduit malgré leur richesse en ce genre. Cet ouvrage est effectivement estimable par l'exactitude des opérations, & les observations fréquentes & judicieuses de manuel. Il se distingue du commun des Chimistes pharmaceutiques dans la classe desquels nous l'avons rangé, par une certaine théorie demi-corpusculaire, dont il a orné ou chargé ses opérations. Il (Lemery's cours of chemistry) a éta le seul proprement classique & élémentaire en France, jusqu'à ce qu'en 1723 le nouveau cours de *Chimie,* selon les principes de Newton & de Stahl, nous apporta le Stahlianisme, & fit la même révolution dans notre *Chimie,* que les réflexions sur l'attraction que publia M. de Maupertuis dans son discours sur les différentes figures des astres, ont opéré dans notre Physique, en nous faisant recevoir le Newtonianism.'

[54] Ibid., p.431, n'est même que depuis que les sciences se sont répandues comme par une sorte de débordement, que la *Chimie* philosophique est sortie du sein de la Medecine, ou sont encore aujourd'hui le plus grand nombre des artistes, les vrais gens du

Chemistry could no longer be contained in pharmacy and medicine, so it finds itself once again standing alone as an independent science. Whether intentionally or not, Venel provides us with more than simply an abstract notion of chemistry's release from its medical captivity. Here, he has identified the way in which the new philosophical chemistry found itself supported outside its traditional, but temporary home in medicine. It continued, of course, to be supported by physicians who had a professional interest in the science, but it was also taken up by a new sort of chemist — the amateur — who was interested in philosophical chemistry for its own sake. This is surely the type of convert Venel was trying to reach with this article in the *Encyclopedia.* He went further along this path, offering an even more direct appeal to this pool of amateurs, a request that such people initiate themselves into the science at Guillaume-François Rouelle's lectures in Paris. And so the article concluded with an advertisement to all aspiring amateur chemists to take themselves along to Rouelle's course. Rouelle, it should be remembered, as well as being a champion of the Stahlian doctrine, was also a qualified pharmacist who had turned his hand to teaching with great success. I want to quote Venel's sales pitch for Rouelle in full, as it gives a sense of the appeal generated around chemistry at this time for those who had no professional stake in the science:

> The courses M. Rouelle has given in Paris for fifteen years are, even in the opinion of foreigners, the best of their kind. The order in which the individual objects are presented, the abundance and variety of examples, the care & exactitude with which the operations are carried out, the origin & connection of phenomena that are brought to light, the new views, illuminating, and extensive, which are suggested there, the excellent precepts for manipulation which are taught there, & fmally the good, the sane doctrine of all the particular pieces of knowledge that is summarized there; all these advantages, I say, make the laboratory of this capable chemist such a good school that after two courses one can, with ordinary ability, leave there well enough instructed to merit the title of distinguished amateur, or of artist capable of successfully applying himself to chemical research. This judgement is confirmed by the example of all the French Chemists, whose first taste of *Chemistry* was subsequent to the first courses of M. Rouelle.
>
> I did not think it possible to finish this article better, an article I have uniquely aimed at exciting the taste for *Chemistry,* than by indicating to the reader in whom I will have been able to inspire [the taste], the source from which he will be able to satisfy it most profitably . *(b)* [55]

Medecine, ou sont encore aujourd'hui le plus grand nombre des artistes, les vrais gens du métier : les autres (excepté les directeurs des grands arts chimiques, classe qui ne peut fournir qu'un ou deux Chimistes à chaque nation) n'étant proprement qu'amateurs.'

[55] Ibid., p. 437, 'Les cours que M. Rouelle fait a Paris depuis quinze ans, sont de l'aveu même des strangers, ce qu'il y a de mieux en ce genre. L'ordre dans lequel les objets particuliers y sont présentés, l'abondance & le choix des exemples, le soin & l'exactitude avec lesquels les opérations y sont exécutées, l'origine & la liaison des phénomenes qu'on y fait observer, les vûes neuves, lumineuses, &endues, qui y sont suggérées, les excellens préceptes de manuel qui y sont enseignés, & enfin la bonne, la saine doctrine qu'on y

It is perhaps ironic that only about one quarter of the first edition of the *Encyclopédia* sold in France, because the invitation to attend Rouelle's course in Paris served as a key element in Venel's attempt to draw more amateurs into the science. Having presented chemistry as worthy of philosophical attention, he finished by inviting the targeted *philosophes* to initiate themselves into the theory and practice of the science as soon as possible. Whether or not it was due to Venel is impossible to say, but Rouelle's classes did attract considerable numbers of gifted amateurs, and chemistry itself would subsequently enjoy a rise in status quite beyond Venel's expectations.

Pierre-Joseph Macquer — chemistry for chemistry's sake

In his biographical study of Guyton de Morveau, one of the authors of the 1787 *Method of Chemical Nomenclature,* Georges Bouchard describes how his protagonist was introduced to chemistry by studying Macquer's works on the subject. Born and raised in Dijon, Guyton was educated as a lawyer, and at the age of twenty-five, his father bought him the important position of advocate-general in the Parliament in Dijon. In order to fill this post, Guyton was obliged to stay in Dijon, and was unable to follow Venel's recommendation to attend Rouelle's lectures in Paris. Nevertheless, Guyton's experience amply demonstrates that being far removed from Paris did not necessarily mean having to forego the study of the fashionable sciences. Those with access to books had access, even if not equal access, to experimental science. In 1784, on the occasion of opening a chemistry course he had established in Dijon, Guyton had this to say about his own initiation into chemistry:

> Those who followed Rouelle's courses have often repeated to me that these courses were the sole instructors of good chemistry; for my part, I was the disciple of M. Macquer's books, and replete with the reading of his writings, I reserve the same sentiment for him. How many [others] had to share him with me? All those

résume de toutes les connoissances particulieres ; tous ces avantages, dis-je, font du laboratoire de cet habile Chimiste une si bonne école, qu'on peut en deux cours, avec des dispositions ordinaires, en sortir assez instruit pour mériter le titre d'amateur distingué, ou d'artiste capable de s'appliquer avec succès aux recherches chimiques. Ce jugement est confirmé par l'exemple de tous les Chimistes François, dont le premier goût de *Chimie* est postérieur aux premiers cours de M. Rouelle. Je n'ai pas chû pouvoir mieux fink cet article, que j'ai uniquement destiné a exciter le goüt de la *Chimie,* qu'en indiquant au lecteur à qui j'aurai pû l'inspirer, la source dans laquelle il pourra le satisfaire avec le plus d'avantage (b)' (The (b) was used to identify Venel's as the article's author).

> born far from the capital or unable to follow lessons at certain designated times, owe to him all that they know ...[56]

Pierre-Joseph Macquer was a Parisian medical doctor and a member of the Royal Academy of Sciences from 1745 until his death in 1784. In fact, he was probably the best-known French chemist prior to the rise of Lavoisier and the chemical revolution, although Guillaume-François Rouelle and Antoine Baum& – both pharmacists – would have to be considered as contenders for this title. Besides his membership of the Royal Academy of Sciences, Macquer held other important positions in the extensive state concerns of *ancien régime* France. He taught pharmacy for one year at the Faculty of Medicine in Paris, and was the professor of general chemistry at the *Jardin du Roi.* He only officially succeeded Bourdelin at this second post in 1777, although Malouin, the encyclopedist we came across earlier, had been relieving an ailing Bourdelin even before Macquer stepped in in 1770. Macquer, like his brother, was also involved in the practical side of French science, and in 1766 he succeeded Hellot as director of the national dyeing-works at *Les Gobelins,* as well as being scientific advisor for the state earthenware factory in Sèvres.[57]

Macquer owes his prominence in the history of science to the importance generally assigned to his 1766 work, the *Dictionary of Chemistry*.[58] This book was part of a wave of dictionaries and encyclopaedias that were triggered by Diderot's epoch-making work, and has sparked much interest in the history of chemistry, including the intriguing rhetorical analysis offered by Wilda Anderson.[59] Nevertheless, before he published his *Dictionary of Chemistry,* Macquer had already written two important textbooks which, taken together, served to replace Lemery's *Cours de Chymie* in the education of chemists, and to which Guyton de Morveau was no doubt referring in his endorsement that I quoted above. In 1749, Macquer published *Élémens de Chymie Théorique (Élements of Theoretical Chemistry),* and this was followed two years later by the *Élémens de Chymie-*

[56] Quoted from Georges Bouchard, *Guyton-Morveau chimiste et conventionnel (1737-1816),* Paris: Perrin, 1938, p.54, 'Ceux qui ont suivi les cours de Rouelle m'ont souvent répété qu'ils étaient les seuls instituteurs de la bonne chimie ; moi j'étais le disciple des livres de M. Macquer, et plein de la lecture de ce qu'il avait écrit, je lui conservais le même sentiment. Combien ont dü le partager avec moi, tous ceux qui nés loin de la capitale ou empêchés d'y suivre des leçons à des heures fixes, lui doivent tout ce qu'ils savent' (Affiches de Dijon, 1784, p. 75).

[57] *Dictionary of Scientific Biography,* 'Macquer' by W. A. Smeaton.

[58] A full bibliography of this work is given in Roy G. Neville and W. A. Smeaton, 'Macquer's *Dictionnaire de Chymie:* A Bibliographical Study', *Annals of Science* 38 (1981): 613-62.

[59] Wilda Anderson, *Between the Library and the Laboratory,* Baltimore: Johns Hopkins University Press, 1984.

Pratique (Élements of Practical Chemistry).[60] An English translation that combined these two works into a two-volume book, *Élements of the Theory and Practice of Chymistry,* appeared in 1758, with several editions bringing this text to the Anglophone market where it enjoyed some considerable success.

Macquer's works present an approach to the teaching of chemistry significantly different from that found in Lemery's treatise discussed above. Macquer was not interested in supplying remedies for various illnesses, and the books' chemistry was aimed explicitly at a target readership of 'amateurs', taking a first-time interest in chemistry:

> Many who have a relish for the Sciences, but have not leisure to read elaborate Works which treat of them minutely, are glad to meet with a book from which, without sacrificing too much of their time, or neglecting their ordinary business, they may obtain a taste or just notion of a Science that is not their principal study. Those who incline to go further, and learn more, may, by reading an Elementary tract, be enabled to understand Authors who, as they commonly write only for proficients in the Art, are obscure and hardly intelligible to mere beginners.[61]

The first book, *Élements of Theoretical Chemistry,* is, as its title suggests, theoretical in orientation, presenting a by now familiar Stahlian picture of the science, and does not require the reader to dirty his or her hands in preparing the chemicals discussed. Here is another important break with tradition, for even in Lemery's relatively theory-rich work, the corpuscular explanations of reactions were inessential additions to the step-by-step instructions for preparing any medicine. Presumably, Lemery's *Course of Chymistry* would not have enjoyed anything like the success it did had he confined the discussion uniquely to theoretical reflections on chemistry. On the other hand, Macquer did not intend to deny the practical side of chemistry either; rather he chose to hive it off to a separate work.

[60] The full title is *Elemens de chymie-pratique, contenant la description des opérations fondamentales de la chymie, avec des explications & des remarques sur chaque opération* or in English, *Elements of Practical-Chemistry, containing the Description of the fundamental Operations of Chemistry, with Explanations & Remarks on each Operation.*

[61] Pierre-Joseph Macquer, *Elemens de chymie theorique,* Paris: Herrisant, 1749, pp. xiv–v, 'Une infinité de personnes qui ont du gait pour les Sçiences, sans avoir assés de loisir pour lire des Traités complets qui decendent dans de grans détails, aiment à trouver un livre par le moyen duquel, sans sacrifier beaucoup de leur tems, & se détourner de leurs occupations ordinaires, elles peuvent prendre une teinture & une idée juste d'une Sçience qui n'est point leur principal objet. Ceux qui ont dessein de pousser plus loin l' étude & d'approfondir davantage, peuvent se faciliter par la lecture d'un Traité élémentaire l'intelligence des Auteurs, qui n'écrivant le plus souvent que pour les gens de l'Art, sont obscurs & difficiles à entendre pour les commençans.' Translation from Pierre-Joseph Macquer, *Elements of the Theory and Practice of Chymistry,* transl. Andrew Reid, London: J. Nourse, W. Strahan, J. & F. Rivington, T. Longman, T. Cadell, & E. Johnston, 1775, Vol. I, p. x.

> I do not talk at all in this Work about manipulation and the different ways to carry out chemical operations, therefore this is only an elementary Treatise of theoretical Chemistry. If the Public judges it worthy of its attention, I will produce another one, where it will be a question solely of operations: it will be like the sequel to this one, it will assume [the reader] has read [this one], and shall be a book on the elements of practical Chemistry. [62]

That an author could publish an independent volume exclusively on the theory of chemistry tells us that the amateur audience for chemistry was growing in the middle of the eighteenth century, at least to the extent that a chemist could afford to cater to purely philosophical interests.

No doubt Macquer's *Élements of Practical Chemistry* was already in the works, if not entirely completed by the time the *Élements of Theoretical Chemistry* was published, and it was only held in reserve due to the reticence of either the author or the publisher, or both. Any doubts were soon disposed of, however, and the two volumes of Macquer's practically-oriented sequel were published in 1751. A second edition of the theoretical work followed in 1753, and a second edition of the volumes on practice in 1756. The two works, dealing respectively with the theory of chemistry and its practice were based on two different plans dictated, Macquer tells us, by the different natures of the subjects in question.

Macquer believed that a particular plan was needed to present the theory of chemistry, a philosophically based plan that proceeds from the simple to the complex. In a sense, the title of his text, *Élements of Theoretical Chemistry,* already gives his pretensions away, but to make it explicit, Macquer saw himself as the Euclid of chemistry, casting the science in an axiomatic form. He conceived of building the theory up from five first principles, the four traditional Aristotelian elements – air, water, earth and fire – plus the flammable principle, phlogiston, popularized through Stahlian chemistry. This very approach was, Macquer claimed, necessitated by his desire to introduce chemistry to amateurs who had received no previous initiation in the subject:

> The general Plan on which I proceed is to suppose my Reader an absolute Novice in Chymistry ; to lead him from the most simple truths, and such as imply the lowest degree of knowledge, to such as are more complex, and require a greater acquaintance with Nature. This order, which I have laid down for my rule, hath obliged me to begin with examining the most simple substances that we know, and which we consider as the elements whereof others are composed; as, by knowing the properties of these elementary parts, we are naturally led to those of their

[62] Pierre-Joseph Macquer, *Elemens de chymie theorique,* Paris: Herrisant, 1749, p. xxii, 'Je ne parle point dans cet Ouvrage, de la manipulation & des différentes manières de faire les opérations chymiques, ainsi ce n'est qu'un Traité élémentaire de Chymie théorique. Si le Public le juge digne de son attention, j'en donnerai un autre, on il sera uniquement question des opérations : il sera comme la suite de celui-ci, en supposera la lecture & sera un livre d'élémens de Chymie pratique.'

> several combinations; and on the other hand, in order to know the properties of compound bodies, it is necessary we should be first acquainted with the properties of their principles.[63]

The *Élements* of Euclid would be a work familiar to his readers who were fortunate enough to have received some schooling, as it was a standard text for teaching geometry. Aligning his course with this particular classical text and the tradition that it represents meant turning away from the tradition of the apprenticeship, which had for so long been the standard model in chemical education. Thus, Macquer would start his teaching enterprise by laying out the principles, rather than following Glaser and Lemery and presenting the laboratory instruments after having given a cursory theoretical introduction.

Furthermore, the geometrical style adapted to chemistry — the simple to the complex — was to be the foundation of the writings of the new chemistry which would follow in the generation of chemists that succeeded Macquer. As we shall see later, Lavoisier dressed up this same form in the garb of Condillac's sensorial version of empiricist philosophy for the presentation of his own chemistry. This plan and its pursuit should prepare us for the otherwise surprising fact that Macquer had no commitment to providing the traditional medical preparations, as this was a work clearly oriented towards presenting 'philosophical' and not pharmaceutical chemistry.

Anyone expecting the practical part of Macquer's *Élements* to provide updated preparations of the sort offered in Lemery's *Cours de chymie* would have been sorely disappointed. Although a book of chemical operations, it was not a book of medicinal recipes. Again we can refer to the two examples used to illustrate Lemery's approach, the preparations of the precipitates of mercury and the rhubarb extract. Although Macquer mentioned the name given to mercury precipitate *per se* as being the same in chemistry and in medicine, he did not supply any of its medical uses. Rhubarb, on the other hand, did not even get an explicit mention. The second volume of Macquer's practical chemistry was dedicated to the vegetable and mineral kingdoms, but, true to a promise given in the introduction, Macquer confined his discussion to quite general techniques. He explained how to obtain extracts from various types of vegetable matter, but did not give any consideration to the medicinal uses of the results. Nevertheless, the break was not total. When Macquer discussed Tartar Emetic *(Tartre Stybié ou Émétique)*[64] he was obliged through linguistic association if nothing else, to address the question of its emetic properties. This pharmaceutical discussion was also confined to a theoretical level, and Macquer abstained from recommending any specific dosages. The *Élements of Chemistry* was not intended to be of use to a practicing pharmacist, except maybe

[63] Ibid., pp. xvi—xvii; translation, p. xi.

[64] This is a preparation containing antimony; Eklund identifies it as Potassium antimonyl tartrate (KSbC4H4O7). John Eklund, *The Incompleat Chymist,* Washington, DC: Smithsonian Institution Press, 1975, p. 42.

in developing his chemical manipulation skills, and deepening his knowledge of chemistry conceived of as something independent from its applications in pharmacy. Macquer's work, unlike those of Glaser and Lemery, could be used without a pharmacopoeia, but it would not directly help an apothecary in his daily practice.

With his 1766 *Dictionnaire de chymie,* Macquer deliberately expanded his purview to include chemical medications. The full title of the dictionary gives an idea of the wide range Macquer intended to cover in this dictionary, as well as giving important clues concerning his perspective on chemistry: *A Dictionary of Chemistry*[65]*, containing the theory & the practice of this science, its application to physics, to natural history, to medicine & to the animal economy; with detailed explanations of the virtues & the manner the action of chemical medicines. And the fundamental principles of the arts, manufactures & crafts which depend on chemistry.'* According to the title, therefore, the virtues of chemical medicines were included in Macquer's brief this time, although even here the focus of discussion was on the debates over how these medicines might work. Nevertheless, true to his word, Macquer did get down to the details of pharmaceutical practice in the Dictionary. In the case of Glauber's salt, for example, where he had given a preparation but no medical prescription in his *Élements of Practical Chemistry* (Vol. I, pp. 121-35), when it came to the *Dictionary,* the reader could find a description of its preparation accompanied by recommended dosages.[66]

In an interesting historical overview offered as the introduction to the *Dictionary,* Macquer made an explicit identification of philosophy with modern chemistry. Furthermore, he reaffirms the observation I made above concerning the changing nature of the audience for chemistry from the middle of the eighteenth century. Having originated amongst the acquisitive, Macquer opined, chemistry had now found a safe haven in the laboratory of the disinterested amateur.[67]

> We have now the advantage of seeing the best days of Chemistry. The taste of our age for philosophical matters; the protection of Princes; the zeal of a multitude of illustrious and intelligent persons attached by inclination to the study of this Science; the profound skill and ardour of modern Chemists, whom we do not attempt to praise, because they are above our eulogiums; seem altogether to

[65] Pierre-Joseph Macquer, *Dictionnaire de chymie, contenant la théorie & la pratique de cette science, son application a la physique, a l'histoire naturelle, a la médecine & l'economie animal; avec l'explication détainée de la vertu & de la maniere d'agir des médicamens chymiques. Et les principes fondamentaux des arts, manufactures & métiers dépendans de la chymie,* Paris: Lacombe, 1766, (2 vols).

[66] Sodium sulphate, which was also known as *'sal mirabile'* due to the miraculous healing powers first proclaimed by the eponymous Johann Rudolph Glauber in the seventeenth century.

[67] For a discussion of the different views concerning the relationship between science and entrepreneurial culture in eighteenth-century Britain see Jan Golinski *Science and Public Culture.* Cambridge: Cambridge University Press, 1992.

> promise the greatest and most brilliant success. We have seen Chemistry drawing its origin from necessity, and receiving a slow and obscure encrease from avarice. To true philosophy it was reserved to bring it to perfection.[68]

This flattering assessment of both contemporary chemistry and its future potential was given at the end of Macquer's historical introduction. In this overview of chemistry's past he offered a historical perspective very similar to that offered by Venel, except that he concluded in a much more upbeat manner. The whole of this historical introduction to the *Dictionary* of 1766 was initially offered in a 1759 advertisement for Macquer's course, written and taught in partnership with the renowned pharmacist Antoine Baumé. The latter would rise to be the most eminent pharmacist during the chemical revolution, and, appropriately enough, opposed the anti-phlogiston theory to the bitter end.[69]

Macquer did not live to see the publication in 1787 of the *Method of Chemical Nomenclature* by Guyton de Morveau, Lavoisier, Berthollet and Fourcroy. Nevertheless, he surely would have recognized its rapid success in bringing a philosophical language to chemistry as one of the great victories for the science, a chemistry with a reformed language was a considerably more perfect, more philosophical science. Although the authors of this epoch-making work belonged to the generation that succeeded Macquer's, the French chemical community (unlike the pharmaceutical community) was not very extensive at this time. It is not surprising, therefore, that Macquer had some chemical connection with all four of the *Method's* authors.

Guyton de Morveau, the initiator of this particular version of reformed chemical language, kept up a correspondence with Macquer from 1762 until 1782, just two years before the latter's death, and, in 1772, he became Macquer's official correspondent in the eyes of the Royal Academy of Sciences in Paris. Following Macquer's death in 1784, Fourcroy inherited his post as the teacher of chemistry at the *Jardin du Roi,* apparently on the former's recommendation, because he had to contend with stiff competition from Berthollet, who had the solid backing of his powerful protector the Duke of Orléans. Nevertheless, Berthollet did succeed Macquer as the head of the Gobelins dyeing and tapestry works, a state-run factory located in Paris. Of the four authors, however, it was Antoine Lavoisier who collaborated most fully with Macquer.

[68] Pierre-Joseph Macquer, *Dictionnaire de chymie ...,* Paris, 1766, p. xxvi. This is identical to the prospectus for the course he offered with Antoine Baumé ; see Pierre Macquer and Antoine Bann* *Plan d'un Cours de Chymie expérimentale et raisonée avec un discours historique sur la chymie,* Paris, 1757, pp. lxii–lxiii. The translation is from the 1771 English edition, p. xii.

[69] Elected to the Academy of Sciences in 1772 to fill Lavoisier's place when the latter was promoted, Baumé was not elected to the *Institut* when it formed in 1795, except as a corresponding member. Thus, he was effectively forced out by the growing school of chemists professing the new chemistry. He died in 1804.

Along with Cadet, and using Cadet's laboratory, Lavoisier and Macquer performed some well known experiments on the combustion of diamond. Lavoisier, as the junior member of the group, was delegated to submit the report, which he did in 1772. This investigation had an unusually high profile and aroused considerable interest around Europe. The destructibility of diamond had previously attracted the attention of Francis I of Lorraine, who is mentioned as one of the first to demonstrate the possibility of 'evaporating' diamonds through the action of heat.[70] Those familiar with Guerlac's thesis will recognize this year — 1772 — as Guerlac's 'crucial year', the year in which Lavoisier started an investigation into the nature of combustion that would ultimately lead to the overthrow of phlogiston. Concerning the experiments on diamond, however, Guerlac concluded in 1961 that he could 'see no bridge between Lavoisier's investigations of the diamond and his experiments on combustion'.[71] Nevertheless, I believe that this series of experiments provides an important bridge between two versions of philosophical chemistry, not so much in the content or interpretation of the experiments as in the chemists it brought together; Macquer and Lavoisier. Macquer attempted to present an autonomous chemistry to a constituency of amateur chemists who had no need for medicinal preparations, but fell back on providing this pharmaceutical information from time to time. In the end he was not ready to slough off his commitments as a physician in order to become a pure 'philosophical chemist'. Lavoisier, by contrast, succeeded in making the break from most of the practical applications of chemistry, and would find no place at all for the concerns of traditional pharmaceutical chemistry in his 'new' chemistry.

[70]Macquer, Cadet, Lavoisier and Mitouart, *Expériences sur le diamant,* Paris, 1772, p. 3. Here, Lavoisier, the official reporter, commented that Francis I had ordered the experiments even though they cost him six thousand florins in diamonds. Guerlac also notes that Cosimo III, grand duke of Tuscany had commissioned experiments on the destruction of diamond at the end of the seventeenth century (not Frances I, as Lavoisier reported). Henry Guerlac, *Lavoisier — The Crucial Year: The Background and Origin of his First Experiments on Combustion in 1772,* New York: Gordon and Breach, 1990 (lst edn, 1961), p. 80.

[71] Guerlac had earlier been of the opinion that the combustion of diamond had led Lavoisier to his understanding that air was absorbed in this process. Guerlac, *Lavoisier — The Crucial Year,* pp. 89-90.

Antoine-Laurent Lavoisier – a new system of chemistry

Lavoisier is commonly regarded as the locus for two defining events in the history of chemistry, the chemical revolution and the founding of modern chemistry.[72] Although I want to question the way they have been dealt with by historians, I would not deny the justice of these claims made on Lavoisier's behalf. If we understand the chemical revolution simply as the introduction of the oxygen theory, it seems likely that Lavoisier was solely responsible for it. Nevertheless, what I am arguing here is that the chemical revolution should be extended to encompass the culmination of a broader social and institutional movement that played out across the eighteenth century. In this picture, the revolution was one in which the discipline of chemistry asserted complete independence from its associated applications, with pharmacy chief among them.

Although I see Lavoisier's role in the chemical revolution as multi-faceted, the particular achievement I want to concentrate on here is his wresting chemistry from the hands of all the various disciplinary competitors who might have laid a claim to it. This point of view gives us new insight into the remarkable nature of his presentation of a new chemistry to the world during the 1780s. Of course the competing group of chemists that will particularly concern me here is the community of French pharmacists who, as I explained above, appear to have lost control of their science of chemistry in the course of this revolution.

Key to Lavoisier's programme was his 1789 work the *Traité élémentaire de chimie, présenté dans un ordre nouveau et d'après les découvertes modernes* (translated into English as the *Élements of Chemistry).*[73] This text has established a central place for itself not just in the history of chemistry, but in the broader discipline of the history of science as well. The most readily accessible eighteenth-century chemistry text, it is truly remarkable for its clarity and the forcefulness of the vision that Lavoisier presents of a new philosophical chemistry. When I say that the *Élements of Chemistry* is accessible, I mean that it is considerably more accessible to the modern student of the history of science than any chemistry book that preceded it, which can be put down to two complementary factors. First, the recently reformed language adopted by Lavoisier makes the book much easier for a modern, chemically informed audience to read than the texts that came before, which were themselves written in a language that has since passed out of usage.

[72] In the view of some historians, these two events are identical. This identification is not a necessary one, however, and much depends on how the individual events are themselves defined.

[73] When he translated Lavoisier's work into English, Robert Kerr gave it this title by which it has become known in the English-speaking world. This is not a literal translation, as the French title was *An Elementary Treatise on Chemistry.* Kerr's title serves, however, to convey the prominence that Lavoisier wants to give to the *more geometricum.* Like Macquer's *Elements of a Theory of Chemistry,* it aimed at giving a Euclidean rendition of chemistry.

Second, for various historical reasons discussed in the introduction, the work has been chosen to represent the chemical revolution to generations of students. It has, in tandem with the revolution it represents, achieved a canonical position in the history of science, and is one of the few primary texts from the history of science that remains widely available. Considering the status that the *Élements of Chemistry* has attained, it is hardly surprising that it is exceptionally difficult to put the work back into its historical context.

In the introduction, Lavoisier announces the *Élements of Chemistry* as simply an extension of the nomenclature offered to the world just two years earlier by Guyton, Fourcroy, Berthollet and himself. Although an apparently implausible claim, this is not as far-fetched as it sounds, particularly if the import of the work is considered from the disciplinary perspective I have been promoting. The nomenclature announced a new language for chemistry that would serve to redefine chemistry and chemists through the language they speak. Furthermore, Lavoisier proclaimed his allegiance to Condillac's view of an empiricist connection between language, ideas and facts:

> The impossibility of separating the nomenclature of a science from the science itself, is owing to this, that every branch of physical science must consist of three things; the series of facts which are the objects of the science, the ideas which represent these facts, and the words by which these ideas are expressed. Like three impressions of the same seal, the word ought to produce the idea, and the idea to be a picture of the fact.[74]

Taken seriously, this connection implies that the extent of the new chemical language directly gauges the extent of the field of chemistry. In effect, this proclamation serves to anchor chemistry more solidly into the mineral kingdom as this is the area of concentration for the new nomenclature. Such a reorientation leaves the vegetable and animal kingdoms, traditionally the source of the majority of pharmaceutical preparations, beyond the pale of the new chemistry. Lavoisier, for example, like his modern counterpart, would not dream of presenting a discussion of the preparation of an extract of rhubarb in his work on chemistry. The red precipitate and precipitate of mercury *per se,* by contrast, are found in the 'Table of the binary Combinations of Oxygen with simple Substances' combined now into the unitary classification of 'red oxyd of mercury'.

What is too often ignored in analyses of Lavoisier's *Élements of Chemistry* is not so much the descriptions of reactions and theories we can find between its covers, but rather what is completely left out of the book. Lavoisier addressed some of these omissions explicitly in the text, explaining that the treatise was intended as an introduction and so needed to be limited in scope. Accordingly, there was simply not enough space to cover the practical side of chemistry, something he admitted was very important. Lavoisier did not hide the commitment needed to

[74] Antoine Lavoisier, *Elements of Chemistry,* Trans. Robert Keir (1790) and Ed. Douglas McKie, New York: Dover, 1965, p. xiv.

become a good chemist, a commitment that went far beyond working through this introductory work:

> It ought likewise to be considered, that very little of chemistry can be learned in a first course, which is hardly sufficient to make the language of the science familiar to the ears, or the apparatus familiar to the eyes. It is almost impossible to become a chemist in less than three or four years of constant application.[75]

Lavoisier also used the excuse of limited space and the introductory nature of the work to absolve himself from the necessity of presenting a review of the history of chemistry, a standard practice for chemical authors of that time. There are, however, elements of contemporary chemistry that are omitted without any accompanying explanation. Macquer, it will be remembered, gave details of preparations in his *Élements of Practical Chemistry,* preparations supplemented by discussion of their medicinal use, and he even went on to recommend prescriptions in his *Dictionary,* including appropriate dosages. For Lavoisier these kinds of pharmaceutical concerns were simply not a part of chemistry anymore, and the omission required no explanation. The *Élements of Chemistry* lent itself to this kind of unregistered exclusion of pharmacy for two reasons: first, because of its introductory nature, a reason which Lavoisier proffered in the cases presented above; second, because of the systematic nature of the work. Anything not pertinent to the methodical presentation of his chemistry had no claim to be included. The place of 'mercury oxyd' in the oxygenic system, for example, was all that Lavoisier had to say about it, he had no interest in giving anything but generalities on the preparation of the 'oxyds', much less details of any possible applications.

Nevertheless, we can detect a bias in the way the different branches of the chemical arts were presented. Thus, Lavoisier deliberately steered clear of all mention of pharmaceutical uses, even when the occasion presented itself. In his discussion of Saccholastic acid, for example, he wrote that it was best known as a pharmaceutical preparation, but felt no obligation to elaborate on its possible uses.

> A species of sugar may be extracted, by evaporations, from whey, which has long been known in pharmacy, and which has a considerable resemblance to that procured from sugar canes.[76]

On the other hand, Lavoisier did find the space in his *Élements of Chemistry* to give a brief description of the industrial manufacture of sulphuric acid.[77] More significantly in terms of the chemical tradition with which he aligned himself, Lavoisier offered a significant amount of commentary on the mineralogical nature of the chemicals he discussed. In Part I, chapter XVI, section 4, 'Of Lime, Magnesia, Barytes, and Argyll', for example, the new nomenclature was put aside

[75] Ibid., p. xix.
[76] Ibid., p. 281.
[77] Ibid., pp. 219-220.

in order to discuss the natural occurrence of these salts. In the subsequent section – 'Of Metallic Bodies' – he explicitly recommended that the interested reader turn to alternative specialized works for more detailed information on how to obtain pure samples of these elements:

> Metallurgy, or the docimastic art, teaches the means of separating them [the metals] from these foreign matters: and for this purpose we refer to such chemical books as treat upon these treatises.[78]

It is interesting in this context to note that when in 1785 Lavoisier reformed the sections of the Royal Academy of Sciences, the chemistry section became the section for chemistry and metallurgy. Obviously Lavoisier considered metallurgy and chemistry to be closely allied, although the explicitly practical orientation of the former placed it outside the sphere of the 'philosophical chemistry' that Lavoisier was articulating in his *Élements of Chemistry*. What, however, would have been the message of Lavoisier's book for a reader interested in the pharmaceutical tradition of chemistry (or, what I am arguing amounts to the same thing, the chemical tradition of pharmacy)? Lavoisier just had no place for pharmaceutical chemistry in his vision of the new systeinatic science, it was no longer a part of chemistry as he understood it. It seems likely that even the complete chemistry textbook he would no doubt have produced, had the tide of French history not turned against him, would have little or nothing to say about pharmacy. In fact, in his plan for just such a textbook, pharmacy did not even find its way into the list of chemical arts. Admittedly these were only notes, but the chemical arts he enumerated were limited to mining, glass-working, bleaching, saltpetre manufacture and dyeing.[79]

This blind spot in Lavoisier's vision of chemistry is not altogether surprising when we recall that he was trained neither as a pharmacist nor as a medical doctor. Lavoisier was a member of Parisian bourgeois society, and the bulk of his sizable income was drawn from his partnership in the tax farm, a group of private speculators who essentially collected taxes on behalf of the crown. He received his 'professional' training as a lawyer at the Parisian courts, but, following a childhood fascination for the sciences, he dedicated more and more of his time to chemistry. [80]

[78] Ibid., p. 159.

[79] Bernadette Bensaude-Vincent, 'A view of the chemical revolution through contemporary textbooks: Lavoisier, Fourcroy and Chaptal', *British Journal for the History of Science,* 23 (1990): 435-460. Appendix 1, p. 456. Lavoisier does, however, think that knowledge of 'les drogues simples' understood as knowledge of the natural bodies as nature presents them, should form a prerequisite for the study of chemistry (Appendix 2, p. 459).

[80] Many intellectual and personal biographies of Lavoisier have been written. Recent ones, produced to coincide with the bicentennial of his death on the guillotine in 1794 include Bernadette Bensaude-Vincent, *Lavoisier: Mémoires d'une révolution,* Paris: Flammarion, 1993 (translated into English by Harvard University Press); Arthur Donovan,

Through the persistent and dedicated pursuit of his scientific interests he soon found himself to be a young, yet highly respected member of the Royal Academy of Sciences. Naturally, Lavoisier had received his training in chemistry mainly from doctors and pharmacists as these formed the overwhelming majority of 'chemists' in the generation that preceded his. Nevertheless, his original entry into the field was through an interest in experimental work relating to the mineralogical natural history of France.

Lavoisier was one of those Parisian chemists to whom Guyton de Morveau was referring when he talked about those who were able to attend Rouelle's lectures. In contrast to the praise that Guyton lavished on them, however, the reviews Lavoisier offered of these courses is mixed to say the least:

> The celebrated professor [Rouelle] united a great deal of method in his manner of presenting his ideas with a great deal of obscurity in the manner of expressing them.[81]

Laurent-Charles de la Planche, another pharmacist teaching chemistry in Paris at the time, draws a similarly cool response from this most critical of students. Lavoisier's frustration with what he perceived as the unsystematic nature of the chemistry he was taught would provide a key target for his reforms. Nevertheless, the important point is that these pharmacists teaching chemistry failed to draw this aspiring scientist into the medicinal applications of chemistry. This shows up the extent of Lavoisier's resistance to pharmacy when we see the weight put on just these elements by La Planche, for example.[82]

In his *Élements of Chemistry,* Lavoisier presented his brand of chemistry with a striking confidence, and so some of the less obvious characteristics of the work are easily overlooked as the reader is caught up in the excitement of this revolutionary vision presented at a revolutionary time. In contrast to Venel, writing some thirty-five years earlier, Lavoisier did not feel the need to get down in the trenches and fight for chemistry's place on the natural philosophical map. Nor did he need to explain what chemistry was and what it was not. He did not need to participate in the same disciplinary game of marking chemistry off from physics, and it usually

Antoine Lavoisier: Science, Administration and Revolution, Oxford: Blackwell, 1993; Jean-Pierre Poirier, *Antoine-Laurent de Lavoisier: 1743-1794.* Paris: Pygmalion, 1993.

[81] Bensaude-Vincent, 'A view of the chemical revolution through contemporary textbooks', Appendix 2, p. 459, quoted from the *Archives de l'Académie des Sciences,* MS 1259. 'Le célèbre professeur réunissait à beaucoup de méthode dans la manière de présenter ses idées beaucoup d'obscurité dans la manière de les énoncer.'

[82] Laurent-Charles de La Planche, *Plan d'un tours de chymie, suivant les principes de BECHER, de BOERHAVE & de STAHL, dans la vue d'enrichir la médecine, d'éclairer la physique & de perfectionner les arts,* Paris, 1765. (In fact the work is from 1764, but is advertising a course to be offered in December 1765). This work presented the plan for the course La Planche was going to give. It is clear from the title alone that LaPlanche would stress the utility of the science, primarily in its medical applications.

escapes unnoticed that he made no mention of the position of pharmacy. Chemistry was at this time clearly striking out on its own as an independent science. Lavoisier took the chemistry that was already shifting away from the pharmaceutical tradition and removed it beyond any measure of doubt. It was up to Fourcroy to try and reestablish some sort of filiation, but this time with chemistry as the dominant science and pharmacy as a subservient art. Of course this meant that the history had to be subtly, or not so subtly, rewritten. Fourcroy was, as we saw in Chapter 2, possessed of a passion for telling and retelling the history of chemistry, making him quite equal to this apostolic task.

The *Encyclopedie methodique*

Even before it was finished, the *Encyclopaedia* was recognized by its editors as incomplete and obsolete. Diderot began planning a revised publication almost straight away and just such an expanded version of the *Encyclopaedia* was produced under the title of the *Encyclopédie méthodique,* published between 1782 and 1832. This project, masterminded by Panckoucke, continued first by his son-in-law and subsequently by the latter's widow, consisted of a series of independent dictionaries covering the most important fields of the science and the arts.[83] The updating of the *Encyclopaedia* in the face of a prodigious expansion in the world of technical learning meant that chemistry, pharmacy and metallurgy would share their own dictionary, as one of the disciplinary subsections of the *Encyclopédie méthodique.* Guyton de Morveau was appointed editor in the 1780s, but ended up overseeing the production of only the first volume. It was midway through this volume that Guyton explained his wholesale conversion to the new chemistry and from that point on he wrote extensively on acids in light of Lavoisier's oxygen theory, which means that the first volume never progressed beyond the entry for acids.[84] Guyton de Morveau committed himself so fully to revolutionary politics that he had no time left for this encyclopaedic project, and the second volume of the Dictionary was taken over by Antoine-François de Fourcroy, a fellow convert to Lavoisier's chemistry and a fellow author of the *Method of Chemical Nomenclature.* As the volumes continued to appear, a subscriber might expect eventually to be able to read a full description of what constituted pharmacy when the alphabetical moment finally arrived. Any such expectation would not, however, be fulfilled. A brief notice at the head of Volume IV (1805) severed pharmacy from

[83] For more of the intricate and intriguing publishing history of the *Encyclopédie méthodique* see Robert Darnton, *The Business of Enlightenment: A publishing History of the* Encyclopédie *1775-1800,* Cambridge: Harvard Univ. Press, 1979, Chapters 8 and 9.

[84] *Encyclopédie méthodique, chimie, pharmacie et metallurgie, la chymie par M. de Morveau, la pharmacie par M. Maret, la métallurgie par M Duhamel,* Paris: Panckoucke; Liège: Plomteux 1786-1815, Vol. I, pp. 625-664. Guyton wrote this second 'avertissement' inserted just before the entry on 'air' explaining his conversion to Lavoisier's theory.

the purview of this dictionary. Here, Fourcroy, under a thin disguise of flattery, laid bare the disciplinary transformation of pharmacy and chemistry I have been outlining in this chapter:

> The articles on Pharmacy have been separated from it [the dictionary]. The pharmaceutical art was thought to be interesting enough in itself to be the subject of a separate Dictionary, and also there is not, today, as formerly was the case, an intimate enough relationship, a necessary enough connection between the preparation of medicines and knowledge of general chemistry to make these two subjects inseparable. Pharmacy assuredly merits a Dictionary of its own, due to its important utility and its progress; but, being dependent on Chemistry, it is really nothing but a chemical art, one of its practical applications which does not form an essential element, as one might formerly have thought. This separation of Pharmacy gives Chemistry the space that it deserves in the following volumes of this dictionary, the necessity of which the [present] state of the science has made obvious.[85]

So the separation was complete. Formerly texts worked with an understanding of chemistry which stressed the link between chemistry and the art of providing medicaments with the latter justifying the pursuit of the former. By the end of the eighteenth century, with Lavoisier's work in particular, the connection was lost in the forcible promotion of a philosophical version of chemistry that had no place for pharmacy.

While metallurgy managed to remain in this encyclopaedic dictionary of chemistry because it provided the means for extracting minerals, pharmacy was finally, formally placed outside the disciplinary bounds of the science of chemistry. One might be tempted to take Fourcroy at his word and regard this as a recognition of the exceptional worth of pharmacy, after all, he did announce that it merited its own dictionary. A search through the almost two hundred volumes of the *Encyclopédie méthodique* for the dictionary dealing with pharmacy would, however, be a search in vain. No such volume was to appear. Thus, the new *Encyclopaedia* embodied the definitive message that pharmacy was no longer considered a part of chemistry. It was left to Fourcroy — the editor of the volume on

[85] *Encyclopédie méthodique, chimie et metallurgie,* Paris: Panckoucke, 1786-1815, Vol. IV, p. (Avertissement), 'On en a séparé les articles de Pharmacie. On a pensé que l'art pharmaceutique &oh assez intéressant par lui-même pour en faire le sujet d'un Dictionnaire particulier, & qu'il n'y avoit pas aujourd'hui, comme cela étoit autrefois, un rapport assez intime, un rapprochement asses nécessaire entre la préparation des médicamens & les connoissances chimiques générales, pour rendre ces deux objets inséparables. La Pharmacie méritoit assurément, & par son importante utilité, & par ses progrès, un Dictionnaire particulier; mais, comme dépendante de la Chimie, elle n'est véritablement qu'un art chimique, une de ses applications pratiques qui n'en fait pas une partie essentielle, comme on a pu le croire jadis. Cette séparation de la Pharmacie rend à la Chimie dans les volumes suivans de ce Dictionnaire, une place qu'elle réclame, & dont l'état de la science a fait sentir la nécessité.'

chemistry and metallurgy— to try to make this new chemistry part of pharmacy and thereby offer what he saw as the only hope for pharmacy's redemption.

Chapter 4

The New Chemistry

Fourcroy, Pharmacy and Revolution

> The Revolution that has just come about in the French empire will doubtless not be limited to giving a new constitution to the State. The Sciences and the Arts cannot be the same in a free people as in an enslaved people.
>
> Jean-Gabriel Gallot
> *General reflections on the Restoration of the Art of Healing,* 1790[1]

> Peace will speedily close the wounds which a cruel war has made on humanity. [...] Chemistry which has now become an essential part of the objects taught in all the schools, will gradually extend itself through all the classes of society, and while advances of this science towards perfection, by the discoveries of learned men, shall proceed with unabated rapidity, it will give additional light to all the manufactures and works of which the prosperity is so intimately connected with its progress.
>
> Antoine-François de Fourcroy
> *A System of Chemical Knowledge,* 1800[2]

More than any other man, it was Antoine-François de Fourcroy who placed French pharmacy on the path to its modern scientific form. Following in the wake of the eighteenth-century movement towards a more philosophical chemistry, he actively redefined pharmacy as a separate art dependent on chemistry, specifically the new chemistry developed by Lavoisier just before the French Revolution. Fourcroy also drew pharmacy into a closer institutional association with medicine, placing them both under direct government control for the first time in French history. Finally, he gathered talented pharmacists around himself and imbued them with a vision of a pharmacy based on the ideas and methods of the new chemistry, a picture of a scientific discipline that would become firmly established in succeeding generations. Fourcroy exercised influence over the profession of pharmacy as scientist, statesman and teacher. It was due to the combination of these roles, assumed during a time of exceptional change in French society, that Fourcroy's

[1] Jean-Gabriel Gallot, *Vues générales sur la restauration de l 'art de guérir,* Paris: Didot, 1790, 'La Révolution qui vient de s'opérer dans l'empire Français ne se bornera point sans doute à donner une nouvelle constitution à l'État. Les sciences et les Arts ne peuvent être les mêmes chez un peuple libre que chez un peuple esclave.'

[2] Antoine-François Fourcroy, *Systême de connaissances chimiques,* Paris: Baudouin, 1800, pp. clxxv–clxxvi. The English is from the 1804 translation, pp. 197-8.

name looms large in almost every area of concern to the pharmacist at the end of the eighteenth century.

Fourcroy's inclusion alongside Lavoisier as one of the authors of the *Method of Chemical Nomenclature,* has ensured his place in even the most cursory history of chemistry, although overall assessments of his ability or importance as a scientist vary widely. Almost inevitably, his chemical career is compared to that of another author of the *Method,* Berthollet, who graduated from the Paris Faculty of Medicine in the same year. Fourcroy usually falls short in such a comparison, with Berthollet's work on the reversibility of chemical reactions marking a vital development in the history of chemical ideas, a scientific contribution that Fourcroy never matched.[3] Fourcroy's political influence in France is not open to such debate. Like Guyton de Morveau, Berthollet, and even Lavoisier before his execution in 1794, Fourcroy rose to prominence as a political figure during the French Revolution and continued his upward course in Napoleonic France. When he died in 1809, he was a Commandant in the Legion of Honour and a Count of the Empire.

In fact, of the authors of the *Method of Chemical Nomenclature,* it seems that the youngest of them, Fourcroy, died at the most opportune moment. Lavoisier was executed in 1794 with many productive years still ahead of him, while Berthollet lived to be 75, dying only in 1822. In the years before his death, Berthollet was obliged to betray Napoleon Bonaparte, his protector and benefactor, only to see him return to power. He subsequently suffered a rapid decline in his fortunes after his patron's final defeat at Waterloo. Guyton de Morveau, as Bouchard points out, died at the worst possible time for his posterity, and it is perhaps because of this bad timing that he rarely receives the recognition he deserves in either the history of chemistry or the history of the French Revolution. Guyton, who rose to be a baron in Napoleon's empire, has a legitimate claim to be considered the first president of France as he was the first president of the notorious *Comité de Salut Public.* Despite an impressive political career, his death at the beginning of 1816 was hardly commemorated at all, as he died under a restored monarchy after having voted in favour of the execution of Louis XVI in 1793. Furthermore, following Napoleon's defeat, the mere mention of the former Emperor's name was punishable by a lengthy jail term, and those Napoleon had favoured preferred to keep a low

[3] It is reasonable to suppose that Fourcroy resented Berthollet. They graduated in the same year from the Faculty of Medicine, with Fourcroy at the top of the class, and yet he was refused the title *Docteur-régent.* Fourcroy needed this title in order to teach at the Faculty, while Berthollet, who was granted the title, had no intention of teaching. That same year, 1780, Berthollet was elected to the Royal Academy of Sciences in an election contested by Fourcroy. In 1784 Fourcroy could easily have lost his position of lecturer in chemistry at the *Jardin du Roi* to Berthollet because of the latter's powerful patrons. The final frustration must have been to see Berthollet become Napoleon's favourite chemist, generously bailed out of whatever financial problems he encountered.

profile.[4] It could be argued, therefore, that Fourcroy had the good fortune to die relatively young, before his position as one of Napoleon's favourites became a liability.

Fourcroy enjoyed a long life in politics, which coincided with the most wide-ranging reforms France had ever experienced. He started his political activity in a revolutionary government whose sometimes radical decisions touched almost every area of life, from the 10-day week and the republican calendar to the raising of a huge conscription army by means of a generalized draft, and he finished his life as a distinguished politician under an imperial government that saw its leader conquer most of Europe. One notable achievement of Fourcroy's political career under Napoleonic rule was the reform of French medical education, an enterprise conceived under the Republic that would profoundly influence the practice of French medicine, including pharmacy, throughout the nineteenth century.

Less generous critics might attribute Fourcroy's prominence in the chemical and French revolutions to his being in the right place at the time. Be that as it may, one talent that Fourcroy is generally agreed to have had was that of being an outstanding teacher, which translated into a prominent role as the self-appointed ambassador for the new chemistry primarily developed by Lavoisier, as we saw in the last chapter. In general, the focus on the intellectual origins and development of Lavoisier's chemistry has obscured the importance of its dissemination, although more recent studies on the language of chemistry have sought to redress the balance.[5] Once we look at the issue of the circulation of the new chemistry, Fourcroy assumes a central position because he, more than any other of the authors of the *Method of Chemical Nomenclature,* realized the need for promoting the new chemistry anywhere it might be usefully applied. Building a broad base of converts would aid the rapid recognition and the widespread influence of this particular philosophical approach to chemistry. It was in this evangelical spirit that Fourcroy worked to introduce the new chemistry to pharmacy, enjoying a considerable amount of success.

[4] Guyton was the first president of the *Comité de Salut Publique,* a committee set up to direct France's war effort which assumed dictatorial powers under Robespierre's presidency, and some regard this committee as the first governing ministry in France.

[5] Bernadette Bensaude-Vincent and Ferdinando Abbri (Eds), *Lavoisier in European Context: Negotiating a New Language for Chemistry,* Canton MA: Science History Publications, 1995. This series of papers by scholars from around Europe works with a more active model of reception and integration of Lavoisier's theory by scientific communities in other countries than the traditional image of dissemination.

The life and times of Antoine-Francois de Fourcroy

Born in 1755, Antoine-François de Fourcroy was the son of a Parisian apothecary.[6] The young Fourcroy would probably have been a career bureaucrat, had it not been for the intervention of a family friend, Félix Vicq d'Azyr, a famous, innovative medical doctor and theorist. Impressed by the young Fourcroy's ability, Vicq d'Azyr encouraged him to study medicine at the University of Paris Faculty of Medicine, providing an entrée into the elite corps of the Paris physicians. Fourcroy's position as Vicq d'Azyr's protégé inevitably led to his involvement in the *Société Royale de Médecine,* a new medical society set up by de Lassone and Turgot in 1776, with Vicq d'Azyr as a prominent permanent secretary, and it was from among the society's members that Fourcroy received the patronage that allowed him to qualify as a medical doctor. This association was not, however, an unalloyed good for Fourcroy; for no sooner had The Royal Society of Medicine received its royal charter *(lettres patentes)* in 1778 than the Paris Faculty of Medicine was on the offensive, attempting to quash what it saw as a government-sponsored rival, not properly subordinate to the faculty itself. That same year, the faculty submitted a complaint to the king and threatened to expel all members of the society. The fallout for Fourcroy was twofold. First, he was turned down for an assortment of scholarships which he might otherwise have expected to receive, and he therefore had to rely on financial support from members of the Royal Society of Medicine. Second, when he qualified as a doctor in 1780, Fourcroy was refused the additional title *docteur-régent* despite his excellent results in the final examination. Either in spite of, or maybe because of, the problems such an engagement caused him, Fourcroy remained loyal to the society, joining in 1780 as an associate, and rising to become its director in 1792.

Although he did have a clientele as a doctor, Fourcroy was evidently much more interested in the sciences associated with medicine than in the clinical practice of medicine itself. Even before qualifying as a physician in 1780, Fourcroy had presented several papers on chemical questions before the Royal Academy of Sciences[7] yet, without the title of *docteur-régent* he was not permitted to teach in the inedical faculty of the University of Paris. Had he been granted the appropriate qualification, Fourcroy might well have succeeded his teacher of chemistry and natural history at the Paris Faculty, Jean-Baptiste Michel Bucquet, who died in 1780. Although he was still under forty when he died, Bucquet was already well established, and continued to exercise a positive posthumous influence on Fourcroy's career, opening up both publishing and teaching opportunities for his

[6] The biographical information is mostly drawn from W. A. Smeaton, *Fourcroy Chemist and Revolutionary 1755-1809,* Cambridge: W. Heffer & sons Ltd, 1962, and G. Kersaint, *Antoine François de Fourcroy (1755-1809) sa vie et son œuvre ,* Paris: Muséum National d'Histoire Naturelle, 1966.

[7] For example, in 1777 and 1778, he read a series of three papers at the Royal Academy of Sciences in Paris on the effects of alkalis on iron compounds.

favourite student. In 1782, Fourcroy published his first major text, the *Élementary Lectures on Natural History and Chemistry,*[8] a work originally planned by Bucquet, and in part based on lessons that Fourcroy's teacher had given with the assistance of his student.

Unable to teach at the faculty of medicine, Fourcroy continued to offer private courses on chemistry, taking over Bucquet's own private teaching on the Rue Jacob after Bucquet had to stop due to ill health in 1779. These private lessons supplied material both for Fourcroy's *Élementary Lectures* of 1782 and for his *The art of knowing and using medicines in illnesses which attack the human body,*[9] which came out three years later. This second work was based on a course of *Materia Medica* that Fourcroy offered during the summer. In both these books, Fourcroy took it for granted that there was a definite distinction between chemistry and pharmacy. His *Élementary Lectures* offered no medical preparations or dosages, and in the introduction to the book he plainly laid out the way in which he viewed the relationship between these two disciplines:

> Chemistry lays claim to all the arts that do not belong to Geometry; one of which, due to the services by which it supports humanity, has earned the recognition of all men, & which, by the knowledge it demands from those who exercise it, comes closest to the sciences; Pharmacy is so closely tied to Chemistry, that the former uses the latter to govern all its operations, & thus it is impossible to be a good Pharmacist without being a Chemist.[10]

For Fourcroy, pharmacy was a chemical art that approached the sciences but could not pretend to be one. It did not, therefore, feature as an element in his *Élementary Lectures,* although, as we see in the citation above, he did expect the pharmacist to know this chemistry. The pharmacist had to learn to be a chemist as an independent undertaking, and this meant attending chemistry lectures that left any direct applications of the science, such as the preparation of medicines, for example, to one side.

[8] Antoine-François de Fourcroy, *Leçons élémentaires d'histoire naturelle et de chimie; dans lesquelles on s 'est proposé, 1° de donner un ensemble méthodique des connoissances chimiques acquises jusqu 'a ce jour; 2° d 'offrir un tableau comparé de la doctrine de Stahl & de celle de quelques modernes: pour servir de résumé a un tours complet sur ces deux sciences,* Paris: Simon, 2 vols, 1782.

[9] Antoine-François de Fourcroy, *L 'Art de connoitre et d 'employer les médicamens dans les maladies qui attaquent le corps humain,* Paris, 1785.

[10] Fourcroy, *Leçons élémentaires d'histoire naturelle et de chimie,* vol. I, pp. 7-8, 'La Chimie revendique tous les arts qui n'appartiennent point à la Géométrie; un de ceux qui, par les bienfaits dont il comble l'humanité, a des droits acquis sur la reconnoissance de tous les hommes, & qui, par les connoissances qu'il exige dans ceux qui l'exercent, se rapproche le plus des sciences, la Pharmacie est tellement liée a la Chimie, qu'elle en règle absolument les opérations, & qu'il est impossible d'être bon Pharmacien sans être Chimiste.'

Fourcroy's division between chemistry and pharmacy is more explicit in his subsequent work, the *Art of knowing and employing medicines,* a book explicitly about pharmacy. Here Fourcroy divided pharmacy into two parts; pharmacy as the term should properly be understood, and something else that he called chemical pharmacy. According to Fourcroy, the term pharmacy should only be applied to traditional Galenic preparations, consisting in the combination of herbs and other plants (the traditional 'simples' of the pharmaceutical trade), while chemical pharmacy or *Pharmaco-chimie* — to use Fourcroy's neologism — comprised the preparations that chemists had introduced into pharmacy. The failure to recognize this distinction, which was so obvious to him, had, he claimed, led to a certain amount of confusion in the pharmaceutical literature:

> The art of preparing chemical medicines is routinely mixed up, in the pharmacopoeia & in the dispensaries, with that of composing Galenic preparations, because both are confided to intelligent & learned artisans, who occupy themselves doing both with equal success.[11]

Fourcroy was dismayed that the pharmacopoeia failed to make a clear division between the chemical and the Galenic because his vision of chemistry did not allow for such careless integration. Already, the artisanal, practical applications of chemistry were something other than chemistry itself, but even these should, he thought, be kept distinct from the most traditional part of pharmacy, the preparation of plant-based medicines. However much Fourcroy may have wanted to institute such a division, he was faced with the problem that I already highlighted in the last chapter. As the majority of chemists were pharmacists, it was difficult to keep the practices apart, and furthermore, it was only relatively recently that chemists in particular had sought to enforce such a division. Indeed, by pointing out that the same 'intelligent & learned artisans' were preparing both chemical and Galenic medicines, he reminds us how the first task in establishing a dominant philosophical chemistry was to remove chemistry definitively from the hands of such artisans.

If Fourcroy ever had any doubts about the validity of such a distinction between pharmacy and chemistry, his association with Lavoisier must have reaffirmed his belief in chemistry's independence. Certainly, the science that Lavoisier put forward was meant to stand alone, offering a chemistry that included little or no reference to pharmacy as it had traditionally been understood.

[11] Fourcroy, *L'Art de connoitre et d'employer les médicamens... ,* p. 5.

Fourcroy and Lavoisier

When he first met Lavoisier, Fourcroy was still Bucquet's student at the Faculty of Medicine. The initial introduction was just one consequence of a major collaboration between Lavoisier and Bucquet, which would ultimately result in Bucquet's election to the Academy of Sciences in 1778. Thus, starting in January 1777, Bucquet was a regular guest at Lavoisier's rooms in the Paris Arsenal, among other things teaching chemistry to Marie-Anne Lavoisier, the celebrated chemist's young wife.[12] It was during this collaboration that Fourcroy started to accompany his professor to the Arsenal, and an important relationship formed between the promising young medical student and the father of the oxygen theory. It was not, however, until the summer of 1786 that Fourcroy would be converted to Lavoisier's anti-phlogistic chemistry.

Fourcroy first publicly adopted Lavoisier's oxygen theory in the enlarged 1786 edition of his *Élementary Lectures,* which he signalled was more than just another edition by renaming it the *Élements of natural history and chemistry*.[13] A little less than a year later, Guyton de Morveau, Lavoisier, Berthollet and Fourcroy jointly authored the *Method of Chemical Nomenclature.* At this time, Fourcroy and his more senior co-authors, shared the distinction of being among the best known chemists in France, if not the world, and together comprised the chemical core of Lavoisier's school. [14]

We can see an extension of Fourcroy's gifts as a lecturer in his ability to communicate Lavoisier's oxygen theory with enthusiasm to several fields in which chemistry could find some application. Although it has escaped the attention of many historians, Fourcroy's vital role as chief propagandist for the new chemistry did not escape the notice of the Parisian satirists. With their pens freed from the constraints of *ancien-régime* censorship by the French Revolution, these populist writers enjoyed considerable circulation, with political satire often dressed up as pornography or just plain gossip. In a stinging pamphlet of 1791, entitled *The Modern Charlatans,* Jean-Paul Marat, the self-styled 'friend of the people', launched an attack on the Academy of Sciences, singling out Lavoisier as a particularly worthy target for his disdain. [15] With Lavoisier in his sights, we should not be surprised to find Fourcroy caught in the line of fire as well:

[12] Jean-Pierre Poirier, *Antoine-Laurent de Lavoisier 1743-1 794,* Paris: Pygmalion, 1993, pp. 120-l.

[13] Antoine-François de Fourcroy, *Élémens d'histoire naturelle et de chimie; seconde édition des leçons élémentaires sur ces deux sciences, publiées en 1782,* Paris: Cuchet, 1786.

[14] Lavoisier's first converts in the Academy of Sciences were the geometers Laplace, Cousin and Van der Monde.

[15] There was considerable enmity between Marat and Lavoisier ever since Lavoisier had headed the commitee of the Royal Academy of Science that had refused to endorse Marat's submission on fire, electricity and light in 1779.

> Proud of his high achievements, now he [Lavoisier] rests on his laurels; while his parasites praise him to the heavens, and his little disciple Fourcroy tours the four corners of Paris to spread these beautiful discoveries. [16]

Evidently, by 1790, Fourcroy had already acquired the reputation of being Lavoisier's chief propagandist. Indeed, from the mid-1780s on, Fourcroy built up a considerable network of associations, which helped him to promote both the new chemistry and himself. Witnessing Fourcroy spread out across the clubs and societies of Paris allows us a glimpse of the flourishing world of scientific opportunity, which this talented philosophical chemist exploited so well. Even though qualified as a doctor, he no longer needed to rely on the traditional medical professional groups for financial support. With a large paying public for his scientific lectures, he could tap the financial rewards associated with his profession of the new chemistry.

Fourcroy's role in the Royal Society of Medicine, which only lost its royal status in France's transition from kingdom to republic, reached its zenith in that same fateful year. Indeed, he became director in 1792, the year in which the monarchy was deposed and the first Republic of France was born. To commit himself to this group, as I suggested above, was to align himself with the enlightened reformers against the more scientifically restrictive tradition of the Faculty of Medicine. This connection, which had caused such problems early in his career, provided access to the reins of power in the medical world of the French Revolution. The rising importance of this society will become clearer when I examine Vicq d'Azyr's 1790 report on medicine, and its influence on the reform of medical education.

Fourcroy was also a member of the Paris Agriculture Society *(Société d 'Agriculture de la Généralité de Paris),* which brought together an assortment of liberal-minded reformers. Its members included a prominent pharmacist, Antoine-Augustin Parmentier, who has since become a household name in France due to his tireless promotion of the health benefits of a potato-rich diet. Lavoisier joined the society in 1783, sharing the knowledge he had gained from running his experimental farm at Freschines, and a year later, both Vicq d'Azyr and Fourcroy enrolled. Fourcroy had himself become a chemistry professor at the Royal Veterinary School in Alfort the year before. In 1788, the society was given royal

[16] Jean-Paul Marat, *Les Charlatans modernes, ou lettres sur le charlatanisme académique,* Paris: Marat, 1791, pp. 36-7, lettre XI, 'Fier de ses hauts faits, il s'endort maintenant sur ses lauriers; tandis que ses parasites l' élevent jusques aux nues, et que son petit disciple Fourcroy fait les quatre coins de Paris pour propager ces belles découvertes.' It is a poignant historical irony that Lavoisier's 'little disciple' would take Marat's place in the National Convention after Charlotte Corday assassinated the now-legendary journalist. Nevertheless, Marat might be said to have had the last laugh, albeit posthumously (if such a thing is possible), as his assassination was in part responsible for creating the bloodthirsty climate of the 'Terror' during which Lavoisier was guillotined.

status and a mandate to improve agriculture throughout the kingdom of France, and the members of what was now the Royal and Central Society for Agriculture even received a small honorarium for attending meetings. Fourcroy was active here as well, and succeeded to the directorship in 1793, the year in which all societies were suppressed by order of the National Convention. Another society to which both Lavoisier and Fourcroy belonged was the Paris Linnean Society, but there is little evidence that either was an active member.

Of course, before the outbreak of the French Revolution, the focus of scientific ambition in France was membership in the Royal Academy of Sciences. Lavoisier had achieved the status of Academician in 1768, at the remarkably early age of 25, and seventeen years later, in his role as secretary, he masterminded the Academy's reorganization. This rearrangement of the classes comprising the institution effectively opened up more places for chemists in the Academy, allowing Fourcroy to become an associate chemist. Thus, by the time the Bastille was stormed in 1789, Fourcroy was well established on the French scientific scene, with a seat in the Academy of Sciences securing his place among the elite of the scientific community. Perhaps more important than this association, however, was his status as a regular member of the group that met at the arsenal under the tutelage of Lavoisier. Here, he joined a much more select gathering of the elite of French chemistry, a group of chemists that would launch an invigorated philosophical chemistry on the world. While Lavoisier worked hard to persuade other chemists of the superiority of his new system, Fourcroy turned his attention to the 'chemical arts', actively spreading the gospel of the new chemistry wherever he could.

Fourcroy's teaching

In June 1780, Anne-Claudine Bettinger and Antoine-François de Fourcroy were married, thereby helping Fourcroy out of some pressing financial difficulties. The hefty dowry he received from the Bettingers allowed him to pay off his debts, buy Bucquet's apparatus, and set up his own laboratory in the Parvis Notre Dame. Here, in the shadow of the great gothic cathedral, Fourcroy continued to offer private courses in natural history and chemistry.

Through his private courses, Fourcroy had established a reputation as an outstanding teacher of chemistry, and in 1783 he was appointed to his first institutional teaching position. For four years he would be professor of general physics and chemistry at the Royal Veterinary School in Alfort, for which he received a stipend of 1500 livres per year, the same amount that his parents-in-law had agreed to pay him in the wedding contract.[17] Fourcroy was not without friends

[17] G. Kersaint, *Antoine François de Fourcroy,* 1966, p. 19. Although this amounts to a respectable income for an eighteenth-century chemist, it is worthwhile noting that in 1780 Lavoisier's income from his position as a member of the *ferme générale* increased from

at Alfort, as Vicq d'Azyr was appointed professor of comparative anatomy at the same time.

The death of Pierre-Joseph Macquer in 1784 opened up another paid position for a chemist, this one much more prestigious than teaching at Alfort. The appointment was teaching general chemistry at the *Jardin du Roi,* an institution beyond the control of the medical faculty. With the support of Buffon, the director of the institution, and with Berthollet as the main competitor, Fourcroy succeeded in adding this post to his *cumul.* The appointment earned him a reputation throughout Paris as the most engaging contemporary chemistry teacher, an excellent start for anyone wishing to write or rewrite the history of the discipline. Moreover, as professor of general chemistry, Fourcroy was following an illustrious lineage; Macquer had been preceded by Malouin, Bourdelin, Louis Lemery (Nicolas Lemery's son) and Etienne-François Geoffroy. This position had traditionally provided an important opportunity for the Parisian public to learn from one of the most prominent chemists of the day, who was, as an examination of the list above will reveal, either a medical doctor, or a pharmacist. Partly because of the popularity of Fourcroy's lectures, Buffon had a new auditorium built at the *Jardin du Roi.* The original auditorium could only seat 600, a capacity that was doubled for the new one completed in 1788. Jauffret provides an interesting description of Fourcroy's chemistry course in 1798, when the *Jardin du Roi* had already been transformed into the *Muséum national d'histoire naturelle.* This description not only bears witness to the popularity of these lectures, their clarity and the importance of the new chemistry and its reformed nomenclature, but also illustrates once again the diversity of the public that attended, including men of all ages and, a group that receives particular attention, the women:

> We went in through the rue de Seine entrance, and while passing by, we saw the building called THE AMPHITHEATRE, in which are held, on certain specified days, very interesting, free lessons on the natural sciences. Apparently, Gustave told me, it is the right day and time for a lesson, and I see several citizens presenting themselves in order to gain entry. They were coming from the street and from all the different parts of the garden. Indeed, my friend, today it is Fourcroy's lesson. Everyone knows and everyone eagerly hurries along. Is he a clever man? What does he teach? Chemistry – what is chemistry? The art of knowing the nature and properties of bodies by their decomposition and combination. The chemist persecutes nature using iron and fire to oblige her to reveal herself despite the care she takes to keep hidden. I see citizens of all ages enter, even men with grey hair. Are these men also going to the lesson? No doubt, and by their example they show us that it is never too late to acquire the knowledge that we lack. Only ignorance is shameful, and, moreover, nature is so vast that even if we were to dwell on the earth for centuries, we would never learn everything. Do you want us to enter the lecture hall for a minute? I am still too young to listen to Fourcroy, but I am interested to see him. With, pleasure, my dear Gustave. Let's go in.

24,000 to a princely sum of 32,000 livres per annum, over ten times Fourcroy's annual income from his teaching Alfort and the dowry from his parents-in-law combined.

> As the lesson had already begun, we found ourselves among the tiers of the amphitheatre already occupied by the public; we could only find a place in a high row: and we were not even seated. Fourcroy spoke with his customary facility, and even though very far away from him, we could see him perfectly. Gustave looked at him with admiration, and then ran his eyes across the audience. He was astonished to see a circle of ladies at the front of the amphitheatre, and speaking to me in a whisper he said, what are these ladies doing here? Do they want to learn chemistry? Yes, my friend, they are the descendants of *Philaminte* and *Bélise,* they come here to draw on the matter for their erudite discussions. Unlike so many frivolous women who talk of nothing but fashion and alterations, and unlike so many common women who only concern themselves with taking care of their domestic tasks, the only objects, apparently, with which these women concern themselves at home are scientific ones. They have just learned from Fourcroy that *nitre* or *saltpetre* is now called *potassium nitrate,* and that *kitchen salt* is called *sodium chloride.* They have just learned how to decompose the elements; how to change water into air and air into water, how to recognize the two bases of common air, which are *oxygen* and *nitrogen gas.* Do they understand all this? Almost all of it, as Fourcroy is able to explain so clearly that he places this science within everyone's reach.[18]

Fourcroy's promotion of the new chemistry was not limited to the opportunities offered by his teaching appointments. Indeed, while Lavoisier set himself single-mindedly to the task of convincing chemists around the world that his theory was correct, Fourcroy looked beyond this immediate audience of peers in the blossoming chemical community. In the same year that he collaborated in the *Method of Chemical Nomenclature,* Fourcroy brought out an abbreviated version of his 1786 *Élements of Natural History and Chemistry* as the *Principles of Chemistry.* This two-volume work appeared in the ninth class of a series of books published in the 'Ladies' Universal Library', a project that ran from 1785 until 1791.[19] Monsieur Cuchet, the Paris bookseller responsible for most of Fourcroy's publications, undertook to provide the subscriber with two volumes every month for a yearly subscription of 72 livres *reliés* (hard-bound) or 54 livres *brochés* (loose-bound).[20] A variation on the encyclopaedic theme, the series started out with voyages, history, theatre and novels, but soon turned to the sciences, no doubt hoping to capitalize on the taste for this fashionable pastime. In his introduction, Fourcroy explicitly acknowledged the current enthusiasm for the sciences, but did

[18] L. F. Jauffret, *Voyage au Jardin des plantes,* Paris: Houel, an VI (1797-8), pp. 34-38. The mention of Philaminte and Wise is a reference to Molière's *Les Femmes savantes* in which these two women are ridiculed for their scientific pretensions.

[19] The catalogue of the *Bibliothèque Nationale* lists 153 volumes under 20 separate subject areas. Although Fourcroy's is the thirteenth such subject area covered according to the catalogue, the frontispiece places it in the 'ninth class'.

[20] These prices are taken from the front of Fourcroy's contribution to the series, so are valid for 1787.

not doubt the ability of educated women to master even the most demanding subjects:

> For several years Ladies have shared this general taste; fortunately, it is recognized that, for the common good, they are capable of the effort necessary to successfully cultivate the sciences. Today their zeal is no more in doubt than their ability; but, the type of education they have received having not disposed their minds towards the exact sciences, it is essential that, for this part of their instruction, there be Works, the clarity & conciseness of which may spare them the difficulties that even the most studious of men have problems in overcoming when they undertake the study of the empirical sciences. [21]

Prior to Fourcroy's work on chemistry, the library had offered volumes on algebra and physics, so we should not think that his was the readers' sole introduction to the sciences. Nevertheless, his contribution to the Ladies' Library is an exceptional item in the campaign for the new chemistry, due to its explicitly female audience. As I have suggested above, it was becoming more cominon to direct chemistry texts towards a public that was unlikely to have any professional interest in chemistry. Nevertheless, even though the taste for chemistry was broadening to encompass a large constituency of amateurs, the new chemists who published and lectured at the end of the eighteenth century were exclusively male, while the women known to have been involved in the science, usually the wives of leading chemists, did not publish original research but limited their participation to secondary, although important roles such as preparing translations of foreign publications and illustrating experiments.[22] The book could not, therefore, be expected to win any powerful allies for the new chemistry within the male-dominated European community of chemists, nor was it aimed at influencing those who practiced chemistry in their professional lives, such as pharmacists or metallurgists.

In the same year, 1787, Fourcroy published another book on chemistry, this time intended to contribute both to his personal fortune and to the greater aim of discipline-building. The *Principles of chemistry, following modern discoveries; for the use of pupils at the Royal Veterinary School in Alfort, near Paris* was meant to be a teaching aid for future veterinarians at Alfort, supplementing Fourcroy's

[21] Antoine-François de Fourcroy, *Bibliothèque universelle des dames: Principes de chimie.* Paris: Cuchet, 1787, pp. xix-xx, 'Les Dames partagent, depuis quelques années, ce gait général; il est heureusement reconnu, pour le bonheur commun, qu'elles sont capables des efforts nécessaires pour cultiver avec succès les sciences. On ne doute pas plus de leur zèle aujourd'hui, que de leur facilité; mail le genre d'éducation qu'elles ont reçu, n'ayant pas disposé leur esprit à l'étude des sciences exactes, il est indispensable qu'il y ait, pour cette partie de leur instruction, des Ouvrages dont la clarté & la concision puissent leur épargner les difficultés que les hommes même les plus studieux, ont de la peine à vaincres lorsqu'ils commencent l'étude des sciences d'observations.'

[22] Jane Marcet, an American popularizer of chemistry enjoyed some considerable success at the beginning of the nineteenth century. M. Susan Lindee, 'The American career of Jane Marcet's "Conversations on chemistry", 1806-1853', *Isis* 82 (1991): 8-23.

lectures with review notes for the chemistry course. Ironically, 1787 was also the year in which Fourcroy lost his job at Alfort due to declining student enrolment in his chemistry course.

Medicine illuminated by the physical sciences

The specific focus for this exploration of Fourcroy's life is, of course, his relationship with pharmacy. It was not, however, until well after the onset of the French Revolution that he launched an extensive campaign for the new chemistry that targeted French pharmacists, in the style of his 1797 speech to the *Société Libre des Pharmaciens* that we saw in Chapter 2. Indeed, in that same year Fourcroy founded a Journal specifically aimed at touching the community of pharmacists, the *Journal of the Society of Pharmacists (Journal de la société des pharmaciens).* Prior to this publication, however, Fourcroy had launched another journal entitled *Medicine illuminated by the physical sciences.* This first journal existed for less than two years, comprising in total only four volumes, but nevertheless represented Fourcroy's first public attempt to win over the medical community to the new chemistry. Unlike his later serial publication, *Medicine illuminated by the physical sciences* was aimed at a broad medical community, of which the pharmacists formed only a part, and the contents of this journal reveals much about Fourcroy's vision for scientific medicine, and how chemistry fitted into this vision. Moreover, a growing dissonance between Fourcroy's declared editorial intentions and the way in which they were put into practice illustrates his increasingly firm belief in the dominant position that should be assigned to chemistry.

Medicine illuminated by the physical sciences first appeared in January 1791, and was supposed to appear regularly on the first and fifteenth of each month. For fifteen livres, the subscriber would receive the annual total of twenty-six issues, thirty-two octavo pages each, which could be bound together into two 416-page volumes. The journal was suspended after two years, apparently because of the weight of Fourcroy's political commitments rather than a lack of interest among its subscribers. The first issues of the first volume presented the ideals on which Fourcroy based his editorial policy, as well as a taxonomy of the physical sciences that fell within the scope of the journal. An editorial board of physicians, surgeons and pharmacists would meet fortnightly in order to select articles from among those that had appeared in the various specialist scientific journals considered relevant to the medical community. Extracts of these articles were to be published alongside short original contributions and letters received from correspondents abroad.

Fourcroy was struck by the expansion he could see everywhere in the sciences, and regarded such a journal as performing an essential role in this particular context. A proliferation of journals containing scientific papers relevant to medicine was, he wrote, symptomatic of rising specialization, which was in turn increasing the commitment required to master any one science:

> Ten years are needed to train a Botanist, a Zoologist, a Chemist, an Anatomist, a Physicist; is it possible that a Doctor could be all these at once ... ?[23]

The aim of the journal, therefore, was not to give doctors a mastery of any particular science, let alone all of them. Instead, what Fourcroy aimed to do was to identify new scientific research relevant to the art of healing, and to present it in a convenient, abridged form. The success of such a journal would close a virtuous circle; providing doctors and others in the healing arts with relevant scientific discoveries would reveal to them how useful such knowledge could be, and so stimulate demand for more of this information. Beyond this, the journal would unite all the branches of healing in an ideal science-based medicine. In his usual grandiloquent style, Fourcroy expressed all the advantages that his journal had to offer to medical doctors:

> To prove the immediate utility of all the Physical Sciences for Medicine, to show that the art of healing cannot make true progress and advance towards perfection except with the aid of all the Sciences combined, to employ a method with the help of which we might facilitate the prompt and easy participation of all the men occupied in this art in all the discoveries that we make daily in the Sciences, to spread illumination everywhere at once, to excite a great movement amongst worthy souls for the propagation of all useful knowledge, to make all the men who are engaged in the same area *au courant* with all the physical Sciences, to raise them up to the same level, to place them at the same height, in order that starting from the same point they can raise themselves up even higher, to bring together in one single place all the rays scattered over an immense surface – these form the basis of the plan according to which we propose to edit this work.[24]

The metaphor of light is casually mixed with one of physical promotion. The illumination provided by the physical sciences promised to raise all those involved

[23] Antoine-François de Fourcroy, *La Médecine éclairée par les sciences physiques, ou Journal des découvertes relatives aux différentes parties de l'art de guérir, rédigé par M Fourcroy,* Paris: Buisson, 1791, Vol. I, p. 5, faut au moins dix ans pour former un Botaniste, un Zoologiste, un Chimiste, un Anatomiste, un Physicien ; est-il possible qu'un Médecin soit tout à la fois ?'

[24] Ibid., p. 9, 'Prouver l'utilité immédiate de toutes les Sciences Physiques pour la Médecine, démontrer que l'art de guérir ne peut faire de véritables progrès et avancer vers sa perfection que par le secours de toutes ces Sciences réunies, employer une méthode à l'aide de laquelle on puisse faire participer promptement et facilement tous les hommes occupés de cet art a toutes les découvertes que l'on fait journellement dans ces Sciences, répandre partout à la fois les lumières, exciter un grand mouvement dans les bons esprits pour la propagation de toutes les connoissances utiles, mettre tous les hommes qui s'occupent du même objet au courant de toutes les Sciences physiques, les élever au même niveau, les placer a la même hauteur, afin qu'ils puissent partir du même point pour s'élever davantage, rassembler en un seul foyer tous les rayons épars sur une surface immense, voila la base du plan d'après lequel on se propose de rédiger cet ouvrage.'

in medicine up to the height of the informing sciences. This vision of promotion summarized Fourcroy's ambition for all the medical arts; the first step on the road to perfection had to be the emulation of the physical sciences.

The sciences that the journal was intended to cover were listed under sixteen heads, a diversity that was never realised in the volumes that followed. Nevertheless, the list is impressive:

> 1° Physics; 2° Mineralogy; 3° Chemistry; 4° Systematic Botany & vegetable Physics; 5° Zoology; 6° human Anatomy & animal Anatomy compared with that of man; 7° Physiology; 8° Hygiene; 9° Pathology; Nosology and Semiology; 10° Therapeutics & Materia Medica; 11° Pharmacy; 12° History of epidemic illnesses, that of endemic [illnesses] and of those that are due to practicing artisanal skills; 13° Surgery; 14° Legal Medicine 15° the Veterinary Art; 16° finally, the destruction of prejudices and errors in Medicine, as well as that [destruction] of the empirics, secret remedies, etc.[25]

Despite this strikingly wide range of subject matter that Fourcroy set out to cover in the pages of his *Medicine illuminated by the physical sciences,* chemistry quickly assumed a privileged position. If we compare the number of articles that appeared in the chemistry and physics sections, it is easy to see the relative growth in the number of articles on chemistry: the first volume had thirteen articles under the rubric of chemistry, and seven under physics, while the third volume (January to June 1792) had twenty-six chemistry articles and only two on physics.[26] After a honeymoon period of even-handedness, Fourcroy began heavily favouring chemistry in his journal. It was perhaps due to complaints from the readership that he felt obliged to redress this balance in the fourth and what was to prove to be the final volume. The opportunity for Fourcroy to present the new science of chemistry to the medical community was clearly too good to be missed. Moreover, Fourcroy was adamant concerning the novelty of the chemistry that had developed during the

[25] Ibid., pp. 15-16, 'D'après ces considérations, sont tous les hommes de l'Art sentiront aisément la force et l'importance, on peut ranger sous seize chefs, ou partager en seize classes, toutes les connoissances utiles ou nécessaires au Médecin : elle comprennent, 1° la Physique ; 2° la Minóralogie ; 3° la Chimie ; 4° la Botanique méthodique et la Physique végétale ; 5° la Zoologie ; 6° l'Anatomie de l'homme, et l'Anatomie des animaux comparée à celle de l'homme ; 7° la Physiologie ; 8° l'Hygiène ; 9° la Pathologic, la Nosologie et la Séméiologie ; 10° la Thérapeutique et la Matière médicale ; 11° la Pharmacie ; 12° l'Histoire des Maladies épidémiques, celle des endémiques et de celles qui sont dues à la pratique des arts; 13° la Chirurgie; 14° la Médecine légale ; 15° l'Art Vétérinaire ; 16° enfin, la destruction des préjugés et des erreurs en Médecine, ainsi que celle des empiriques, des remèdes secrets, etc.'

[26] The size of the articles or letters varied a great deal, sometimes with two or three on a page, at other times with articles running over half a dozen pages. Therefore, the numbers compared here should be considered only as very rough and ready measures of the weight given to any subject.

eighteenth century. This novelty made the science especially deserving of space in the journal:

> This science, which one may regard as absolutely new since the work of the moderns, could on its own fill a great part of this Journal, either on the grounds of the new facts that it continually presents to those who cultivate it, or due to its applications in all the branches of the art of healing.[27]

When Fourcroy went on to discuss pharmacy he made it clear just how this particular discipline should be considered in relation to chemistry. He presented a relationship of complete subordination, in which chemistry was to dictate the nature of pharmacy. Therefore, it was no great leap on Fourcroy's part to consider that pharmacy itself had been recreated by the revolution that had recently taken place in chemistry. The radically new science had brought forth an equally new art:

> Thus, pharmacy will be nothing henceforth but an entirely chemical Art; the operations relating to the preparation of medicines will be entirely marked out following the precepts of Chemistry, and in this respect we can already regard it as a new Art. Considering how much light modern Chemistry can shed on the preparation of remedies ... one cannot help but be astonished by all the improvements that this very useful Art is going to receive from this Science, and by the simplicity that will be introduced into these procedures. We will have occasion, in the first issues of this Journal, to make known some of the principal advantages that the discoveries of modern Chemists present to the pharmaceutical Art, and which [discoveries] have been so neglected by some Pharmacists that they conduct themselves in their laboratories as though they did not exist.[28]

The pharmacists, according to Fourcroy's familiar formula, needed first to recognize the position of pharmacy as subordinate to chemistry, and then to work

[27] Fourcroy, *La Médecine éclairée par les sciences physiques,* Vol. I, p. 18, 'Cette science, qu'on peut regarder comme absolument nouvelle depuis les travaux des modernes, pourroit à elle seule remplir une grande partie de ce Journal, soit a raison des faits nouveaux qu'elle présente continuellement à ceux qui la cultivent, soit par ses applications à toutes les branches de l'art de guérir.'

[28] Ibid., p. 34, 'Ainsi, la Pharmacie ne sera incessamment qu'un Art entièrement chimique ; les opérations relatives à la préparation des médicamens seront entièrement tracées d'après les préceptes de la Chimie, et à cet égard on peut déjà la regarder comme un Art nouveau. En considérant combien de lumières la Chimie moderne peut répandre sur la préparation des remèdes terreux, acides, alkalin, salins neutres, sulfureux, métalliques, et même sur l'extraction et les combinaisons des matières végétales et animales, on ne peut s'empêcher d'être &étonné de toutes les améliorations que cet Art si utile va recevoir de cette Science, de la simplicité qui sera mise dans ses procédés. Nous aurons occasion, dans les premiers numéros de ce Journal, de faire connoître quelques-uns des principaux avantages que les découvertes des Chimistes modernes présentent à l'Art pharmaceutique, et qui ont été si négligées par quelques Pharmaciens qu'ils se conduisent encore dans leurs laboratoires comme si elles n'existoient pas.'

actively in order to acquaint themselves with the new discoveries. *Medicine illuminated by the physical sciences* provided the perfect vehicle for the pharmacists to do both. Another role of the journal was to inform physicians that pharmacy no longer existed except as a sub discipline of the new chemistry.

After presenting the journal's specific contributions to the reform of pharmacy, Fourcroy proceeded to rehearse themes he would repeat many times over in his dealings with the pharmacists. Pointing out the past contributions of pharmacy to chemistry, he encouraged pharmacists to continue contributing what they could to the science. He used this reflection on the past and future both to assert the distance between the disciplines and to maintain the hope that pharmacists could close the gap by keeping abreast of chemical innovation. The individual elements had not yet been drawn together into the forceful argument he would present to the Society of Pharmacists in 1797, but they were all ready to hand. While the Fourcroy of 1797 felt the need to threaten a recalcitrant pharmaceutical community with images of the disaster that would inevitably follow its neglect of chemistry, the journal editor of 1791 seems to believe that just presenting the new chemistry to eager citizen-pharmacists would be all that was needed:

> Despite the utility Chemistry may offer to most of the Arts, we know that it has not yet been sufficiently cultivated by most of those who practice it for the Science to be able to enjoy all the possible advantages. The Pharmacists are the only ones who have felt all the influence of Chemistry on their Art, and among whom there have always been distinguished Chemists; it is in part due to their work that we have had progress in this Science during the last century and at the beginning of this one. Although many other men occupy themselves with it [chemistry] today, the Pharmacists must not forget that they can be singularly useful to it, and that they always have before their eyes the opportunity to observe with care, to observe precisely and fruitfully. They must, however, first be highly informed in modern discoveries; they must make a profound study of Chemistry and the chemical Arts. A part of this Journal will be specifically dedicated to fulfilling this objective, and to presenting Pharmacists with the true state of this Science, as well as its immediate application to pharmaceutical preparations.[29]

[29] Ibid., pp. 32-34, 'Trois objets fixeront particulièrement notre attention sur la Pharmacie : l° l'abolition des drogues trop composées et la critique sévère des formules mélangées ; 2° l'amélioration et la rectification de toutes les préparations chimiques ; 3° la description de tous les phénomènes chimiques qui se présentent aux Pharmaciens, dans les opérations de leur Art. Malgré l'utilité dont la Chimie peut être dans la plupart des Arts, on sait qu'elle n'a point encore été assez cultivée par le plus grand nombre de ceux qui l'exercent, pour que cette Science ait pu en retirer tous les avantages possibles. Les Pharmaciens sont les seuls qui aient senti toute l'influence de la Chimie sur leur Art, et parmi lesquels il a toujours existé des Chimistes distingués ; c'est en partie à leurs travaux qu'on a dû, dans le siècle dernier et dans le commencement de celui-ci, les progrès de cette Science. Quoique beaucoup d'autres hommes s'en occupent aujourd'hui, les Pharmaciens ne doivent point oublier qu'ils peuvent lui être singulièrement utiles, et qu'ils ont sans cesse sous leurs yeux les occasions d'en observer avec soin, pour voir avec exactitude et avec

By looking beyond the programmatic introduction to the actual contents of the journal, we can see how Fourcroy's views affected its classification in very practical terms. Even though only four volumes were ever published, it is clear that the editors were shifting more and more material into the chemistry section, including articles that at first sight seem as though they ought to have fallen under the heading of pharmacy. Meanwhile, the pharmacy section came to feature predominantly inorganic preparations, with examinations of traditional organic medicines either becoming incorporated into the chemistry section or dropping out of the journal altogether. The analysis of mineral waters provides a nice example of this tendency, as it was one of the practices that fell between the disciplines of pharmacy and chemistry as their paths diverged in the course of the eighteenth century. The original interest in spring waters came from their medicinal virtues, and chemical analysis had traditionally been conducted on the same basis as analyses of other medicaments. In the pages of the journal, Vauquelin offered the reader his analysis of the waters of Ville d'Avray, for example, and Fourcroy promptly placed it under the head of chemistry.[30] This move illustrates two important trends evident at the end of the eighteenth century. First, and most obviously, we can see another illustration of the movement of disputed territory away from pharmacy and into chemistry. Second, if we look at the content of these analyses, we can witness the reinscription of traditional pharmaceutical analyses in a new, chemical analytical mode where the aim is to determine the content of the waters in terms either of elements or of acidic bases, central terms in Lavoisier's system, although marginal in terms of medicinal theory. The analysis of these waters became a search for known elements or acids, rather than an exploration of what lent the waters their medicinal virtues, which had always been the point of contact between chemistry and pharmacy. In these ways, Fourcroy was introducing the physicians and pharmacists to a new conception of their traditional analytical practices, rendering them scientific but at the same time somewhat foreign.

Fourcroy was not simply promoting his view of the need for the introduction of science into the medical arts in the vain hope that doctors and pharmacists would come around to his way of thinking of their own accord. It should be born in mind that *Medicine illuminated by the physical sciences* was an intervention in a particular historical context; it was published at the height of the French Revolution, and was discontinued just before the Terror. This period witnessed a dramatic increase in the possibilities for reform in all areas of French life. Medicine

fruit, il faut qu'ils soient d'abord très-instruits dans les découvertes modernes ; il faut qu'ils aient fait une étude approfondie de la Chimie et de principaux Arts chimiques. Une partie de ce Journal sera particulièrement destinée à remplir cet objet, età offrir aux Pharmaciens le véritable &at de cette Science, ainsi que son application immédiate aux préparations pharmaceutiques.'

[30] Again, in Vol. II of the journal, an investigation of sulphur in mineral water is placed in the chemistry rather than the pharmacy section.

was one area where reform seemed both to be most needed and eminently possible, and Fourcroy used the journal to remind reformers, both within and outside the medical profession, that a key element of any such reform should be the establishment of a scientific basis for medicine. The subjugation of pharmacy to the new science of chemistry would be an important step in fashioning an appropriate scientific form of medicine for the new republic.

The origins of revolutionary reform in medical education

Historians are deeply divided over the interpretation of the French Revolution, with the reading typically reflecting the historian's own political leaning, a tendency particularly marked among French historians. It is, however, indisputable that the French Revolution did offer a range of unforeseen opportunities to put large-scale innovative projects into effect, and medicine was an obvious target for such enlightened republican reform. Prior to the revolution, three groups of medical professionals played distinct roles in French medicine. The physicians – members of the medical faculties, who received a theory-dominated training – tended to treat only wealthy patrons who came to them through a network of personal connections. The surgeons, apprenticeship-trained and guild-controlled, were the chief providers of care in rural areas, and were unquestionably the physicians' social inferiors. Then there were the pharmacists whose work consisted in preparing and dispensing the medicines prescribed by the physicians, medicines that formed the main constituent of any medical treatment at this time. In normal circumstances, the pharmacists were not permitted to prescribe medicines themselves, although their infringement of this rule provoked regular litigation on the part of the faculties of medicine. Even this brief sketch of the pre-revolutionary situation should make it clear how French medicine was structured according to a hierarchical system that served at least as much to protect the privileges of the physicians as to effectively treat the population. The French Revolution brought about both a reassessment and a reorganization of all areas of medicine, extending from the position of the doctor in society right down to the role of the citizen-patient in a republic. The introduction of new ways of teaching and practicing medicine would shape the profession as it developed in nineteenth-century France, turning it into a model that the rest of the Western world would follow.[31]

[31] There is not the space to go into the history of the other branches of the medical profession. A recent work which presents the changes, although focusing mainly on the hospital is Dora B. Weiner, *The Citizen-Patient in Revolutionary and Imperial Paris,* Baltimore, MD: Johns Hopkins University Press, 1993. For the teaching of Medicine, see Charles Bedel and Pierre Huard, *Médecine et pharmacie au XVIIIe siècle,* Paris: Hermann, 1986, one part of the more comprehensive project organized by René Taton (ed.), *Enseignement et diffusion des sciences au XVIIIe*

In 1790, the Royal Society of Medicine offered its own plan for reform which, although never formally adopted by the National Assembly, became an important model for the legislation that was ultimately put into place, first in the Republic, and later under the rule of Napoleon Bonaparte. The plan was signed by Vicq d'Azyr alone, but it is particularly relevant to our discussion of Fourcroy, because this was the first piece of medical reform on which he worked. Although the plan proposed only minor amendments to the organization of pharmacy in France, nevertheless, the suggestions it offered for the reform of medical education and practice would inform later legislation that would touch more directly on the pharmacists' interests.

The *New Plan for the Constitution of Medicine in France*[32] turned around several key themes. In particular, it emphasized plans for reforming medical education, the need to unify all the areas of medicine in the person of the trained medical doctor, and the importance of public health and hygiene. Public health and hygiene, however, were no longer the dominant concerns that they had been in the reports previously drawn up by the Committee on Poverty. This is hardly surprising, as Vicq d'Azyr's plan was not addressed to the Committee on Poverty, but rather to the Committee of Health, a break-away group consisting entirely of physicians. Joseph-Ignace Guillotin had surreptitiously stolen the physicians away from the Committee on Poverty, with the express intention of forming a new committee composed exclusively of doctors. Considering its composition, it is not surprising that the Committee of Health shifted its focus onto the fate of the medical profession itself, and at the same time distanced itself from national administrative concerns associated with instituting a Republic-wide public health system.[33]

The Royal Society's *New Plan* opened with a programmatic call to return medicine to 'the state of unity and simplicity that it enjoyed at the time of Hippocrates'.[34] The unified and uniform education of a new interdisciplinary doctor-surgeon was considered essential to achieving this mythical ideal. The Royal Society of Medicine envisaged the prospective physician receiving a thorough training that would cover sixteen separate subjects, including chemistry, pharmacy, the art of formulation (making up medicines) and *materia medica*. All these subjects would be offered within the walls of a single Parisian school which the authors characterized as 'a great encyclopaedic institute'. Although the *New Plan* sought to do away with the distinction between the surgeon and the physician, in the aim of uniting all the various parts of medicine, the third medical professional, the pharmacist, was not included in the plans for a new educational regime. Thus,

[32] *Nouveau plan de constitution pour la médecine en France présenté a 1 'assembée nationale par la société royale de médecine,* Paris, 1790.

[33] Dora B. Weiner, *The Citizen-Patient in Revolutionary and Imperial Paris,* Baltimore: The Johns Hopkins University Press, 1993.

[34] *Nouveau plan de constitution pour la médecine en France,* 1790, p. l, 'la nécessité de la [Médecine] rappeler à l'état d'unité et simplicité où elle &oft du temps d'Hippocrate...'

according to this initial plan, pharmacy would be a part of the curriculum, but pharmacists would not be a part of the student population.

Although the education of the pharmacist did not feature among the items for reform, the *New Plan* did propose regulations for the business of pharmacy itself. Thus, while important, the reform of pharmacy was clearly not central to the author's plans for French medicine, and the pharmacists entered into a liminal position in the institutional world of medicine, a position they would continue to occupy until Fourcroy's wholesale reform of medical education in 1803.The lack of concern for the pharmacist's position becomes clearer when we look at certain details of the *New Plan*. For example, the Royal Society was explicitly opposed to any guilds surviving the reform of the medical system, and yet it did not give any clear indication as to what body, if any, should oversee the pharmacists' training after the guilds had been done away with.[35] One obvious way to monitor pharmaceutical education would have been to allow the pharmacist to share in the doctor's formal training, but this option, as we shall see, was explicitly ruled out of the plan. Part III Section IV of the *New Plan* was the section that dealt with pharmacy, and the first article laid out the minimal requirements that a pharmacist had to satisfy if he wanted to ply his trade:

> The sale and preparation of medicines presupposes knowledge of Natural History, *Materia Medica* and chemistry in the people charged with their execution.
>
> It is therefore necessary that their capacity be assessed through legislated tests.
>
> These tests should consist in examinations of which the object will be l° Knowledge of simple drugs, of their qualities, principles, & the alterations that different circumstances can bring about. 2° The art of conserving them 3° Pharmaceutical Chemistry. 4° The art of combining & mixing drugs to make compound medicines.[36]

Where was the pharmacist supposed to get an education that would enable him to pass these examinations? One way that he might conceivably do it would be by going to medical school with the new surgeon-doctor, where he could pursue the relevant parts of the revised, more scientific curriculum. By taking advantage of the school's projected botanical gardens and laboratories, the pharmacist would be able to perfect his skills. This was not, however, the way the Royal Society envisioned

[35] Ibid., p. 193, Article LXVI, 'Les Médecins, les Chirurgiens & les Pharmaciens, ne formeront plus de Corporations, chacun devant exercer son Art, sous la seule tutelle des loix.'

[36] Ibid., pp. 112-113, 'La Vente & la préparation des médicamens supposent dans les personnes qui en sont chargées des connaissances d'Histoire naturelle, de Matière médicale & de chimie. Il est donc nécessaire que leur capacit é soit constatée par les épreuves légales.

Ces épreuves doivent consister dans des examens dont l'objet sera 1° La connoissance de drogues simples, de leurs qualités principales, & des altérations que différentes circonstances peuvent y occasionner. 2° L'Art de les conserver 3° La Chimie pharmaceutique 4° L'Art de combiner & de mélanger les drogues pour en faire des médicamens composés.'

the future of pharmacy. The pharmacist would not be required to go to the new medical schools, and in a footnote accompanying article I, the authors insisted that pharmacy, 'for which everything concerning the human body is foreign, should not be mixed up with Medicine, [rather] it should remain united to it by close ties, the maintenance of which will lead to the perfection of the Art and the good of humanity'. Thus, pharmacy would not be fully integrated into a universal healing profession, as was suggested at the outset of the *New Plan,* and instead the pharmacist – along with the midwife – would be left just where the Royal Society had found him, partly inside and partly outside the medical establishment.

Although, as I have already said, Vicq d'Azyr's plan was never adopted, it did lay the groundwork for the education of physicians in republican France, presenting central themes that would be taken up and implemented by later legislation. First, there would be a limited number of schools (in Vicq d'Azyr's plan, there was to be just one – in Paris), which would provide prospective physicians with an extensive theoretical and practical education, including both clinical and scientific teaching. The school would also furnish the extra-metropolitan areas of France with juries of qualified medical personnel to examine any aspiring physician not fortunate enough to attend the school itself. This two-tiered system of medical education and qualification was to become a central feature of nineteenth-century French medicine, and when the time came for reform in pharmacy, a variant would be imposed on this profession as well.

Four years after the Royal Society of Medicine submitted their *New Plan,* a decree was passed by the National Convention establishing not one, but three central schools of Health *(Écoles de Santé)* at Montpellier, Strasbourg and Paris. Thus, it was the reform of 14 Frimaire year 3 (4 December 1794) that finally reintroduced limited regulation of the medical profession, and it did so along the lines of Vicq d'Azyr's *New Plan.*[37] Following this model from 1790, the three central schools were to provide juries in order to examine candidates who had not attended the schools themselves, but wanted to practice medicine locally.

A report by Fourcroy, which had originally been presented before the National Convention, was recycled as a preface to the 1794 legislation. In it he outlined the desperate need for training and policing both doctors and surgeons, at this time known collectively as health officers *(officiers de santé).* War had cost the French an estimated 600 health officers in a year-and-a-half, and, not only was there a lack of trained medics for the army, but behind the front the number of untrained 'charlatans' was also reaching epidemic proportions. Fourcroy recognized that the dissolution of educational establishments threatened to drain medicine of its expertise, and he aptly summarized the dire situation with his statement that 'for the

[37] It should be remembered that, according to the d'Allarde law of 2-17 March 1791, anyone could practice medicine.

last five years, the most difficult art seems no longer to have had any masters, and the schools that preserve their stock have been closed'.[38]

As with the plan drafted four years earlier, the 1794 legislation had nothing to say about the fate of the pharmacists. The only mention the decree made of pharmacy was the promise that the Committee of Public Instruction would prepare a report on the subject. In his introduction, however, Fourcroy was more expansive, giving positive reasons as to why pharmacists should be excluded from the training for the health officers. The primary reason seems to have been a fear that the schools, which needed to produce as many doctors as possible, would become clogged up with pharmacists:

> The committee does not recommend you include pharmacists among the students of the central school of health, because already the estimated number of students will be well below what is needed, and also because the studies [appropriate] for the practice of medicine or surgery are much more extensive than those needed for pharmacy.[39]

On a more practical note, Fourcroy explained why pharmacists did not need to be trained in the new school; the pharmacists still had their own system of education, which had survived the darkest days of the terror intact:

> In fact, this profession has a school in Paris that is still open, and which has, for a long time, been more comprehensive *(plus complète)* than those for medicine or surgery.[40]

The courses taught at this school not only covered botany, the natural history of drugs, chemical pharmacy and pharmacy 'proper', but the student-pharmacists also had the advantage of receiving a practical training in the school's laboratory. Fourcroy, who was himself at least partly responsible for keeping the College of Pharmacists intact in all but name, concluded that the reform of pharmaceutical education was not a pressing issue:

[38] *Rapport et décret de la convention nationale, sur les écoles de santé de Paris, Montpellier et Strasbourg,* Paris: Comité de Salut Public, 14 Frimaire, an 3, 1794, p. 5, 'depuis cinq ans, l'art le plus difficile semble n'avoir plus de maîtres, et les écoles qui en conservoient le dépôt sont fermées.' Originally, *Rapport sur l'établissement d'une école centrale de santé a Paris* (Paris, 7 Frimaire, an 3).

[39] Ibid., p. 23, 'Parmi les élèves de l'école centrale de santé le comité ne vous propose point de comprendre les pharmaciens, parce qu'alors le nombre des élèves indiqué seroit bien au-dessous des besoins, et parce qu'aussi les études pour l'exercice de la médecine et de la chirurgie sont beaucoup plus &endues que celles qui sont nécessaires a la pharmacie.'

[40] Idem., Tette profession a d'ailleurs, a Paris, une école toujours ouverte, et qui depuis long-temps est plus compléte que celles qui étoient destinées à la médecine et à la chirurgie.'

> Very few changes are needed in order to render pharmaceutical instruction more complete, and the committee of public instruction will consider it with the speed that the public good demands.[41]

Once again, pragmatic political considerations overcame an ideological desire for the unification of medicine. Pharmacy was a victim – or a beneficiary, depending on one's point of view – of its own exceptional survival across the French Revolution as a professional community. republican legislators already had their hands full trying to bring physicians under control, and to produce sufficient doctors and health officers in order to supply the nation's needs. Therefore, pharmacy, while acknowledged as necessary to the state, was left in what was considered to be a satisfactory state of institutional limbo.

Riding out the political storm

Tracing Fourcroy's career from 1789 to 1803 gives us an illuminating perspective on the remarkable events of the French Revolution. Partly through skill, and partly through good fortune, Fourcroy managed successfully to navigate the most treacherous days of the Terror, making the transition from kingdom to republic to empire.[42] On the way, he transformed himself from subject into citizen, before being made a count by the emperor Napoleon.

Fourcroy's success is less surprising when we compare his political life to those of the other authors of the *Method of Chemical Nomenclature,* who were all mobilized to some extent by a republic very much enamoured of its *savants.* Berthollet opted to keep a low profile during the revolutionary period, flowering only later as a personal favourite of Napoleon Bonaparte. Lavoisier worked in various capacities for the Republic, among other things designing new *assignats* that were less easy to forge than their predecessors, and supervising the demolition of the Bastille. As is well known, however, Citizen Lavoisier's pre-republican life as a tax farmer eventually caught up with him, and he was executed in May 1794. Finally, Guyton de Morveau enjoyed a revolutionary career as a citizen-administrator, even more distinguished than Fourcroy's, although, as I explained above, he remains a neglected figure.

Like many other important figures in the French Revolution, Fourcroy took his first step into the political arena with the election of the Estates General in 1789. Nominated as a substitute elector in the *Blancs-Manteaux* district of Paris,

[41] Ibid., p. 24, 'Très-peu de changemens sont nécessaires pour rendre l'instruction pharmaceutique plus complète, et le comité d'instruction publique s'en occupera avec la célérité que le bien public exige.'

[42] Dorinda Outram (1983) reminds us that many Academicians were executed during the Terror. Nevertheless, it seems that exaggerated opportunities came hand in hand with the exaggerated risks of that period.

Fourcroy helped to draw up Paris's *cahiers de doléances* (list of grievances), as well as electing deputies for the Estates General. In September of 1792, just prior to the decisive French defeat of the Prussians at Valmy and the declaration of France as a republic, Fourcroy found himself nominated by Marat for election as deputy to the new National Convention, an offer he could refuse only at great personal risk. He remained a substitute deputy for Paris until his sponsor's assassination in July 1793, when he succeeded to the vacant seat.[43] It was during this period of proximity to the National Convention that Fourcroy began his serious political involvement with the Republic, joining the Jacobin club and serving as expert adviser on several commissions.

The summer of 1792 was a time of exaggerated paranoia, when émigré counter-revolutionary threats were seen everywhere. In August 1792, names of èmigrés and suspected counter-revolutionaries were purged from the membership of the (no longer Royal) Society of Medicine, and a similar move was initiated at the Academy of Sciences. Citizen Fourcroy was probably involved in both these purges, which, like his failure to save Lavoisier from the guillotine, have earned him opprobrium from several historians of science. Be that as it may, such displays of good citizenship, along with all his valuable committee work, were serving to position Fourcroy for a more central role in the government of France.

No sooner a deputy in the National Convention, Fourcroy had a place on the Committee for Public Instruction. Here he presented a project to institute a de-regulated education system in which any French citizen, after having furnished proof of their civic virtue *(civisme),* could offer classes, although even this plan did not demand the immediate dissolution of alls schools and colleges.[44] This was the most radical and outspoken Fourcroy would be on the subject of education, and, as we saw above, the exigencies of war forced him to adopt a more pragmatic approach towards putting a viable and productive education system in place.

After the fall of Robespierre in July 1794, Fourcroy was elected to the newly disempowered Committee for Public Safety where he worked to organize the supplies for the extensive republican armies. In 1795, Fourcroy joined the Council of Elders, part of new system of government presided over by a five-man directory (the *Directoire).* Throughout this period, Fourcroy involved himself intimately in the development of a national education system that would, he hoped, place much-

[43] The irony of these events is exquisite; Charlotte Corday murdered the renowned Marat while his former arch-enemy, Lavoisier, was struggling to defend himself and his fellow tax farmers against the Republic's accusations. One of the results of this assassination was to heighten the fury of the terror and hasten Lavoisier's execution, while another was to promote one of Lavoisier's 'parasites' to the National Convention.

[44] A.-F. Fourcroy, *Rapport et projet de décret sur l'enseignement libre des arts et de's sciences,* Paris, n.d. (Convention, 9 December 1793).

needed emphasis on the new scientific subjects, at the expense of the classical languages.[45]

The elections of 1797 briefly removed Fourcroy from public life, but when Napoleon swept to power in 1799 – shortly after Fourcroy had divorced his wife of nineteen years – the chemist was appointed councillor of state. From this position he again set to work with the aim of reforming education in France. Two separate pieces of legislation that he drafted would provide the basis for the administration of medicine in nineteenth-century France. The first, in March 1803, called for the foundation of three new medical schools in Mainz, Genoa and Turin, as well as formalizing a bipartite division between doctors and health officers, separating them in terms of both qualification and orbit of practice.

The second law was the law of Germinal year 11 (April 1803), which provided the first ever national system of education and registration for pharmacists in France. This law marked the reinstitution of pharmacy as a fully recognized profession, in a nation that had thrown off its guild tradition without ever replacing it.

The provisions of the law of Germinal

The two laws governing medicine in Napoleonic France followed one another in quick succession. The first was passed on the 19 Ventôse year XI (10 March 1803), after Fourcroy had spoken in favour of it two weeks earlier. The second – exclusively concerned with pharmacy – was approved a month later. It is the first of these two laws that normally dominates discussions of Napoleonic medical reform, because it insisted on clinical training, a transformation in medical education that generates much excitement amongst medical historians.[46] The law also introduced a two-tier model of medical practice, reminiscent of the de facto *ancien-régime* division between doctors and surgeons. Now, however, surgeons were promoted to the elite group, and a new, inferior medical practitioner was invented to cater to the rural populations. Along with doctors in medicine, doctors in surgery would be trained over a minimum of four years in one of the six proposed medical schools, in Paris, Montpellier, Strasbourg, Mainz, Turin and Genoa (three of which would no longer be in France a decade later). The aspiring doctor would qualify by passing exams set by the school, at least two of which, the law insisted, had to be in Latin.

[45] For a discussion of the shifting fortunes of science in the context of republican education, see L. Pearce Williams, 'The Politics of Science in the French Revolution' in *Critical Problems in the History of Science,* Marshall Clagett (Ed.), Madison: University of Wisconsin Press, 1959: 309-16.

[46] Good treatments of this period can be found in: Toby Gelfand, *Professionalizing modern medicine: Paris surgeons and medical science and institutions in the 18th century,* Westport: Greenwood, 1980, and Matthew Ramsey, *Professional and popular medicine in France, 1770-1830,* Cambridge: Cambridge University Press, 1988.

The members of this inferior stratum of medical personnel inherited the revolutionary neologism of health officers *(officiers de santé)* and were intended to receive a practical training appropriate to the more straightforward illnesses they would encounter in rural France. Although the trainee had the option of attending one of the medical schools for three years, he was required to spend six years learning from a practicing doctor, or five in a hospital; the trainee health officer was essentially serving out an updated, state-regulated apprenticeship. After his training, the prospective candidate would then be examined by a 'medical jury' in the administrative department in which he intended to exercise his art. As I said above, the jury was supplied by the nearest medical school, and thus the government assumed responsibility, albeit indirectly, for the examination of all medical professionals, whatever their qualifications.

As a reflection of his limited knowledge of the theory of medicine, the health officer was restricted geographically as well. While the qualified doctor was allowed to practice anywhere in France, the health officer was confined to the department in which he had qualified, and, in addition, any 'major surgery' required the supervision of a doctor. The reason I mention this legislation is because a parallel distinction would be introduced in the law covering pharmacy, which followed only a matter of weeks later. Thus, if we are to understand how the law of Germinal ordered the profession of pharmacy, it is important to recognize how the law of Ventôse was structuring the rest of the medical profession. First, it was placing doctors under state control, albeit indirectly, a position that would prove to be permanent for the medical profession in France. Second, it introduced a new distinction into the medical profession between the doctors and surgeons that served an urban elite and the health officers who would take care of the rural populations. Third, it was limiting the educational opportunities for the doctors to state-licensed medical schools.[47] These medical schools would eventually absorb many of the satellite branches of the medical arts, such as midwifery, which at that time lay outside their orbit. The health officers would likewise be absorbed, when the motivating principle of a separate, inferior health service for rural areas became politically unacceptable. The fact that the health officers survived for most of the nineteenth century, only being eliminated in 1893, says much about France's discriminatory treatment of its urban and rural populations.

21 Germinal year 11 (11 April 1803) is probably the most important date in the history of modern French pharmacy. It is neither the birth date of a famous

[47] Michel Foucault in his *Birth of the Clinic* (New York: Vintage, 1975, pp. 80-81) regards health officers and doctors as being only different in degree of (practical) training, as opposed to the *ancien-régime* surgeons and doctors, who were different in kind, embodying practice and theory respectively. While this may have been the tenor of the wording of the 1803 legislation, I am not convinced that such a radical reorientation was ever expected. Rather, the important shift, as I see it, is not the introduction of a unified ideal of medical practice across France, but the universal scope of the state supervision of medical practice.

pharmacist, nor does it mark the discovery of a particularly effective pharmaceutical agent; rather it is the date on which Napoleon's legislative body adopted Fourcroy's proposed law for the organization of pharmacy with 202 votes in favour and four against. Thirty-eight articles under four titles established the basis for the modern French pharmaceutical profession, permanently removed from guild control. According to this legislation, pharmacy, like the rest of medicine, would be organized around six state-controlled schools of pharmacy to be set up alongside the medical schools. These schools, funded and administered by the government, assumed the role of the guilds, both organizing and policing the practice of pharmacy over the whole extent of France. Although the law – supplemented on 25 Thermidor year XI (13 August 1803) by an *arrêté* detailing the organization of the pharmacy schools – recycled many of the old regulations concerning pharmacy, it is important to note three fundamental shifts in the conception of how pharmacy would operate, which reflect the transformations in the wider medical profession.[48]

The first and probably the most dramatic change was one that I have already mentioned; the end of guild control of the profession. The institution of government control at this moment is more striking in the case of pharmacy than it is in the case of the other medical professions, because the pharmacists had managed to retain their guild, albeit in various disguises, throughout the revolutionary period, a time when almost all such groups were dissolved. The second point to notice in the reforms of the law of Germinal, is the increased emphasis on both theoretical and formal education in the training and practice of the pharmacist. Carret, a tribune from the department of the Rhône offered a commentary on the new law. In his capacity as representative of the ministry of the interior, he argued that the law effected a separation of the College of Pharmacy as a teaching establishment from the College of Pharmacy as a guild. The professional organization had no place in post-revolutionary French culture, so only the former component was worth salvaging. Indeed, in Carret's view the teaching establishment had to be retained precisely because of pharmacy's connection with the science of chemistry:

> But, as the sciences approached the point of perfection they have reached today, their victorious momentum communicated itself naturally to all those things that had a more or less distant relationship to them. Thus chemistry's progress has brought along with it and facilitated that of pharmacy, and so what had until then been nothing but a sort of routine became a science that needed special study and specialized teachers.[49]

[48] In his *History of Social Organisation in Pharmacy,* François Prevet draws rather a bland and uninformative conclusion concerning the reforms: 'The law of Germinal reproduced all the measures that were in place at the dawning of the Revolution and that were not incompatible with the new social state.' François Prevet, *Histoire de l'Organisation Sociale en Pharmacie,* Paris, 1940.

[49] Carret, *Sur le projet de loi concernant la police et l'organisation de la pharmacie, 21 germinal an XI,* Paris: Imprimerie Nationale, year 11 (1803), pp. 4-5, 'Mais à mesure

Chemistry promised to liberate pharmacy from dull artisanal routine, but in order to share fully in the benefits that the perfection of science in the eighteenth century offered, pharmacy now required a formal educational structure.

Understanding this last transformation allows us to understand the nature of a third structural change in pharmacy, one that might at first sight appear a little puzzling. The law of Germinal introduced a novel two-tier system into pharmacy, mirroring the division in medicine between doctors and health officers, although in the case of the pharmacists the distinction was not marked by any difference in name. Those pharmacists examined in one of the six schools, as well as paying a higher fee for the examination – 900 francs as opposed to 200 – would be allowed to practice anywhere in France, whereas those examined by the juries set up to examine the health officers would be confined to the department in which they qualified.[50] Although not explicitly stated in the law, the idea was that those who chose to attend one of the schools would form an elite stratum of pharmacists, even though all pharmacists passed the same kind of examination. Article 8 required a minimum eight-year apprenticeship before becoming a pharmacist, but this could be cut down to three if the apprentice spent another three years at one of the schools. Therefore, additional cost could be traded off against a reduced training period; those who were able to afford to go to the schools were encouraged to do so not only by the prospect of qualifying in six instead of eight years but also by the enhanced opportunity and prestige such an education would provide.

In an earlier report to the tribune, Carret specifically mentioned the reduction in the amount of time required to qualify, describing it as a deliberate incentive for able students to attend the schools. In justifying this clause, he referred to the author of the bill – coincidentally the same person as the Government orator whom Carret also mentions – the ever-present Fourcroy.

> The favour accorded these last [those who attend one of the schools and so qualify more quickly] is based on the nature of things, for as the Government orator has said, theory renders practice more prompt and more reliable. In fact, this favour is a lure which will attract the participation of many students in the schools; they [the schools] will thus have more splendour: the students will leave them better instructed, and the art will in consequence, become more perfect. [51]

que les sciences s'approchèrent du point de perfection où elles touchent aujourd'hui, leur impulsion victorieuse se communiqua naturellement a tout ce qui avait avec elles un rapport plus ou moins éloigné. Ainsi les progrès de la chimie entraînaient et facilitaient ceux de la pharmacie; et ce qui n'avait jusqu'alors été qu'une espèce de routine devint une science qui eut besoin d'études spéciales et de professeurs particuliers.'

[50] Articles 23 and 24.

[51] Carret, *Projet de loi concernant l'organisation et la police de la pharmacie, 17 germinal an XI,* reproduced in Alfred de Beauchamp, *Médecine et pharmacie, projets de lois,* Paris: Imprimerie Nationale, 1888, p. 591, 'La faveur accord& aux derniers est fondée sur la nature même des choses; car, comme l'a dit l'orateur du Gouvernement, la théorie

It is important to note that the distinction between what is learnt in schools and what is learnt in apprenticeship is characterized as the difference between theory and practice. It is theory, moreover, that takes precedence, guiding and perfecting practice. The superiority of philosophical chemistry – the theory – over the chemical art of pharmacy – the practice – finds its institutional reflection in precisely this aspect of Fourcroy's 1803 law.

Henceforth, pharmacists would be divided into two groups; those educated in schools, and those trained in the apprenticeship system, reflecting a decision imposed on them from outside the profession. The differences in prestige that existed between the capital and the provinces before the Revolution, with Paris as the place to achieve national recognition, would be reinstantiated as a multiple layering.[52] The six schools across France would provide centres of theoretical learning, including the new chemistry, and would administer the training and testing of the more practically orientated pharmacists confined to their own departments.

It is not clear, however, just how divisive this legislation was in reality. Unlike doctors and health officers, who took different examinations, all pharmacists were required to take examinations of the same kind. While one might suspect that the examinations in the provinces were more traditional in nature, Anne-Claire Déré's research on the pharmacists in and from Nantes (where there was no school of pharmacy) suggests that the juried examinations were just as weighted towards new chemical preparations and the new chemical nomenclature, for example, as those administered in Paris.[53] Thus, although professional prestige was inevitably centred on the schools located in urban centres, with Paris supplying the national focus for pharmacists' ambition, the spread of a modern chemical education was not thereby withheld from the provinces. By insisting on modern chemical preparations even in the provinces, the juries were effectively obliging all the elements of the pharmaceutical education system to be up to date with developments in the new science of chemistry, including its revised vocabulary. Fortunately for those who wanted to qualify under the new regime, there had been a journal around since 1797 specifically conceived to acquaint pharmacists throughout France with the

rend la pratique plus prompte et plus süre. D'ailleurs, cette faveur est un appât qui attirera un grand concours d'élèves dans les écoles; elles en auront plus de splendeur : les Nèves en sortiront plus instruits, et l'art sera, par conséquent plus parfait.'

[52] I have simplified the situation, as there were other important provincial centers of learning in eighteenth-century France. The medical faculty at Montpellier certainly challenged Paris's supremacy in this domain.

[53] Anne-Claire Déré, *L 'Évolution des sciences pharmaceutiques a Nantes pendant la Révolution,* Nantes: Université de Nantes Centre d'histoire des sciences et des techniques, 1989, pp. 95-103: Ch.3 'Vers une autre science', Section A 'L'impact de la loi de germinal an XI'.

latest developments in their field as seen from the capital, the *Journal de pharmacie,* another one of Fourcroy's editorial projects.

The *Journal de pharmacie*

The *Journal* of *the Paris Society* of *Pharmacists, or a Collection* of *Chemical and Pharmaceutical Observations (Journal de la société des pharmaciens de Paris ou recueil d 'observations de chimie et de pharmacie)* was the most direct attempt Fourcroy would make to turn French pharmacists into his ideal of enlightened artisans. As well as propagating the idea of pharmacy as an art fully dominated by the developing science of chemistry, he also used this journal to establish a group of like-minded, chemistry-oriented pharmacists in Paris. The names that appear on the cover of the journal's collected issues are those of some of the major players in the introduction of the new chemistry into pharmacy at the beginning of the nineteenth century: Fourcroy, Vauquelin, Parmentier, Déyeux and Bouillon-Lagrange.[54] I will have more to say about Vauquelin in particular in the next chapter, but all five were active members of the Free Society of Pharmacists *(Société Libre des Pharmaciens)* and proponents of the new chemistry. Fourcroy, Vauquelin and Déyeux would eventually sit together on the editorial board of the *Annales de chimie,* and Vauquelin, Bouillon-Lagrange and Parmentier would all become editors of the *Bulletin de pharmacie.* In fact, the attentive reader will recall that Parmentier's name appeared at the beginning of the second chapter of this book, as he signed the letter from the *Bulletin's* editors to the Society that criticized pharmacists for losing touch with the new chemistry. It is worthwhile noting once again, that all these editors were qualified pharmacists except, of course, for Fourcroy himself.

The first issue of the journal was published on 15 Prairial, year 5 (3 June 1797), five months after Fourcroy's speech before the Society of Pharmacists, and his simultaneous honorary enrolment as the only non-pharmacist member of the organization. Although it was the first exclusively pharmaceutical journal in France, the *Journal de pharmacie* never had sufficient appeal to pay for itself, and was as a consequence short lived. The conditions under which the journal was first produced were rather unusual, and help to explain why Fourcroy was reluctant to continue with this particular editorial project beyond its first three years. From the outset, it was quite clearly Fourcroy's journal, even though the Society of Pharmacists agreed to support the venture for the first six years, after which time it would be entirely the editor's responsibility, financially as well as editorially.[55] The Society's contribution bought it a place in the journal's title, and so its name

[54] These five were only editors for the seven issues of the journal's third and fmal year, before this the editors were Fourcroy, Demachy and Bouillon-Lagrange.

[55] Susan Court and W. A. Smeaton, 'Fourcroy and the Journal de la Société des Pharmaciens de Paris', *Ambix* 26 (1979), pp. 39--55.

featured on the title page along with Fourcroy's as the editor, and those of two members of the Society assigned to assist, or to supervise, his activities. The older of the two editorial assistants, Citizen Demachy (1728-1803) was almost seventy by this time, but had nevertheless been appointed to teach Natural History at the *Ècole gratuite de pharmacie* (The Free School of Pharmacy, the teaching division of the Free Society of Pharmacists). We have, of course, come across this pharmacist twenty years earlier, when, as a demonstrator for the course in botany and natural history at the then new *Collège de pharmacie,* he had confidently declared chemistry to be the fate of pharmacy. Demachy had subsequently distinguished himself as an outspoken critic of the new chemistry. The other assistant was the much younger Citizen Bouillon-Lagrange (1764-1844), a chemistry professor at the same school and one of a new generation of pharmacists who had adopted Lavoisian chemistry, which is not surprising if we consider that he started working as Fourcroy's assistant as early as 1788.

The journal consisted of a collection of short articles, the majority of which were written by a small group of Parisian pharmacists. There were also summaries of 'news' concerning the various sciences collected from around Europe. The first issue carried both 'news in Chemistry' and 'news in Pharmacy', while later issues carried 'news from Paris' and even the quite general 'news in the sciences'. During the second year, the 'news' items were phased out entirely in favour of more editorial commentary on the published articles. Before their disappearance, however, the 'news' items themselves provided an opportunity for introducing general editorial comments not directly related to any particular article. As one might expect, Fourcroy took full advantage of this editorial space and introduced the first 'news in chemistry' by once again situating pharmacy in relation to chemistry:

> There is hardly any new fact in Chemistry, any work in this science, any feature of its history that does not more or less immediately concern either pharmaceutical theory or pharmaceutical practice.[56]

Fourcroy's implicit characterization of the asymmetric relationship between chemistry and pharmacy — with the former informing the latter, but not vice versa — is unsurprising in light of what we have already seen, and, following the logic of Fourcroy's views, one of the journal's principal aims was to communicate the new chemistry to the mass of practicing pharmacists. Thus, for example, the editorial team took care to ensure that the chemistry articles that dominated the journal were presented in the new nomenclature, even if this risked alienating their potential audience. In the first issue, a little note, probably written by Vauquelin, possibly by

[56] *Journal de la société des pharmaciens de Paris ou recueil d'observations de chimie et de pharmacie* 1797 (year VI), Vol. I, p. 7, 'II n'y a presque aucun fait nouveau en Chimie, aucun travail dans cette science, aucun trait de son histoire qui n'intéresse plus ou moins immédiatement ou la théorie ou la pratique pharmaceutiques.'

Fourcroy, reminded the readers of the almost total victory the systematic nomenclature introduced in 1787 had achieved by this time. But the fact that the reminder was needed – the piece is called 'On the necessity of employing the methodical nomenclature of modern chemistry in pharmacy' – suggests that pharmacy was regarded as one of the last strongholds of the barbaric chemical language the author so roundly condemns:

> Habit and prejudices have given way almost everywhere to the advantage of substituting these significant and exact words for the barbarous, mysterious, erroneous and arbitrary words given at different epochs of science to all the compositions that art produces or that nature provides.[57]

The reforming spirit of the venture therefore required suitable editorial intervention. In the second year, for example, Citizen Save, a pharmacist from Saint-Plamard, succeeded in publishing his 'Observations on ethiops martial and nutritum unguent'. In the title he was allowed to use the traditional names, but in the text, the first term was replaced by its new equivalent 'black oxide of iron,' with 'ethiops martial' only appearing in parentheses. Although not certain, it seems likely that the new nomenclature was added by the editors in order to keep pharmacy on track.[58] The hard sell of the new chemistry to the pharmacists did, however, also succeed in generating resentment and resistance.

The end of the second year of publication saw a dramatic change in the editorial personnel of the journal as well as the articulation of a desire to reorient the content away from chemistry. This shift had been preceded by the Paris Society of Pharmacy's withdrawal of financial support on 5 Fructidor year 6 (22 August 1798), so that, left with only promises from the Society to keep soliciting material, Fourcroy was now both editor and the sole publisher of the journal. Nevertheless, the remaining nine issues of the second year remained more or less unchanged, suggesting that the Society was prepared to support Fourcroy until the end of that particular publication year. The third volume, carrying simply the title *Journal of Pharmacy (Journal de pharmacie),* was printed by a new printer, Quillau, who also handled subscriptions, and featured a revamped editorial 'society'. Demachy was gone, and Citizens Parmentier, Déyeux and Vauquelin took his place, apparently accepting Fourcroy's invitation 'with ardour'. [59] These new editors brought with

[57] Ibid., p. 22, 'De la nécessité d'employer la nomenclature méthodique de la Chimie moderne en Pharmacie.' (Anon) 'L'habitude, les préjugés ont cédé presque par-tout a l'avantage des mots signifians et exacts mis à la place des noms barbares, mystérieux, erronés, arbtraires, donnés à différentes époques de la science à toutes les compositions que l'art produit ou que la nature offre.'

[58] Citoyen Save 'Observations sur l'éthiops martial et sur l'onguent nutritum" *Journal de la société des pharmaciens de Paris ou recueil d'observations de chimie et de pharmacie,* Vol II, year VII, p. 248.

[59] For Fourcroy's description of the decision see *Journal de la société des pharmaciens de Paris ou recueil d'observations de chimie et de pharmacie,* Vol II, year

them the promise of 'rendering this Journal ever more interesting and above all more immediately useful to those who occupy themselves with pharmacy in particular.'[60]

The final issue of the old version carried Fourcroy's prospectus for the relaunched journal, in which he promised to keep the focus on pharmacy. Every issue, he insisted, would have at least one useful application of chemistry to pharmacy, with the aim that 'one would not be able to reproach the *Journal of Pharmacists* [a name never adopted] for offering only the facts of chemistry, and not containing enough on pharmaceutical subjects, and consequently for distancing itself from the very goal that it was our initial wish to attain.'[61] The complaint about the old journal's overemphasis on chemistry must have been coming in loud and clear, and perhaps one of Fourcroy's reasons for packing the editorial board with pharmacists was to curb his own predilections as a chemist. Despite changes in the editorial board, the printer and the title, the journal did not shift ground a great deal, and evidently failed to attract a greatly expanded readership as this third year proved to be its last. In the end, the journal was absorbed into the *Annales de chimie.* The journal's trajectory serves as a good symbolic illustration of the changing relationship between pharmacy and chemistry as it played out across the eighteenth century, which was the subject of the last chapter. The posthumous fate of the journal is equally rich in lessons about this relationship, as will be clear from the exploration of the disciplinary fall-out of the merger between the *Journal de pharmacie* and the *Annales de Chimie* offered in Chapter 5.

Conclusion

In the present chapter I have tried to turn one of the most traditional forms of history of science – the biography of a prominent scientist – to a novel end. In charting Fourcroy's trajectory across revolutionary France, it has not been my aim to uncover who Fourcroy was as a person, or to review his major scientific achievements, but rather to use his career in order to understand the enabling power of the extraordinary political circumstances that shaped it. On the one hand, I have used Fourcroy's life as a synecdoche for the promotion of the relatively new group of philosophical chemists in the public arena at a time of radical change in French

VII, p. 369. It is interesting to note that in the first issue of volume 3 the list of editors runs Foucroy, Parmentier, Vauquelin, Bouillon-Lagrange and Déyeux, while in subsequent issues the order of the last two names is reversed. INyeux was not prepared to be upstaged by this young pharmacist nineteen years his junior, whereas Vauquelin only a year older than Bouillon-Lagrange was presumably too close to Fourcroy to be displaced.

[60] *Journal de la sociéth des pharmaciens de Paris ou recueil d 'observations de chimie et de pharmacie,* Vol II., Year VII, p. 369.

[61] Idem.

society, while on the other hand, what interests me is his individual, personal interaction with, and influence on, the profession of French pharmacy.

Fourcroy's position as one of Lavoisier's disciples and subsequently chief amongst the apostles of the oxygen system placed him at the forefront of the French scientific community at the dawn of the French Revolution. His renown as scientist and lecturer (whether deserved or not) provided an ideal base from which to launch a successful political career under a series of governments that considered reforming practically every aspect of life based on a rational, scientific model.[62] His political success in this exceptional period of French history placed him in a position from where he would eventually be able radically to reform the profession of pharmacy.

Prior to the events of the early 1790s, Lenoir's close supervision of the newly-formed College of Pharmacy discussed in Chapter 2 constituted an extreme example of outside interference in a guild's affairs. In a paradoxical move, the guild compromised its independence only in order to ensure a rise in status that promised to guarantee its long-term independence. Even after 1777, the guild maintained the right to establish the regulations under which pharmacy would be administered in Paris, and Lenoir never challenged the guild's privilege of deciding what was best for the profession. Before the king's arrest in the summer of 1792, and the subsequent radicalization of the Revolution, it was inconceivable that someone from outside the guild could step in and dictate the terms of the internal regulation of the professional body and the training of its members. After the dissolution of the guilds, however, it was only a matter of time before some person or committee would take on the task of fixing the form that the professions would assume in the new republic. In the end, many such reforms, including that of the profession of pharmacy, had to await the more politically stable times of Napoleon's rule.

The task of reforming pharmacy was undertaken by an outsider, albeit an honorary member of the Society of Pharmacists, Antoine-François de Fourcroy. As I have stressed, Fourcroy was not a pharmacist, he was a philosophical chemist, and as such it was inevitable that his conception of what pharmacy could and should be, would differ from the traditional view, internal to the profession. When Fourcroy finally did come to write the legislation for pharmacy in the more politically predictable climate of Napoleon's first empire, he retained many of the features of the profession as it was exercised under guild control in the *ancien régime.* This continuity has tempted historians to see only the similarities and to overlook the importance of the changes that were introduced. Nevertheless, understanding who Fourcroy was in terms of his background, both scientifically and politically, allows us more clearly to see the professional transformations contained in the law of

[62] Among the impressive transformations were the reform of the army, the reform of the calendar and the introduction of the metric system. At the root of these moves was an ideal aim of reforming human relations and human beings themselves on the basis of the equality of citizens.

Germinal. A recurrent theme in Fourcroy's work is his uncompromising view that chemistry was a philosophical science superior to its dependent arts, of which pharmacy was only one, no matter its practical importance. What Fourcroy sees quite unproblematically as his redemption of pharmacy by attaching it to chemistry, can also be seen as its condemnation to a permanently inferior position in the hierarchy of the sciences. Chemistry had become the fate of pharmacy in a way quite different from that envisaged by Demachy twenty-five years earlier. The new chemistry was not reintegrated into pharmacy to give an indissociable entity as had been the case in preceding centuries; instead the two fields were put into a new relationship of interdependent definition. Pharmacists began to understand themselves in relation to chemistry as the scientific master-discipline, and similarly chemists began to understand chemistry itself as being a completely independent alternative to pharmacy, which was in turn regarded by them as a lower-status subdiscipline of chemistry.

Chapter 5

The New Pharmacy

The First Generation of Chemical Pharmacists

> The connection between chemistry and pharmacy is so intimate, that these two sciences have long been considered as one and the same; and chemistry, for a long time, was cultivated only by physicians and apothecaries. It must be allowed that, though the chemistry of the present day is very different from pharmacy, which is only an application of the general principles of this science, these applications are so numerous, the class of persons who cultivate pharmacy is in general so well informed, that it is not at all to be wondered at, that most apothecaries should endeavour to enlighten their profession by a serious study of chemistry, and by the happiest agreement unite the knowledge of both.
>
> J. A. Chaptal, *Elements of Chemistry,* W. Nicholson (trans.), London: G. G. J. & J. Robinson, 1791, pp. lvii–lviii

In what ways was pharmacy transformed by the advent of Lavoisier's new chemistry? The corollary of this question is to what extent such transformations might be integrated into our understanding of the chemical revolution. The purpose of this final chapter is to examine the changing relationship between chemistry and pharmacy as the separate disciplines emerged from the ferment of the French Revolution. This is a task that I started at the beginning of the very first chapter, where I presented a letter written by the editors of the new *Bulletin of Pharmacy* in 1809 bemoaning the untheoretical nature of pharmacy. This letter was addressed to the Society of Pharmacists by six of its own members, and in it they plainly announced their dissatisfaction with the current state of pharmacy. The complaints voiced in the letter were not the traditional concerns of encroachment on the pharmacist's territory by the 'druggist' on one side or the physician on the other, but a criticism of the majority of pharmacists for failing to keep up with recent developments in chemistry. This failure to keep pace with philosophical chemistry threatened to turn pharmacists into mere 'manipulators' mechanically turning out prescriptions without understanding what it was they were doing.

The success of Lavoisian chemistry in the closing decades of the eighteenth century had created an atmosphere of crisis among many pharmacists who wanted to remain in touch with the flourishing discipline of chemistry. These were the artisan-scientists who recognized – either implicitly or explicitly – that they were no longer essential participants in a science that had traditionally been an essential part of their art. The concern was not, however, that pharmacy itself was on the decline. As I explained in the first chapter, pharmacy survived the French

Revolution institutionally and educationally intact while most other occupations had been thrown into disarray by the Revolution's legislative attacks on guilds and professional monopolies. Rather, the point is that pharmacy appeared to be losing ground when its maintenance of a healthy status quo was measured against the dramatic rise of chemistry.

The success of a chemistry wholly independent of pharmacy had the result of dividing pharmacists between those who wanted to retain the image of the pharmacist as chemist, which seemed to require accepting the new chemistry on its own terms, and those who felt that pharmacy could very well stand on its own by continuing just as it had up to this point. This chapter is specifically about the former group, those pharmacists intent on remaining an active constituent of the chemistry community, as it was at this level that the new chemistry was most rapidly integrated. Nevertheless, we will occasionally come across the comments of those other pharmacists who were content with the traditional, artisanal identity of their profession, and from these clues we can begin to piece together what was no doubt a common reaction to the scientific developments at the turn of the century.

As chemistry became stronger and better defined, in opposition to its traditional practical applications, pharmacists who consciously chose to remain up-to-date chemists found themselves trying to span two traditions that were rapidly drifting apart. The strained relationship between the *Annales de chimie* and pharmacy represents this development, and I want to start by showing how the journal's absorption of the *Journal de pharmacie* served to exacerbate this situation. Following this, I will examine the heated exchange between Thenard and Delunel in the pages of the *Annales de chimie.* In this debate, Thenard took the side of the new chemistry against Delunel who defended the values of the non-scientific apprentice-based tradition of pharmacy. I suspect that Delunel spoke for many pharmacists who never had the opportunity to express their views in print, but at the very least this exchange illustrates the disharmony that was triggered in certain cases by the divisive disciplinary situation that the pharmacists found themselves in with respect to chemistry.

Having sketched these internecine disputes, I want to finish the chapter with an exploration of scientific pharmacy. Indeed, at the beginning of the nineteenth century, we find the pharmacist-chemists casting about for ways to establish a scientific identity consonant with a new era in both chemistry and pharmacy. This venture was inevitably bound up with the institutional reforms introduced in post-revolutionary France. Hence the scientific and social revolutions were brought together in the constitution of what I term the 'new pharmacist' in the first decades of the nineteenth century.

In fleshing out the characteristics of this new pharmacist, I will be using Nicolas Vauquelin as my model. Vauquelin succeeded in remaining close to the developing science of chemistry, while at the same time never renouncing his identity as a pharmacist. Indeed, as Fourcroy's successor, Vauquelin blazed an institutional and scientific trail that other pharmacists who sought recognition both for pharmacy and as scientists in their own right could try to follow. Through his analytical research,

he helped to redefine the part of chemistry that could legitimately remain in the pharmacists' hands – pharmaceutical chemistry – and succeeded in increasing its scientific viability by associating it more closely with the new chemistry. Furthermore, through his institutional position Vauquelin was able to introduce a rising generation of pharmacists to the new chemistry as the science that directed the hand of the pharmacist.

I will close the chapter with the journal that provided the opening citation for this book, the *Bulletin de pharmacie.* This publication was effectively the new pharmacists' own journal, and it served to bring together the elite Parisian scientific pharmacists of the early-nineteenth century. Thus, it was a vehicle for a particular vision of the new pharmacy that would be projected to hundreds of pharmacists throughout France.

The *Annales de chimie* and the *Journal de pharmacie*

On 18 December 1799, the editorial board of the *Annales de chimie* met to vote on a proposed merger with the floundering *Journal de pharmacie.* The board's acceptance of the merger, or more accurately an agreement whereby the *Annales de chimie*[1] would absorb the ailing journal, can hardly be regarded as a great surprise, considering that Fourcroy – the chief editor and publisher of the *Journal de pharmacie* – was also one of the senior editors on the board of the *Annales de chimie.*[2] All the same, this merger was pregnant with meaning for the emerging disciplines represented by the two journals, chemistry and pharmacy. It symbolized the hope for a reintegration of the two fields, albeit one that would be carried out in terms dictated by the dominant partner. Formerly it had been pharmacists who had accepted the title of chemist, now it was the turn of the new chemists to invite the pharmacists to share their disciplinary turf.

The *Annales de chimie* itself had risen to prominence in a very short time, primarily as the mouthpiece of the new chemistry, and, even though production of the journal was suspended between 1793 and 1797, it remained the preferred venue for publications by the leading French chemists of the time, most of whom also sat

[1] The full title of this work up until year VIII (1800) was the *Annales de chimie, ou recueil de mémoires concernant la chimie, et les arts qui en dépendent.* With the merger of the journal with the *Journal de pharmacie* (formerly the *Journal de la société des pharmaciens de Paris),* the journal adopted the new name *Annales de chimie, ou recueil de mémoires concernant la chimie, les arts qui en dépendent et spécialement la pharmacie;* the last phrase was added in disproportionately large type.

[2] In 1799 the members of the Editorial board were; Guyton de Morveau, Monge, Berthollet, Fourcroy, Adet, Hassenfratz, Séguin, Vauquelin, C. A. Prieur, Chaptal and Van Mons.

on its editorial board.[3] The journal was founded in 1789 by Lavoisier along with the other chemists involved in the *Method of Chemical Nomenclature;* Guyton de Morveau, Berthollet, Fourcroy, Hassenfratz and Adet. [4] The founding editors also included two other prominent French scientists, Monge and Baron de Dietrich. Adet had originally proposed the *Annales de chimie* with the idea of publishing a simple translation of Crell's successful *Chemische annalen,* featuring extracts from various other relevant publications, but the journal was eventually launched under Lavoisier's guidance as a periodical containing original submissions on chemistry,[5] including occasional pieces explicitly in the area of pharmacy. Although it never proclaimed an exclusive editorial policy, the *Annales de chimie* printed contributions to the new chemistry in opposition to La Métherie's staunchly phlogistic journal, the *Journal de physique.* Bringing submissions into line with the new nomenclature is just one example of how the *Annales* promoted Lavoisier's chemistry.[6]

As I mentioned, publication of the *Annales de chimie* was suspended in 1793, at the height of the French Revolution, and when it resumed publication in 1797, two of its original editors had been executed; Dietrich and, of course, Lavoisier. Dietrich disappeared from the list of editors in the October 1791 volume, but by this time the board had already added two new members — Vauquelin and Seguin — whose names appeared on the title page of Volume 7 a full year earlier. Vauquelin was thus the first pharmacist to gain entry to the exclusive club of French scientists that made up the editorial board of the *Annales de chimie,* although he had to share this distinction with Bertrand Pelletier when the latter joined in April 1792, a year before the temporary hiatus in publication. With the return of the *Annales de chimie* in 1797, Lavoisier's name was gone from the title page, but three new editors — Prieur, Chaptal and Van Mons — joined the survivors of the Terror on the board. Pelletier did not serve on the relaunched journal for very long, however, as he died

[3] For a detailed history of the *Annales de chimie* and an attempt to place it in the context of contemporary politics and publications, as well as science, see Maurice Crosland, *In the Shadow of Lavoisier: The* Annales de chimie *and the establishment of a new science,* Oxford: British Society for the History of Science, 1994.

[4] Adet and Hassenfratz contributed a symbolic notation to the 1787 *Method of Chemical Nomenclature.* These two men were Lavoisier's laboratory assistants and so attended the informal meetings at the Paris arsenal which brought together the core of the new chemists during the 1780s.

[5] For an interesting analysis of the *Chemische annalen,* along with a discussion of how central it was to the formation of a German chemical community, from what was formerly a metallurgical and pharmaceutical community see Karl Hufbauer, *The formation of the German chemical community, 1720-1795,* Berkeley: University of California Press, 1982.

[6] Baumé, for example, who was never converted to Lavoisier's theory, published several articles in the *Annales de chimie,* but never anything in defence of the phlogistonist position.

that very same year, making Vauquelin the only pharmacist on the editorial board that decided in favour of the 1799 merger with the *Journal de Pharmacie.*

Pharmacy in the *Annales de cheimie*

Pharmacy had been a part of the *Annales de chimie* since its inception in 1789, but never a large part. Before the merger, metallurgy and mineralogy accounted for considerably more of the journal's contents than pharmacy did, with regular contributions from Germanic countries, as well as home-grown mineralogical observations supplying a sizeable amount of copy. General observations on reactions of common inorganic substances such as phosphorus and sulphur may have been informative to the more chemically-sophisticated pharmacist, but it is hard to believe that such observations were indispensable to the everyday practices of the pharmacist in his *officine.* Just as the contents of the *Journal de Pharmacie* had not been practical enough to appeal to a sufficient number of working pharmacists in order to survive, so the *Annales de chimie* would have to publish considerably more concerning the daily chemical operations of the pharmacopoeia before it could expect to find a place in every pharmacist's library. All the same, there was the occasional article specifically on analysis of some vegetable remedy, usually by Fourcroy or Vauquelin, but these were few and far between, and offered little in the way of practical advice for assessing or administering such treatments.

The relaunch of the *Annales de chimie* in 1797not only saw changes in the editorial board, but also a striking emphasis on the immediate, practical application of chemistry in France. The first volume of this period, Volume 19, was packed with practical advice on the domestic, commercial manufacture of materials needed to supply France, which was suffering under a Europe-wide blockade at this time. Fourcroy and Vauquelin, the authors of practially all the pharmaceutical content in the journal, were also caught up in this patriotic fervour, publishing several articles on domestic manufacture, as well as experiments on explosives. As might be expected, the mood of the journal soon became less urgently practical and the content returned to the balance it had enjoyed before the suspension of publication.[7] Nor did the merger of the *Annales de chimie* with the *Journal de pharmacie* have any immediate effect on the content of the journal. It was not until 1801 that the pharmaceutical content began to pick up, with contributions coming not only from the expanded contingent of pharmacists on the editorial board but also from others, some of whom were not even based in Paris.[8] The contributions on pharmaceutical topics finally began to match the mineralogical ones, although this was mainly due to the decline in the number of mineralogical contributions. In the intervening time,

[7] In 1797, the editors put out six rather than the usual four volumes meaning that volumes 19 through 24 are all dated 1797.

[8] Volume 38 (20 April 1801) has an article by Margueron, a pharmacist from Strasbourg, and one from Dubuc the elder, a pharmacist working in Rouen.

the editors had shifted their focus of interest towards the relatively new and exciting subject of electricity, which occupied more and more pages of the *Annales* in the years that followed.

Although the number of pharmaceutical articles did increase following the merger with the *Journal de pharmacie,* the journal was never in danger of becoming a practically useful pharmaceutical journal. Indeed, many of the more practical discussions of pharmaceutical preparations were extracted from other journals such as the *Bibliothèque britannique,* and sundry German pharmacy journals rather than being contributed by French chemists. Overall, it is hard to conclude very much concerning the state of relations between pharmacy and chemistry just by looking at the changing proportions of the content of the *Annales de chimie* subsequent to its merger with the *Journal de pharmacie.* This does not mean, however, that clear signs as to the nature of this relationship were nowhere to be found in the *Annales.*

The pros and cons of integration

Although, at the time the merger deal was struck the *Annales de chimie* was unquestionably the dominant journal, its integration of the *Journal de pharmacie* should not be viewed purely as an act of charity engineered through Fourcroy's insider pressure. As a business venture, rather than a state-funded publication, the *Annales de chimie* had obvious advantages to gain from the proposition. First, it could tap into a new pool of potential subscribers. From 1800, the journal's revised title page placed particular emphasis on pharmacy, and the editors no doubt assumed that some of the large number of French pharmacists would subscribe to the journal. Right from the beginning, those with current subscriptions to the *Journal de pharmacie* would receive the *Annales de chimie* in its place for the balance of the subscription, a trial period in which they could judge the journal's quality and relevance.

It is, however, extremely difficult to gauge the success of the journal in attracting pharmacists as subscribers.[9] Looking forward to the launch of the *Bulletin de pharmacie* in 1809, we can see that a decade after the loss of their own journal in its merger with the *Annales de chimie,* pharmacists felt that they could and should once again support an independent specialist journal. Evidently the time was ripe for such a publication, as this journal, like the *Annales de chimie,* has remained in existence right up to the present day, albeit with a number of changes in its title. Therefore, we can conclude that there was a significant market for this science-oriented journal amongst pharmacists sympathetic to the new chemistry.

[9] Crosland informs us that in 1806 there were 600 subscribers to the *Annales,* but without more complete subscription information it is impossible to judge the importance of pharmacists as readers.

How successfully the *Annales* exploited this market, however, is a matter for speculation.

Beyond the potential for a larger subscription base, another advantage the *Annales de chimie* stood to gain from its union with the *Journal de pharmacie* was the claim to utility that would accompany a closer relationship to pharmacy. Through the ups and downs of the revolutionary period in France the editors had learnt the value of promoting the social utility of science with an eye to currying political favour. Although the military applications of science led the pragmatic field, supporting and improving medicine followed a close second. After Napoleon took power, utility remained a primary concern, and, despite the first consul's interest in the mathematical sciences – including chemistry[10] – the health of French citizens continued to provide an important justification for the state's support of science.

In 1804, the editors changed printer, leaving Fuchs, who had published the *Annales* since 1789, and moving the operation to Bernard, the official publisher for the *tcole Polytechnique* and the *tcole des Ponts et Chaussées.* This move gave the journal indirect access to the state subsidies associated with these official government-run institutions. So, although the state had no part in editorial policy, it was nevertheless supporting the journal to some extent starting in 1804. The journal also received direct official support under the empire, with government agencies promoting the journal's value among pharmacists. An 1806 circular from the Ministry of the Interior to the prefects of all the departments of France recommended the chemical discoveries contained in the journal as particularly relevant to pharmacists and health officers alike.[11] Despite this evidence that the *Annales* attempted to capitalize on its incorporation of pharmacy, it would be a leap of logic to infer that the content of the journal made it indispensable for practicing pharmacists, either before or after its merger with the *Journal de pharmacie.*

When announcing the decision to absorb the *Journal de pharmacie,* the editors of the *Annales de chimie* understandably put a positive public face on it. They optimistically declared it to be the obvious move, considering the similar content of the two journals:

> These considerations [the similarity of subject matter] have determined the editors to unite these two collections, and to publish only one in the future, for the benefit of both sets of subscribers.[12]

[10] Napoleon Bonaparte was elected to membership of the section of 'mechanical arts' in the first class of the *Institut de France* in December 1797.

[11] Maurice Crosland, *In the Shadow of Lavoisier,* 1994, p. 312. Crosland reproduces the circular from Champagny, Minister of the Interior in an appendix.

[12] Ibid., p. 311, les considérations ont déterminé les rédacteurs de ces deux recueils à se réunir et à n'en publier a l'avenir qu'un seul pour l'avantage des souscripteurs de l'un et de l'autre.' Crosland reproduces the minutes of the whole of the December 1799 meeting, but the statement drafted at the meeting, including this quote, was published as 'Avis des editeurs d'annales de chimie' in *Annales de chimie* 32, year VIII (October 1799), p. 332.

The editorial board's matter-of-fact optimism masks any differences of opinion that may have existed among members of the board, although it is fairly safe to assume that the identification of interests of pharmacists and chemists did not convey the unanimous conviction of the board.

The positive arguments for the merger (an increased subscription base, and a closer association with the utility of pharmacy) seem to make it an unobjectionable move, but I now want to consider the arguments against absorbing the *Journal de pharmacie* into the *Annales de chimie.* The most obvious reason to oppose the union of these journals was the threat that such a merger would undermine the advances that chemistry had made towards becoming an independent philosophical science. There were those who, following Venel's line in the *Encyclopédie,* wanted chemistry to be considered in the same light as Newtonian mathematical physics rather than any practical art, as only this first association would allow the science to transcend its pre-scientific confusion with alchemy, metallurgy and pharmacy. For these scientists, reattaching chemistry to pharmacy was a step backwards, a step away from the alignment with mathematical physics that promised to earn chemistry recognition as a truly philosophical endeavour. This is just the kind of concern that must have been troubling Claude-Louis Berthollet as he saw the merger between the *Annales de chimie* and the *Journal de pharmacie* approved by the board.

The new chemistry after Lavoisier

At the time of the merger, three of the four senior editors, Guyton de Morveau, Fourcroy and Berthollet, were the surviving authors of the *Method of Chemical Nomenclature.*[13] Together these men represented the elite of French chemistry at the close of the eighteenth century. The very collaboration with Lavoisier that had placed them at the forefront of theoretical and disciplinary innovation a decade earlier now situated them at the centre of the scientific establishment. Nevertheless, their formative association under Lavoisier did not mean that they shared an identical vision of chemistry's status and future, particularly in relation to pharmacy.

We have already dealt in some detail with Fourcroy's views on the subject, and how he saw it as a central task of chemistry to raise pharmacy up to the same scientific level so that, theoretically at least, reintegration would be a meeting of

The inconsistency in dates shows that publication of the *Annales de chimie* was mildly off schedule at this time. A few months was little compared to the track record of the old *Mémoires* of the Royal Academy of Sciences whose publication ended up slipping years behind the date on the cover.

[13] The fourth, Gaspard Monge, had performed pioneering work on the synthesis of water in 1783. He later converted to Lavoisier's oxygen theory.

equals. Indeed, this was a mission that was only fully formed after his collaboration with Lavoisier and intensified during the course of the French Revolution. By contrast, Berthollet, after teaching a course in *materia medica* in 1780 as a newly qualified physician, seemed to show no particular interest in the scientific fate of pharmacy, and instead saw chemistry's future in terms of a closer association with the other physical sciences.[14] In his research, Berthollet followed Lavoisier's lead and never strayed into traditional pharmaceutical areas. Furthermore, although actively interested in the practical application of chemistry to dyeing, an area where he sought to introduce modem chemical theory, Berthollet did not make any comparable attempts to reform pharmacy.[15] It is hard to believe that a scientist like Berthollet, who had moved away from medicine and pharmacy in his pursuit of chemistry, would have been happy with the integration of the *Journal de pharmacie* into the leading French chemical journal of the day.

We find confirmation of Berthollet's view of chemistry as remote from pharmacy by looking a few years into the future, when he would found his own scientific society, the Society of Arcueil. This society had neither formal structure nor charter, and only announced its existence to the world with the publication of its *Mémoires de la Société d 'Arcueil* in 1807, but the group of scientists Berthollet brought together was to have a profound influence on the course of French chemistry over the next fifty years.[16] Laplace, who in 1806 moved to become Berthollet's neighbour in the eponymous Paris suburb of Arcueil, can be considered the society's co-founder. A contemporary of Berthollet, he brought his exceptional mathematical skills with him to Arcueil, skills that had been so important for his collaboration with Lavoisier on the questions of physical chemistry that they tackled in the 1780s. Laplace's first collaboration with Lavoisier was in designing a piece of apparatus to measure the caloric released in reactions,[17] but he had also worked with the leading figure in French chemistry on other projects. Lavoisier even wrote that Laplace had conceived a plan to calculate all the chemical affinities on the Newtonian model for gravitational attraction in the solar system. Although no such mathematical system was worked out, the basic assumption that chemical affinity could be described in terms of short-range

[14] The course was advertised in a pamphlet of 1779 called *Cours de matière médicale chymique et pharmacologique.* Already here, he expressed his own preference for chemistry as a science. Nevertheless, he does make an appeal for the rational application of chemistry to the *materia medica* as far as it was possible.

[15] See Berthollet's *Éléments de l 'art de teinture,* Paris: Firmin Didot, 1791, where he presents his plans for the scientific reform of dyeing.

[16] See Maurice Crosland, *The Society of Arcueil: A View of French Science at the Time of Napoleon I,* Cambridge MA: Harvard University Press, 1967. Chapters 5 to 8 deal with the society itself, while the rest gives background to science in France under Napoleon's empire.

[17] Lissa Roberts offers a rhetorical analysis of this venture into calorimetry in her article 'A word and the world: The significance of naming the calorimeter', Isis 82 (1991)f 199-222.

attractive forces, as suggested by Newton, was to remain a powerful idea in chemistry.[18]

Laplace found echoes of his earlier work when Berthollet published his own two-volume treatise on chemical affinity, the *Éssai de statique chimique* of 1803. Berthollet agreed with Laplace's Newtonian view in principle, but considered chemical interaction too complex for any straightforward mathematical description. The variables that Berthollet considered particularly important for the outcome of any reaction were the quantity of reagents involved, and the physical circumstances under which the reaction took place. Berthollet's exploration of these concerns produced a comprehensive and influential treatise which found only a small amount of space for vegetable and animal chemistry, the rising focus for pharmaceutical chemistry.

Although Laplace and Berthollet were commanding scientific figures in their own time, as the years passed their immediate influence gave way to that enjoyed by the society's younger members. From a total of fifteen members of the Society of Arcueil, there were three older, established scientific figures, all disciples of Lavoisier: Berthollet, Laplace and Chaptal. The rest, the junior members of the society, were between twenty and forty years younger than these men, and included several scientists who would themselves become central figures in nineteenth-century French chemistry: Gay-Lussac, Thenard, Biot and Dulong, to name but four. Berthollet put his Arcueil laboratory at the disposal of the younger members of the society, allowing them valuable research and publication opportunities outside the constricted atmosphere of the Parisian scientific elite.

Typical examples of the directions these younger members of the society followed are supplied by Arago's research on light, and Gay-Lussac's investigation into volume changes associated with various gaseous reactions, work that led to the articulation of the law of combining volumes. Taken as a whole, the research generated by the Society of Arcueil was quite distinct from the pharmaceutical chemistry that developed around the Paris School of Pharmacy during the early part of the nineteenth century. Despite notable scientific successes, Fourcroy's pharmaceutical heritage was on the wane as Berthollet's school continued to rise in prestige. Although, as we shall see, the pharmacists were well represented on the Parisian scientific scene even at the time of the Society of Arcueil's inception, their presence began to decline with the rise of the younger members of this society who more closely fitted the profile of modern theoretical chemists.

Returning to the *Annales de chimie* and its merger with the *Journal de pharmacie,* it should be born in mind that although there were fifteen full members

[18] For the story of the development of Newtonian atomic theory within chemistry, see Arnold Thackray, *Atoms and powers; an essay on Newtonian matter-theory and the development of chemistry,* Cambridge MA: Harvard University Press, 1970. Mi Gyung Kim has recently offered an updated history of the concept of affinity and its role in the chemical revolution, see Mi Gyung Kim, *Affinity, that Elusive Dream: A Genealogy of the Chemical Revolution,* Cambridge MA: MIT Press, 2003.

of the Society of Arcueil,[19] only two of its future members were on the 1799 editorial board of the *Annales de chimie,* Berthollet and Jean-Antoine Chaptal. It can not be inferred from his association with the Society of Arcueil, however, that Chaptal shared Berthollet's views on the form that chemistry should take, rather it is more likely that Berthollet's closest ally on the board of the *Annales de chimie* would have been Gaspard Monge, who, despite his early work on the constitution of water, is best remembered for his work in mathematics and physics.

Overall, however, it is hard to see the members of the society of Arcueil, and Berthollet in particular, seeing eye to eye with Fourcroy on the desirability of integrating the *Journal de pharmacie* with the *Annales de chimie.* The period when Gay-Lussac and Arago became the editors of the *Annales de chimie* provides further evidence of this divergence of opinion. After the deaths of both Fourcroy and Guyton, Berthollet assumed control of the *Annales de chimie,* and in 1816 he appointed Gay-Lussac and Arago as its only two editors. They took the opportunity to rename the journal the *Annales de chimie et de physique,* expunging the reference to pharmacy from the title along with the earlier general reference to other chemical arts. Although pharmacy did not drop out of the contents of the journal, it was reduced to a marginal position. With Fourcroy dead, Berthollet's school had assumed control of one of the central tools for defining the direction chemistry would take in the nineteenth century. Lavoisier's journal, initially launched in order to promote his new chemistry, would remain the *Annales de chimie et de physique* until the First World War.

One of the younger members of the Society of Arcueil, Louis-Jacques Thenard, was a former student of both Fourcroy and Vauquelin, a pharmacist who crossed party lines in order to work in Berthollet's 'school'. In fact, Thenard is best-remembered for his fruitful collaboration with Gay-Lussac under the auspices of the Society of Arcueil, during which they performed elementary analyses of organic compounds, using potassium chlorate. I will return to this important research later, when I look at Vauquelin's analysis of plant matter, but I want now to turn to an earlier incident in Thenard's life, which suggests that already, by the end of the century, he had chosen chemistry over pharmacy.

[19] The full fifteen were: Claude-Louis Berthollet (1748-1822), Pierre Simon Laplace (1749-1827), Baron Friedrich Wilhelm Karl Heinrich Alexander von Humboldt (1769-1859), Jean Antoine Chaptal (1756-1832), Augustin Pyramus de Candolle (1778-1841), Jean Baptiste Biot (1774-1862), Étienne Louis Malus (1775-1812), Dominique François Jean Arago (1786-1853), Siméon Denis Poisson (1781-1840), Joseph Louis Gay-Lussac (1778-1850), Louis Jacques Thenard (1777-1857), Pierre Louis Dulong (1785-1838), Hippolyte Victor Collet-Descotils (1773-1815), Jacques Étienne Bérard (1789-1869), Amédée Barthélemy Berthollet (1780-1810). For brief biographies of all fifteen, see Crosland (1967), pp. 97-138.

Delunel and Thenard

In 1800, Thenard was the catalyst for a revealing debate that played out in the pages of the *Annales de chimie,* openly pitting the new pharmacists against those wary of philosophical chemistry. The whole affair started innocently enough, with an advertisement in the *Annales de chimie* that took the form of an article. The competitive examinations that students had to sit in order to gain admission to the *École Polytechnique* presented a business opportunity, and various polytechnicians had banded together to exploit it by teaching private preparatory courses. Courses would be offered in mathematics, physics and chemistry, at the rate of 20 francs a month. Thenard, who was employed at this time as a *préparateur* at the *École,* assumed responsibility for the chemistry course. The advertisement opened with its authors presenting general information on the courses, and then Thenard offered a description of what he would teach his students in the chemistry section:

> A practical chemistry course, where the subscribers will practice manipulations; these manipulations will have as their object the preparation of divers chemical substances, the use of these substances in the arts and the analysis of mineral, vegetable and animal matter.[20]

This completely standard description of an eighteenth-century chemistry course would have shocked neither a chemist nor a pharmacist. In the next part of the article, Guyton, in his capacity as director of the *École Polytechnique,* conveyed the editorial committee's endorsement of these courses offered by the school's staff and students.

This official note of approval was followed by a more tendentious argument from Thenard concerning the value of his course. He entitled this discourse 'On the need to unite the practice to the theory of chemistry, in order to render its applications to the arts useful'. It was this part of the article that would draw an extremely defensive response from the Parisian pharmacist Delunel, and not without justification. Thenard started by bemoaning the impossibility of getting a practical chemistry training anywhere in Paris, mentioning the *École Polytechnique,* the *École de Mines,* and the *École de Santé* as the only three schools offering courses in chemistry. Unfortunately, as Thenard was only too keen to point out, all three were closed to anyone not enrolled. He strategically left the *École de Pharmacie* out of his list, as this school was required by its own charter to offer public lectures, and presumably the last thing on Thenard's mind was to

[20] Rigault Tours de Mathématiques, physique et chimie; *Par une société d'anciens élèves de récole polytechnique' Annales de chimie, ou recueil de mémoires concernant la chimie, les arts qui en dépendent, et spécialment la pharmacie,* 34 (1797, year VIII), p. 103, Un tours pratique de chimie, ou les souscripteurs seront exercés aux manipulations ; ces manipulations auront pour objet la préparation des diverses substances chimiques, l'emploi de ces substances dans les arts, et l'analyse des matières minérales, végétales et animales.'

promote this kind of competitor.[21] Nevertheless, this was only the first of several slights that would draw a heated response from Delunel, the pharmacists' champion.

Although he omitted to mention the pharmacists' school in Paris, Thenard exhibited no such restraint when it came to criticizing the traditional apprentice-based education received by pharmacists. He was quite blunt about what he saw as its shortcomings:

> There is, among the young people who choose pharmacy, an error that is indeed fatal, and which it is important to destroy; they ordinarily go to a pharmacist, pass two or three years there in order to learn by rote the preparation of a great number of medicaments; at the end of two or three years, they then follow one or two chemistry courses, and thus only learn this science superficially. So, what is the result? That they spend a long time learning very little.[22]

According to Thenard, learning pharmacy was quite clearly not the same as learning chemistry. At first glance, it might seem that he identified pharmacy with practice, and chemistry with theory, but the situation was more complicated than that. Looking back at Thenard's description of his own course, we see that he himself stressed practical manipulation as the major part of learning chemistry. The point of Thenard's denunciation was that the preparation of medicines learned in a pharmacist's apprenticeship (an apprenticeship that he himself had served) consisted in learning a routine, empty practice, and thus did not match the educational form of practical experience offered in his course; practice guided by chemical theory. It was this more sophisticated, systematic manipulation that made a chemist, while the 'empty', routine production of materials, an occupation that, by implication, was not accompanied by an understanding of what was involved (that is the chemistry of the relevant combinations), characterized the ignorance of the pharmacist. No doubt, Thenard was painting a pharmacist's education in the darkest possible hues, and thus his criticisms exaggerate the theoretical poverty of pharmaceutical education. Nevertheless, it is important to understand the sentiment that Thenard was expressing – that pharmacists did not really know chemistry and it was only chemists, trained in chemistry, who could teach the subject. Thus, even

[21] Thenard also failed to mention the courses in chemistry offered at the *jardin des plantes,* where he himself had attended Fourcroy's lectures, as well as the chemistry course at the *Collège de France.* These courses were free to the public.

[22] Louis-Jacques Thenard, 'Sur la nécessité de réunir la pratique à la théorie de la chimie, pour en faire d'utiles applications aux arts', *Annales de chimie,* 34 (1797, an VIII) pp. 107-8, 'il existe, parmi les jeunes gens qui se destinent à la pharmacie, une erreur qui leur est bien fatale, et qu'il est bien important de détruire; ils vont ordinairement chez un pharmacien passer deux ou trois ans pour apprendre par routine la préparation d'un grand nombre de médicamens; au bout de ces deux ou trois ans, ils suivent ensuite un ou deux cours de chimie, et n'apprennnent ainsi que superficiellement cette science. Qu'arrive-t-il alors? qu'ils ont employé beaucoup de tems pour apprendre peu de chose.'

the schools where pharmacists taught chemistry could only offer a 'superficial' knowledge of the subject. Thenard's picture of chemistry teaching in Paris shows that things had changed a great deal since the time when the courses offered by Rouelle, a practicing pharmacist, were considered the finest possible introduction to chemistry.

Delunel took it upon himself to reply to Thenard's attack on the pharmacist's education, and he quickly penned a response. The editors of the *Annales de chimie* were reluctant to publish his rejoinder, however, hoping to keep such polemics out of the pages of their journal. Delunel did not give up, and appealed to Josse, the director of the *École de Pharmacie,* who intervened to have the piece printed. Josse reminded the editorial board that not only had they started the affair by publishing Thenard's inflammatory piece in the first place, but also that they had recently accepted a union with the journal of the Society of Pharmacists, and so owed a special allegiance to the profession. Whether the editors were persuaded by these arguments or were convinced by other considerations is not clear, but Delunel's reply to Thenard appeared, along with Josse's letter, in the next volume of the *Annales de chimie.*

Delunel's article, 'observations on the discourse of Citizen Thenard offers us an interesting insight into the disciplinary insecurity of pharmacy. He was clearly reacting to a perceived threat much greater than any contained in the unguarded opinions of a young apostate pharmacist. Thenard was only twenty-three at this time, and, although a rising star, his career as a renowned chemist and member of Berthollet's Society of Arcueil was still ahead of him. Delunel's piece is, therefore, symptomatic of a heightened sensitivity the pharmacists felt at this time, rooted in their unresolved relationship with the successful science of chemistry. Whether Delunel thought that others were behind Thenard's provocation or he believed it to be representative of a generalized disdain for pharmacy is not clear, but whatever the case, the response was aggressive.

While chemistry could be learnt by attending any course, only the *College de pharmacie,* according to Delunel, offered appropriate instruction for those who wished to practice the art of pharmacy. This course would not burden the students with a lot of useless chemical knowledge, but would instead concentrate on 'pharmaceutical chemistry', defined by Delunel as 'the analysis of diverse simple substances that compose medications'.[23] So, although he did not want to reject chemistry *in toto,* Delunel limited his attention to one specific part of it, a part that could be considered to belong exclusively to the pharmacists. The student pharmacist was, therefore, to be confined as much as possible to this single area:

[23] Delunel, 'Observations sur le discours du cit. Thenard *Annales de chimie,* 35 (1797, year VIII) p. 77, Tanalyse des diverses substances simples qui component les médicamens.'

> While a young pharmacist may learn very useful notions in a general course of chemistry, he will not acquire true learning except in a course of pharmaceutical chemistry.[24]

As we shall see, this was not the teaching philosophy adopted in the Paris School of Pharmacy set up three years later, where the new chemistry would be the primary focus of its chemistry courses. Nevertheless, pharmaceutical chemistry would turn out to be vitally important for defining pharmacists' scientific research in subsequent decades. This pharmaceutical chemistry would not, however, be based on the traditional search for simples as described by Delunel, but rather on chemical analyses oriented towards the species brought to the fore by the new chemistry.

Delunel also addressed the question of the relationship between theory and practice, another point where his views differed from Thenard's. Delunel reversed the priority offered by Thenard, who had argued that theory should come before practice, by insisting that practice should take precedence over theory. It was practice, Delunel asserted, that gave the pharmacist his characteristic professional knowledge, and it seems that he really did mean practice in the sense of routine manipulation:

> It is not an error for them [pharmacy students] to start their studies in a pharmacy, and to finish with one or a number of courses in chemistry, botany, natural history or *materia medica.* The reason for this preference is this: in whatever course, one learns more theory than practice; but, to train a true pharmacist, he must be made to exercise all his senses, and only time may accustom them to necessary and certain judgment in the exercise of such an important art. If a chemist makes a mistake in his laboratory, this error might harm science; but the error of a pharmacist might kill a man, therein lies the difference.[25]

The 'true pharmacist' according to this critique was not a theoretician but a practician.[26] Delunel was attempting to turn the status of chemists against

[24] Ibid., p. 78, 'un jeune pharmacien peut prendre des notions très-utiles dans un cours général de chimie, mais qu'il n'acquerra sa véritable instruction que dans un cours de chimie pharmaceutique.'

[25] Ibid., p. 80, 'Ce n'est point une erreur pour eux que de commencer leurs travaux par ceux d'une pharmacie, et de finir par un ou plusieurs cours de chimie, de botanique, d'histoire naturelle et de matière médicale. La raison de cette préférence, la voici: dans un cours quelconque, on 'pprend beaucoup plus la théorie que la pratique ; mais, pour former un vrai pharmacien, il faut l'exercice de tous ses Sens, et le tems seul peut les habituer au jugement nécessaire et certahn dans l'exercice d'un art aussi important. Qu'un chimiste se trompe dans son laboratoire; cette erreur peut nuire à la science; mais l'erreur d'un pharmacien peut tuer un homme, voilà la différence.'

[26] Delunel is valorizing just the low-level chemical practice that the chemist-pharmacists who founded the *Bulletin de pharmacie* explicitly targetted as a weakness of pharmacy. See the beginning of Chapter 2.

themselves (in the pages of their own journal), reviving the image of the amateur whose work is diverting but unimportant when compared with the practical application of knowledge for the care of others. In the end, Delunel, who himself ran a pharmacy in the rue Saint-Honoré, trumped Thenard's arguments in favour of the priority of chemical theory, with an appeal to the utility of pharmacy.

In his denunciation of chemistry, Delunel was drawing on an ongoing Enlightenment debate over the relative merits of the sciences, the liberal arts and the mechanical arts. The traditional hierarchy, with the contemplative sciences at the top and the mechanical arts at the bottom had come under attack in the eighteenth century, most notably in Diderot and d'Alembert's *Encyclopedia.* In the anonymous article on the arts, the author, probably Diderot himself, offered the following definitions: the sciences were the occupations whose object was purely contemplation, while the arts were those whose object was action. Further, he loosely defined the liberal arts as those that involved principally the mind, and the mechanical arts as those that involved principally the hand. The main complaint of the article was that the prejudice against the mechanical arts and in favour of the liberal arts threatened to 'fill the cities with proud reasoners & useless contemplators.[27] The focus on the practical utility of an art as supplying its value implied a parallel condemnation of the sciences and the liberal arts as effete. Such an approach would obviously resonate among those professionals proud of their productive role in society. Thus, Delunel is happy to be considered an artisan, while Thenard's argument that the pharmacists should learn the science of chemistry carries with it the threat of making them redundant. [28] Where fifty years earlier Delunel might have pushed the point that chemistry itself was an art, he instead takes refuge in reaffirming the artisanal nature of pharmacy. In effect, Delunel and Thenard agree on the nature of both chemistry and pharmacy, although the values they assign to each are diametrically opposed. Thus, it is quite natural that they should disagree over whether the pharmacist should be trained as a chemist.

Beyond reminding Thenard of the essentially artisanal nature of pharmacy (including pharmaceutical chemistry), Delunel felt the need to point out a problem within the company of qualified pharmacists itself. There were those, Delunel concluded, who had succeeded in qualifying as pharmacists, even though they were really only chemists in the derogatory sense in which he understood the term (essentially idle speculators). Because they had concentrated exclusively on philosophical chemistry, these impostors could be assumed not to have properly

[27] Diderot and d'Alembert (eds), *Encyclopédie,* Vol. I, p. 714.

[28] For a broader discussion of the history of theory and practice in chemistry, see: Christoph Meinel 'Theory or Practice? The Eighteenth-Century Debate on the Scientific Status of Chemistry', *Ambix* 30 (1983): 121-132. Jan Goldstein offers an interesting discussion of the contemporary value of liberal and mechanical arts in the introduction to her book *Console and Classify: the French psychiatric profession in the nineteenth century,* Cambridge: Cambridge University Press, 1987.

learnt the art of pharmacy. Delunel even seems to have been suggesting the need for an active programme to root out these false pharmacists, although he disguised the threat beneath a rather strained floral metaphor.

> It will be in vain for you [Thenard] to cite examples in support of your opinion: those who have learnt pharmacy following your principles and allow themselves to exercise it are nonetheless [correctly] classified in the opinion of the masters of the art; the merit of a language is a flower that does not always bear the requisite fruit, and their existence, as a kind of parasite, is an evil that must be destroyed at its roots.[29]

The implication was that there were philosophical chemists hiding behind the name of pharmacist, impostors who put everything at risk, not only the lives of French citizens, but also the reputation of the 'true pharmacist' himself. Delunel did not go as far as naming any names, but Nicolas-Louis Vauquelin must have been a prime target for the older pharmacist's veiled denunciation. Vauquelin, Fourcroy's favourite student, was the chief carrier of the infection of philosophical chemistry into the heart of pharmacy, and yet, only three years later, thanks to the good offices of his teacher and patron, he would become the most influential pharmacist in France.

Fourcroy's heirs: the new pharmacists

However extensive Fourcroy's influence on pharmacy may have been, it is important to remember that he was never a pharmacist. Although his father was a pharmacist, and Fourcroy was made an honorary member of the Society of Pharmacists (the only non-pharmacist to be granted this honour) he himself was trained as a medical doctor and, outside his political commitments, he lived his life almost exclusively as a practicing chemist. This last point, that Fourcroy managed to make a living teaching chemistry, without directly resorting to its practical applications (his venture into chemical manufacture was a dismal failure), indicates how much the possibilities had changed in the course of the preceding century. As a professional 'chemist' who was neither an apothecary nor a mineralogist nor engaged with any of the other numerous chemical arts, he followed a career path that was only beginning to develop at the start of the French Revolution.[30]

[29] Delunel, 'Observations sur le discours du cit. Thenard ...' 1797, p. 83, 'En vain citeriez-vous des exemples à l'appui de votre opinion : ceux qui, suivant vos principes, ont appris la pharmacie et se permettent de l'exercer, n'en sont pas moins classés dans l'opinion des metres de l'art ; le mérite du langage est une fleur qui ne donne pas toujours le fruit nécessaire, et leur existence, en quelque sorte parasite, est un mal qu'il faut détruire dans sa racine.'

[30] For further discussion of the development of the scientific profession, see Maurice Crosland 'The Development of a Professional Career in Science in France' and Roger Hahn

Fourcroy, therefore, took chemistry to the pharmacists as an outsider. During the course of the French Revolution he became, as we have seen, an outsider who wielded considerable political influence, and was courted ever more assiduously by the pharmacists, but he was never properly one of them. Nevertheless, he did recruit his own disciples who had trained as pharmacists, and who would come to form part of the vanguard of the new pharmacy at the beginning of the nineteenth century It is one of these pharmacists in particular – Nicolas-Louis Vauquelin – who will form the focus of the analysis that follows, as he provided an exemplary model for the institutional and scientific life of an elite nineteenth-century Parisian pharmacist.

Although Fourcroy encouraged and supported several budding scientists, among them the pharmacist Edmé-Jean-Baptiste Bouillon-Lagrange, and the apprentice pharmacist Thenard, his foremost protégé was Nicolas-Louis Vauquelin. With his star in the ascendant on the French political and scientific scenes, Fourcroy was able to provide these younger men with invaluable openings, although it was their individual talents that allowed them to take full advantage of these opportunities. Over a relatively short period of time, Fourcroy's disciples became prominent figures on the Parisian scientific scene, and were important influences both in spreading the new chemistry among the pharmacists and in helping to determine the scientific form of nineteenth-century pharmacy.

The pharmacists in this group were none the less far from being typical pharmacists. They certainly did not confine their activities to the preparation and sale of medicaments. These men formed an elite group within the community, and assumed the administrative control of Parisian pharmacy once the traditional guild structures had been removed. They took charge of a rapidly evolving field of pharmacy in a changed scientific and social context. Several things distinguished these 'new pharmacists' from their forbears, who had formed the elite of the Parisian College of Pharmacy. First, they generally held positions funded by the French government rather than teaching privately or under the aegis of a guild of pharmacists. The second difference was their close association with chemists and chemistry, as opposed to pharmacists and pharmacy.

We should not, however, get carried away by these associations and consider Vauquelin, for example, as a specialized chemical scientist performing fundamental research in order to supply innovation for a distinct sector of commercial pharmacy. In many respects he was a typical professional pharmacist. After having completed his apprenticeship, Vauquelin managed a pharmacy himself, and, in 1795, he reaffirmed his commitment to pharmacy when he was received as *maître en pharmacie* in Paris. Nevertheless, it is very possible that Delunel was referring

'Scientific Careers in Eighteenth-century France' both in Maurice Crosland (ed.), *The Emergence of Science in Western Europe,* New York: Science History Publications, 1976. Crosland supports the view that I am putting forward here concerning the importance of the French Revolution as a watershed for the professionalization of scientific careers in France. Hahn is more skeptical about the view of French science as a state-supported enterprise.

to Vauquelin, among others, when he denounced those pharmacists who were too attached to chemical theorizing to be competent practitioners. Delunel articulated a professional suspicion, stemming from the strangeness of the new chemistry in the eyes of the traditional pharmacist, when he suggested that anyone educated primarily in theoretical chemistry could not be a good, practical pharmacist. In a sense Vauquelin confirmed this suspicion by reorienting many promising young pharmacists away from the concerns of filling prescriptions in their *officines,* and towards a more elevated interest in laboratory research shaped by ideas imported into pharmacy from the new chemistry. It would not, however, be until the second half of the nineteenth century that any such pharmaceutical scientists would eventually abandon the business of pharmacy altogether in favour of the full-time pursuit of the new discipline of organic chemistry.[31]

In terms of both his institutional appointments and his scientific research in Paris, Vauquelin followed Fourcroy's lead. As I have already mentioned, the position he attained at the head of the leading educational institution for pharmacy in France allowed him to influence, at the very least, the students passing through this establishment. But his research work also provided a model for chemical pharmacists to follow in their own scientific endeavours, a model that gave rise most notably to the analytical successes of Pelletier and Caventou in isolating a series of important alkaloids during the final decade of Vauquelin's life.

In many ways, Vauquelin's biography mirrors that of his sponsor. Like Fourcroy, he came from a poor family, but, unlike Fourcroy, he laboured under the additional handicap of not coming from Paris. Vauquelin was born of peasant stock in 1763 in a small Norman town, but, with the help of the local nobility, he managed to work his way up to an apprenticeship with the Parisian pharmacist Picard.[32] In 1783, Vauquelin was admitted to the Hotel-Dieu, afflicted by an illness that could easily have proved fatal. Nevertheless, the time he spent at this notoriously dangerous Parisian hospital, which was better known for killing than for curing, exercised an important influence on his life. Here he met another Parisian pharmacist, Chéradame, who took him on as an apprentice once he had been discharged from hospital. Chéradame introduced his promising provincial apprentice to one of his cousins, a certain Antoine-François de Fourcroy, and in the

[31] For the crucial role played by Liebig in producing chemists from pharmacists, see the classic paper by Morrell; J. B. Morrell, 'The Chemist Breeders: The Research Schools of Liebig and Thomas Thomson', *Ambix* 19 (1972): 1-46, as well as the more recent biography, William Brock, *Justus von Liebig: The Chemical Gatekeeper,* Cambridge: Cambridge University Press, 1997.

[32] For more details on Vauquelin's life see, Alain Queruel, *Vauquelin et son temps (1763-1829),* Paris: L'Harmattan, 1994. There is no biography available in English beyond Crosland's entry in the *Dictionary of Scientific Biography,* and Donald Tower's slightly longer introduction to Vauquelin's thesis in medicine; Donald Tower, *Brain chemistry and the French connection, 1791-1841,* New York: Raven Press, 1994.

same crucial year of 1783 Fourcroy engaged Vauquelin as his own assistant.[33] The two remained united by a bond of close friendship, and later in a working partnership, until Fourcroy's death in 1809. Vauquelin's contact and collaboration with Fourcroy would direct his scientific career over the intervening quarter of a century, setting him on the path to an outstanding career.

Vauquelin in Paris

Fourcroy not only employed Vauquelin as his assistant for a chemistry course at the *Lycée,* but also encouraged him to teach. Although he did try teaching at this stage, Vauquelin apparently never enjoyed the success of his sponsor in front of an audience.[34] Vauquelin extended his relationship with Fourcroy well beyond their professional association, taking up residence with Fourcroy's two sisters, Mesdames Guesdon and Lebailly with whom he continued to live right up until their deaths.[35] Vauquelin also worked managing a pharmacy, all the time increasing his expertise in the new philosophical chemistry which Fourcroy was no doubt happy to share with him.

Vauquelin's institutional associations in Paris started to blossom with the coming of the French Revolution. In 1789, he was elected to membership of the *Société philomatique,* a minor scientific society founded a year earlier, which subsequently assumed greater importance due to the Revolution. Still in his twenties, Vauquelin was one of two representatives that this society sent to the newly formed *Bureau de consultation des Arts & Metiers* in 1791. The membership of the *Société philomatique* was greatly enhanced by an influx of former members of the disbanded Academy of Sciences in 1793, and so, for a brief time, the society became a central meeting place on the Parisian scientific scene. Ironically,

[33] According to Délepine, this is the way in which Cuvier recounted Fourcroy's offer of employment:

> On dit, Monsieur Vauquelin, que vous aimez beaucoup la chimie!
> Beaucoup....
> Est-ce que vous voudriez en faire?
> Ce serait mon bonheur.
> Voulez-vous venir chez moi, il vous faudra travailler; je ne suis pas bien riche, mais je vous nourrirai et je vous donnerai cent écus par an.

Delépine, *Un grand chimiste analyste: Louis-Nicolas Vauquelin,* 1941, p. 11.

[34] Chevallier and Robinet offered a eulogy for Vauquelin in 1830, and pointed out the unfavourable comparison between his teaching and Fourcroy's. Apparently he was difficult to hear, and more generally they had this to say. "M. Vauquelin manquait d'éloquence et le défaut de méthode dans son discours l'exposait souvent à se répéter. Cependant la simplicité et la naïveté de son langage avaient un certain charme." Damning with faint praise. Quoted from Jacques de Mari, *La Société libre des pharmaciens de Paris (1796-1803),* Grenoble: Prudhomme & Cie, 1944. p. 50.

[35] Madame Lebailly died in 1819 and Madame Guesdon in 1824.

Vauquelin was elected to membership of the Academy of Sciences this same year, but the Academy was dissolved before the appointment could be confirmed by the government. Clearly, Vauquelin was assuming a prominent position in French science just as Lavoisier, his teacher's teacher, was falling into the official disfavour that would cost him his life the following year.

The revolutionary government, fighting both external and internal wars, found a practical use for Vauquelin, and ended up pushing this young scientist between the poles of the chemical arts. First, in 1793, he was pressed into service as a military pharmacist, but he soon switched to join a team of scientists entrusted with the mission of increasing the domestic supply of saltpetre, a key ingredient for making gunpowder. As necessity demanded the mobilization of first pharmacists and then analytical chemists, the hard-pressed government saw no problem in consecutively deploying Vauquelin in these two roles.

Despite his uninspired debut as Fourcroy's assistant, Vauquelin initiated a career in teaching upon his return to Paris. His first independent position was at the *École de Mines,* where he started teaching crystallography in 1794. Vauquelin's competence in this field was gained through an education from Renè-Just Hail)/ rather than Fourcroy, but his ability to secure the government appointment was due to his association with the latter rather than the former. Haily, the founder of the science of crystallography, was also a priest who refused to pledge his allegiance to the Republic, a stand that landed him in prison in 1792. In 1795, Vauquelin took up two more teaching posts. He had already been employed as a demonstrator at the *École de Pharmacie,* at that time still run by the Paris Society of Pharmacists, and in 1795 he was promoted to professor of chemistry. He also assumed the position of chemistry professor at the *École centrale des travaux publics,* the original, incarnation of the *École Polytechnique* during the Revolution.

This same year, 1795, the Academy of Sciences was reconstituted as part of a new body honouring French citizens distinguished in the arts and sciences, the *Institut de France.* As a reaffirmation of the value assigned to the natural sciences by the French government, the scientists were placed in the First Class of the *Institut.* The chemistry section, like all the others, was to have six members. The ruling Directory directly appointed the first two members of the section, Guyton de Morveau and Berthollet. In turn, their nomination to fill the third seat was the third surviving author of the *Method of Chemical Nomenclature,* Fourcroy. The next three nominees were Bayen, Pelletier and Vauquelin. Vauquelin, cheated of membership in the Academy of Sciences, could now finally enjoy official recognition as one of the leading scientists in France.

Bayen was the only member of the chemistry section of the *Institut* who was not also a member of the editorial board for the *Annales de chimie,* but he was nevertheless one of those senior chemists who were not opposed to the new chemistry. Antoine Bourné, by now an elderly pharmacist, remained opposed to Lavoisier's chemistry and he found himself demoted from full membership in the Academy of Sciences to the position of corresponding member of the *Institut.* Boumé's demotion effectively made room for the younger pharmacist-chemists,

already converted to the new chemistry. Upon Pelletier's death in 1797, Déyeux, another pharmacist, took his place in the chemistry section. Déyeux had already been a frequent contributor to the *Annales de chimie* and would join its editorial board in 1800 subsequent to the merger with the *Journal de pharmacie.*

The dawning of the new century, and Napoleon's assumption of dictatorial powers, brought even more to Vauquelin. In 1801 he succeeded d'Arcet as professor of chemistry at the *Collège de France,* and in 1803, he was appointed director of the *École de Pharmacie* in Paris, making him the most senior administrator-pharmacist in the country. The next year Vauquelin gave up his position at the *College de France* in order to follow Fourcroy to the *Muséum d 'histoire naturelle.* It is a measure of their affection for each other that this exchange of posts meant a cut in pay for Vauquelin. He proceeded to move into the apartment at the museum that came with the job, accompanied, of course, by Mesdames Guesdon and Lebailly. Vauquelin received recognition for his distinguished service from both the emperor, and the Parisian Society of Pharmacists; in 1808, Napoleon awarded him the title of *Chevalier de 1 'Empire,* and the Parisian pharmacists elected him to presidency of their society in 1805, 1808 and 1814.

The last teaching position that Vauquelin took up was as professor of chemist at the *École de Médecine* in Paris, an appointment pregnant with significance in terms of Vauquelin's assumption of Fourcroy's institutional estate. Fourcroy had held this post at the medical school until his death in 1809, when Vauquelin was duly elected as his successor by the faculty. But Vauquelin was a pharmacist, not a physician, and as a result was technically not permitted to teach in the school until he had qualified as a medical doctor. Thus, Vauquelin submitted a thesis to the faculty of medicine in 1811, which consisted in a reworking of the chemical analysis of the brain that Fourcroy had carried out some years previously, and in this way he could be officially appointed to the position at the *École de Médecine* in 1812. Vauquelin's teaching career closed where it had started, in Fourcroy's footsteps. Thinking back to the early part of Fourcroy's career, we might be tempted to see this last appointment of Vauquelin's as something of an irony. After all, Fourcroy had been denied a teaching position at the *ancien régime* Faculty of Medicine, the predecessor of the new republican medical school precisely because of his involvement in the scientifically oriented Royal Society of Medicine, while it was Vauquelin's association with such scientific groups that assured him his position. All the same, this is probably better seen as another sign of the important transformations the French Revolution had wrought in the institutions responsible for medical education and administration.

Unlike Fourcroy, Vauquelin never involved himself in revolutionary politics, although he did become a deputy to the Convention late in life.[36] Nevertheless, it was during the period of the French Revolution that he started to take advantage of

[36] Vauquelin was elected as deputy for Lisieux in Calvados on 17 November 1827. He sat with the liberal opposition in the National Assembly.

his connections with Fourcroy – combined with his own growing scientific reputation – in order to establish a solid institutional base in Paris. Indeed, as a qualified pharmacist, he proved an ideal partner for Fourcroy's plans to take this profession in hand. The reform of 1803, which stripped the guild of its control over pharmacy, provided the opportunity for Fourcroy to place his own protégé in charge of the education of France's elite pharmacists. Although it was Napoleon, through the intermediary of the minister of the interior, Chaptal, who officially appointed Vauquelin to his post as director of the Paris School of Pharmacy, it was no doubt Fourcroy who supplied the name.[37] Thus, while Fourcroy reformed and controlled pharmacy from the outside, Vauquelin set to work on the inside, actively promoting a new brand of pharmaceutical chemistry to a new generation of French pharmacists. It was an extension of this version of analytical chemistry that would bring the elite pharmacists to prominence in the scientific world of the nineteenth century, so it is important to understand the nature of this field. We can see the origins of this practice, and the lines along which it would develop, traced out in Vauquelin's own scientific research. Moreover, examining his teaching of chemistry at the Paris School of Pharmacy reveals how he was educating the next generation, the generation of the 'new pharmacists.'

Vauquelin's scientific research and the art of hybrid analysis

Alain Queruel, a recent biographer of Vauquelin, concluded a description of his protagonist's life with a soaring homily intended to convey the range of his remarkable scientific achievements:

> In turn chemist, pharmacist, biologist, mineralogist, doctor ..., this omniscient was surely one of the greatest scientific figures of his time.[38]

The image that this eulogy conveys to the modern reader is that of a polymath, spreading himself across a wide variety of disciplines with no single one sufficient to satisfy his inquisitive spirit. Yet this is not an accurate historical image of Vauquelin as a scientist. It is true that, with the exception of the anachronistic classification of biology, Vauquelin did work in all these areas, even as they were understood in eighteenth-century France. Indeed, we have already seen that he qualified as a medical doctor (albeit in extremis) as well as a master-pharmacist. Nevertheless, all his work, however we might categorize it today, also fell under the broad contemporary understanding of chemistry. This was a chemistry, as I have

[37] Vauquelin's letter to Chaptal in which he accepted the appointment is still preserved in the archives of the BIUP, dated 30 Vendemaire year 12.

[38] Alain Queruel, *Vauquelin et son temps (1763-1829),* Paris: Harmattan, 1994, p. 241 'Tour à tour chimiste, pharmacien, biologiste, minéralogiste, médecin...., cet omniscient est assurément un des plus grands scientifiques de son temps.'

been arguing throughout this book, that was in the process of crystallizing out into a modern scientific discipline quite distinct from its dependent arts, such as pharmacy or mineralogy to name but two. Thus, the broad disciplinary spectrum of Vauquelin's scientific activity described by Queruel is as much a trick of historical perspective as it is a reflection of his wide-ranging interests.

One of my central concerns in what follows will be the work Vauquelin carried out in pharmaceutical chemistry, or, as Fourcroy termed it, chemical pharmacy, which was particularly significant for the development of pharmacy. In fact, I want to argue here that, following Fourcroy's lead, Vauquelin helped to define what would constitute pharmaceutical chemistry for the coming generation of scientific pharmacists in France. The analytical methods these men developed brought extractive techniques, which had been passed on from a purely pharmaceutical tradition, into contact with some of the techniques – but more particularly the ultimate analytical aims – drawn from the new chemistry. The 'hybrid analysis' that resulted turned out to be crucial for the development of organic and pharmaceutical chemistry, particularly during the first third of the nineteenth century.

Looking back across Vauquelin's career in print, we see a precursor for more modern patterns of scientific publication.[39] He published only one book of his own, which originally carried neither a title nor the name of its author, a practical handbook on assaying for use by government employees in the *Bureau de Garantie.* These civil servants were responsible for checking the authenticity of currency, and so they needed a concise summary of the methods used to determine the purity of metals and alloys. This manual was republished several years later as the *Manuel de l'essayeur* this time with Vauquelin taking explicit credit as the author.[40] Ironically, considering that his first work was anonymous, the only other book published under Vauquelin's name was not written by him at all. Rather, the 1826 *Dictionary of Chemistry* had been compiled by a group of unknown chemists who used Vauquelin's name in order to add credibility to the project.[41] Unlike Lavoisier, Berthollet, Bergman, Chaptal and Fourcroy, Vauquelin never presented any systematic treatise, choosing instead to present his research piecemeal in the

[39] I take this to be a sign of the growing significance of journals rather than a conscious attempt on the part of Vauquelin to break with tradition.

[40] N. L. Vauquelin, *Manuel de l'essayeur,* Paris: Klostermann fils, 1812. The original was published in year 7 (1799/1800). The authorship of the handbook was always known, and a contemporary review in the *Annales de chimie* names Vauquelin as the author: 'Manuel de l'essayeur du cit. Vauquelin, extrait par le cit. Bouillon-Lagrange', *Annales de chimie* 30 (1799), pp. 303-311.

[41] N. L. Vauquelin, *Dictionnaire de chimie,* 1826. In fact the dictionary was compiled by Messieurs Brismontier, Le Coq and Boisduval. The English translation by Mrs Almira H. Lincoln *(Dictionary of Chemistry, containing the Principles and Modern Theories of the Science, with its applications to the Arts, Manufactures and Medicine,* New York: G. & C. H. Carvill, 1830) explains that 'their work having been submitted to the great chemist, Vauquelin, appeared under the sanction of his illustrious name' p. viii.

form of short articles. Thus, we have to turn to the rapidly expanding scientific journals in order to find the bulk of Vauquelin's published material.

Vauquelin was responsible for some three hundred articles over the course of his lifetime, not including those he published in collaboration, with Fourcroy leading the list of co-authors. His contributions were regular features in all the journals that Fourcroy founded, *La Médecine éclairée par les sciences physiques,* the *Journal de pharmacie,* and the *Annales de la muséum d'histoire naturelle,* a government-sponsored journal initiated to showcase the work of the Natural History Museum's staff. In fact Vauquelin's copy was vital for keeping these projects in production, particularly during the early stages. In this exploration of Vauquelin's work, however, I want to focus on his contributions to the *Annales de chimie,* the journal that was so central to the identity of the new chemistry in France, even as the publication moved beyond Lavoisier's direct control.

Vauquelin made his début in the pages of the *Annales* in 1790. His first article – 'The analysis of Tamarind, and reflections on some of its medicinal preparations'[42] – illustrates quite clearly the direction that chemical analysis would take in the hands of pharmacists over the succeeding half a century. It was one of very few articles in the *Annales de chimie* to deal directly with pharmacy, analysing a commonly prescribed preparation rather than just offering general observations on some frequently used inorganic compound. Furthermore, the title of Vauquelin's article suggests that the orientation of his analysis would be pharmaceutical or medical in nature. Such an approach situates him squarely within a long tradition of chemical analysis as it was understood in French pharmacy, a tradition that I already presented in Chapter 3. Vauquelin, however, did not pursue this kind of analysis, and looked instead towards the model of the new oxygen theory of chemistry to provide the goals for his chemical analysis.

The task that Vauquelin undertook was the identification of any vegetable acids present that would account for the acidic nature of the extract of tamarind used in pharmacy. At this time, just one year after the publication of Lavoisier's *Élements,* it would have been impossible to present a search for acids without expecting the reader to make some association with Lavoisier's oxygenic theory. After all, acids were central to Lavoisier's system; oxygen was one of the universal principles (along with caloric, light, nitrogen – or azote as it was known – and hydrogen) and was named oxygen precisely because of its characteristic property of generating acids. Moreover, the analysis was presented in the *Annales de chimie,* the flagship journal for Lavoisier's new chemistry.

In the end, Vauquelin concluded from his experiments that the tamarind contained citric, tartarous and malic acids, and he advised against administering the tamarind at the same time as any other medications that might react with one of these acids, in particular any preparation containing potassium or sodium salts. The conclusion did not contain any reflections concerning the medicinal essence of

[42] N. L. Vauquelin, 'Analyse du Tamarin, & Réflexions sur quelques-unes de ses Préparations médicinales', *Annales de chimie, 5* (1790), pp. 92-104.

tamarind, nor did it propose any way to enhance or improve the preparation or administration of the drug. Furthermore, Vauquelin's conclusion drew only on the unsophisticated empirical knowledge that acids were neutralized by alkaline salts. Considering the reforms that Lavoisier had brought about in chemical theory, the blandness of Vauquelin's conclusions is somewhat surprising. What's more, the basic contra-indication he supplied for the pharmacist belied the sophistication of his analytical work.

Looking ahead to the development of pharmaceutical analysis, however, the conclusion is the least interesting aspect of the article, rather, it is the analysis itself that is important, precisely because of the combination of techniques and styles that Vauquelin deployed, and their integration into a search for vegetable acids. The procedures by which Vauquelin obtained the different extracts from the tamarind were maceration and decoction in water, extractive techniques standard in pharmacy. Vauquelin first left the tamarind to soak in cold water for several hours in order to separate out the portion that would dissolve: this was the maceration. Then he treated the remainder with hot water and thus obtained a second solution: this was the decoction. He used chemical tests on these two solutions in order to determine the presence or absence of the acids he was seeking, before evaporating the water to leave himself with a set of undifferentiated residues that received suitably vague characterizations.

Thus, although the title of this paper suggested that he would be searching out a medically active principle in tamarind, Vauquelin attempted only to determine which vegetable acids accounted for the tamarind's acidity. In searching exclusively for acids, he was aligning his investigation with the analytical interests of the new chemistry in contrast to the usual aims of pharmacy, although he did employ the traditional techniques of the art. The pharmacists were not so much interested in the acidity of the material as its effect on the human body. Nevertheless, the investigation into the nature of the acidity was quite appropriate in the context of the *Annales de chimie.*

Vauquelin further reflected his attachment to Lavoisier's style of chemistry by scrupulously equating the weights of starting materials and products, recalling Lavoisier's dictum, that nothing is created or destroyed in a chemical change, a view explicitly reaffirmed for the case of vegetable analysis in his *Élements of Chemistry.*[43] To this end, Vauquelin made up the weight of the original tamarind pulp by adding the necessary amount of water to the products of analysis in order to balance his account.

Vauquelin was not, however, blindly reproducing Lavoisier's analytical technique, far from it. Lavoisier's goal in his own analyses of vegetable acids was to determine their elementary composition, wishing ultimately to confirm the view

[43] A.-L. Lavoisier, *Elements of Chemistry,* New York: Dover, 1965, pp. 130-131, 'Upon this principle the whole art of performing chemical experiments depends: We must always suppose an exact equality between the elements of the body examined and those of the products of its analysis.'

that all organic matter was made up of a few chemical elements — namely carbon, hydrogen and oxygen — in varying proportions. Vauquelin's aim, however, was not the elementary analysis that so concerned Lavoisier; instead he was looking for known chemical species that he suspected were present in the tamarind. Nevertheless, although Vauquelin never articulated his belief in the elementary constitution of the species he was seeking, as it had become a background assumption for those working within the new chemistry at this time. In contrast, Fourcroy, who learnt his chemistry before Lavoisier's explicit redefinition of what constituted an element, was concerned to make it clear how any analysis might have related to Lavoisier's elements. In light of his much more deliberate approach, it is useful to look at Fourcroy's analysis of another important medication published a year after Vauquelin's work on tamarind.

Volume 8 of the *Annales de chimie* contained the first part of Fourcroy's 'Analysis of Cinchona from Santo Domingo, to serve for the analysis of dry vegetable matter in general', with the rest following in the subsequent volume.[44] After an initial examination of cinchona's natural history, Fourcroy subjected samples of the cinchona to a series of treatments: pulverization, maceration and decoction, separating out substances according to differential solubility, this time in both water and alcohol. The extracts were subjected to chemical analysis, in an attempt to identify their constitutive acidifiable vegetable bases, from amongst those that were already known. Apart from the use of an extra solvent, this procedure was similar to that carried out in Vauquelin's analysis of tamarind, and it was quite possible that they shared the work on one or both of these analyses. Nevertheless, unlike Vauquelin, Fourcroy felt obliged to point out the compound nature of the vegetable bases he was trying to identify, repeating Lavoisier's view that they were all composed of some combination of three simple elements:

> It is well recognized today that the vegetable acids are formed from the same principles *viz* hydrogen, carbon and oxygen, & that they do not differ from each other except with respect to the proportions of these principles.[45]

Fourcroy, like Vauquelin before him, did not himself choose to pursue Lavoisier's interest in the composition of the acids any further, because he was searching for the medically active principles. In fact, he explicitly stated that 'the goal of this analysis is to discover the truly active principles of cinchona from Santo

[44] Antoine Fourcroy, 'Analyse du Quinquina de Saint-Domingue pour servir a celle des matières végétales sèches en géneral', *Annales de chimie* 8 (1791) pp. 113-183 and 9 (1791) pp. 7-29. One of the reasons for this analysis was purely economic. Fourcroy wanted to demonstrate that the Cinchona from Santo Dominga was just as good as that from Chile.

[45] Ibid., p. 158, 'Il est bien reconnu aujourd'hui que les acides végétaux, sont formés des mêmes principes, savoir d'hydrogène, de carbone & d'oxigène, & qu'ils ne diffèrent les uns des autres que par les proportions de ces principes.'

Domingo.'[46] This analytical ambition, although never directly tied to the practical issues of preparation for administering the drug, or to any discussion of appropriate dosages for prescription, had its roots in pharmacy and was itself quite foreign to Lavoisier's reductionist quest to know the elementary constitution of organic substances.

It seems, therefore, that Fourcroy was articulating his research around two quite different types of analysis aimed at achieving two separate goals, one the search for the elementary constitution of vegetable matter, the other a search for the medically active principles. In his conclusion, Fourcroy explicitly acknowledged this tension, suggesting that although the elements were the true ends of analysis, the pharmacists could not entirely reject their traditional aims in order to go in pursuit of the more elusive elementary composition of matter. Fourcroy did, however, hold up elementary analysis as a goal worth pursuing, and one to which pharmacists could actively contribute through an elaboration of traditional pharmaceutical analytical techniques:

> There is a great hope that by pursuing vegetable analysis with the attention it deserves, we shall find the means perfectly to separate the four or five principles that constitute the basis for all organized bodies.[47]

According to Fourcroy's programmatic claim, the pharmaceutical tradition of pursuing the medicinal essences through the solvent extraction of plant and animal matter could be turned to a more elevated end drawn from the new chemistry.[48] The skill of the pharmacist could thus contribute to the eventual analysis of all matter down to the new list of chemical elements presented in Lavoisier's work.[49] Nevertheless, the initial contribution of the pharmacists to this greater endeavour should be limited to isolating the intermediate components of organic matter, in particular those that were medically active. Fourcroy's tactic was, therefore, to inscribe this pharmaceutical concern within a new scientific analytical program, with its accompanying language and certain methodological priorities inherited

[46] Ibid., p. 140, 'Le but de cette analyse étant de découvrir les principes véritablement actifs du quinquina de S. Domingue

[47] Ibid., p. 170, 'II y a un grand espoir qu'en s'occupant de l'analyse végétale avec l'attention qu'elle exige, on trouvera les moyens de séparer parfaitement ces quatre ou cinq principes qui constituent la base de tous les corps organisés.' Berthollet had already determined the existence of nitrogen in animal matter.

[48] For the development of solvent extraction across the seventeenth and eighteenth centuries, see Frederic L. Holmes, 'Analysis by Fire and Solvent Extractions: The Metamorphosis of a Tradition', *Isis,* 62 (1971), pp. 129-48.

[49] Lavoisier believed organic compounds to be composed of carbon, hydrogen and oxygen, while it was Berthollet who suggested that nitrogen should be added to the list of organic elements. For a full discussion of Lavoisier's analytical work on vegetable matter, see part three of Frederic Lawrence Holmes *Lavoisier and the Chemistry of Life,* Madison: University of Wisconsin Press, 1984,291-409.

from Lavoisier. This new orientation, foreshadowed by Vauquelin's analytic work on tamarind, would give rise to a new tradition of hybrid analysis characteristic of early nineteenth-century pharmaceutical chemistry.

It should be noted that both Fourcroy and Vauquelin, following in a Lavoisian tradition, focused their analytical attention on the vegetable acids, trying to determine the presence of known acidifiable bases. In the decades that followed, the pharmacists' analytical attention would shift to precipitating salts from vegetable extracts, and the resulting salifiable bases would, in the 1820s, provide exciting discoveries for French pharmaceutical chemistry. One of the first such salifiable bases isolated by the celebrated partnership of Pierre-Joseph Pelletier (the son of Bertrand Pelletier) and Joseph-Bienaimé Caventou was strychnine. Initially, the young pharmacists named the substance *vauqueline* in honour of the 'doyen of pharmacy', but the toxic nature of this extract provided a convenient excuse for refusing the honour, and the name strychnine was adopted based on the name of the plant.[50] Soon afterwards, Pelletier and Caventou successfully extracted quinine, another salifiable base, from the same cinchona that Fourcroy had analysed some thirty years earlier.

The development of pharmaceutical analytical chemistry in the first half of the nineteenth century has a rich and fascinating history, which I do not intend to recount here.[51] The point I want to emphasize is the reorientation of pharmaceutical analytical practice towards the new chemistry. The analyses that resulted would be the key to establishing a distinct identity for scientific pharmaceutical chemistry and as such had the potential to satisfy a diverse constituency within the profession. We already saw how Delunel was looking to pharmaceutical chemistry as the proper domain of the pharmacist, although his conception of this field encompassed only the more utilitarian practices of pharmacy. It would, however, be the melding of the standard pharmaceutical quest for the medicinal essence with goals drawn from the new chemistry that would shape the pharmaceutical chemists' research work in the early part of the nineteenth-century. This is precisely the program of research exemplified by the work of Caventou and Pelletier.

To put this development into context, it is useful to compare the pharmaceutical research into the composition of animal and vegetable matter with analyses

[50] Pelletier and Caventou 'Mémoire sur un nouvel Alcali végétal *(la Strychnine)* trouvé dans la fève de Saint-Ignace, la noix vomique, etc.', *Annales de chimie et de physique,* 10 (1819), pp. 145-6, 'Nous l'avions d'abord nommée *vauqueline,* en l'honneur du célèbre chimiste qui le premier a signalé un *alcali organique;* mais nous nous somme rangés à l'avis de MM. les commissaires de l'Académie, qui ont pensé *qu 'un nom chéri ne pouvait étre appliqué a un principe malfaisant.'* For a detailed analysis of the isolation and naming of strychnine, see J. Simon, 'Naming and Toxicity: a history of strychnine', *Studies in History and Philosophy of the Biological and Medical Sciences,* 30C (1999): 505-525.

[51] A recent thesis deals with precisely this history in the first half of the nineteenth century. Sacha Tomic, *Pratiques et enjeux de l'analyse chimique des végétaux : étude d culture hybride (1790-1835),* PhD Thesis, University of Paris X, 2003.

performed by Thenard and Gay-Lussac under the auspices of the Society of Arcueil. These men collaborated on a number of destructive elementary analyses of organic compounds using potassium chlorate to oxidize the compounds in place of Lavoisier's method of combustion in oxygen. Employing this new technique, they were able to classify different vegetable matter in terms of their relative proportions of oxygen and hydrogen.[52] The technique of analysis using oxidizing agents was later simplified by Liebig and Wohler allowing the wealth of elementary analyses that were so important in the development of organic chemistry.[53]

Although his pioneering analysis of medicinal plant-material was very important for the integration of Lavoisian philosophical chemistry into pharmacy, it was not typical of Vauquelin's work in the *Annales de chimie.* In fact, his analyses of vegetable matter were relatively rare, and the volume of his publications in the mineral kingdom easily equalled that of his vegetable and animal analyses combined. It is not, therefore, inappropriate that he is better remembered for his discovery of Chromium than for his analysis of tamarind. He contributed articles to the *Annales* on meteorites (or aerolites), naturally occurring minerals, and chemical manufacture, as well as many investigations into animal matter, often undertaken in partnership with Fourcroy. In particular, these two collaborated on a series of analyses of various human excretions; tears and nasal humours, urine, and an extensive study of gall stones collected from all over France.

When Vauquelin repeated Fourcroy's chemical examination of the brain in order to earn his medical degree in 1811, he also marked a return to the Lavoisian goal of elementary analysis. In his dissertation, Vauquelin reported the presence of phosphorous in the human brain, adding another Lavoisian element to the ultimate composition of organic matter. This discovery represents the ideal tribute to his lifelong mentor, colleague and friend, for it was Fourcroy who had expressly advocated the mobilization of the pharmaceutical tradition in advancing the cause of Lavoisier's elementary analysis of organic matter. It is, therefore, quite appropriate that his favourite student should have aided in elucidating the ultimate elementary constitution of the brain. All the same, the question we are left with is how to assess such a diverse body of work as that supplied by Vauquelin. Although, as I said, it can all be counted under the most general understanding of chemistry, it was not confined to the areas that were favoured by Lavoisier's new chemistry.

In his memoirs, the famous English chemist Sir Humphry Davy provides us with a series of vignettes describing all the prominent scientists he had come across during his own life in science. Among these verbal portraits, there is, quite naturally, one of Vauquelin:

[52] Joseph-Louis Gay-Lussac and Louis-Jacques Thenard, 'Sur l'analyse végétale et animale', *Journal de physique,* 70 (1810): 257-266. In this same year, Gay-Lussac succeeded Fourcroy as chemistry professor at the *École Polytechnique.*

[53] For about the development of organic chemistry, see Henry Marshall Leicester, *Development of biochemical concepts from ancient to modern times,* Cambridge, MA: Harvard University Press, 1974.

> *Vauquelin* was in the decline of life when I first saw him in 1813, – a man who gave me the idea of the French chemists of another age; belonging rather to the pharmaceutical laboratory than to the philosophical one.[54]

This assessment provides a sharp contrast to that of the accomplished modern scientist Queruel wants to convey. Nevertheless, neither has quite captured Vauquelin, Queruel because he cannot see how Vauquelin still belonged in part to a pharmaceutical laboratory tradition, and Davy because he did not have the prescience to recognize how important the organic analyses that Fourcroy and Vauquelin had pioneered would turn out to be. Davy saw Vauquelin as a traditional pharmacist, while Queruel sees him as a modern chemist. In fact, Vauquelin's hybrid identity reflected that of his research. He refused to choose between the increasingly distinct identities of the scientific chemist and the professional pharmacist, the philosophical and pharmaceutical laboratories, as Davy put it. He was a pharmacist by trade, but continued to exhibit a strong orientation towards Lavoisier's new chemistry in his research. This, I want to claim, is the model that would be imitated by several generations of new pharmacists in France.

Nor was Vauquelin's attachment to the new chemistry confined to his experimental work. Despite the difficulties he apparently faced in developing an effective style for the lecture hall, he never abandoned his teaching positions. Indeed, beyond administering the newly-founded *tcole de Pharmacie de Paris,* he also taught at this elite school. The year after the school was founded, Bouillon-Lagrange, another of Fourcroy's disciples taught chemistry, and starting in the summer of 1804, Vauquelin assumed responsibility for this course.

Teaching at the *Ecole de Pharmacie*

Bouillon-Lagrange gave the first lesson of his chemistry course on 21 Germinal, year 12 (11 March 1804).[55] In the introduction, he offered the student pharmacists a pithy definition of chemistry and then proceeded to list the eight branches of this science. First came 'natural philosophical chemistry' *(la chimie philosophique naturelle),* the master-discipline, while pharmaceutical chemistry, the most relevant subject for his audience, came only sixth in this clearly hierarchical order. The list itself, like much of the course was taken directly from Fourcroy's ten-volume chemistry text, *Systême des connaissances chimiques (General System of Chemical Knowledge),* which had been published four years earlier.[56] Here, the branches of

[54] John Davy (ed.), *The Collected Works of Sir Humphry Davy Vol I: Memoirs of His Life,* London: Smith, Elder & Co., 1839, p. 166.

[55] The notes from this course, taken by a student called Moutillard, are held in the archives of the BIUP, MS 26.

[56] The full title is *Systeme des connaissances chimiques, et de leurs applications aux phenomenes de la nature et de 1 'art*

chemistry were presented in exactly the same order, along with Fourcroy's unambiguous claim that *'chemical philosophy* precedes and dominates all the others.'[57] Following Fourcroy's lead, Bouillon-Lagrange used his chemistry course to introduce the pharmacy students to precisely this chemical philosophy as it had been systematized in Lavoisier's new chemistry. For example, the first lessons dealt with light, caloric, oxygen, azote (nitrogen) and hydrogen, the five universal elements that head the systematic order of elements in Lavoisier's *Élements of Chemistry*.

The next chemistry course at the School of Pharmacy was taught by its director, Vauquelin. This course, comprising around ninety lessons offered between 2 Frimaire (23 November 1804) and 11 Prairial of year 13 (31 May 1805), was very similar to Bouillon-Lagrange's. Vauquelin introduced the student pharmacist to philosophical chemistry over the course of six months. He ran through the elements and their reactions, taking two-thirds of the course to cover the mineral kingdom. In Lesson 61, Vauquelin used mineral waters to make the transition from the mineral into the vegetable kingdom, and only the final ten lessons were on the subject of animal matter. This course was about chemistry, understood as the new chemistry, and was not going to teach the student how to prepare the medicines that they would find in the pharmacopoeia. Students were being taught the value of chemistry as a science, the only science that could inform and justify a respectable discipline of pharmacy.

This orientation towards an independent discipline of chemistry extended to include the research projects of the pharmacists associated with the school as well. Rather than considering chemistry to be constituted by the more or less unreflective practices of pharmacists, the new pharmacists accepted what was essentially Lavoisier's implicit conception of chemistry as an independent master-discipline. Indeed, the next generation of elite pharmacists was learning this reverent attitude to the new chemistry in the amphitheatre of the Paris School of Pharmacy. These pharmaceutical chemists – who would earn considerable scientific prestige for the discipline – were the fruits of Fourcroy's labour, educated in the new chemistry by his protégés, while attending a school set up by his legislation. Pierre-Joseph Pelletier, the co-discoverer of quinine, for example, graduated from the school in 1810.

The *Bulletin de pharmacie*

No enterprise represents the new pharmacy in France better than the *Bulletin de pharmacie,* the pharmacists' own journal. Indeed, I began the second chapter with a letter written by the *Bulletin's* editors denouncing the members of the Paris Society of Pharmacists for not aligning themselves with the new chemistry and I want to

[57] Antoine-François Fourcroy, *Systême de connaissances chimiques.* Paris: Baudouin, 1800. p. 6, 'La *chimie philosophique* précède et domine toutes les autres.'

close the present chapter with an examination of the journal that prompted this attack. On 20 September 1808 (the traditional pre-revolutionary calendar was restored by Napoleon in 1806), a group of like-minded pharmacists formed the Bulletin of Pharmacy Society. These were the same men who signed their names to the letter cited at the beginning of Chapter 2: Jean-Antoine-Augustin Parmentier, Charles-Louis Cadet de Gassicourt, Louis-Antoine Planche, Pierre-François-Guillaume Boullay, Jean-Pierre Boudet and Pierre-Regnaud Destouches, All these men were qualified pharmacists and members of the Paris Society of Pharmacy, the body to which they addressed their letter of complaint. Thus, the *Bulletin de pharmacie is* the first scientific journal in France published by pharmacists for their own professional community. Prior to this, the only such publication for pharmacists had been undertaken by Fourcroy, who, once again, was not himself a pharmacist.

It seems that enthusiasm ran high among members of this new society as they prepared to embark on what was to prove a remarkably successful publishing venture. Emile Bourquelot reports that Cadet de Gassicourt literally sang the praises of the new journal at a dinner hosted by Vauquelin.[58] Indeed, both Vauquelin and Parmentier supported the *Bulletin* from the outset, although while Parmentier headed the original society of editors, Vauquelin did not join the editorial board until 1818. Vauquelin's fellow teacher at the School of Pharmacy, Bouillon-Lagrange, joined the editors of the journal one year before Vauquelin, when the publication had already changed name to become the *Journal de pharmacie et des sciences accessoires.* The journal bore this title for 26 years, from 1815 to 1841, until it was once again renamed in 1842. Here, we can see the developing disciplinary dependence of pharmacy reflected in the new mid-century title, *Journal de pharmacie et de chimie.*[59]

The first 48-page issue of the *Bulletin de pharmacie* was dated January 1809, and issues followed every month, giving a first volume of 576 pages for that year, complemented by a comprehensive 10-page index. Of course, the obvious comparison that suggests itself is between this new publication venture and Fourcroy's *Journal de pharmacie* published a decade earlier. Indeed, although the

[58] Émile Bourquelot, *Le Centenaire du journal de pharmacie et de chimie 1809-1909. Histoire du journal et notices biographiques par Emile Bourquelot avec 32 portraits,* Paris: Octave Doin et Fils, 1910, p. 4. Cadet de Gassicourt was a fairly well known poet, and even composed a eulogy set to music in honour of Marat and Pelletier, which he delivered at an unveiling of their busts (See document 645.a.41 (2) at the *Bibliothèque Nationale de France).*

[59] Parmentier was very attached to the original title of the journal, perhaps favouring the informality conveyed by the word *bulletin,* and when there was a suggestion that the journal should be renamed *Journal de pharmacie et des sciences accessoires* starting from 1814, the compromise of *Bulletin de pharmacie et des sciences accessoires* was adopted. Parmentier died at the end of 1813, and so this interim name – although a strangely appropriate hybrid itself – only lasted for one year.

content of the two journals differed in certain respects, overall they were remarkably similar. One striking similarity that arises from the comparison of the first volumes of each journal (year VI (1797/1798) for the *Journal* and 1809 for the *Bulletin)* is that by far the largest number of articles in both journals fell under the heading of chemistry.[60] Further, the editors were responsible for the majority of the material in the form of original contributions, translations and reports on others scientists' research. Still, this shared characteristic gave the *Bulletin* an advantage in terms of diversity, as it boasted six editors in its first year compared to the *Journal's* three. The *Bulletin,* like Fourcroy's journal before it, supplemented the editors' work with articles written by doctors and pharmacists from every part of France. Starting in the fourth issue, however, the editors of the *Bulletin* further emphasized the importance of the readers' contributions by the inclusion of a correspondence section. Pharmacists' letters came in with observations from all over Napoleon's expanding empire. Indeed, Cadet de Gassicourt was a regular correspondent as he followed the French army across Europe in his capacity as Napoleon's pharmacist.

This effort to include pharmacists from all over France in the *Bulletin* served to complement the make-up of the editorial board that was very much Paris-centred. As I mentioned before, all the editors were qualified pharmacists and members of the Paris Society of Pharmacists, despite their threats of resignation. They also shared a commitment to the new pharmacy, understanding it as a scientific discipline oriented towards the new chemistry. Despite their scientific inclinations, they were careful from the outset to include a relatively high proportion of articles that specifically addressed everyday pharmaceutical operations, an area of obvious utility to the practicing pharmacist and a field in which Fourcroy's journal had lacked material. There were several categories in the *Bulletin's* index that had not featured in the *Journal.* First, a small but significant number of articles were placed under the descriptive heading of practical pharmacy, and one, entitled 'miscellaneous – recipes',[61] encompassing various preparations, mineral and vegetable, including an anti-syphilitic conserve, and a remedy for cancer of the lips. Others covered such areas as secret remedies, and legislation directly affecting the pharmacist (although there was only one article under this heading). One mistake that Fourcroy had made and that the editors of the *Bulletin* did not want to repeat consisted in trying to transform the pharmacist into a philosophical chemist without taking his professional interests into consideration. This goal had been pursued rather too zealously by the *Journal,* as even Fourcroy had to admit when he relaunched it in 1799. The pharmacist did not need philosophical chemistry in order to make a living, and hence neither the *Journal de pharmacie* nor the *Annales de chimie* were indispensable. In fact, the pharmacist could have managed quite

[60] Although these articles were grouped together under *Chimie* in the index, they were sometimes given the heading *Arts Chimiques* or *Chimie Pharmaceutique* in the text of the *Bulletin.*

[61] vari étés — recettes'.

well without the *Bulletin de pharmacie,* but one of the things that enabled this particular journal to succeed was the fact that it did not limit itself to satisfying the philosophical, scientific interests of the pharmacist but also addressed the needs associated with his professional life. This is not to say that chemistry was absent from the *Bulletin,* the science was still a dominant theme. For, although not as aggressive as Fourcroy's attempt, the *Bulletin* was clearly a tool for proselytizing. As should be expected, the editors did, for the most part, insist on the new nomenclature (now twenty years old) for chemicals from the mineral kingdom and they also subscribed to pharmacy's subordination to chemistry, but they did not thereby disregard the recipes and routine preparations that were of vital practical importance to the professional pharmacist.

Nevertheless, if we are trying to understand why the *Journal de pharmacie* failed while the *Bulletin de pharmacie* survived, the most important single factor was probably the respective timing of their launches. The *Bulletin* was based on two different foundations which had not been solidly established when Fourcroy undertook essentially the same enterprise. First, there was the institutional stability of pharmacy introduced by the law of Germinal. Starting in 1803, pharmacy had been operating under a new system of administration in France, one that cast elite pharmacists in the role of civil servants, and put all their fellow professionals under state control. This provided an institutional base that could only reinforce the pharmacists' sense of security. Second, there was the establishment of the new chemistry as a high science independent of pharmacy. The new discipline was by this time supplying its own new breed of professional chemists who began to squeeze the pharmacists out of the elite posts associated with chemistry, both in teaching establishments and in the prestigious *Institut.*

If I am correct in my reasoning concerning the crucial role that the timing of the *Bulletin's* launch played in its enduring success, then it signals another irony. Indeed, it seems that the pharmacists profited from Fourcroy's new regulation of pharmacy in order to succeed where Fourcroy's own publishing venture had failed.

More importantly, however, the difference between the revolutionary and post-revolutionary contexts allows us to reassess what might be considered revolutionary about the chemical revolution beyond a change of theoretical commitment from Stahl's phlogiston theory to Lavoisier's oxygen theory. The group that was promoted above the pharmacists (Fourcroy, Berthollet and Guyton de Morveau were the ones who survived the Terror) constituted a new category of scientists born both out of the change in chemical theory, and changes in French society. These changes were not only reflected in the institutional reform of pharmacy, but also represent the culmination of the gradual social ascent of chemistry in France across the eighteenth century. The *Bulletin* is a clear historical indicator of the post-revolutionary relationship between chemistry and pharmacy, as they set out on different, although interconnected paths through the nineteenth century. Indeed, it is in this journal that we find pharmacists reflecting for the first time on the divergent paths that chemistry and pharmacy were taking. Demachy's bold statement thirty

years previously that chemistry was pharmacy's fate now had to be radically reinterpreted in terms of both a new chemistry and a new pharmacy.

Cadet de Gassicourt's conclusions

One of the headings in the index of the *Bulletin de pharmacie* was 'Pharmacology,' a term introduced to cover efforts aimed at systematizing pharmacy and thereby rendering it more scientific. Several reflections on the current state of pharmacy in Europe were gathered together under this broad heading, and it was here that the editors classified the opening article of the very first issue of the *Bulletin de pharmacie.* In this piece, Charles-Louis Cadet de Gassicourt presented an incisive summary of contemporary French pharmacy, one that reviewed and assessed the importance of the major developments in the field across the French Revolution. This eight-page statement, entitled 'Reflections on the present state of pharmacy'[62] provides the perfect vehicle for summing up the outcome of pharmacy's realignment with chemistry during this period.

Cadet de Gassicourt's article was divided into two sections, the first treating the science of pharmacy, in particular its relationship to chemistry and medicine, and the second the business of pharmacy and its institutional administration. Although it is his reflections concerning the place of chemistry in pharmacy that are of particular interest for the argument that I have presented in this book, Cadet de Gassicourt's comments on the commercial side of pharmacy supply a useful reminder of the importance these mundane professional concerns held for the practicing pharmacist. Furthermore, as I argued above, it was the editors' sensitivity to such professional matters that provided the bridge between the compelling practical interests of the pharmacist and the scientifically informed pharmacy that the *Bulletin* was trying to promote.

Employing a quite standard trope, Cadet de Gassicourt opened his considerations with a historical review, briefly stating how pharmacy had arrived at its present state. He recalled the time, prior to the rise of an independent chemistry, when the chemists were still by and large pharmacists:

> Before the natural and physical Sciences submitted themselves to the analytic method that today renders their study easy and their progress rapid, before they each had a particular domain and delimited borders, they were all mixed up together in pharmacy. There were neither Chemists nor Naturalists, only Pharmacists, or Doctors who occupied themselves with pharmacy.[63]

Cadet de Gassicourt was here reiterating a theme we have already encountered: the idea that pharmacy was the root of chemistry. The authority he cited in his favour

[62] C.-L. Cadet de Gassicourt, 'Considérations sur l'étât actuel de la pharmacie', *Bulletin de pharmacie,* 1 (1809): 5-12.

[63] Ibid., p.5.

was, of course, Fourcroy, the semi-official historian of modern French chemistry. With the arrival of pneumatic chemistry the science had definitively separated from pharmacy. Interestingly, it was precisely this moment, the introduction of the chemistry of the airs, that Fourcroy dubbed the chemical revolution in his *General System of Chemical Knowledge* of 1800. Moreover, when he proceeded to describe the new science of chemistry taking flight, Cadet de Gassicourt employed the same metaphor that had featured so prominently in Fourcroy's speech to the pharmacists just over a decade earlier. Where Fourcroy had held out the hope of redemption for pharmacy through its acceptance of chemistry, Cadet de Gassicourt now chose to name those pharmacists (most of whom were still alive) who had accepted this challenge. These included most of the pharmacists who were involved in founding the *Bulletin de pharmacie,* although Cadet de Gassicourt modestly omitted his own from the list.

> *Bayen, Pelletier, Vauquelin, Parmentier, Deyeux* and *Proust* have exerted themselves in order to ensure that through their dedicated work and inspired research Chemistry would never have to blush at its origins.[64]

This optimistic note was immediately negated by the sentence that followed, which pointed to the unfortunate situation in which pharmacists now found themselves. As he turned his attention to what he saw as the most shameful aspect of contemporary pharmacy, Cadet de Gassicourt echoed the words of the letter to the Paris society of pharmacists:

> Nevertheless, it must be acknowledged that today the line of demarcation is so distinct that for many people Pharmacy is nothing but more or less adept manipulation, which can be regarded as independent of the Sciences that illuminate it.[65]

Beyond calling to mind the letter composed by the *Bulletin's* editors, Cadet de Gassicourt's admission of the low esteem pharmacy enjoyed at this moment should remind us of the proclamations of two medical doctors we have already encountered. Over fifty years earlier, Venel had complained in the *Encyclopédie* that people were still confusing chemistry with pharmacy, a conception that Cadet de Gassicourt was suggesting had now been reversed. People not only knew what chemistry was, but also knew that pharmacy was no longer ranged alongside this science. A little over a decade before the first issue of the *Bulletin,* Fourcroy had also used this image of one discipline illuminating the other, but according to his metaphor, pharmacy had illuminated chemistry with the fire of its furnaces and could potentially do so again. Cadet de Gassicourt was not in a position to repeat this suggestion here; pharmacy had to be satisfied to bask in the reflected glory of chemistry.

[64] Ibid., p. 7.
[65] Mein

The final sentences reaffirm this acceptance of the new place of pharmacy as chemistry's institutional inferior. While admitting that the *Annales de chimie* did publish articles on pharmacy, Cadet de Gassicourt claimed that most pharmacists would feel out of place submitting their own work to the *Annales* to be presented side by side with that of the true, that is to say, the philosophical chemists.

> [T]hey would be afraid of looking ridiculous, talking about the modifications of an electuary or an unguent in the same pages where the great questions of the decomposition of alkalis, of the equilibrium of affinities, of the formation of aerolites etc are dealt with.[66]

Cadet de Gassicourt, it seems, has accepted that pharmacists no longer had any significant control over the destiny of chemistry. Although he presented this image of the pharmacist as a spectator, left on the sidelines of scientific progress, Cadet de Gassicourt also offered the consolation of pharmaceutical chemistry. This niche, within a larger science of chemistry, would provide a legitimate role for the pharmacist in the grander philosophical enterprise of nineteenth-century science:

> Even if there are some Pharmacists, and even a few doctors who entertain themselves with the study of these abstract discussions, the greater part desires to remain in the sphere that is granted to them, to occupy themselves in extending it by means of purely pharmaceutical work, without thereby being strangers to the progress of the natural Sciences.[67]

Despite the successes that pharmaceutical chemistry would enjoy in the decades that followed, this constituency of scientific pharmacists was not a large enough market to support a journal. Understanding the diversity of their potential market, the editors changed Fourcroy's proselytizing zeal into an invitation to pharmacists to interest themselves in the sciences, chemistry in particular, while maintaining the flow of purely practical information. This change in approach reflected not only a healthy pragmatism, but also an acceptance of the new place of pharmacy as chemistry's institutional inferior. A decade into the nineteenth century, pharmacists were obliged to accept that chemistry no longer formed a part of their demesne.

[66] Ibid., p. 13.
[67] Idem.

Chapter 6

Conclusion

The Pharmaceutical Revolution

The central argument of this book has been that chemistry, formerly considered an integral part of pharmacy, grew away from its attachment to medical applications during the course of the seventeenth and eighteenth centuries. This movement culminated in a definitive split between the disciplines of pharmacy and chemistry at the end of the eighteenth century that should be considered a constitutive part of the event known as the chemical revolution. Furthermore, this social, institutional and intellectual redefinition of both pharmacy and chemistry depended to a large extent on the upheavals of the French Revolution. In the course of the nineteenth century, French pharmacy and chemistry would reconstitute themselves around their own specific, although overlapping professional occupations and scientific practices. The history that follows this one would describe how further disciplinary subdivisions marked the development of both chemistry and pharmacy, the differentiation between organic and inorganic chemistry being one of the most noteworthy.[1] It would not only have to recount the evolution of both disciplines within the modern university system, however, but also the rise of both the chemical and the pharmaceutical industries in the nineteenth and twentieth centuries. The transformation of both pharmacy and chemistry from local artisanal practice to large-scale industry is one of the major developments in the making of the modern world.

Pharmacy was an indispensable element in this history. But how does the recognition of this fact ameliorate or simply change our vision of the history of chemistry? Looking from the point of view of pharmacy opens our eyes to peculiarities in the development of chemistry that could otherwise appear to be the inevitable accompaniment of a predestined course of scientific progress. Why did post-Lavoisian chemistry focus on what we would term 'inorganic' and 'physical' chemistry, leaving a certain tradition of 'organic' chemistry to one side? Arthur Donovan has argued for an interpretation in terms of the alignment of chemistry

[1] Alan J. Rocke, *Quiet revolution: Hermann Kolbe and the science of organic chemistry,* Berkeley: Univ. California Press, 1993. Ursula Klein also talks about the importance of pharmacy as an influence on nineteenth-century organic chemistry; U. Klein, *Experiments, models, paper tools: cultures of organic chemistry in the nineteenth century,* Stanford, CA: Stanford University Press, 2003.

with experimental physics.[2] This is no doubt part of the explanation, one that works well for the experimental investigation of heat, for example, as a model of Lavoisian science. Nevertheless, to understand the overall form of the emerging discipline of chemistry we need to identify the areas and traditions that chemists wanted to eliminate from their discipline, not only those that they wanted to emulate. Here, I have looked at the evolution of the relationship between chemistry and pharmacy, but there are equally interesting histories to be told about mineralogy, dyeing and other areas of what we would now consider applied chemistry.

The historian of science who takes an interest in this area cannot help but be struck by how underdeveloped the history of pharmacy is when compared to the history of chemistry (itself not the most highly developed branch of the history of science). One of the reasons for this historical imbalance is that it has never been clear exactly how the history of pharmacy should be written. Is it the history of the development of a science, in which the entry into maturity needs to be located at the earliest in the nineteenth century, if not solidly in the twentieth? Should the historian be searching for dominant paradigms driving pharmaceutical research? Or is it more appropriate to try to write an industrial history, or must the history of pharmacy inevitably be a social one that concentrates on pharmacy's guild structure and the interminable struggle to establish professional privilege and monopoly? We might pose this same question differently, asking who was the pharmacist's most important partner or competitor; the grocer, the chemist, or the physician?

What would be the result of including the history of pharmacy as an integral part of the history of science? Does it have a place in the scientific revolution? More pertinently, was there a pharmaceutical revolution that set pharmacy on the path of its modern scientific development? If we choose to understand the pharmaceutical revolution as broadly as the interpretation of the chemical revolution that I have been arguing for here, it makes sense to claim that France experienced a pharmaceutical revolution at the beginning of the nineteenth century, and that its contours are laid out in the two chapters that preceded this one. The isolation of a series of alkaloids — most famously quinine — by Pelletier and Caventou and the attempts to characterize them in terms of their elementary constitution is only the most visible sign of a transformation in pharmacy and a reformed vision of the pharmacopoeia. Although still empirical to a large degree (and despite all the talk of drugs designed by computer, pharmaceutical innovation remains largely empirical even today) pharmacy increasingly aimed to characterize the nature and action of drugs in terms of chemistry. The alignment of pharmacy with chemistry rather than the alternative of natural history is worth noting in this context. After all, natural history, in particular botany continued to dominate the education of the pharmacist, as one of the pharmacist's principal occupations was identifying and collecting plants in order to concoct the vegetable preparations that

[2] Arthur Donovan, *Antoine Lavoisier: Science, Administration and Revolution,* Oxford: Blackwell, 1993.

filled the pharmacopoeia. Indeed, the early pharmaceutical industry would concentrate on just such vegetable preparations, and the nineteenth century saw several small businesses develop around the combination of vegetable extracts in popular patent medicines, and the scaling up of their production.[3] Thus, while botany and the cultivation of plants as raw materials would remain a major part of modern pharmacy right up until the middle of the twentieth century, pharmacists nevertheless sought to define the scientific profile of their discipline in terms of chemistry.

One thing is clear, that the history of pharmacy as it exists today does not resemble the histories of the other sciences – mathematics, physics, chemistry, and biology – that form the standard against which such history is judged. In general there is more emphasis placed on the economic and institutional social aspects (guild structure, legislation, etc.) of pharmacy, with less on pure history of ideas. Indeed, the closest that historians of pharmacy come to this genre is the history of the discovery of medicines, which tends to be written as a series of happy accidents rather than the logical evolution of a series of ever more adequate theories of pharmacology and biochemistry.[4] Nevertheless, the history of science has changed over the course of the last thirty years. Following the development of 'science and technology studies' inspired by a critical turn in the philosophy and sociology of sciences in the 1970s, history of science has itself abandoned a certain positivist approach that involved unveiling the long march of science towards the truth. Furthermore, those working in the wider field of science studies have become increasingly interested in areas outside 'pure' theoretical science; the interface between science and society, the dependence of science on instrumentation or choices of experimental models.[5] In this increasingly hybrid world of science studies, PCR and BSE have become just as interesting topics for research as the discovery of the structure of DNA or Einstein's general theory of relativity. Pharmacy is an excellent example of this kind of hybridity, constantly blending science with commerce; it is, after all one of the major modern science-based industries and defines its research agenda as much in terms of social or economic considerations as scientific ones.[6] Thus, we can expect much interesting research to

[3] For an example of one such early industry based on patent medicines and vegetable extracts, see Michèle Ruffat, *175 ans d'industrie pharmaceutique française: Histoire de Synthélabo,* Paris: La Découverte, 1996.

[4] See, for example, François Chast, *Histoire contemporaine des médicaments,* Paris: La Découverte, 1995.

[5] For a general introduction to these themes see Mario Biagioli (ed.) *The Science Studies Reader,* New York: Routledge, 1999, and for more on experimental systems, Hans-Jôrg Rheinberger *Toward a History of Epistemic Things: Synthesizing Proteins in the Test Tube,* Stanford: Stanford University Press, 1997.

[6] The various 'orphan drug' programs are based on the premiss that no pharmaceutical laboratory would spontaneously try to develop a drug for a disease that affects only a few people.

come out of the study of pharmacy over the next few decades. History should not be left aside in this movement, as understanding the historical trajectory that has brought pharmacy to where it is today will help in the analysis of both its present form and its future orientation. The conclusion that it is important to develop the history of pharmacy does not, however, answer the question of what form this history should take.

Here, I want to propose two guiding principles for the history of pharmacy, one of a general methodological type, the other much more specific. The first is based on the argument I have been making in this book, and it is the idea of an inclusive history of pharmacy that integrates social, institutional, practical, experimental and theoretical analyses. The second one points to what is missing from the present study, and that is the need for comparative studies. Such comparative studies between different national contexts promise to reveal much about the development of pharmacy. Thus, in Britain, where the situation of the pharmacist was much less formalized than in France, there was apparently no concerted effort for the kinds of reform that we see in France at the end of the eighteenth century. Indeed, the schism in nineteenth-century British pharmacy was between those who remained apothecaries and those who became physicians. There is much to learn from the difference in the trajectory of French pharmacy when compared to other countries. One of the questions that arise out of such comparisons concerns the forces that pushed towards a relative uniformity in pharmaceutical education and practice across the industrial world in the twentieth century. No doubt a large part of the answer is linked to the development of a supranational pharmaceutical industry and the increasing uniformity of medical diagnosis and prescription during this period. Thus, comparisons between France, Britain, Germany, and other European and non-European country will greatly enrich our understanding of the history and present state of pharmacy.

Coincidences and history

Much of what I have presented in this history of social and scientific revolutions depends on historical coincidence in the most neutral sense of the term. Had Fourcroy never met Lavoisier, it is unlikely that he would have been such a fervent disciple of the new chemistry. In this case, who, if anyone, would have taken on the task of informing the pharmacists about the new chemistry and eventually reshaping the pharmaceutical community under the Republic? Without Vauquelin and the new School of Pharmacy in its post-revolutionary form, would there have been a Pelletier and Caventou? Evidently, I am not posing these counterfactual questions in the hope of receiving definitive answers; rather the point is to reflect on the difference between the unavoidable and the accidental in the evolution of both pharmacy and chemistry during this period. Like the 'nature versus nurture' debate, this question of the accidental versus the inevitable in the history of science will never be closed, but this does not mean that it is pointless to rehearse it once again.

I propose to do so by looking at the extreme positions on either side, and seeing what the present historical study can add to this debate.

One vision of the history of science (inspired by positivist philosophy of science) has been one of its inexorable evolution towards an ever more correct (adequate) version of the world. This version of history is about the removal of obstacles that block the preordained march of successive generations of scientists towards the truth about the world. Thus, to give a classic example, Galileo and Descartes removed the obstacle constituted by the Aristotelian idea that the natural state of a body was rest, allowing the substantially correct notion of momentum to be characterized in the course of the 17th century. According to this point of view, accidents of history can deflect the progress of science, but due to its very nature, science will ultimately arrive at a transcendent truth about the world. Although the details of this history may be largely about individual scientists, their thoughts and their publications, in the master-narrative the accidental plays a secondary role to the inevitable, as it is a story of the identification of errors and the formulation of increasingly true theories of the world. The opposite approach that emphasizes the accidental has been much defended in theory, but little practiced in detail, and consists in arguing that the content of science reflects the social relations and context in which the scientists find themselves, rather than any super-social truth about the world. In this version of the history of science – in general associated with the 'strong programme' of the Edinburgh school in the 1970s – the accidental assumes greater importance as the development of science does not have any transcendent directing principle. At any moment, science is the sum of its accidental incorporations in the instruments, personnel and institutions that comprise its many disciplines.

The history I have presented here, like most histories, offers a vision of a scientific revolution somewhere that lies in between these extremes, although biased towards emphasizing the role of social and institutional relations in determining the form and approach of the science and scientists in question. In this story, accidents of history have become crucial factors. I have stressed the importance of the coincidence of the French Revolution as a force for radical social reform with Lavoisier's own innovative vision of chemistry presented in his *Élements of Chemistry* of 1789. Without the opportunities presented by the social transformation of France at the end of the eighteenth century, the new theory of chemistry would not have been diffused as rapidly. Its uptake depended greatly on elite schools such as the *École Polytechnique* and the *École de Pharmacie* that, as reformed republican institutions, offered the unusual possibility of introducing a radically new curriculum. This type of rupture is particularly rare in state-run education systems, and, in my opinion, it is not an overstatement to qualify it as a revolution.

What about the importance of individual actors in this story? I have already suggested how central Fourcroy was to the reforms that took place in pharmacy, and I have also tried to show that had a pharmacist developed the new chemistry instead of Lavoisier, it would almost certainly have looked very different. The role

of these individual scientists leads to a paradoxical historical situation. The movement of the strong programme and its successors aimed to play down the role of great individual scientists in the history of science. No longer would this history be the saga of a series of the 'great men' who progressively discovered the truth about the world, but would reintroduce the 'invisible' actors; the laboratory technicians, teachers, propagandists, and all those neglected men and women who have collectively made science. Nevertheless, when the accidental contingencies of history are seen to assume a more important role in determining the form (or even the content) of modern science, the influence of individuals likewise becomes more important. If it is the scientists who *make* science rather than struggling to reveal the truth about the world (a job for which in principle any two equally gifted scientists would be interchangeable), then exceptional individual scientists such as Lavoisier have greater scope for influencing the nature of science itself. As I hope is clear from the present work, I am convinced of the importance of Lavoisier's thought in shaping the nineteenth-century discipline of chemistry, as well as the influence of Fourcroy and Vauquelin in shaping French pharmacy in the same period. One area where Lavoisier's influence is profound and durable is in the understanding of chemical analysis. Elementary analysis is so well established as a fundamental notion in modern chemistry it is hard to imagine that such an approach might not have held any great interest for a practicing pharmacist at the beginning of the nineteenth century.[7]

Finally, I believe that the attempt to integrate the history of chemistry with the history of pharmacy comes at a propitious time. It looks as though interest in the former is on the decline while the latter is attracting increasing attention. What's more, as I have explained, there is a rich tradition of intellectual history in chemistry, and more social and economic history associated with pharmacy. Bringing these two fields together will offer a cross-fertilization of work that stands to benefit both areas over the long term. Such cross-fertilization must inevitably engender future generations of hybrids with a great potential for innovative and enlightening research.

[7] For a more detailed discussion of this point, see Jonathan Simon, 'Analysis and the Hierarchy of Nature in Eighteenth-Century Chemistry', *British Journal for the History of Science,* 35 (2002): 1-16.

Bibliography

Albury, William Randall, 'The Logic of Condillac and the Structure of French Chemical and Biological Theory, 1780-1801', Diss. Johns Hopkins University, 1972.

Anderson, Benedict, *Imagined Communities: reflections on the origin and spread of nationalism,* New York: Verso, 1991 (revised and extended edn).

Anderson, Wilda, *Between the Library and the Laboratory,* Baltimore MD: Johns Hopkins University Press, 1984.

André-Pontier, L., *Histoire de la pharmacie,* Paris: Octave Doin, 1900.

Beauchamp, Alfred de, *Médecine et pharmacie, projets de lois,* Paris: Imprimerie Nationale, 1888.

Bedel, Charles and Pierre Huard, *Médecine et pharmacie au XVIIIe siècle,* Paris: Hermann, 1986.

Belhoste, Bruno, Claudette Balpe and Thierry Laporte (eds), *Les Sciences dans l'enseignement secondaire francais,* Paris: Institut national de recherche pèdagogique, 1995.

Bensaude-Vincent, Bernadette, 'A Founder Myth in the History of Sciences? – The Lavoisier Case', in Loren Graham, Wolf Lepenies, and Peter Weingart (eds), *Functions and Uses of Disciplinary Histories,* 1983, 53-78.

___, *Lavoisier: mémoires d 'une révolution,* Paris: Flammarion, 1993.

___, *A Propos de* Méthode de nomenclature chimique; *esquisse historique suivie du texte de 1787,* Paris: Centre de Documentation sciences humaines, 1983.

___, 'A View of the Chemical Revolution Through Contemporary Textbooks: Lavoisier, Fourcroy and Chaptal', *British Journal for the History of Science* 23 (1990): 435-60.

Bensaude-Vincent, Bernadette and Ferdinando Abbri (eds), *Lavoisier in Éuropean Context: Negotiating a New Language for Chemistry,* Canton, MA: Science History Publications, 1995.

Bensaude-Vincent, Bernadette and Isabelle Stengers, *Histoire de la chimie,* Paris: La Découverte, 1993.

Beretta, Marco, *The Enlightenment of Matter: the Definition of Chemistry From Agricola to Lavoisier,* Nantucket, MA: Science History Publications, 1993.

Berman, Alex, 'The Cadet Circle: Representatives of an Era in French Pharmacy', *Bulletin of the History of Medicine,* 40.2 (1966): 101-111.

___, 'Conflict and anomaly in the Scientific Orientation of French Pharmacy 1800-1873', *Bulletin* of *the History* of *Medicine,* 37 (1963): 440-462.

Berthelot, Marcellin, *La Revolution chimique: Lavoisier ; ouvrage suivi de notices et extraits des registres inédits de laboratoire de Lavoisier,* Paris: Félix Alcan, 1890.

Berthollet, Claude-Louis, *Éléments de l'art de teinture,* Paris: Firmin Didot, 1791.

___ *Cours de matière médicale chymique et pharmacologique,* Paris, 1779.

Bouchard, Georges, *Guyton-Morveau chimiste et conventionnel (1737-1816),* Paris: Perrin, 1938.

Bouillon-Lagrange, Edmé-Jean-Baptiste, 'Manuel de l'essayeur du cit. Vauquelin, extrait par le cit. Bouillon-Lagrange' *Annales de chimie* 30 (1799): 303-11.

___, *Manuel du Pharmacien,* Paris, 1803.

Bourquelot, Emile, *Le Centenaire du journal de pharmacie et de chimie 1809-1909. Histoire du journal et notices biographiques par Émile Bourquelot avec 32 portraits,* Paris: Octave Doin et Fits, 1910.

Boussel, Patrice, Henri Bonnemain and Frank J. Bové, *History of pharmacy and the pharmaceutical industry,* Trans. James Desmond, Paris: Asklepios Press, 1983

Bouvet, Maurice, *La Confrérie de saint-Nicolas des apothicaires et des épiciers de Paris,* Paris, 1950.

-___, *Histoire de la pharmacie en france des origines a nos fours,* Paris: Occitania, 1937.

Brock, William, *Justus von Liebig: The Chemical Gatekeeper,* Cambridge: Cambridge University Press, 1997.

Broman, Thomas 'The Habermasian Public Sphere and "Science in the Enlightenment"', *History of Science,* 26 (1998): 123-149.

Butterfield, Herbert, *Origins of Modern Science: 1300-1800,* New York: Macmillan, 1957.

Cadet de Gassicourt, Claude-Louis, 'L'Etat actuel de la pharmacie', *Bulletin de pharmacie* 1.1 (1809): 5-12.

Cazé, Michel, *Le College de pharmacie de Paris (1777-1796),* Fontenay-aux Roses: L. Bellenand & fils, 1945.

Carret, *Sur le projet de loi concernant la police et l 'organisation de la pharmacie, 21 Germinal an XI,* Paris: Imprimerie Nationale, year 11 (1803).

Charas, Moyse, *Pharmacopée royale galénique et chimique,* Paris: Charas, 1676.

Chartier, Roger, *The Cultural Origins of the French Revolution,* Durham, NC: Duke University Press, 1991.

Chast, François, *Histoire contemporaine des médicaments,* Paris: La Découverte, 1995.

Cheylud, Emile, *Histoire de la corporation des apothicaires de Bordeaux,* Bordeaux: Mollat, 1897.

Christie, J. R. R., and Jan Golinski, 'The Spreading of the Word: New Directions in the Historiography of Chemistry 1600-1800', *History of Science* 20 (1982): 235-66.

Clow, Archibald and Nan L. Clow, *The Chemical Revolution,* New York, NY: Gordon and Breach, 1992, (1st edn 1952).

Cohen, H. Floris, *The Scientific Revolution: a Historiographical Inquiry,* Chicago, IL: University of Chicago Press, 1994.

Cohen, I. Bernard, *Revolution in Science,* Cambridge, MA: Harvard University Press, 1985.

Conant, James Bryant, *The Overthrow of the Phlogiston Theory: The Chemical Revolution of 1775-1789,* Cambridge, MA: Harvard University Press, 1950.

Convention Nationale, *Rapport et décret de la convention nationale, sur les écoles de santé de Paris, Montpellier et Strasbourg,* Paris: Comité de Salut Public, 14 frimaire, year 3 (1794).

Court, Susan, 'The *Annales de Chimie,* 1789-1815', *Ambix* 19 (1972): 113-128.

Court, Susan, and William A Smeaton, 'Fourcroy and the *Journal de la société des pharmaciens de Paris', Ambix* 26.1 (1979): 39-55.

Crosland, Maurice, 'Chemistry and the Chemical Revolution', in G. S. Rousseau and Roy Porter (eds), *The Ferment of Knowledge: Studies in the Historiography of Éighteenth-Century Science,* Cambridge: Cambridge University Press, 1980.

___, 'The Development of a Professional Career in Science in France', in M. Crosland (ed.), *The Émergence of Science in Western Éurope,* New York, NY: Science History Publications, 1976.

___, *Historical Studies in the Language of Chemistry,* London: Heinemann, 1962.

___, *In the Shadow of Lavoisier: The* Annales De Chimie *and the Éstablishment of a New Science,* Oxford: British Society for the History of Science, 1994.

___, 'Lavoisier, the Two French Revolutions and "The Imperial Despotism of Oxygen"', *Ambix* 42 (1995): 101-18.

___, *The Society of Arcueil,* Cambridge: Harvard University Press, 1967.

Cunningham, Andrew and Perry Williams, 'De-centring the 'big picture': The Origins of Modern Science and the modern origins of science', *British Journal for the History of Science,* 26 (1993): 407-432.

Dagognet, François, *Tableaux et langages de la chimie,* Paris: Seuil, 1969.

Darnton, Robert, *The Business of Enlightenment: A Publishing History of the Encyclopédie 1775-1800,* Cambridge, MA: Harvard University Press, 1979.

___, *The Great Cat Massacre and Other Épisodes in French Cultural History,* New York, NY: Vintage, 1985.

Dehillerin, Bénèdicte and Jean-Pierre Goubert, 'A la Conquete du monopole pharmaceutique Le Collège de pharmacie de Paris (1777-1796)' *Historical Reflections* 9: 233-248.

Delépine, Marcel, *Un grand chimiste analyste: Louis-Nicolas Vauquelin,* Paris, 1941.

Delunel, 'Observations sur le discours du cit. Thenard', *Annales de chimie,* 35 (year 8, 1800): 76-83.

Dérè, Anne-Claire, *L 'Évolution des sciences pharmaceutiques a Nantes pendant la révolution,* Nantes: Université de Nantes Centre d'histoire des sciences et des techniques, 1989.

Diderot, Denis and Jean D'Alembert, *Encyclopédie ou dictionnaire raisonné des sciences des arts et des métiers par une société de gens de lettres,* Paris: Panckoucke, 1751-1765.

Dijksterhuis, Eduard Jan, *The Mechanization of the World Picture,* Trans. C. Dikshoorn, London: Oxford University Press, 1961.

Dillemann, Georges, Henri Bonnemain and André Boucherle, *La Pharmacie francaise; ses origines, son histoire, son évolution,* Paris: Tec & Doc, 1992.

Dobbs, Betty Jo, *The Janus faces of genius: the role of alchemy in Newton's thought,* Cambridge: Cambridge University Press, 1991.

Donovan, Arthur, *Antoine Lavoisier: Science, Administration and Revolution,* Oxford: Blackwell, 1993.

___, 'The Origins of Modern Chemistry', in Arthur Donovan (ed.), *The Chemical Revolution: Éssays in Reinterpretation, Osiris,* 2nd Series, 4. Philadelphia: History of Science Society, 1988: 214-31.

Dorveaux, Paul, Procès-verbaux des délibérations du Collège de pharmacie de Paris', *Revue d'histoire de la pharmacie* 90,91 and 92 (1935).

Duncan, Alistair, *Laws and Order in Éighteenth-Century Chemistry,* Oxford: Clarendon Press, 1996.

Earles, M. P., 'The Pharmacy Schools of the Nineteenth Century', in F. N. L. Poynter, (ed.), *The Évolution of Pharmacy in Britain,* London: Pitman Medical Publishing Co. Ltd, 1963: 79-95.

Eklund, Jon Bledge, 'Chemical Analysis and the Phlogiston Theory, 1738-1772: Prelude to Revolution', Diss. Yale University, 1971.

___, *The Incompleat Chymist: being an essay on the eighteenth-century chemist in his laboratory, with a dictionary of obsolete chemical terms of the period,* Washington: Smithsonian Institution Press, 1975.

Farber, Paul, *The Émergence of Ornithology as a Scientific Discipline 1760-1850,* Dordrecht: D. Reidel, 1982.

Fontenelle, Bernard Le Bovier de, *Éloges des académiciens,* Brussels: Culture & Civilisation, 1969, (1st ed. 1740).

Foucault, Michel, *Birth of the Clinic: An Archaeology of Medical Perception,* New York, NY: Vintage, 1975.

___, *Discipline and Punish: the Birth of the Prison,* Trans. Alan Sheridan, New York, NY: Pantheon Books, 1977.

___, *The Order of Things,* New York, NY: Vintage, 1973.

Fourcroy, Antoine-François de, 'Analyse du Quinquina de Saint-Domingue pour servir a celle des matières végétates sèches en géneral', *Annales de chimie,* 8 (1791): 113-183 and 9 (1791): 7-29.

___, *L 'Art de connoitre et d 'employer les médicamens dans les maladies qui attaquent le corps humain,* Paris, 1785.

___, *Discours prononcé a la société libre des pharmaciens,* Paris: Quillau, 1797.

___, *Discours sur 1 'état actuel des sciences et des arts dans la république francaise,* Paris, 1793.

___, *Éléments d'histoire naturelle et de chimie;* 2nd edn, Paris, 1786.

___, *Journal de la société des pharmaciens de Paris ou recueil d 'observations de chimie et de pharmacie,* Paris, 1797-1799.

Fourcroy, Antoine-François de, *Lecons élémentaires d'histoire naturelle et de chimie; dans lesquelles on s 'est proposé, 1° de donner un ensemble méthodique des connoissances chimiques acquises jusqu'cl ce jour; 2° d 'offrir un tableau comparé de la doctrine de stahl & de celle de quelques modernes: pour servir de résumé a un cours complet sur ces deux sciences,* Paris: Simon, 1782.

___, (ed.), *La Médecine éclairée par les sciences physiques, ou journal des découvertes relatives aux différentes parties de 1 'art de guérir,* Volume I-IV, Paris: Buisson, 1791-2.

___, *Notice sur la vie et les travaux de Lavoisier,* Paris, 1796.

Philosophie chimique ou vérités fondamentales de la chimie moderne disposées dans un nouvel ordre, Paris, 1792

___, *Principes de chimie: bibliothèque universelle des dames,* Paris: Cuchet, 1787.

___, *Prospectus d'un cours de matière médicale.* Paris, 1782.

___, *Rapport et projet de décret sur l'enseignement libre des arts et des sciences,* Paris, n.d. (1793).

___, *Rapport sur le Traité élémentaire de chimie' de M Lavoisier, fait a la Société royale de médecine,* Paris, 1789.

___, *Système de connaissances chimiques,* Paris: Baudouin, 1800.

___, *Tableaux synoptiques de chimie,* Paris: Baudouin, 1800.

Fox, Robert, 'Science, the University and the State in 19th century France', in G. L. Geison (ed.), *Professions and the French State 1700-1900,* Philadelphia, PA: University of Pennsylvania Press, 1984. 66-111.

Freudenthal, Gad (ed.), *Études sur / Studies on Hélene Metzger,* Leiden: E. J. Brill, 1990.

Fuller, Steve, *Thomas Kuhn: a philosophical history for our times,* Chicago, IL: University of Chicago Press, 2000.

Gallot, Jean-Gabriel, *Vues générales sur la restauration de l'art de guérir,* Paris: Didot le jeune, 1790.

Gelfand, Toby, 'A "Monarchical Profession" in the Old Regime: Surgeons, Ordinary Practitioners, and Medical Professionalization in Eighteenth-Century France', in G. L. Geison (ed.), *Professions and the French State, 1700-1900,* Philadelphia, PA: University of Pennsylvania Press, 1984.

___, *Professionalizing Modern Medicine: Paris Surgeons and Medical Science and Institutions in the 18th Century,* Westport, CT: Greenwood, 1980.

Gillispie, Charles Coulston, 'The *Encyclopédie* and the Jacobin philosophy of science: a study in ideas and consequences', in Marshall Clagett (ed.), *Critical Problems in the History of Science,* Madison, WI: University of Wisconsin Press, 1959.

___, *Science and Polity in France at the End of the Old Regime,* Princeton. NJ: Princeton University Press, 1980.

Glaser, Christophle, *Traité de la chymie,* 1st edn Paris: Glaser, 1663.

___, *Traité de la chymie,* Paris: Jean d'Houry, 1668.

Goldstein, Jan, *Console and Classify: the French Psychiatric Profession in the Nineteenth Century,* Cambridge: Cambridge University Press, 1987.

Golinski, Jan, *Science and Public Culture,* Cambridge: Cambridge University Press, 1992.

___, 'The Theory of Practice and the Practice of Theory: Sociological Approaches in the History of Science', *Isis,* 1990 (81): 492-505.

Gough, Jerry Bruce, 'The Foundations of Modern Chemistry, the Origin and Development of the Concept of the Gaseous State and Its Role in the Chemical Revolution of the Eighteenth Century', Diss. Cornell University, 1971.

Graham, Loren, Wolf Lepenies, and Peter Weingart (eds), *Functions and Uses of Disciplinary Histories,* Dordrecht: Kluwer Academic Publishers, 1983.

Grave, E., *État de la pharmacie en France avant la loi du 21 Germinal an XI,* Mantes, 1879.

Grimaux, Edouard, *Lavoisier: 1743-1794 d'après sa correspondance, ses manuscrits, ses papiers de famille et d 'autres documents inedits,* Paris: F. Alcan, 1888.

Guédon, Jean-Claude Daniel Roger, 'The Still Life of a Transition: Chemistry in the *Encyclopédie ,* Diss. University of Wisconsin, 1974.

Guerlac, Henry, 'Chemistry as a Branch of Physics: Laplace's Collaboration with Lavoisier', *Historical Studies in the Physical Sciences,* 7 (1976): 193-276.

___, 'Lavoisier and his Biographers', *Isis* 45 (1954): 51-62.

___, *Lavoisier – the crucial year: the background and origin of his first experiments on combustion in 1772,* Ithaca, NY: Cornell University Press, 1961.

Guyton de Morveau, Louis-Bernard, 'Mémoire sur les dénominations chymiques, la nécessité d'en perfectionner le systeme, & les règles pour y parvenir', *Observations et mémoires sur la physique, sur 'histoire naturelle, et sur les arts et métiers,* 19 (1782): 370-82.

Guyton de Morveau, Lavoisier, Berthollet and Fourcroy, *Méthode de nomenclature chimique,* Paris: Cuchet, 1787.

Guyton de Morveau, Maret, Chaussier, Duhamel and Vauquelin, *Encyclopédia méthodique, chimie, pharmacie et metallurgie,* Paris: Panckoucke, 1786-1815, 6 vols.

Hahn, Roger, *The Anatomy of a Scientific Institution, the Paris Academy of Sciences, 1666-1803,* Berkeley, CA: University of California Press, 1971.

___, 'Scientific Careers in Eighteenth-century France' in M. Crosland (ed.), *The Émergence of Science in Western Éurope,* New York, NY: Science History publications, 1976.

Hall, A. Rupert, *The Scientific Revolution, 1500-1800; the Formation of the Modern Scientific Attitude,* London: Longmans, 1954.

Hall, Marie Boas, *Robert Boyle and Seventeenth-Century Chemistry,* Cambridge: Cambridge University Press, 1958.

Hankins, Thomas L., *Science and the Enlightenment,* Cambridge: Cambridge University Press, 1985.

Hannaway, Owen, *The Chemists and the Word: The didactic Origins of Chemistry,* Baltimore, MA: John Hopkins Univ. Press, 1975.

Higby, Gregory J. and Elaine C. Stroud, *The History of Pharmacy: a selected annotated bibliography,* New York, NY: Garland, 1995.

Hobsbawm, Eric J., *The Age of Revolution, 1789-1848,* New York, NY: New American Library, 1962.

Holmes, Frederic L., 'The Boundaries of Lavoisier's Chemical Revolution', *Revue D'Histoire Des Sciences* 48 (1995): 9-48.

___, *Éighteenth-Century Chemistry As an Investigative Enterprise,* Berkeley, CA: Office for History of Science and Technology, University of California at Berkeley, 1989.

___, *Lavoisier and the chemistry of life: an exploration of scientific creativity,* Madison, WI: University of Wisconsin Press, 1985.

Hufbauer, Karl, *The Formation of the German Chemical Community, 1720-1795,* Berkeley, CA: University of California Press, 1982.

Ihde, Aaron John, *The Development of Modern Chemistry,* New York, NY: Harper & Row, 1964.

Jauffret, L. F., *Voyage au Jardin des Plantes, contenant la description des galeries d 'histoire naturelle, des serres ou sont renfermés les arbrisseaux strangers, de la partie du jardin appelée 1 'école de botanique ; avec I 'histoire des deux éléphans, et celle des autres animaux de la ménagerie nationales,* Paris: Houel, 1798 (year 6).

Jomard, E. F., *Notice sur la vie et les ouvrages de CL-L. Berthollet,* Annecy: Burdet, 1844.

Kearney, Hugh F., *Science and Change, 1500-1700,* New York, NY: McGraw-Hill, 1971.

Kersaint, G., *Antoine Francois de Fourcroy (1755-1809) sa vie et son oeuvre,* Paris: Muséum National d'Histoire Naturelle, 1966.

Kim, Mi Gyung, *Affinity, that Élusive Dream: A Genealogy of the Chemical Revolution,* Cambridge, MA: MIT Press, 2003.

Klein, Ursula, *Éxperiments, Models, Paper Tools: Cultures of organic chemistry in the nineteenth century,* Stanford, CA: Stanford University Press, 2003.

___, *Verbindung and affinitat: die grundlegung der neuzeitlichen chemie an der wende vom 17. zum 18. jahrhundert,* Basel: Birkhauser, 1994.

Knight, David, *Ideas in Chemistry: a History of the Science,* New Brunswick, NJ: Rutgers University Press, 1992.

Koyré, Alexandre, *From the Closed World to the Infinite Universe,* Baltimore, MD: Johns Hopkins Press, 1957.

Kremers, Edward, and George Urdang, *History of Pharmacy: a Guide and a Survey,* Philadelphia, PA: J. B. Lippincott Co., 1940.

Kuhn, Thomas S., *The Éssential Tension: selected studies in scientific tradition and change,* Chicago, IL: University of Chicago Press, 1977.

___, *The Structure of Scientific Revolutions,* Chicago, IL: University of Chicago Press, 1970, 2nd edn (1st edn, 1962).

Lakatos, Imre, *The Methodology of Scientific Research Programmes,* John Worrall and Gregory Currie (eds), Cambridge: Cambridge University Press, 1978.

Lambert, Jacques, 'Analyse Lavoisienne et Chimie Condallacienne?' in Jean Sgard (ed), *Condillac et les Problèmes du Langage,* Geneva: Slatkine, 1982: 369-377.

LaPlanche, Laurent-Charles de, *Plan d'un cours de chymie, suivant les principes de BÉCHÉR, de BOÉRHAVÉ & de STAHL, dans la vue d'enrichir la médecine, d'éclairer la physique & de perfectionner les arts,* Paris, 1764.

Lavoisier, Antoine, *Élements of Chemistry,* Trans. Robert Keir, Edinburgh: William Creech, 1790.

___, *Traité elémentaire de chimie, présenté dans un ordre nouveau et d'après les déscouvertes modernes,* Paris: Cuchet, 1789.

Leicester, Henry Marshall, *Development of biochemical concepts from ancient to modern times,* Cambridge, MA: Harvard University Press, 1974.

Lémery, Nicolas, *Cours de chymie,* 1st edn, Paris: Lémery, 1675.

Cours de chymie, 8th edn Paris: Michallet, 1696.

___, *Cours de chymie,* Théodore Baron (ed.), Paris: D'Houry, 1756.

___, *A Course of Chymistry,* Trans. Walter Harris, London: Kettilby, 1677.

Levere, Trevor, 'Lavoisier: Language, Instruments and the Chemical Revolution', in Trevor Levere and William Shea (eds), *Nature, Éxperiment, and the Sciences,* Dordrecht: Kluwer, 1990: 207-223.

Levin, A., 'Venel, Lavoisier, Fourcroy, Cabanis and the Idea of Scientific Revolution: The French Political Context and the General Patterns of Conceptualization of Scientific Change', *History of Science,* 22 (1984): 303-320.

Lincoln, Almira H. (ed.), *Dictionary of Chemistry, containing the Principles and Modern Theories of the Science, with its applications to the Arts, Manufactures and Medicine,* New York, NY: G. & C.H. Carvill, 1830.

Lindee, M. Susan 'The American career of Jane Marcet's "Conversations on chemistry", 1806-1853', *Isis* 82 (1991): 8-23.

Macquer, Pierre-Joseph, *Dictionnaire de chymie, contenant la théorie & la pratique de cette science, son application a la physique, a l'histoire naturelle, a la médecine & a 1 'economie animal; avec I 'explication détainée de la vertu & de la maniere d'agir des médicamens chymiques. et les principes fondamentaux des arts, manufactures & métiers dépendans de la chymie,* Paris: Lacombe, 1766.

___, *Élemens de chymie-pratique, contenant la description des opérations fondamentales de la chymie, avec des explications & des remarques sur chaque opération,* Paris: Herrisant, 1758.

___, *Élemens de chymie theorique,* Paris: Herrisant, 1749.

___, *Élements of the Theory and Practice of Chymistry,* Trans. Andrew Reid, London: J. Nourse, W. Strahan, J. & F. Rivington, T. Longman, T. Cadell & E. Johnston, 1775.

Macquer, Pierre and Antoine Bawl* *Plan d'un cours de chymie expérimentale et raison& avec un discours historique sur la chymie,* Paris, 1757.

Macquer, Cadet, Lavoisier and Mitouart, *Éxpériences sur le diamant,* Paris, 1772.

Marat, Jean-Paul, *Les Charlatans modernes; ou lettres sur le charlatinisme académique,* Paris: Marat, 1791.

Mari, Jacques de, *La société libre des pharmaciens de paris (1796-1803),* Grenoble: Prudhomme & Cie, 1944.

Martin Saint-Léon, Emile, *La Crise de l'apprentissage et la reforme de l'enseignement professionel,* Lyon: Chronique Sociale de France, 1908.

Matthews, Leslie G., *History of Pharmacy in Britain,* Edinburgh: E. & S. Livingstone Ltd., 1962

Mauskopf, Seymour H., 'Lavoisier and the Improvement of Gunpowder Production', *Revue d'histoire des sciences,* 48 (1995): 95-121.

McCann, H. Gilman, *Chemistry Transformed: the Paradigmatic Shift From Phlogiston,* Norwood, NJ: Ablex, 1978.

McGuire, J. E. and P. M. Rattansi, 'Newton and the Pipes of Pan', *Notes and Records of the Royal Society of London* 21 (1966): 108-143.

McEvoy, John. 'The Chemical Revolution in Context', *The Éighteenth Century: Theory and Interpretation* 33 (1992): 198-216.

___, 'Continuity and Discontinuity in the Chemical Revolution', in Arthur Donovan (ed.), *The Chemical Revolution: Éssays in Reinterpretation,* Philadelphia, PA: History of Science Society, 1988: 195-213.

___, 'Joseph Priestley: philosopher, scientist and divine', Diss. University of Pittsburgh, 1975.

McKie, Douglas, *Antoine Lavoisier: Scientist, Économist, Social Reformer,* London: Constable, 1952.

___, *Antoine Lavoisier: the Father of Modern Chemistry,* London: V. Gollancz Ltd, 1935.

___, 'The Birth of Modern Chemistry', in *A Short History of Science; Origins and Results of the Scientific Revolution, a Symposium,* Garden City, NY: Doubleday, 1959: 69-77.

Meinel, Christoph, 'Theory or Practice? The Eighteenth-Century Debate on the Scientific Status of Chemistry', *Ambix* 30 (1983): 121-32.

Meldrum, Andrew Norman, *The Éighteenth Century Revolution in Science, the First Phase,* Calcutta: Longmans, Green and Co., 1930.

Melhado, Evan M., 'Toward an Understanding of the Chemical Revolution', *Knowledge and Society: Studies in the Sociology of Science Past and Present* 8 (1989): 123-37.

___, 'Scientific Biography and Scientific Revolution', *Isis* 87 (1996): 688-694

Metzger, Hélène, *Les Doctrines chimiques en france du début du XVIIe a la fin du XVIII siècle,* Paris: Presses universitaires de France, 1923.

Moran, Bruce T., *Chemical pharmacy enters the university: Johannes Hartman and the didactic care of chymiatria in the early seventeenth century,* Madison, WI: American Institute of the History of Pharmacy, 1991.

Mornet, Daniel, 'Les enseignements des bibliothèques privées (1750-1780)', *Revue D 'Histoire Littéraire De La France* 17 (1910): 490.

Morrell, J. B., 'The Chemist Breeders: The Research Schools of Liebig and Thomas Thomson' *Ambix* 19 (1972): 1-46.

Multhauf, Robert P., 'John of Rupescissa and the Origin of Medical Chemistry', *Isis* 45 (1954): 359-367.

___, *The Origins of Chemistry,* New York: F. Watts, 1967.

Musgrave, Alan, 'Why Did Oxygen Supplant Phlogiston? REsearch Programmes in the Chemical Revolution', in C. Howson (ed.), *Method and Appraisal in the Physical Sciences: The Critical Background to Modern Science, 1800-1905,* Cambridge: Cambridge University Press, 1976: 181-209.

Neville, Roy G., and W. A. Smeaton, 'Macquer's Dictionnaire De Chymie:A Bibliographical Study', *Annals of Science* 38 (1981): 613-62.

Nye, Mary Jo, *Science in the provinces: scientific communities and provincial leadership in France, 1860-1930,* Berkeley, CA: University of California Press, 1986.

Outram, Dorinda 'The Ordeal of Vocation: The Paris Academy of Sciences and the Terror, 1793-95' *History of Science* 21 (1983): 251-273.

Partington, James Riddick, *A History of Chemistry,* London: St. Martin's Press, 1961-1970, 4 vols.

___, *A Short History of Chemistry,* London: Macmillan, 1937.

Percheron, Dr Maurice and Madeleine Le Roux, *Petite histoire de la pharmacie,* Avignon: Aubanel, 1955.

Perrin, C. E., 'The Chemical Revolution: Shifts in Guiding Assumptions', in Arthur Donovan, Larry Laudan and Rachel Laudan (eds), *Scrutinizing Science: Émpirical Studies of Scientific Change,* Dordrecht: Kluwer Academic Publishers, 1988: 105-124.

___, 'Chemistry as Peer of Physics: A Response to Donovan and Melhado on Lavoisier', *Isis* 81 (1990): 259-270.

Poirier, Jean-Pierre, *Antoine-Laurent se Lavoisier: 1743-1794,* Paris: Pygmalion, 1993.

Porter, Theodore M., 'The Promotion of Mining and the Advancement of Science: the Chemical Revolution of Mineralogy', *Annals of Science* 38 (1981): 543-70.

Prevet, François, *Histoire de l 'organisation sociale en pharmacie,* Paris, 1940.

—, *Les Statuts et Rêglements des Apothicaires,* Paris, 1950.

Queruel, Alain, *Vauquelin et son temps (1763-1829),* Paris: L'Harmattan, 1994.

Ramsey, Matthew, *Professional and Popular Medicine in France, 1770-1830,* Cambridge: Cambridge University Press, 1988.

Rappaport, Rhoda, 'G.-F. Rouelle: An Eighteenth-Century Chemist and Teacher', *Chymia,* 6 (1960): 68-101.

Rheinberger, Hans-Jörg, *Toward a History of Épistemic Things: Synthesizing Proteins in the Test Tube,* Stanford, CA: Stanford University Press, 1997.

Roberts, Lissa, 'Condillac, Lavoisier, and the Instrumentalization of Science', *The Éighteenth Century* 33 (1992): 252-271.

Roberts, Lissa, 'Setting the Table: The Disciplinary Development of Eighteenth-Century Chemistry as Read through the Changing Structure of its Tables', in Peter Dear (ed.), *The Literary Structure of Scientific Argument,* Philadelphia, PA: University of Pennsylvania Press, 1991,

___, 'The Word and the World: The Significance of Naming the Calorimeter', *Isis,* 82 (1991): 199-222,

Rocke, Alan J., *Quiet revolution: Hermann Kolbe and the science of organic chemistry,* Berkeley, CA: University of California Press, 1993.

Ruffat, Michèle, *175 ans d 'industrie pharmaceutique francaise: Histoire de Synthélabo,* Paris: La Découverte, 1996.

Sadoun-Goupil, Michelle, *Claude-Louis Berthollet (1748-1822): sa vie son oeuvre,* Paris: Vrin, 1977.

Salomon-Bayet, Claire, 'L'Institution de la science: un exemple au XVIII[e] siècle' *Annales: economies, sociétés, civilisations,* 30 (1975): 1028-44.

Sauterey, Robert, 'Les Institutions scientifiques a Pépoque de la révolution française' in *Sciences en Révolution 1770-1830,* Paris: Centre Interdisciplinaire d'Etude de l'Evolution des Idées des Sciences et Techniques, Université de Paris-Sud, 1983,69-145.

Scagliola, Robert, *Les Apothicaires de Paris et les distillateurs,* Clermont-Ferrand, 1943.

Schama, Simon, *Citizens,* New York: Knopf, 1989.

Schofield, Robert E., *Mechanism and Materialism; British Natural Philosophy in an Age of Reason,* Princeton, NJ: Princeton University Press, 1970.

Schwab, R. N., and W. E. Rex, 'Inventory of Diderot's *Encyclopédie', Studies on Voltaire and the Éighteenth Century* 93 (1972).

Senac, Jean-Baptiste, *Nouveau cours de chymie, suivant les principes de Newton et de Sthall,* Paris, 1723.

Shapin, Steven, 'Discipline and Bounding: The History and Sociology of Science As Seen Throught the Externalism-Internalism Debate', *History of Science* 30 (1992): 333-69.

___, *The Scientific Revolution,* Chicago: University of Chicago Press, 1996.

___, *A Social History of Truth: Civility and Science in Seventeenth-Century England,* Chicago: University of Chicago Press, 1994.

Shinn, Terry, 'The French Science Faculty System, 1808-1914: Institutional Change and Research Potential in Mathematics and the Physical Sciences', *Historical Studies in the Physical Sciences* 10 (1979): 271-332.

___, 'Science, Tocqueville, and the State: The Organization of Knowledge in Modern France' *Social Research,* 59 (1992): 533-566.

Siegfried, Robert, *From Élements to Atoms: A History of Chemical Composition,* Philadelphia, PA: American Philosophical Society, 2002.

___, 'The Chemical Revolution in the History of Chemistry', *The Chemical Revolution: Éssays in Reinterpretation,* Arthur Donovan (ed.) *Osiris* series 2,4 (1988): 34-50.

Siegfried, Robert and Betty Jo Dobbs, 'Composition: A Neglected Aspect of the Chemical Revolution', *Annals of Science* 24 (1968): 275-293.

Simon, Jonathan, 'Analysis and the Hierarchy of Nature in Eighteenth-Century Chemistry', *British Journal for the History of Science* 35 (2002): 1-16.

___, 'Naming and Toxicity: a history of strychnine', *Studies in History and Philosophy of the Biological and Medical Sciences* 30C (1999): 505-525.

Smeaton, William A., *Fourcroy Chemist and Revolutionary 1755-1809,* Cambridge: W. Heffer & sons Ltd, 1962.

Smith, John Graham, *The Origins and Éarly Development of the Heavy Chemical Industry in France,* Oxford: Clarendon Press, 1979.

Société Royale de Médecine, *Nouveau plan de constitution pour la médecine en France présenté a l 'assemblée nationale par la société royale de médecine,* Paris, 1790.

Sordes, René, *Histoire de 1 'enseignement de la chimie en France,* Paris: Chimie & Industrie, 1928.

Stichweh, Rudolf, *Zur Entstehung des modernen systems wissenschaftlicher disziplinen: physik in deutschland 1740-1890,* Frankfurt am Main: Suhrkamp Verlag, 1984.

Stroud, Alice, 'Wilhelm Homberg and the Search for the Constituents of Plants at the 17th-century Académie Royale des Sciences', *Ambix* 26 (1979): 184-201.

Taton, René, *Enseignement et diffusion des sciences en France au XVIII' siécle,* Paris: Hermann, 1986.

Thackray, Arnold, *Atoms and Powers, an Éssay on Newtonian Matter-Theory and the Development of Chemistry,* Cambridge, MA: Harvard University Press, 1970.

___, 'History of Science', in Paul Durbin (ed.), *A Guide to The Culture of Science, Technology, and Medicine,* New York, NY: The Free Press, 1980,3-69.

Thagard, Paul, 'The conceptual structure of the chemical revolution', *Philosophy of Science, 57* (1990): 183-209.

Thenard, Louis-Jacques 'Sur la nécessité de réunir la pratique a la théorie de la chimie, pour en faire d'utiles applications aux arts' *Annales de chimie, ou recueil de mémoires concernant la chimie, les arts qui en dépendent, et spécialment la pharmacie* 34 (1800): 106-110.

Tomic, Sacha Tratiques et enjeux de l'analyse chimique des végétaux: étude d'une culture hybride (1790-1835)', Diss. University of Paris X, 2003.

Vauquelin, Nicolas-Louis, 'Analyse du tamarin, & réflexions sur quelques-unes de ses préparations médicinales', *Annales de chimie 5* (1790): 92-104

___, *Dictionnaire de chimie,* Paris, 1826.

___, *Manuel de 1 'essayeur,* Paris: Klostermann fils, 1812.

Weber, Eugen, *Peasants into Frenchmen: the modernization of rural France, 1870-1914,* Stanford, CA: Stanford University Press, 1976.

Weiner, Dora B., *The Citizen-Patient in Revolutionary and Imperial Paris,* Baltimore, MD: The Johns Hopkins University Press, 1993.

Williams, Alan, *The Police of Paris, 1718-1789,* Baton Rouge LA: Louisiana State University Press, 1979.

Williams, Elizabeth, *A Cultural History of Medical Vitalism in Englightenment Montpellier,* Aldershot: Ashgate, 2003.

Williams, L. Pearce, 'The Politics of Science in the French Revolution', in Marshall Clagett (ed.), *Critical Problems in the History of Science,* Madison, WI: The University of Wisconsin Press, 1959, 309-16.

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