BSHS Monographs **publishes work of lasting scholarly value that might not otherwise be made available, and aids the dissemination of innovative projects advancing scholarship or education in the field.**

13. Chang, Hasok and Jackson, Catherine (eds.). 2007. *An Element of Controversy: The Life of Chlorine in Science, Medicine, Technology and War.*
ISBN: 978-0-906450-01-7.

12. Thackray, John C. (ed.). 2003. *To See the Fellows Fight: Eye Witness Accounts of Meetings of the Geological Society of London and Its Club, 1822-1868*. 2003.
ISBN: 0-906450-14-4.

11. Field, JV and James, Frank AJL. 1997. *Science in Art.*
ISBN 0-906450-13-6.

10. Lester, Joe and Bowler, Peter. *E. Ray Lankester and the Making of Modern British Biology.* 1995.
ISBN 978-0-906450-11-6.

09. Crosland, Maurice. 1994. *In the Shadow of Lavoisier:*
ISBN 0-906450-10-1.

08. Shortland, Michael (ed.). 1993. *Science and Nature.*
ISBN 0-906450-08-X.

07. Sheets-Pyenson, Susan. 1992. *Index to the Scientific Correspondence of J. W. Dawson.*
ISBN 978-0-906450-07-9.

06. Morris, PJT, and Russell, CA; Smith, JG (ed.). 1988. *Archives of the British Chemical Industry, 1750-1914: A Handlist.*
ISBN 0-0906450-06-3.

05. Rees, Graham. 1984. *Francis Bacon's Natural Philosophy: A New Source.*
ISBN 0-906450-04-7.

04. Hunter, Michael. 1994. *The Royal Society and Its Fellows, 1660-1700.* 2nd edition.
ISBN 978-0-906450-09-3.

03. Wynne, Brian. 1982. *Rationality and Ritual: The Windscale Inquiry and Nuclear Decisions in Britain.*
ISBN 0-906450-02-0

02. Outram, Dorinda (ed.). 2009. *The Letters of Georges Cuvier.* reprint of 1980 edition.
ISBN 0-906450-05-5.

01. Jordanova, L. and Porter, Roy (eds.). 1997. *Images of the Earth:* 2nd edition.
ISBN 0-906450-12-8.

For e-prints and ordering information, visit the BSHS Monographs Website:
www.bshs.org.uk/monographs

BSHS MONOGRAPHS

— 9 —

THE *ANNALES DE CHIMIE*

BSHS MONOGRAPHS

Series Editor: Dr P.J. Weindling, University of Oxford

1. *Images of the earth: Essays in the history of the environmental sciences.* Edited by L. J. Jordanova and Roy Porter. 1979, reprinted 1981.

2. *The letters of Georges Cuvier: A summary calendar of the manuscript and printed materials preserved in Europe, the United States of America, and Australasia.* Edited by Dorinda Outram. 1980.

3. *Rationality and ritual: The Windscale inquiry and nuclear decisions in Britain.* By Brian Wynne. 1982.

4. *The Royal Society and its Fellows, 1660-1700: The morphology of an early scientific institution.* By Michael Hunter. 1982, reprinted 1985; 2nd edition 1994.

5. *Francis Bacon's natural philosophy: A new source.* A transcription of manuscript Hardwick 72A with translation and commentary. By Graham Rees assisted by Christopher Upton. 1984.

6. *Archives of the British chemical industry, 1750-1914: A handlist.* By Peter J. T. Morris and Colin A. Russell. Contributing editor John Graham Smith. 1988.

7. *Index to the scientific correspondence of John William Dawson.* By Susan Sheets-Pyenson. 1992.

8. *Science and nature: Essays in the history of the environmental sciences.* Edited by Michael Shortland. 1993.

For titles 1-5 the series editor was Dr Roger Smith, University of Lancaster; for titles 6 and 7 the series editor was Dr J. G. Smith, University of Leicester.

IN THE SHADOW OF LAVOISIER:

THE *ANNALES DE CHIMIE*

and the establishment of a new science

Maurice Crosland
University of Kent at Canterbury

BRITISH SOCIETY FOR THE HISTORY OF SCIENCE

© *Maurice Crosland, 1994*

ISBN 0-906450-10-1

Printed in Great Britain by The Alden Press, Oxford

Contents

Preface ix

Introduction 1

Chapter 1 THE NEW CHEMISTRY
1 The study of chemistry 6
2 The development of the concept of the 'chemical revolution' 10
3 The chemical revolution 14
4 Descriptions of the new chemistry 19
5 The uncertain territory of 'physics' 22
6 The expanding frontiers of chemistry 29

Chapter 2 THE PRINTED WORD: A LEGACY OF FRENCH TEXTBOOKS AND JOURNALS
1 The textbook tradition 37
2 Lavoisier's *Traité élémentaire de chimie* and other contemporary textbooks. 42
3 The *Mémoires* of the Paris Royal Academy of Sciences 49
4 The *Observations sur la physique* and the *Journal des savants* 51
5 Different types of scientific discourse 55
6 Texts and authority 59

Chapter 3 THE *ANNALES DE CHIMIE*
1 Crell's *Annalen*: a precedent in a German context 64
2 French periodicals and newspapers: challenges to censorship on the eve of the Revolution 68
3 The founding of the *Annales* 71
4 An international journal of the new chemistry 76
5 Discontinuity in publication 81
6 Translations and abstracts 86

Chapter 4 THE EDITORIAL BOARD: BUSINESS, IDEOLOGY AND PHARMACY
1 The formal organisation of the editorial board 92
2 The working of the editorial board 95
3 Problems with the publishers 101
4 Conflicting personalities and ideologies 105

5 Pharmacy 109
6 Government support 114
7 Circulation of the *Annales* 117

Chapter 5 OTHER FRENCH SCIENTIFIC JOURNALS, c.1800
1 The *Mémoires* of the First Class of the Institute 121
2 The *Bulletin* of the Philomatic Society 123
3 The *Mémoires* of the Society of Arcueil 127
4 The *Moniteur* and the *Journal des mines* 130
5 The *Bibliothèque britannique* 135
6 La Métherie's editorship of the *Journal de physique* 137
7 Attacks on Lavoisier and support for Davy 142
8 The *Journal de physique* and the scientific fringe 146

Chapter 6 THE RANGE AND CONTENTS OF THE *ANNALES*
1 A wide range of subject matter 152
2 Chemistry as a basic science 156
3 Chemistry, the war effort and public service 160
4 The *Annales* as a journal based in Paris 164
5 Correspondence as a feature of the *Annales* 167
6 Joint articles, announcements and book reviews 172
7 The index volumes 176

Chapter 7 CHEMISTRY AFTER LAVOISIER
1 The oxygen theory, respiration and oxidation 180
2 Quantitative analysis: organic and inorganic 185
3 The oxygen theory of acidity: criticism and development 189
4 New earths and new elements 193
5 Davy's work on the isolation of elements 198
6 Applied chemistry 201
7 Disinfection 206

Chapter 8 PHYSICS AS AN EQUAL PARTNER WITH CHEMISTRY
1 The 1815 crisis and its resolution 211
2 The early years of the new series 214
3 Physics - as presented by Arago 219
4 The chemical content 228
5 Links with the Academy of Sciences 232
6 Reporting research from other countries 234
7 Later editorial control 238
8 Expansion of the editorial board and later series 241

Chapter 9 CHEMICAL JOURNALS IN THE LATER NINETEENTH CENTURY
1 Rival French chemical journals 245
2 The decline of the *Annales* 252
3 British chemical journals 255
4 German and other journals 262
5 Abstracts and surveys of recent advances in chemistry 268

Chapter 10 FRENCH CHEMISTRY IN THE NINETEENTH CENTURY
1 The resurrection of Lavoisier 274
2 Chemistry in the Academy and the Société chimique 278
3 Schools of chemistry 282
4 Books and laboratories 286
5 Some national comparisons 288
6 Conclusion 292

APPENDICES No.1 Supporting Documentation 298
No.2 Members of the editorial board 318

BIBLIOGRAPHY 330

NAME INDEX 342

SUBJECT INDEX 349

JOURNAL INDEX 352

ILLUSTRATIONS

Figs. 1 & 2. Title pages of the first and second editions of Vol.1 of the first series of the *Annales de chimie* 73

Fig. 3. Title page of the only volume published of the rare English translation of the *Annales* 87
(by kind permission of the Beinecke Rare Book and Manuscript Library, Yale University)

Fig. 4 & 5. Title pages of the two rival editions of Vol.50 of the *Annales* 104

Fig. 6. Title page of Vol.1 of a new series of the *Observations sur la physique*, now including the word 'chemistry' in the title 141

TABLES

Table 1. Membership of the editorial board of the first series of the *Annales* 96

Table 2. Members of the editorial board of successive series of the *Annales*, 1789-1913 243

ABBREVIATIONS

A.c. Annales de chimie
A.c.p. Annales de chimie et de physique
B.J.H.S. British Journal for the History of Science
C.R. Comptes rendus hebdomadaires des séances de l'Académie des Sciences
D.S.B. Dictionary of Scientific Biography, ed. C.C. Gillispie, 16 vols., New York, 1970-1980
J. de phys. Journal de physique
Obs. Observations sur la physique

PREFACE

> 'During the years 1790-1825 France had more scientists and technologists of the first rank than any other nation had ever had over a comparable period of time'
>
> (D.S.L. Cardwell, *Technology, science and history*, London, 1972, p.123.)

> 'The discontinuous and fragmentary nature of the extant documentation from the revolutionary period is one of the most telling consequences of the deregulationist cultural policies of the [French] government.'
>
> (Carla Hesse, *Publishing and cultural politics in revolutionary Paris, 1789-1810*, Berkeley, Cal., 1991, p.133.)

One could imagine someone giving a prescriptive view of how the history of a journal should be written. Yet to accept any such single view would be equivalent to accepting the idea that there is only one way to write a biography. Someone who is a friend of the family and has access to a lifetime of personal correspondence will probably produce a different kind of biography from a person who has worked more remotely from published sources only. Thus, irrespective of the predilections of the author, the material available will have an important effect on the product, and this is certainly the case with the history of a periodical. An author, who only had the published volumes of the periodical itself to work from, would be obliged to focus on the *contents* of the journal, which might provide a largely internalist view of the development of science in the period. At the other extreme we could imagine someone, who had been given all the business records of a journal, marvellously preserved, who might very well produce a business history with little discussion of the science itself or its development.

In the writing of this book the author finds himself in an intermediate position. Over the years he has been able to collect a fair number of manuscript sources: a few letters, accounts, and precious minutes of meetings of the editorial board, as well as certain other material giving a background to the publication. Unfortunately, many business records have not survived, and

evidence of the circulation of the journal is patchy. Yet, given the importance of the *Annales de chimie* as a focus for the new chemistry, it would be a great pity if the absence of complete records prevented a study of this key journal. For a journal, which passed through the thick of the revolutionary turmoil and which changed publisher and printer many times in the period 1789-1815, it would be totally unrealistic to expect perfect documentation. The floodgates which were opened in 1789-90 by the newly-won freedom of the press, produced a torrent of largely unrestricted publications. It was, therefore, a period of great opportunity but also of exceptional instability for publishers and printers. It was only later, under Napoleon, that control of the press was reintroduced.

A slight change of strategy, therefore, suggested itself. The understandable abence of some primary sources has encouraged the author to cast his net more widely. Instead of a very detailed history of one journal, such as might be of interest to only a few specialists, he has tried to present the history of the *Annales* in the fuller context of publication of scientific material in France at the time and also, more generally, in Europe. And if there is any reader who thinks that one can write the history of science without reference to general history, it may be pointed out that the political and economic history of the period affected not only the foundation of the *Annales* in 1789 but also its temporary closure at the end of 1793; it affected not only the resumption of publication in 1797 but also to some extent the decision to conclude the first series in 1815 and begin a new series in 1816, echoing the political and social transition from the Napoleonic period to the period of the Bourbon Restoration.

The difficult political situation during the early years of the *Annales de chimie* is reflected in the different versions of the name of one of its editors, as printed on the title page of successive volumes of the journal. Guyton de Morveau, unlike Lavoisier, survived the period of violence of the early republic. In the first few volumes of the *Annales* his name had appeared as 'De Morveau' after the property owned by his family. Already by 1790, however, the use of the particle 'de' in a name became inadvisable and he described himself simply as 'Guyton' or even briefly as 'Monsieur Guyton'. By the time the *Annales* reappeared after the Terror he had become 'Citizen Guyton'. In the early years of the Empire he reverted to 'Monsieur Guyton' and eventually from volume 73 (1810) he settled for 'Guyton-Morveau'. In the final years of Napoleon's rule he was to become a Baron.

Here is ample evidence of the swing of the pendulum of history. The *Annales* had to appeal to a public living through a period of political extremes. It had to appeal to values such as utility and enlightenment, which transcended political change. Yet at the same time it could not ignore the momentous events taking place on its very doorstep. Thus, when the *Annales* resumed

publication in 1797 after an interruption of three years, it devoted the first two volumes to the advisory work 'of national importance' that had been carried out in the meantime by men of science, including members of its editorial board.

This study focuses principally on three dimensions: the political, the economic and, of course, the scientific. It was more than a coincidence that the *Annales de chimie* dates from the revolutionary year of 1789. But it was not only a question of freedom to publish outside the framework of the established Academies; in those unsettled times there was the recurring problem of finding a publisher who could ensure the regular printing of manuscripts. And behind all this was the *raison d'être* of the *Annales* - the new chemistry of Lavoisier and his colleagues. Both the contents and style of the *Annales* are examined, but with more attention given to the former. As we shall see, the contents were quite wide-ranging and so inevitably was the style since, unlike a book by a single author, the very strength of the *Annales* lay in its multiplicity of authorship. It might be unkind to describe the contents as miscellaneous, but the articles came from so many different sources and were (as we shall see) in so many forms that any attempt to characterise a single style would be futile. Only in the second series of the *Annales* did a more uniform presentation of the scientific memoir emerge.

The emphasis of this study is very much on the first series of the *Annales de chimie* and its transformation into the second series, which is arguably of comparable major importance. In other words it is far from being an exhaustive study of the *Annales* throughout the nineteenth century. This is, therefore, a task for the future. Yet a word of warning may be permitted. There might be a temptation for some researchers, having access to the massive array of volumes of the *Annales* extending throughout the nineteenth century, to attempt some superficial quantitative analysis. Thus one could simply count the number of articles by different authors or even count the number of pages devoted to different subjects. Such a task could be delegated to a junior research assistant, who might not even be required to understand the contents of the periodical. Yet we should recognise that a quantitative analysis of scientific work may *supplement* but it can never *replace* a qualitative study. Thus while one might simply count the number of pages published by a prolific author like Marcellin Berthelot, who, in a superficial sense, was most 'productive' in the last quarter of the nineteenth century, this is not much use without a critical evaluation of what was published, paying particular attention to the duplication of published research. The *Annales* has been described as 'an inexhaustable mine'[1], an indication that, while this book represents the first extensive study of it, it will certainly not be the last.

---

[1] 'une mine inépuisable' - F. Dagognet, *Pasteur sans la légende*, Paris, 1994, p.393.

Apart from the *Annales,* there will be room for further studies of other journals which reflect the enormous growth of chemistry in the later nineteenth century. But, of course, other sciences were also growing and establishing their necessary institutional bases. Researchers in the future will no doubt look at the journals sponsored by scientific societies of all kinds as well as journals like the *Annales,* which operated independently of the main societies and where the choice of editors was of greatest importance. We shall see that, although the *Annales* was often under the control of one or two dominant figures, at other times it appeared as the product of a committee, with understandable consequences.

I am indebted to many scholars, whose work I have used. Footnotes and bibliography provide a good indication of the debt owed by any author to previous writers. In addition I should like to thank my colleagues and especially my former postgraduate students both at the University of Kent and at the University of Leeds, who have supplied relevant information or who have helped me to develop my ideas. For particular help with sources I must thank the staff of the archives of the Académie des Sciences, the Archives Nationales, and the Collège de France. Monsieur Andrieu, mayor of Saint-Léonard de Noblat in 1991, was good enough to supply me with a microfilm of a book containing the minutes of the editorial board of the *Annales de chimie*. Marco Beretta kindly supplied copies of some pages of the *Annales*, although most of my study has been based on the holdings of the University of Kent, supplemented by visits to the London libraries. I should like also to express my gratitude to William A. Smeaton, who placed his unrivalled knowledge of the background to late eighteenth-century French chemistry at my disposal. He was specially helpful in providing information on some of the work of Guyton de Morveau. Yet, if he was able to correct a number of errors in the draft typescript of some of the early chapters, any remaining errors must remain the responsibility of the author.

The typing of the first part of the manuscript and the French text in Appendix I was the work of Irene Crow before her recent retirement. She was succeeded most ably by Trish Hatton who, since 1992, has taken over the labour of typing. In addition, Mrs Hatton has coped most patiently with the tedious task of transforming the text and footnotes from one computer system to another. I should like to thank her for her invaluable help in producing the final text of this book. Alex Dolby also provided assistance with the word processor. I should like to give particular thanks to William Brock and John North for the encouragement they offered the author at different stages in the production of this book. I should also like to thank Paul Weindling for his support and co-operation in publishing the book. Finally I am obliged to half a dozen anonymous referees, who read my typescript and recommended publication.

INTRODUCTION

> 'The scientific periodical ..... is more amenable to study because it is a visible part of the total structure of scientific communications and is represented by a large number of physical artifacts that can be examined and analysed.'
>
> (David A. Kronik, *A History of Scientific and Technical Periodicals ..... 1665-1790*, 2nd edn., Metuchen, N.Y., 1976.)

> 'The scientific periodical has responsibilities additional to that of communication. Journals form the scientific archive; they are the official public records of scientific achievement.'
>
> Bernard Houghton, *Scientific Periodicals. Their Historical Development, Characteristics and Control*, London, 1975, p.43.

There have been many studies of 'great books' in science and of their authors, but very few of important scientific periodicals. Yet in the late eighteenth century the periodical was beginning, in some ways, to replace the book as the principal method of conveying scientific information. It has been remarked that:

> The periodical shares with the book the characteristic of not being as firmly bound to the events of the day as the newspaper, and has in common with the newspaper that it is usually issued at regular intervals and generally with the view of continuation into the indefinite future.[1]

One of the reasons for the comparative neglect of the periodical is that it is usually the work of many authors and, therefore, more difficult to deal with. Yet it has a certain unified character through the consistency of its format and its editorial policy.[2] At the most superficial level this unity is achieved by repeating the title at the beginning of each issue, and in the method of presentation of the contents.

---

[1] David Kronick, *A History of Scientific and Technical Periodicals*, 2nd edn., Metuchen, N.Y., 1976, p.15.

[2] *Ibid.*, p.17.

A further characteristic of the periodical relates to its distribution. It must be available to all those willing to pay for it and the cost of one issue would normally be quite modest compared with some books. One way of keeping the cost down would have been to limit strictly the number of illustrations. It would be important to ensure continuity of sales by means of subscriptions paid in advance. This implies a major commitment on the part of the reader, which might be encouraged by a previous knowledge of the journal, or by confidence inspired by the reputation of the editor(s), or the wish to adhere to a particular community. In the case of the *Annales de chimie* a nucleus of subscribers would be members of the chemical community. Indeed, the *Annales* greatly helped to establish such a community both in France and abroad.

Although the regular appearance of periodicals at stated intervals of time gives them an obvious feature in common with newspapers, two important criteria may be cited to distinguish a periodical from a newspaper.[3] Newspapers are closely associated with the events of the day or the week. One reads newspapers only to learn what is currently happening in the parish, the country or the world. Newspapers, therefore, quickly become out of date in a way periodicals do not. Also newspapers are addressed to a much wider audience than the periodical. The public for a newspaper usually has a geographical basis, while the readers of a periodical are based more on a community of interests.

Many journals of different kinds were founded in the eighteenth century, but most were short-lived. Although there was an impressive growth in the number of French journals (around 80 by 1785), they lagged behind the numbers in some other countries, particularly the German states.[4] This was partly because of greater political centralisation in France, leading to a less active provincial life. It also reflected the greater emphasis on literacy in Protestant northern Germany, which also benefited by a network of universities providing an institutional base for the support of very many German periodicals. Yet, as has been pointed out,[5] there was no direct correlation between the amount of publication and local contributions to science in the late eighteenth century. Much of the outstanding work in chemistry was taking place in France or Britain rather than Germany, which may provide one of the reasons for the greater number of reviews in various German periodicals; many of them devoted a considerable space to translating, abstracting and reviewing foreign journals and books. This in turn was to be one motive for the

---

[3] These points, originally made by J. Kirchner (*Das deutsche Zeitschriftenwesens, seine Geschichte und seine Probleme*, 2 vols., Wiesbaden, 1958-62.) are reported by Kronick, *op cit.*, pp.17-18.

[4] Jack R. Censer and Jeremy D. Popkin, 'Historians and the press' in their *Press and Politics in Pre-revolutionary France*, Berkeley, Cal., 1987, pp.1-23.

[5] Kronick, *op.cit.*, p.191.

Lavoisier circle launching a chemical journal in Paris, since the French capital itself had an enviable concentration of talent. In addition to many chemists and pharmacists in the Paris region and a sizeable student population (especially after 1794), we know, from the evidence of letters published in the *Annales de chimie,* that provincial readers included a fair number of pharmacists, physicians, teachers and industrialists.

Most scientific journals are either substantive journals or society proceedings.[6] 'Substantive' here means 'not derivative or dependent' and this is the main category we shall be considering. In late eighteenth-century France, both the *Observations sur la physique* and the *Annales de chimie* fall into this category, although that is not to say that they did not also contain abstracts from other (usually foreign) journals and book reviews. Indeed the first project for the *Annales* was simply for a translation of a German journal, possibly supplemented by some abstracts of other chemical papers. Fortunately, by the time the *Annales* was launched, the editors had become much more ambitious, with the bulk of the contents being based on original French papers. Although many of the papers were by members of the editorial board, in principle any chemist could write in to report his experimental work and this would be published, subject only to basic refereeing.

This provides a contrast to the procedings of scientific societies, which would normally only publish papers previously read at meetings by their own members. In this study, the *Mémoires* of the Paris Academy of Sciences and its successor, the First Class of the Institute, provide the prime example of such a journal. Here we may point to a contrast. Unlike the traditional state-subsidised, ponderous and expensively produced *Mémoires* of the Academy with sumptuous bindings, compiled at a leisurely pace by an elite for the admiration of posterity, the *Annales* was a private initiative intended for immediate consumption. Nor was the readership expected to be necessarily passive. Readers were encouraged to think of themselves as potential contributors to the *Annales*, which soon changed from a quarterly to a monthly publication. It was, therefore, an important source of scientific news and its modest price helped to make it available to most members of the growing community of chemists and others interested in the new science.

Yet, although each issue would be scanned with great interest at the time of publication, the *Annales* had much more than the ephemeral value of a newspaper. The separate issues would be bound up into volumes and kept on the shelves as a part of the owner's personal library, where they could be referred to as required. Thus, in addition to their function as communication, many

---

[6] *Ibid.*, p.77.

scientific periodicals also came to have an archival value.[7]

One basic theme of the book, brought out in Chapter 1, is the emergence of chemistry as a new science, a study transformed by Lavoisier and his associates. Before the work of Lavoisier, chemistry had been largely pharmacy or the work of modest artisans. It is true that it had also been caught up in an ambitious reductionist programme, which tried to relate it to Newtonian mechanics. Some chemists may even have welcomed some association with Newton as providing a mantle of respectability[8], but Newton had little useful to offer. Lavoisier's transformation of chemistry was to be quite independent of Newton. Nor did Lavoisier have much to do with the pharmaceutical tradition in chemistry, as we shall see.

In a way the story of the *Annales* encapsulates the whole making of modern chemistry: the emergence of chemistry from pharmacy, and its new status in the nineteenth century as a science related to physics. After the death of Lavoisier there were differences of opinion among the leading members of the editorial board, representing different ideologies within the new chemistry. The pharmacy element was strongly represented by Fourcroy until his death in 1809. Even then Guyton continued to represent a medical dimension through his many papers on fumigation. Guyton's death in the winter of 1815-16 gave Berthollet, the only surviving chemist on the original editorial board, the opportunity to bring to the fore his own interest in allying chemistry with physics. This alliance was made explicit in the expanded title given to a new series of the journal, which now became the *Annales de chimie et de physique*. Berthollet was able to call on two young protégés, Gay-Lussac and Arago, who would respectively be responsible for articles on chemistry and physics. Thus, although chemistry was to be associated with physics, it was, nevertheless, for the most part, differentiated from it.

The story of the *Annales* is taken up to the beginning of the twentieth century, by which time it had come under the control of Marcellin Berthelot, regarded by many of his contemporaries as the *doyen* of French science. This time span enables us to go beyond the early years of the *Annales*, when it dominated the reporting of chemical research in France, and to look at the later years of decline in the face of growing competition. In other words, the story told is one of the rise and fall of the *Annales*. The story is taken up to 1913, by which time the century-old practice of combining chemistry and

---

[7] Bernard Houghton, *Scientific Periodicals. Their Historical Development, Characteristics and Control*, London, 1975, p.43.

[8] Thus Mary Jo Nye writes: "allusions to Newton by chemists in the eighteenth century . . . can be understood as a means of legitimation for apron-coated chemists among the black gowned philosophers of the university". *From Chemical Philosophy to Theoretical Chem-istry*, Berkeley, Cal., 1993, p.264.

physics in the same journal was found to be too restrictive, so separate series were opened for the two sciences.

The *Annales de chimie* was not a vague concept, but a very concrete thing and we cannot ignore the practical dimension of making the periodical a reality. It required considerable organisation and support to bring out a multi-authored work at regular intervals. With a different emphasis, therefore, from some recent books which have concentrated on the rhetoric of science, this study must in the first place draw attention to the political situation in France, which acted as a constraint on the launching of the *Annales* and subsequently interrupted its publication. Not unrelated is the question of censorship, which has two aspects. Although in principle there was some political censorship from time to time, notably in the early years and again in the late 1820s, the *Annales* had no direct political input and this aspect is less important than the more permanent problem of possible scientific censorship. In the early days of the *Annales* this would relate mainly to the issue of publishing papers based on the old phlogiston theory. Later, as, for example, when Dumas was editor, it might relate to adherence to a specific theory of organic chemistry or membership of a particular research school. This is a large question, where direct evidence is difficult to find, and no doubt there will be further research as well as speculation in this area.[9]

A second practical dimension is the economic one. The *Annales* was founded as a business venture, in which any profits were to be shared by the publisher and the members of the editorial board. We shall see how difficult it was in the early period to find a reliable publisher, who could manage to stay in business for more than a few years. No doubt the *Annales* was unfortunate in the choice of some of the succession of publishers, who contracted to bring out monthly issues of the journal during the revolutionary and Napoleonic periods. We have sufficient evidence to provide a basic business history of the *Annales*, a reminder that the activity we call science involves much more than what is done in the laboratory. If the work done there was not published and hence communicated to the scientific community, modern science would be impossible. Thus although in this book the actual development of chemistry is not ignored (see, for example, Chapter 7), it is not studied in great detail, so allowing the emphasis to fall on publication.

---

[9] However, the accusation made by Gerrit Moll, and often repeated, that Gay-Lussac refused to accept one of Davy's research papers for the *Annales* is refuted in M. Crosland, 'Humphry Davy - An alleged case of suppressed publication', *B.J.H.S.*, *6* (1973), 304-10.

CHAPTER ONE

THE NEW CHEMISTRY

> It is between the years 1780 and 1790 that the work took place which raised this science [i.e. chemistry] to the rank of the exact sciences by placing it on a firm base and giving it a methodical and systematic language.
>
> (Extrait du rapport du Jury central sur les produits de l'industrie française, 1819, *A.c.p.*, *13* (1820), 81.)

> Lavoisier had set chemistry on course as an independent science, its axioms being its own and not derived from mechanical or atomic models developed by physicists.
>
> (David Knight, *Ideas in Chemistry*, London, 1992, p.157.)

1. *The study of chemistry*

A book focused on French chemistry might appear to be dealing with a rather specialist area. Yet it has been claimed that chemistry was the most active branch of science around 1800.[1] Indeed some of the work done by chemists would now be described as 'physics'. This was a period when there was an interesting overlap between chemistry and physics which was to be reflected in the *Annales*. Not only was the late eighteenth and early nineteenth century an exceptional period in the development of chemistry but it is also clear that France was the scene of extraordinary activity in that science. A detailed study of a standard English text-book of 1818 reveals that 35% of all references (nearly 300) were to French journals and that the majority of these were to the *Annales de chimie*,[2] one of the first specialist journals of any science.

But why should the science of chemistry, a comparative upstart, claim the privilege of a special journal? Other sciences, notably astronomy, botany and

---

[1] A claim to be substantiated later in this chapter. See Section 6.

[2] The book is William Henry, *Elements of Chemistry*, 8th edition, London, 1818. See S. Lilley '"Nicholson's Journal" (1797-1813)', *Annals of Science*, *6* (1948), 78-102 (99). The other French journal much quoted in Henry's text book is the *Mémoires .... de la Société d'Arcueil*, 3 vols, Paris, 1807-17.

anatomy, could claim some seniority. These studies were all flourishing in the sixteenth century when the chemistry of the time was part pharmacy, part alchemy. Yet by the end of the eighteenth century, having long since shaken off its alchemical origins, chemistry had become a rational modern quantitative science which could bring practical results. Reflecting the Baconian concern for utility, which was to come to the fore in the French Revolution, the editors of the *Annales* claimed that chemistry was the science that was most applicable to industry.[3] Certainly the French about this time were making major contributions to chemical industry,[4] a fact sometimes forgotten by economic historians, who have traditionally concentrated on British contributions to the industrial revolution of the eighteenth century, notably textile machinery and the steam engine.

Chemistry was also very much a fashionable science around 1800. The poet Coleridge attended Humphry Davy's chemical lectures at the Royal Institution to improve his stock of metaphors. In the 1790s Edmund Burke had made much use of chemical metaphors in his classic *Reflections on the Revolution in France*.[5] Chemistry also had the great advantage of ready researchability. That is to say that it offered an almost unrivalled field for inexpensive study in a simple laboratory. There were now so many different substances to be investigated, so many different reactions to be studied. With the most basic training a person with a little skill, some leisure and ambition could aspire to join the growing band of chemists. As a token of his aspiration to membership of the emerging scientific community such a person could communicate an account of his experiments to an appropriate journal. If he lacked confidence or facilities he could at least keep in touch by subscribing to a scientific periodical such as the *Annales de chimie*.

The availability of public lecture courses in chemistry in Paris had helped to recruit members of the audience to a study of the subject. Diderot had said that such public courses would naturally have the effect of whetting the appetite of those attending. Some would become enthusiasts and a few of these would subsequently decide to devote themselves more seriously to chemistry.[6] We are not yet at the stage of the training and commitment of the modern professional scientist but a few men of independent means were at least able to give a large part of their time to scientific pursuits. The young Lavoisier himself had attended the course in chemistry given by G.F. Rouelle

---

[3] 'c'est sans doute la Chimie, de qui la plupart de nos manufactures empruntent leurs procédés,' *A.c.*, *1* (1789), Avertissement, Appendix 1, No.3.

[4] J. Graham Smith, *The Origins and Development of the Heavy Chemical Industry in France*, Oxford, 1979.

[5] Maurice Crosland, 'The image of science as a threat: Burke versus Priestley and the "Philosophic Revolution"', *B.J.H.S.*, *20* (1987), 277-307.

[6] *De l'Interprétation de la nature*, Paris, 1753, section xxxix.

at the Jardin du Roi, probably in 1762-63. Rouelle was a flamboyant lecturer, whose audience combined young apothecaries, students, society persons and even a few men of letters including Diderot and the economist Turgot.[7] While, for some, science would never be more than an amusement, for Lavoisier it was to become a vocation and, for his successors, a career.

There will be some readers who have memories of a childhood in which chemistry used to be associated with (or was even occasionally described as) 'stinks'.[8] In the English educational system every child (with the possible exception of those attending a small number of girls' schools) at some time heated the contents of a test tube with a Bunsen burner with varying degrees of understanding of what was happening. Often the subject was abandoned with relief, not only by those who were labelled 'non-scientists' but even by some with a mathematical bent, who concentrated on physics or mathematics, or others who preferred biology for its greater 'human interest' and environmental relevance.

To recapture the spirit of chemistry in the late eighteenth century, one has to banish any such images from the mind and try to recapture the spirit of the Enlightenment, which saw in such subjects as chemistry and electricity two wonderful examples of the mastery of the natural world and incontrovertible examples of human progress, and this within the lifetime of many people living in the historic year of 1789. Of course, there were no professional chemists at that time. Even for Lavoisier, arguably the greatest chemist of them all, chemistry could be no more than a hobby to be pursued in the early morning, the evening or perhaps on Sundays. As an exceptionally able and ambitious young man in 1766, he had set himself the task of understanding the nature of the physical world by studying in turn the four so-called 'elements' of Aristotle: air, earth, water and fire.[9] It was to be in the study of 'air' that he was to find the key to the comprehension of basic transformations of matter.

We are obviously not talking about advanced science. A basic understanding of chemical composition could be seen as part of the mental baggage of any educated person. It might not be too much to expect a fair proportion of the literate middle classes to be aware of the recent discovery that the air they breathed every moment of their lives was a mixture (in a ratio of approximately one to four) of two invisible gases, one of which supported life while

---

[7] Henry Guerlac, art. 'Lavoisier', *D.S.B.*, vol.8, pp.66-91 (68). Rouelle included a strong mineralogical element in the course.

[8] This relates to the widespread use since the nineteenth century of the gas hydrogen sulphide, which has a smell of bad eggs, for qualitative analysis. Although this procedure might only be used by senior pupils, the unpleasant smell often lingered in the chemistry laboratory and in adjacent corridors.

[9] J. B. Gough, 'Lavoisier's early career in science: An examination of some new evidence', *B.J.H.S.*, *4* (1968-9), 52-7.

the other did not. Lavoisier had not only demonstrated this but also, by particularly rigorous experiments, he had shown that water, so long assumed to be a simple substance, was actually a compound of two gases. The 1780s had certainly witnessed the unveiling of some fairly fundamental secrets of the natural world and it was the chemists of the new school who rightly received the credit. Ballooning was an activity pioneered in France and the 1780s witnessed the use of the hydrogen balloon as a triumph of human inventiveness over the force of gravity.[10] Thus at the time of the foundation of the *Annales de chimie*, of all the sciences, chemistry was probably the one most in the public spotlight.

And this was a time when science seemed to offer new hope to the human race. The authority of the Christian churches had been increasingly challenged and in France political stability was far from secure. It is more than a coincidence that a few months after the publication of the first volume of the *Annales* the Bastille was to be stormed. Of course, this was very far from being a case of cause and effect, but it is an indication of a common context. Several generations of *philosophes* had helped to undermine religious and political control while at the same time looking for other sources of authority. Voltaire had been inspired by the achievements of Newton while Rousseau found a new source of authority in Nature. Although Rousseau was ambivalent about science itself, favouring a study of plants rather than physical science, the growing interest in nature could only lend support to the study of the natural world. Thus, whereas the eighteenth-century Enlightenment was partly built on the success of seventeenth-century science, and particularly the work of Newton, it in turn helped to provide more general support in society for the scientific enterprise.

In France the Paris Royal Academy of Sciences was the leading scientific society.[11] Antoine Laurent Lavoisier himself had been elected to a junior rank in the Academy at the unusually early age of 25 and there is no doubt that the Academy was to become the focus of his scientific life. When he discovered that combustion was sometimes accompanied by a gain in weight, rather than a loss, as might be expected from the current theory of phlogiston, it was to the Academy that he addressed a sealed note in 1772, asking for the note to be read out a few months later when he had confirmed his findings.[12] Over the next 20 years the Academy was to receive a succession of memoirs by Lavoisier in which he developed his oxygen theory. It was not until 1785,

---

[10] Although electricity could provide a few spectacular effects in the eighteenth century, unlike chemistry, it had to wait a long time for the practical applications, which only became widespread in the twentieth century.

[11] Roger Hahn, *The Anatomy of a Scientific Institution. The Paris Academy of Sciences, 1666-1803*, Berkeley, Cal., 1971.

[12] Henry Guerlac, *The Crucial Year*, Ithaca, N.Y., 1961.

however, that he was ready to deliver a frontal attack on the alternative theory of phlogiston.[13]

Throughout the 1780s there were frequent debates about the rival merits of a theory of phlogiston and the oxygen theory. Yet there was not one phlogiston theory but many. For some chemists, any discussion of changes in weight, was irrelevant to their conception of chemistry. For those prepared to admit that combustion was often accompanied by an increase in weight, the phlogiston theory could be saved by attributing to phlogiston a negative weight. For L.B. Guyton de Morveau this was a *relative* negative weight[14] whilst for others it was an absolute negative weight.[15] Lavoisier complained that supporters of phlogiston arbitrarily changed its supposed properties in the light of any new experimental evidence until the theory lost all credibility, since a theory, which can be adapted to explain everything, in the end explains nothing. It might be thought that frequent discussions about phlogiston and oxygen would tend to steer the public away from chemistry. On the contrary, it gave greater publicity to the subject. As Guyton de Morveau remarked:

> It should be noted that the heated discussions for or against the phlogiston theory ... greatly increased the followers of this science.[16]

2. *The development of the concept of the 'chemical revolution'.*

For a whole generation there has been much talk of 'scientific revolutions', largely inspired by T. S. Kuhn's book, *The Structure of Scientific Revolutions*.[17] Understandably after one or two decades a reaction set in, which challenged the metaphor of widespread 'revolutions' in science. In particular a growing number of people were dissatisfied with one general so-called 'scientific revolution' of the seventeenth century, which probably began in the sixteenth century anyway.[18] It is the long period of time, over which this revolution is supposed to have taken place and its diffuseness, which present particular obstacles to its easy acceptance. And there is also the problem of chemistry, which seems to have escaped the new direction given to some other sciences, notably mechanics and astronomy. Some writers have, there-

---

[13] 'Réflexions sur le phlogistique', *Mém.Acad.*, 1783, *Oeuvres de Lavoisier*, Paris, 1864-93, vol.2, pp.623-655(640).

[14] 'Dissertation sur le phlogistique', *Digressions académiques*, Dijon, 1772.

[15] J. R. Partington & D. McKie, 'Historical studies on the phlogiston theory', *Annals of Science*, *2* (1937), 361-404; *3* (1938), 1-58, 337-371; *4* (1939-40), 113-149.

[16] *Encyclopédie méthodique*, *Chimie*, vol.3, 1796, p.561.

[17] T. S. Kuhn, *The Structure of Scientific Revolutions*, Chicago, 1962; second edition, 1970.

[18] David C Lindberg & Robert S Westman (eds.), *Reappraisals of the Scientific Revolution*, Cambridge, 1990.

fore, spoken of a 'postponed' scientific revolution in chemistry,[19] referring to the eighteenth-century work of Lavoisier.

It is certainly much easier to make a case for the beginning of a new chapter - or even a new book - in the history of chemistry at the time of Lavoisier than to focus on earlier figures such as Boyle or Stahl. With any major figure in any science one can, of course, point to certain changes which may have been more or less influential but there are very few occasions in the history of chemistry when the whole direction of the science changed, when it was given new goals and new methods. Thus whereas even the concept of the famous 'Copernican revolution' is challenged from time to time,[20] the chemical revolution of the late eighteenth century is much more firmly established and several general historians of science, not simply historians of chemistry, have supported this.[21] Of course, there will be challenges from time to time from some who fear Lavoisier's own personal claims were excessive or who wish to find an alternative heroic figure but no-one has faced the challenge of arguing cogently and systematically against the claims for a chemical revolution around the 1780s centred in France.

A revolution in science cannot be simply the introduction of a new theory; it requires the overthrow of an established theory vigorously defended by its adherents. Further evidence in favour of a genuine scientific revolution is provided by a later discussion in Chapter 5 of the constant attacks launched on the new chemistry by the *Journal de physique,* since no revolution ever takes place without a struggle. Most accounts of the chemical revolution have focused on the period before 1789 and studied such conflicts as that between Lavoisier and Priestley. Since our story only starts in 1789, it might be thought difficult to find further evidence of resistance to the new ideas. Yet a study of the *Journal de physique* in the 1790s and early 1800s provides evidence of a significant rearguard action by the old orthodoxy even if the main battles had already been won.

It is worth asking whether the French chemists of the late eighteenth century saw themselves as associated with a revolution in their science or whether, like 'the Middle Ages', this was a label attached later. We may begin with the ambitious young Lavoisier himself, who in 1773 used the phrase 'une révolution en physique et en chimie' to describe his own plans.[22] As has

---

[19] Herbert Butterfield, *The Origins of Modern Science*, 1949, Chapter 11.

[20] E.g. Norwood Russell Hanson, 'The Copernican disturbance and the Keplerian revolution', *Journal of the History of Ideas*, *22* (1961), 169-184.

[21] E.g. I. Bernard Cohen, 'Lavoisier and the chemical revolution', Chapter 14 of *Revolution in Science*, Cambridge, Mass., 1985.

[22] M. Berthelot, *La Révolution chimique. Lavoisier*, Paris, 1890, p.48.

been remarked,[23] however, this phrase may well have reflected Lavoisier's own optimism at the time rather than something more concrete. Yet by 1782 Fourcroy was speaking of Lavoisier's achievement as 'a great revolution' at a time when he himself still accepted phlogistic ideas.[24] When Fourcroy reviewed Lavoisier's *Traité* in February 1789 on behalf of the Société Royale de Médecine, he remarked that 'the revolution which chemistry has passed through over the past years is due to the experiments of M. Lavoisier'.[25] In 1790 and 1791 Lavoisier was himself describing his achievement as a revolution in letters to Franklin and Chaptal respectively.[26]

After the early nineteenth century the work of Lavoisier and his colleagues came to be overshadowed by new developments in chemistry, notably the electro-chemical theory of Berzelius and the rise of organic chemistry. It was J.-B. Dumas (1800-1884) more than anyone else who revived the memory of Lavoisier. In the course of lectures he was called upon to deliver at the Collège de France in 1836 Lavoisier was presented as a heroic figure, almost a martyr in the light of his execution. Dumas had no hesitation in using the term 'revolution' to describe his work.[27] In fact he went so far as to assert that Lavoisier had destroyed two thousand years of falsehood.[28] Dumas did even more to perpetuate Lavoisier's work by taking responsibility for a complete edition of his works.[29] This is an invaluable collection, reproducing the contents of his books and memoirs but it did not include Lavoisier's correspondence; nor did it take into account his role in founding the *Annales de chimie*, thus leaving two important aspects of his work for later generations of scholars.

It was the centenary of the French Revolution in 1889 which turned the minds of many Frenchmen back to those momentous days. Chemists were prompted to remember Lavoisier, and Edouard Grimaux wrote a major biography based on manuscript sources.[30] The year 1889 was also to see the

---

[23] Henry Guerlac, 'The chemical revolution: A word from Monsieur Fourcroy', *Ambix, 23* (1976), 1-4.

[24] Fourcroy, *Leçons élémentaires d'histoire naturelle*, Paris, 1782, vol.1, p.22, quoted by Guerlac, *op.cit.*

[25] 'C'est aux expériences de M. Lavoisier qu'est due la révolution que la chimie a éprouvé depuis quelques années...', Lavoisier, *Traité*, 1789, vol.2, p.629.

[26] Guerlac, *op.cit.*, p.2.

[27] J.B. Dumas, *Leçons sur la philosophie chimique*, 1839. Facsimile edition with introduction by Albert Bruylants, Brussels, 1972, pp.106-161 (113).

[28] Ibid., p.160.

[29] *Oeuvres de Lavoisier*, 6 vols., 1864-1893. Dumas only lived to see the publication of the first four volumes.

[30] E. Grimaux, *Lavoisier, 1743-1794, d'après sa correspondance, ses manuscrits, ses papiers de famille et d'autres documents inédits*, Paris, 1888.

election of Marcellin Berthelot[31] as secretary of the French Academy of Sciences. One of the duties of the secretary was to compose *éloges* of deceased members of the Academy, usually those who had died recently. It is extraordinary that no previous secretary had taken the opportunity of commemorating France's famous chemist[32] and Berthelot siezed the opportunity. As a committed Republican and a chemist Berthelot was keen to draw a parallel between progress in society and in science and, when he developed his *éloge* as a book, he gave it the title: *La Révolution chimique. Lavoisier*. This important book greatly consolidated the idea of a chemical revolution but clearly it did not invent it.

One aspect not mentioned hitherto is that of nationalism. This only really emerged in the nineteenth century and it tended to affect historical interpretation. There was certainly hostility between Britain and France in the period 1793-1815, when these countries were at war, and this sometimes spilled over on to the intellectual plane. German nationalism was fostered by the invasion of the German states by French troops. In the introduction of the new chemistry into Germany there had been a certain reluctance to accept French ideas, all the more so as they threatened to displace the ideas of the German Stahl.

Considering the dominant position of German chemistry in the second half of the nineteenth century, it was tactless of Wurtz in 1869 to claim that 'chemistry is a *French* science, founded by Lavoisier of immortal memory'.[33] The Franco-Prussian war of 1870-71, in which the Germans were the victors, accentuated distrust between the two nations. The French cried out for revenge against the Germans and the Germans tended to undervalue the French. Against this background of military defeat we can appreciate that the French in the period 1870-1914 had a special need for national heroes and strong claims unsupported by documentary evidence made in this period for Frenchmen, particularly as opposed to Germans, require special scrutiny. Yet any attempt to explain away the chemical revolution in terms of post 1870 historiography is doomed to failure. To accept the chemical revolution of the late eighteenth century is not to devalue the important contributions made by German chemists in the nineteenth century. But although chemistry (particularly organic chemistry) grew enormously, there was never a major break, a re-evaluation of the whole subject comparable to that of the 1780s.

Finally, we should perhaps not place too much emphasis on Lavoisier's prediction that he would bring about a revolution. We may allow that he already appreciated in 1773 that the gain of weight of metals on calcination had

---

[31] The chemist Marcellin Berthelot (1827-1907) is occasionally confused with the chemist C. L. Berthollet (1748-1822), the former colleague of Lavoisier.

[32] Some of the political reasons for this omission are touched upon in M. Crosland, 'Lavoisier, le "mal-aimé"', *La Recherche*, *14* (1983), 784-791.

[33] *Dictionnaire de chimie*, 1869, Introduction (my italics).

dealt a severe blow to the phlogiston theory but he can hardly have anticipated its implications for a general theory of chemical composition, nor could he have predicted his table of elements. In other words we may repeat that his claim was as much an index of self-confidence and ambition as of actual achievement. Also we should remember that there are major revolutions and minor ones. We are claiming the former; yet Lavoisier was not averse to using the expression in the latter sense (presumably) when he referred in 1790 to Black's work on fixed air as bringing about a 'revolution'.[34] Also we should be fully conscious of the period when political revolution was in the air. It required no great stretch of the imagination around 1789 for anyone to speak of any change as a 'revolution'. What we now have to show is that the ramifications of the work of Lavoisier and his colleagues were so widespread within the science of chemistry that they did constitute a major scientific revolution.

3. *The chemical revolution.*

What precisely constituted the chemical revolution associated with the name of Lavoisier? This section will provide a very brief summary. In the first place we might mention the central role of oxygen in the new system. The oxygen theory was used to explain combustion: instead of phlogiston being given off, combustion usually involved the absorption or combination of oxygen. Thus, if we may represent this schematically in the case of a metal, instead of:

$$\text{metal} \rightarrow \text{calx} + \text{phlogiston}\uparrow$$

we have:

$$\text{metal} + \text{oxygen} \rightarrow \text{metal oxide}$$

But Lavoisier was very conscious of the heat given out in combustion, so that the above scheme may be shown more accurately as:

$$\text{metal} + \underset{\text{(oxygen principle + caloric)}}{\text{oxygen gas}} \rightarrow \underset{\text{(metal + oxygen principle)}}{\text{metal oxide}} + \text{caloric}\uparrow$$

(Lavoisier's idea of heat as a material substance ('caloric')[35] was soon to be challenged but without affecting the basic chemical reaction.) The idea that chemical reactions other than combustion involved combination with oxygen ('oxidation') was important in Lavoisier's chemistry.

It may be appropriate to consider Lavoisier's ideas in a historiographical perspective.[36] The chemical revolution used to be thought of largely in terms

---

[34] *A.c.*, *7*(1790), 194-237.

[35] Robert Fox, *The Caloric Theory of Gases from Lavoisier to Regnault*, Oxford , 1971.

[36] It does not seem appropriate here to launch into a full historiographical essay. See, however, *inter alia*, M. Crosland, 'Chemistry and the chemical revolution', Chapter 10 of G.S.

of a new understanding of combustion and calcination. If this was all that was involved, the question of whether there was a loss or gain of weight on combustion would have been the most crucial one and it was in this spirit that Henry Guerlac wrote his book, *Lavoisier - The Crucial Year*,[37] in which Lavoisier's discovery of the gain in weight was meticulously documented. Since then, however, other perspectives have come to the fore. For example, we should not overlook Lavoisier's special concern with the gaseous state.[38] It was important that he considered gases as distinct chemical entities and as not chemically different from the more familiar forms of matter;[39] they simply contained a greater proportion of caloric. Thus caloric provided a convenient explanation of the three states of matter.

Historians of science, who take a broad view of Lavoisier's achievements, would want to include not only chemistry but also physiology, since he drew an important analogy between the combustion of a candle and respiration.[40] Thus he was able to extend the power of chemistry to the realm of the life sciences. It is interesting that, despite his prolonged interest in the subject of respiration, Lavoisier made no mention of it in his *Traité élémentaire de chimie* (1789). His later work in collaboration with Séguin was published by the latter in the *Annales*.[41] In this way the journal contributed more than the textbook to demonstrating the wide applicability of the oxygen theory.

Lavoisier's understanding of oxygen was a part of his study of the atmosphere, which he showed to consist of two gases, one of which ('vital air') supported combustion while the other ('azote') did not. He was later to show both by analysis and synthesis that water is a compound of hydrogen and oxygen. Oxygen, therefore, was a substance of exceptional importance. Yet Lavoisier believed it was even more important as the universal principle of acidity. Indeed this was its etymology: *oxus* = acid, *geinomai* = I produce. Generalising from a few cases such as carbon, sulphur and phosphorus, he argued that all oxides formed acids.[42] When evidence to the contrary emerged, this caused a minor split in the Lavoisier school. Although it soon

---

Rousseau and Roy Porter (eds.), *The Ferment of Knowledge. Studies in the Historiography of Eighteenth-Century Science*, Cambridge, 1980, Arthur Donovan (ed.) 'The chemical revolution. Essays in reinterpretation', *Osiris*, 2nd series, *4* (1988).

[37] Henry Guerlac, *Lavoisier - the Crucial Year. The Background and Origin of his First Experiments on Combustion in 1772*, Ithaca, N.Y., 1961.

[38] M. Crosland, 'The development of the gaseous state as a third state of matter', *Proceedings of the Xth International Congress of the History of Science*, Ithaca, N.Y., 1962, pp.851-4. R. Siegfried, 'Lavoisier's view of the gaseous state and its early application to pneumatic chemistry', *Isis*, *63* (1972), 59-79.

[39] J. Golinski, *Science as Public Culture*, Cambridge, 1992, p.131.

[40] F.L. Holmes, *Lavoisier and the Chemistry of Life. An Exploration of Scientific Creativity*, Madison, Wisconsin, 1985.

[41] See Chapter 7.

[42] M. Crosland, 'Lavoisier's theory of acidity', *Isis*, *64* (1973), 306-325.

emerged that it is only oxy-acids that contain oxygen and, therefore, it cannot be a principle of acidity, this theory constituted an interesting attempt at explanation in terms of property-bearing principles.

One of the consequences of the oxygen theory was a completely new understanding of chemical composition and it has been argued that this too was an important part of the chemical revolution.[43] Thus, if we return to the above scheme of combustion, a metal had implicitly been regarded as a compound substance since it could split up into a calx and phlogiston. According to Lavoisier, metals were simple substances while the 'calx' was a compound, since it consisted of the metal plus oxygen. In his *Traité élémentaire* Lavoisier drew up a list of simple substances or elements, including the metals, non-metals, some of the gases and several earths which had not yet been decomposed. It is noteworthy that he gave a definition of element in purely operational terms, that is something which had *not yet* been decomposed, leaving to the next generation the possibility of its decomposition using new tools, notably the electric battery. This definition of an element in operational or laboratory terms may be contrasted with the vagueness of the Aristotelian theory of four so-called 'elements', which were really the general principles of which everything was supposed to be made. Thus 'earth' was anything solid and 'water' anything liquid. The 'three principles' introduced in the sixteenth century by Paracelsus: sulphur, salt and mercury, although certainly more chemical, were hardly a great advance. The 'sulphur' of Paracelsus was not identical with brimstone but was a vague metaphysical principle of inflammability.

In the early eighteenth century chemistry had grown both by the discovery of new substances and by a closer examination of familiar substances, previously described by such simple labels as 'alkali' and 'earth'. Thus the 'volatile alkali' (ammonia) was identified, and salts of soda could sometimes be distinguished from salts of potash by their crystalline form. Similarly the vague 'absorbent earth' included in Geoffroy's table of affinities of 1718 was subdivided later in the century into several distinct species: silica, alumina, magnesia, chalk and baryta. It was very tempting in the eighteenth century to think of chemistry as a branch of natural history. Chemistry in its qualitative stage was much concerned with classification. It could follow the precedents set by botany and mineralogy. Fourcroy's early approach to chemistry was on these lines, as can be seen from such textbooks as his *Élémens d'histoire naturelle et de chimie*, which went through several editions in the 1780s.[44]

---

[43] R. Siegfried and B.J. Dobbs, 'Composition, a neglected aspect of the chemical revolution', *Annals of Science*, *24* (1968), 275-293.

[44] For a precise bibliographical history of this book see W. A. Smeaton, *Fourcroy, Chemist and Revolutionary, 1755-1809*, Cambridge, 1962, p.213.

Lavoisier's work marks a break with the natural history tradition. It was not something to be condemned as wrong, but rather irrelevant to chemistry as a quantitative science. Of course, Lavoisier was not the first to introduce the balance into chemistry. Black had used the balance effectively in the 1750s in his study of magnesia and chalk.[45] The balance was a particularly useful instrument in reactions involving invisible gases which might be taken in from the air (as in combustion) or given off on heating a substance (as in the case of chalk). Yet in the mid-eighteenth century there were still many chemists, for whom the balance seemed irrelevant to their craft, which they saw as rather concerned with essences and internal changes. Such was Venel, the author of the major article on chemistry in Diderot's famous *Encyclopédie.*[46] For Lavoisier on the other hand chemistry was to be a physical science. It is understandable that Lavoisier should find some of his colleagues in the chemistry section of the Academy resistant to his new interpretation of chemical phenomena. It is instructive that he seems to have compensated for this by associating more with mathematicians and members of the newly-created section of physics, which he himself had helped to found in 1785.

Related to his quantitative approach was Lavoisier's statement of the principle of conservation of matter as a general principle and it is most important to note that this included gases, which so often had been allowed to escape in reactions as irrelevant or even dangerous. A corollary of the principle is the possibility of writing chemical equations:

> We may lay it down as an incontestible axiom that, in all operations of art and nature, nothing is created; an equal quantity of matter exists both before and after the experiment... 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. Hence, since from must of grapes we procure alcohol and carbonic acid, I may state that:
>
> must of grapes = carbonic acid + alcohol[47]

This reaction had been known in principle since ancient times but had never been analysed in this way before.

Although no recent work on the history of chemistry has invalidated the concept of a chemical revolution associated with the name of Lavoisier, it is

---

[45] *Experiments upon Magnesia Alba, Quicklime and Some Other Alkaline Substances* (1755), Alembic Club Reprint, Edinburgh, 1944.

[46] M. Crosland, 'The development of chemistry in the eighteenth century', *Studies on Voltaire and the Eighteenth Century, 24* (1963), 369-441 (409-10).

[47] *Elements of Chemistry*, Edinburgh, 1790, pp.130-1. Since the translator did not appreciate the potential importance of the equations and omitted the mathematical symbols in the original French text, the last sentence has been re-translated by the present writer.

understandable that scholars should look for new perspectives or seek to revive or revise old ones. One such perspective is concerned with apparatus. Lavoisier spent considerable sums of money employing the best instrument makers to construct not only very sensitive balances but entirely new kinds of apparatus such as his ice calorimeter.[48] Plates illustrating Lavoisier's complex apparatus are to be found in his *Traité élémentaire* and belong more to the textbook tradition than to the genre of the new periodical.

We come finally to the question of nomenclature. Substances had been given such arbitrary, trivial and even misleading names, as we are reminded by such common names as Epsom salts, flowers of sulphur and oil of vitriol. The association of Lavoisier in 1787 with Guyton de Morveau, Berthollet and Fourcroy to compile the *Méthode de nomenclature chimique* was a major landmark in the rationalisation of chemistry.[49] It was the first public collaboration of these chemists in a major project. A second brief association of these chemists was in connection with a French translation in 1788 of Richard Kirwan's *Essay on Phlogiston* with extensive criticisms and refutations by the French *savants*.[50] Finally, and of infinitely greater importance, there was the launching of the *Annales* a year later.

The new nomenclature began from certain basic principles, for example, that a simple substance should be denoted by a simple name and a compound by a compound name *reflecting its actual composition*. Hence such informative names as: oxide of mercury, nitrate of potash, sulphur*ic* acid, where the suffix *-ic* denoted that it contained a large proportion of oxygen. Existing names were kept when they were not misleading. But if one aspect of the new nomenclature was its rationality, a more controversial aspect was that it was not neutral. At a time when some chemists were still defending aspects of the phlogiston theory, here was a nomenclature which clearly pre-supposed the truth of the oxygen theory. Certainly it created resentment among many senior chemists who challenged the validity of Lavoisier's work. Priestley, for example, a distinguished senior figure in the chemistry of the 1780s, was put in the position of having to learn his subject again from the beginning, a sure sign of a genuine revolution. He was virtually forced into this position because Lavoisier and his colleagues gave their ideas currency by the immediate use of these new names in their publications.

---

[48] T.H. Lodwig and W.A. Smeaton, 'The ice calorimeter of Lavoisier and Laplace and some of its critics', *Annals of Science*, *31* (1974), 1-18. Lissa Roberts, 'A word and a world. The significance of naming the calorimeter', *Isis*, *82* (1991), 199-222.

[49] M. Crosland, *Historical Studies in the Language of Chemistry*, 2nd edn., New York, 1978, pp.168 ff.

[50] *Essai sur le phlogistique et sur la constitution des acides*, traduit avec des notes de MM. de Morveau, Lavoisier, de la Place, Monge, Berthollet et de Fourcroy, Paris, 1788.

The new nomenclature signals the opening of a new chapter in the history of chemistry. For many modern readers it would mark the stage at which chemical descriptions became intelligible. Some of Lavoisier's opponents interpreted the new nomenclature negatively as a conspiracy to obliterate the old phlogistic chemistry, whereas for Lavoisier and his colleagues it was a positive move to simplify chemistry on rational and even natural lines.

Recently there has been renewed interest in the language of chemistry, which, in its more extreme form, has taken the view that the chemical revolution was essentially a linguistic one.[51] It would be more reasonable to argue that the reform of nomenclature was a late (and optional) step to *consolidate* the new laboratory-based theory. It is universally agreed, however, that, by inventing a new chemical language, Lavoisier and his colleagues forced their opponents *to think in their terms*. Thus the *Annales* by the continuous and unapologetic use of this nomenclature was helping to ensure the universal acceptance of the new chemistry.

4. *Descriptions of the new chemistry.*

We have spoken of the chemical revolution associated with the name of Lavoisier but was it entirely *Lavoisier's* chemical revolution? This is certainly how Lavoisier saw it and he was annoyed to hear the new chemistry described as that of 'the French chemists'. In a posthumously-published memoir he wrote:

> This theory is not, as I have heard it described, the theory of the French chemists; it is mine and it is property which I claim from my contemporaries and from posterity.[52]

It was almost certainly because of Lavoisier's public association with his colleagues in the *Annales*, and even more clearly in the *Méthode de nomenclature chimique* of 1787, that the view of the oxygen theory as 'the theory of the French chemists' had emerged. But, whereas the nomenclature was explicitly a collaborative effort, the theory was largely if not entirely, the work of Lavoisier. Lavoisier had several collaborators and assistants but he was clearly the leader of the group that worked in his laboratory at the Arsenal in Paris.[53]

---

[51] Thus one writer claims that the nomenclature was 'at the heart of his reorganisation of chemistry', Wilma C. Anderson, *Between the Library and the Laboratory. The Language of Chemistry in Eighteenth-century France*, Baltimore, 1984, p.47. A more recent and more persuasive case, based on firm historical evidence, is made by Marco Beretta, *The Enlightenment of Matter. The Definition of Chemistry from Agricola to Lavoisier,* Canton, MA.. 1993, chapters 4 and 5.

[52] 'Cette théorie n'est donc pas, comme je l'entend dire, la théorie des chimistes françois; elle est la mienne, et c'est une propriété que je réclame auprès de mes contemporains et de la postérité.' *Mémoires de chimie*, 1803?, vol.2, p.87.

[53] See M. Crosland, 'Lavoisier, lone genius or "chef d'école"? The testimony of Fourcroy', in Michelle Goupil (ed.), *Lavoisier et la révolution chimique*, Paris, 1992, p.p. 1-12.

In his annual survey of recent scientific developments the ultra-conservative editor of the *Observations sur la physique*, La Métherie spoke in 1787 of the supporters of the oxygen theory as those 'who have undertaken to explain everything without mentioning phlogiston'[54] and the following year he described them as 'the adversaries of Stahl's theory',[55] a negative view which is understandable from his own position. By 1789 he had graduated to speaking of 'the partisans of the new theory',[56] and this phrase is useful for our purposes since, although it focuses on the supporters of the theory, it does incidentally refer directly to the theory. When another person hostile to the new chemistry, De Luc, who was then living in London, made a number of contributions to La Métherie's journal on the subject, they were described as being about 'the new chemistry'[57] or 'modern chemistry'.[58] Although such terms seem reasonably neutral, one can see how in the revolutionary era anything described as 'new' or 'modern' might seem to have received a stamp of approval, which would not be welcome to supporters of the phlogiston theory.

The new theory was sometimes described as the 'antiphlogistic theory', a curiously negative term coined by Richard Kirwan in 1787 but perhaps indicative of how well entrenched the phlogiston theory had been. Kirwan introduced the term to argue *against* the new theory, although he claimed that it was not intended to be understood in a pejorative sense but merely 'to prevent circumlocution'.[59] On reflection, it is hardly a neutral term but perhaps one which accords with the practice of followers of the phlogiston theory to adopt the name of that hypothetical substance to describe new discoveries, as when Priestley described as 'dephlogisticated air'[60] the gas later known as vital air or oxygen. Kirwan's attack on the new theory was thought to be of sufficient importance by the French chemists for a French translation (by Madame Lavoisier) to be published with replies by Guyton, Lavoisier, Laplace, Monge, Berthollet and Fourcroy. It therefore gave some circulation in France to the phrase 'antiphlogistic theory'[61]. But the second most important use of this term was in a book by William Higgins: *A Comparative View of the Phlogistic*

---

[54] 'les savants qui ont entrepris de tout expliquer sans phlogistique', Discours préliminaire, *J. de phys.*, *30* (1787), 29.

[55] 'les adversaires de la doctrine de Stahl', Discours préliminaire, *J. de phys.*, *32* (1788), 12.

[56] 'les partisans de la nouvelle doctrine', Discours préliminaire, *J. de phys.*, *34* (1789), 25.

[57] 'Troisième lettre de M. de Luc à M. Fourcroy sur la nouvelle chimie', *J. de phys.*, *39* (1791), 117.

[58] 'Lettre de M. de Luc à M. Fourcroy sur la chimie moderne', *J. de phys.*, *38* (1791), 460.

[59] Richard Kirwan, *An Essay on Phlogiston and the Constitution of Acids*, 1789, p.7.

[60] *Experiments and Observations on Different Kinds of Air*, 1774, pp.48-9.

[61] The recent publication of Lavoisier's correspondence shows that several continental chemists, including Landriani, also spoke of the 'antiphlogistic theory' - Michelle Goupil (ed.), *Oeuvres de Lavoisier. Correspondance,* vol. 5, Paris, 1993, p.219..

and Antiphlogistic Theories (London, 1789).[62] Higgins used the term in the text[63] without any introduction or apology, just as he spoke of 'dephlogisticated air'. His viewpoint was, however, the very opposite of Kirwan's and indeed he claimed to be the first British convert to the new theory.

From the above we may understand why, when Fourcroy wrote about the new theory, he was very clear that it was foreigners ('les étrangers') who described the theory as 'antiphlogistic'.[64] Fourcroy was tempted from time to time to describe it simply as the theory of 'the French school'[65] but in his main historical review of the theory he consistently favoured the description 'the pneumatic theory',[66] which emphasises how much the theory owed to the greater understanding of gases in the second half of the eighteenth century. It is true that he sometimes added the phrase 'antiphlogistic theory' by way of further elucidation, this term, as we have seen, having gained some currency through the French translation of Kirwan. Lavoisier himself came to use the term but I cannot agree with a recent author who wants to claim that 'the term "antiphlogistic" can now be seen as an accurate description of the origin and conception of much of Lavoisier's chemistry'.[67] There is not only the evidence given above but also the fact that Lavoisier waited until June/July 1785 to present his attack on phlogiston to the Academy.[68] In earlier years there had been the possibility of some intermediate theory that involved both phlogiston and oxygen.[69] But even in the fully articulated oxygen theory it has been argued that Lavoisier's 'caloric' corresponded to one interpretation of phlogiston, although in a new guise. It was not so *anti*phlogistic after all. And there is much more to the new theory than simply a theory of combustion.

If we look for contemporary descriptions of the new theory we find the use of all possible terms but mainly the ones discussed above. The influence of the interpretation of the theory as 'the pneumatic theory' may be seen in the title of Lamarck's book, which attacked it:

> *Réfutation de le théorie pneumatique ou de la doctrine des chimistes modernes* (Paris, 1796)

It should be noted that this book was published several years before Fourcroy's historical review and, therefore, suggests a widespread currency of the

---

[62] See T. S. Wheeler and J. R. Partington, *The Life and Work of William Higgins, Chemist (1763-1825). Including Reprints of 'A Comparative View...'* etc., Oxford, 1960.

[63] *Op. cit.*, pp.iv-v.

[64] A. F. Fourcroy, *Système des connaissances chimiques*, 1800, vol.1, p.47

[65] 'l'école française que les étrangers nomment antiphlogistique', *ibid.*

[66] 'la doctrine pneumatique', 'Histoire de la chimie', *ibid.*, pp.36-49.

[67] Robert Siegfried, 'Lavoisier and the phlogistic connection', *Ambix*, *36* (1989), 31-40 (38).

[68] 'Réflexions sur le phlogistique', *Oeuvres,* vol.2, pp.623-655.

[69] Carleton Perrin, private communication.

term. It was used by Guyton in the *Annales* and was used by authors outside the charmed Parisian circle, for example Proust,[70] and it is also found in the title of a book by the provincial pharmacist, Tissier:

> *Essai sur la théorie de trois élémens comparée aux élémens de la chimie pneumatique* (Lyon, 1804).

Yet, although of great historical interest, the term 'pneumatic chemistry' was dated and too restrictive and therefore far from ideal. The early nineteenth-century followers of Lavoisier would take the gaseous state largely for granted and the term was soon dropped. This explains why it has been overlooked. The term 'antiphlogistic theory' had a longer life not only through the books of Kirwan and Higgins, but because it has a polemical ring. The historian today may be tempted to speak simply of 'the oxygen theory'[71] but, although this is more positive and by implication it embraces the theory of combustion, the theory of acidity and the theory of composition, it is still hardly wide enough to represent adequately the whole of the new chemistry.

5. *The uncertain territory of 'physics'*

The principal subject of this book is the *Annales de chimie*. The very title of the journal may lull the modern reader into making the understandable assumption that this was a periodical dealing exclusively with chemistry, and *chemistry in the modern sense*. Thus one would not expect to find in it articles on heat, light and electricity, for example, since these subjects are now studied as part of physics. When the modern reader pursues the *Annales* and finds some articles on these subjects he is likely to be puzzled. Obviously, neither chemistry nor physics had acquired their present sophistication but it would be easy for the reader to assume that both of these titles stood for exactly the same territory but in a less well-developed form. If we take the subjects in turn, the chemistry of 1789 was largely mineral chemistry with some elementary knowledge of vegetable and animal substances. Organic chemistry was largely a nineteenth-century development and the nearest anyone came to elementary 'physical chemistry' was probably in relation to discussions of chemical affinity. It is comparatively easy to characterise the chemistry of the late eighteenth century. The real problem comes with the neighbouring science of physics. We must overcome the prejudice that the boundaries of any named branch of science are permanent.

In France the studies described as 'physics' (*la physique*) were undergoing important changes in the late eighteenth century. But whereas the changes

---

[70] E.g. Guyton described Winterl as a chemist who did not accept 'la doctrine de la chimie pneumatique', *A.c.*, *47* (1802), 313. Proust used the term, for example, in *J. de Phys.*, *39* (1804), 343.

[71] On one occasion Fourcroy refers to the two respective theories as 'la théorie du phlogistique et de l'air vital'. *Encyclopédie méthodique. Chimie*, vol.3, Paris, 1796, p.561.

about the same time in chemistry were spectacular enough to be characterised as 'the chemical revolution', the changes in physics were more subtle and have not received the same attention from historians. There are two main problems: the diversity of meanings of *la physique* in late eighteenth-century France and the evolution of the subject itself. In some ways it may be considered to be a new subject although the name goes back to the time of Aristotle, who wrote a book entitled *Phusis* or 'Physics', which provided a general philosophical study of the natural world. This meaning persisted in the eighteenth century even though the term was also beginning to be used in a narrower sense. In Britain what physics existed was usually described as 'natural philosophy' and this term (with its rather wider connotations) continued into the nineteenth century and even beyond. Alternatively the general field was sometimes described as 'mechanical philosophy', thus acknowledging the central importance of mechanics in the early history of physics. British natural philosophy was to receive a major French transplant in the early nineteenth century[72] and it was after this that it began to be called physics.

In order to establish the meaning of *la physique* towards the end of the eighteenth century, several standard French textbooks and dictionaries of *la physique* have been consulted and as a result we can distinguish four main meanings of the term. First there was the most general meaning. Sigaud de la Fond in 1787 said simply:

> Physics is the science of bodies. Everything which falls under our senses is in its province and it recognises no other boundaries other than that which circumscribes the material universe.[73]

To make this even clearer the author went on to say that *la physique* included natural history and chemistry.

A less comprehensive view was taken by the author Mathurin Brisson, who, nevertheless said that *la physique* was the most extensive of all the sciences.[74] He allowed chemistry and natural history an independent existence but said that physics was more general than natural history since the latter was confined to the earth, whereas the former extended to the heavens.

A third meaning of *la physique* is found in the *Histoire* section of the *Mémoires* of the Paris Royal Academy of Sciences in the 1770s and early 1780s. The secretary Condorcet in summarising the year's work of the Academy used the term as a catch-all for topics ranging from economics to the

---

[72] M. Crosland and C. Smith, 'The transmission of physics from France to Britain, 1800-1840', *Historical Studies in the Physical Sciences*, *9* (1978), 1-61.

[73] Sigaud de la Fond, *Élémens de physique théorique et expérimentale* (2nd edn., ed. Rouland, Paris, 1787, 4 vols.), vol.1, p.1.

[74] Brisson, *Traité élémentaire ou principes de physique* (3 vols., Paris, 1789), vol.1, p.1. See also Brisson, *Dictionnaire raisonnée de physique* (3 vols., Paris, 1781) e.g. vol.1, p.v, where chemistry is considered as a parallel science to physics.

borders of chemistry, from public health to travellers' tales. *La physique* almost meant 'general science'.

A fourth meaning of *la physique* was given by La Métherie, the editor of the journal *Observations sur la physique*. He said in 1791 that physics was beginning to have a more restricted meaning and was now used to describe the study of the laws of different bodies.[75] He helpfully gave a list of the main branches of physics: statics, hydrostatics, optics, electricity and magnetism. The narrowing of meaning of the term 'physics' may be worthy of further consideration.

There are various ways in which one might regard this development towards a more restricted meaning for physics. One would be simply a move towards specialisation. It might have been satisfactory for the ancient Greeks to have one name for the study of the whole of nature but by the eighteenth century it was to be expected that a more specialised approach would be required. Yet this is not really the issue here since even the Greeks had made elementary studies of statics, hydrostatics and optics. What is more at issue is the bringing together of such studies into one grand science called 'physics'. Without a unifying principle it was not clear how many of these studies belonged to physics. Thus the study of heat in the eighteenth century was as often considered a part of chemistry as of physics.

We may recall that one of the factors which encouraged Copernicus to advance his new theory of the solar system was the lack of agreement among astronomers on the details of the old system.[76] The fact that there was no general agreement among men of science about the definition or the scope of physics encouraged the incursions of others, notably the chemists. This was not so much a case of the invasion of other people's territory as an exemplification of the existence of mobile frontiers which changed according to the development of new knowledge and techniques.

The idea of a mobile frontier was supported by Haüy in his influential textbook of physics. He remarked:

> In reality all the sciences which respect natural objects compose only one and the same science, which we have subdivided in such a manner that different minds may distribute between them the study of the various branches...[77]

Thus to a certain extent the divisions people made in their knowledge was arbitrary:

---

[75] Discours préliminaire, *Observations sur la physique*, *38* (1791), 12.

[76] N. Copernicus, *De revolutionibus orbium coelestium* (1543), trans. E. Rosen, *Nicholas Copernicus on the Revolutions*, London, 1978, Preface, p.4.

[77] R. J. Haüy, *An Elementary Treatise on Natural Philosophy*, trans. O. Gregory, London, 1807, p.ii.

> the distinction which we have placed between them proceeds solely from the limits of our mind and those of the time which is granted us for their cultivation.[78]

According to one author - and this may seem a rather extreme view - 'physics was simply what remained' when other sciences such as chemistry had claimed their territory.[79]

On the other hand there was a growing interest in *physique expérimentale* in France in the eighteenth century, exemplified by the demonstration lectures of the abbé Nollet (1700-1770), and it was this tradition rather than the more ancient and ambiguous 'physics' or Newtonian mechanics which inspired Lavoisier.[80] A recent writer has said:

> The mid-eighteenth-century conception of experimental physics turned out to be only a way station in the evolution of physics from the Aristotelian and Cartesian past to the synthesis of mathematics and experiment that was effected in the first half of the nineteenth century.[81]

In other words physics in a nineteenth-century sense had to wait for the nineteenth century.

It was actually in France that two major events in the establishment of the new science of physics were centred. These were first the reorganisation of the Paris Royal Academy of Sciences in 1785 to include a section described as *la physique* and, some 20-25 years later, the neo-Newtonian research programme of Laplace, bringing together the sciences of mechanics, optics, electricity, etc.

The first major step was the recognition by the Paris Academy of 'physics' as one of the accepted branches of science. Yet this recognition came late.[82]

---

[78] *Ibid.*, pp.ii-iii.

[79] R. H. Silliman, 'Fresnel and the emergence of physics as a discipline', *Historical Studies in the Physical Sciences, 4* (1974), 137-162 (140).

[80] The author is glad to see confirmation of his ideas in a new book: *Lavoisier. Mémoires d'une révolution* (Paris, 1993, pp.69-71) by Bernadette Bensaude-Vincent, who clearly distinguishes the tradition of *physique expérimentale* from the tradition of Newtonian mechanics, which was largely irrelevant to Lavoisier's chemistry.

[81] Arthur Donovan, 'Lavoisier and the origins of modern chemistry' in *The Chemical Revolution, Osiris, 4* (1988), 214-231 (222).

[82] My interpretation differs from that of Henry Guerlac in his paper: 'Chemistry as a branch of physics' (*Historical Studies in the Physical Sciences, 7* (1976), 193-276), although it should be pointed out that Guerlac's former research assistant, Carleton Perrin, warned him that this title might be taken literally, which was not his intention (*Isis, 81* (1990), 268). I agree very much with Guerlac that the term *la physique* was used loosely in the eighteenth century but I cannot share his puzzlement (*loc.cit.*, p.195) that the reorganisation of the Academy in 1699 did not include a section for it. This was half a century before the work even of Nollet. In the seventeenth century there was mechanics but not physics except in its all embracing meaning as used by Aristotle.

Already in 1699 the Academy had recognised what it regarded as the six main branches of science: mathematics, astronomy, mechanics, chemistry, botany and anatomy.

It was Lavoisier, who had found the application of physical methods so fruitful in his own work, who was most instrumental in revising the constitution of the Academy. He thought it was important that physics should be recognised in the Academy by a section with that name:

> The very name, the title given to places influences genius, determines it to apply itself to one object rather than to another....[83]

Lavoisier argued that earlier studies of experimental physics had been abandoned because they did not receive recognition in the state system. It was the duty of the government to create honourable positions for naissant talent, since he believed that the prospect of such places would excite the zeal of young men and encourage them to take up a scientific career.

We have noted that mechanics was one of the early recognised branches of science and it could be argued that this provided the nucleus around which physics was later to form. There was a body of knowledge going back to Newton of the calculation of forces, which on the one hand provided a theory of the solar system and on a terrestrial plane might be applied, for example, to an understanding of the tides. But mechanics was not yet physics and, as we shall see, there would be some disagreement later about which other studies should cluster round mechanics. There were, for example, ambitious but unsuccessful attempts in the eighteenth century to reduce chemistry to mechanics. Mathematisation was obviously a powerful tool and came to be applied increasingly to the study of physical phenomena.

Yet chemistry represents an older tradition than rational mechanics. It developed from an old craft tradition which drew on certain skills and operations including solution, calcination, distillation and sublimation. Alchemical laboratories always contained a furnace. Often they contained a series of furnaces to be used according to the intensity of the heat required. Early chemistry proceeded almost entirely in a practical context up to the eighteenth century. Its artisanal heritage,[84] originally a disadvantage in society, may have become one of the strengths of eighteenth-century chemistry. No-one could call himself a chemist who had not handled a pestle and mortar, metals and acids, flasks and furnaces. This essentially practical and non-mathematical basis may be constrasted with a greater diversity in physics which might include practitioners working exclusively in applied mathematics and others of more practi-

---

[83] Lavoisier, *Oeuvres*, Paris, 1864-93, vol.4, p.559.

[84] A term used by Lissa Roberts, 'Setting the table: the disciplinary development of eighteenth-century chemistry as read through the structure of its tables' in Peter Dear (ed.), *The Literary Structure of Scientific Argument. Historical Studies*, Philadelphia, 1991, chap.4, p.101.

cal bent; it might even include some who earned a living from the construction of scientific instruments.

It is worth noting that the Academy section devoted to *la physique* was not yet representing what in the early nineteenth century would be called physics, since it formally excluded mechanics in so far as there was already a long-established section with that name. Also the actual composition of the section was rather strange. It did not, for example, contain the person we would regard as the most distinguished physicist, Coulomb, who was allowed to remain in the mechanics section. Only after the abolition of the Royal Academy and the foundation of the National Institute in 1795 did Coulomb become a member of the section of physics. Yet the physics section of 1785 actually contained two astronomers, Bailly and Méchain, thus giving support to our description of the section as 'miscellaneous physical science'. The member most clearly identified with 'physics' was Brisson, the author of textbooks of *la physique*. It was a pity that the abbé Nollet (1700-1770), who had done so much to put experimental physics on the map, was not still alive. In other words, although there was a feeling that physical science should receive greater recognition in the Academy, there was neither a group nor even an individual nor an explicit research programme which exemplified unambiguously what *la physique* was. There is reference above to the use in the Academy of the term *la physique* in a sense almost equivalent to 'general science'. It is significant that the last volume of the Academy's *Mémoires* to include this usage was that for 1782, published in 1785. Thus the year 1785 represents an important stage along the road rather than a turning point in the development of the concept of physics in the nineteenth-century sense.

Although institutions are often of major importance in the introduction of new disciplines, the Royal Academy had only a few more years of existence before it was suppressed in 1793. But on the precedent of the old Academy the First Class of the National Institute, founded in 1795, also had a section devoted to *la physique*.[85] This contained no astronomers but a majority of men associated more with what we would call physics. Not only was Coulomb a member but also Charles (sometimes remembered for 'Charles' law') and Brisson. Charles had inherited the electrical apparatus of the abbé Nollet and Brisson had been encouraged by Nollet to study *la physique*. They could, therefore, be seen as his heirs. Also there was Lefèvre-Gineau who played a prominent part in establishing the experimental basis of the new metric system, notably in connection with the standard of mass.

La physique was also represented in the new educational institutions but it is interesting that in one of the most famous, the Ecole Polytechnique, the low-quality lectures on physics by Hassenfratz were quite overshadowed by

[85] Now described as *physique expérimentale*.

the many lectures on chemistry to students in their first, second and third years by Fourcroy, Guyton and Berthollet.[86] One might have thought that physics was more relevant to students of engineering than chemistry but *la physique* did not yet have a high status in the Polytechnique.

If the Academy and its successor, the First Class of the Institute, provided the first important institutional recognition of *la physique* in France, the second major contributor was Laplace (1749-1827) in the early years of the nineteenth century. It may be asked why he did not make his crucial contribution earlier, for example in the 1780s. In this case chemistry and physics might have advanced together rather than leaving physics to develop later after the spectacular success of chemistry. In fact in the early 1780s Laplace had collaborated with Lavoisier on experiments to measure the heat given off in the combustion of various substances.[87] Laplace then became deeply involved in astronomy, producing major papers on planetary theory in the later 1780s.[88] The Revolution caused some interruption to Laplace's work but, after some contribution to the metric system, he returned to astronomy in his semi-popular *Exposition du système du monde*, first published in 1796. In the following years he undertook some revisions and at the same time he undertook his very technical multi-volume *Mécanique céleste*, of which the first two volumes appeared in 1799. Volumes 3 and 4 of this great work occupied the years up to 1805. Apart from compiling a series of addenda which make up volume 5, this effectively marked the completion of his astronomical system. Laplace was now ready to consider general problems of physics. Most importantly he brought to the subject a ready-made research programme.

In fact it was in 1806 that Laplace moved to Arcueil, a village to the south of Paris, where he bought a country house close to that of Berthollet, who had already gathered round him a few young men interested in chemistry, notably Gay-Lussac and Thenard.[89] Since Berthollet was interested in pursuing the physical aspects of chemistry, this made an intellectual partnership with Laplace all the more feasible.

Laplace's semi-'retirement' to Arcueil provided him with an opportunity to open a new chapter in his life relating to experimental research. He would transfer his neo-Newtonian programme of research from the solar system to the micro world. Helped by Gay-Lussac, Biot and Malus, he would work out

---

[86] J. Langins, *La république n'a pas besoin de savants*, Paris, 1987, pp.50 ff.

[87] Lavoisier and Laplace, 'Memoire sur la chaleur', *Mémoires de l'Académie des Sciences*, 1780, 355. *Oeuvres de Lavoisier*, vol.2, pp.283-333. These experiments, presented to the Academy in June 1783, had been carried out the previous winter. They involved the famous ice calorimeter.

[88] The information on Laplace is based on the extensive article in C. C. Gillispie (ed)., *Dictionary of Scientific Biography*, 1970-80, Vol.15 (Supplement), pp.322 ff., (347).

[89] M. Crosland, *The Society of Arcueil. A View of French Science at the Time of Napoleon I*, London, 1967.

theories of capillarity and optics for which his assistants could provide experimental data. When the Arcueil group publicly announced its existence in 1807 under the title 'Society of Arcueil' it was to be as an equal partnership between physics and chemistry. Laplace's protégés Biot and Poisson were particularly important in putting physics on the map. The corpuscular theory of optics of Malus and Biot was soon to be challenged by Arago and Fresnel, but this would only lead to an even more powerful physics.

If, therefore, the several subjects constituting physics seemed temporarily overshadowed by the new science of chemistry in the 1790s and early 1800s, they were beginning by around 1807 to gain a new vitality and coherence under the powerful tutelage of Laplace. The period focused on here lasted hardly more than 20 years; perhaps it was about 25 years or a quarter of a century. But it was sufficient to give chemistry encouragement to expand its territory, as we shall see in the next section.

Yet although Laplace and his followers made a major contribution towards the establishment of classical physics it was probably the energy concept of the 1840s that did most to give a unity to physics and even this took several decades to be fully established.[90] We can therefore understand why Auguste Comte, writing in the 1830s, could speak of physics as a science consisting of 'numerous branches almost completely isolated from each other'.[91] He said that in that period it was much easier to define chemistry than physics[92] and he returned to his earlier theme of the miscellaneous nature of physics:

Physics ... constitutes a group of different sciences almost isolated from one another much more than a truly distinct science.[93]

6. *The expanding frontiers of chemistry.*

Perhaps a useful way to understand the boundaries of chemistry and physics in the late eighteenth century might be to consider the metaphor of national frontiers which are not clearly defined. The most satisfactory frontier between two countries is a permanent natural feature such as a large river. It is much less satisfactory to have an arbitrary division such as an artificial line of latitude or longitude. So the question we are concerned with is: was there a natural division between physics and chemistry? Certainly when chemistry was in the purely qualitative stage, depending on classification rather than measurement, there was no danger that it would be confused with a more quantitative science. But, once Lavoisier had decided that the way forward lay

---

[90] Crosbie Smith, *The Science of Energy: The Construction of Energy Physics in the Nineteenth Century*, London, 1994.

[91] Comte, *Cours de philosophie positive*, vol.2, Paris, 1835, p.429.

[92] *Ibid.*, vol.3, Paris, 1838, p.12 (see also pp.13-14n).

[93] *Ibid.*, p.72.

in making chemistry a *quantitative* physical science, the frontiers became blurred. Perhaps there should have been formal negotiations between the 'great powers' to settle any possible border disputes? But this is not how things worked in science and certainly not in the late eighteenth century. When Lavoisier and his colleagues wanted to introduce a new language of chemistry they did not ask permission of other chemists. They just went ahead and used it, relying on the internal logic of the new system and their own eminence in chemical research. Similarly in scientific territory, to put it crudely, there seemed to be clear rights of occupation. If the chemists could investigate a problem successfully, using mainly chemical methods, then that problem became a part of the territory of chemistry. This is well illustrated by the history of galvanism.

The original investigator, Galvani, who observed the twitching of the legs of a dead frog when in contact with certain metals, had thought that this was essentially a vital phenomenon.[94] But Volta went on to show that an electric current could be produced in the absence of animal material. Galvanism thus became a part of physical science rather than biological science, but it did not simply become a part of physics. Electrostatics might have been physics but 'galvanism', depending on the newly acquired electric current from the electric cell or battery, was regarded as a separate science. It was not primarily the physicists but the better organised chemists who most exploited galvanism. Thus we find in the *Annales* Desormes making a chemical study of the electric battery.[95] In another volume of the *Annales* an article on galvanism turned out to be a study of the oxidation of metals[96] and even Biot - a 'physicist' - studied the action of air on a battery.[97] But above all for chemists the electric battery was an ideal tool for the decomposition of substances, one of the main programmes of post-Lavoisier chemistry. Volta described his construction of his 'pile' or battery in a letter to Sir Joseph Banks, which was read at a meeting of the Royal Society in June 1800 and published in the *Philosophical Transactions* in the same year. But even before the paper had been published the enterprising William Nicholson, author of a weighty *Dictionary of Chemistry*, in collaboration with Anthony Carlisle was able to announce that they had used the voltaic pile to decompose water into hydrogen and oxygen gases.[98] Of course, Lavoisier had previously decomposed water in his famous gun barrel experiment into hydrogen and iron oxide but to obtain the *two* gases was a superior achievement. It was also to provide volumetric data which was to be of some importance later on. At the time, however, the

---

[94] W. F. Magie, *Source Book in Physics*, Cambridge, Mass., 1935, pp.421-4.
[95] *A.c.*, *37* (1800), 284-321.
[96] *A.c.*, *39* (1801), 203-210.
[97] *Ibid.*, 242-250.
[98] *Nicholson's Journal*, *4* (1800), 179-187.

greatest significance of the electrolysis of water was that it firmly linked galvanism with chemistry. It was the chemists who had the laboratories where they had considerable expertise in the handling of gases. They studied solutions, they were interested in different metals. Above all they had a special interest in decomposing substances with the aim of adding to Lavoisier's list of elements.

The most famous actor on this stage was Humphry Davy, who probably did more than any other single person to present electro-chemistry *as chemistry*. His spectacular decomposition of potash and soda to produce the extremely reactive elements potassium and sodium would have been alone sufficient to make his name. The powerful battery he had assembled at the Royal Institution to decompose the alkalis was largely forgotten in the interest in the products of electrolysis. The moral for the general public was 'what clever things these chemists can do'. Only in the next generation would claims be made for laws of electrolysis. Davy the showman saw himself as a chemist contributing to the expansion of Lavoisier's table of elements.

Galvanism was not only an important part of Davy's research, it was an integral part of his teaching. Davy in his *Syllabus of a Course of Lectures* to be delivered at the Royal Institution in 1802 divided the course into three parts. In part 2 he dealt successively with heat, light, electricity and galvanism. He claimed that these topics 'form an interesting part of chemical science'.[99] Taking a purely pragmatic line, he did not necessarily agree that either heat or light were substances, but they were clearly related to chemistry. Galvanism provided 'powerful and novel instruments of chemical and physiological investigation'.[100] He produced tables of different metals to 'show how intimately primary chemical changes are connected with the production of galvanism'.[101]

Again, although we tend to think of the study of light as being an essential part of physics, we should remember that Lavoisier listed light together with caloric among his chemical elements. In 1727 Schulze had discovered the discolouration of silver salts in the presence of sunlight, a reaction which was only to find its most important application in photography a century later. In 1779 both Priestley and Ingen Housz commented on the action of sunlight on plants which seemed to 'purify' the surrounding air.[102] Explanations of these reactions were tentatively offered in terms of phlogiston. Later when Berthollet found that hydrochloric acid gas was given off when silver chloride

---

[99] *Collected Works*, ed. John Davy, vol.2, pp.386.
[100] *Ibid.*, p.402.
[101] *Ibid.*, p.403.
[102] J. R. Partington, *History of Chemistry*, vol.3, pp.277-280.

was blackened, one conclusion drawn was that the rays were 'hydrogenating'.[103]

Sunlight was found to affect the speed of some chemical reactions. Gay-Lussac and Thenard studied its influence on the reaction between hydrogen and chlorine.[104] The change in colour of the gaseous mixture enabled them to follow the process of slow combination during several days of hazy sunshine. In bright sunlight the gases reacted violently, shattering the flasks containing the gases. Meanwhile, the astronomer William Herschel had published his observations of the heating effect of different parts of the spectrum, showing the greatest effect at the red end.[105] Wollaston made a preliminary study of the other end of the spectrum. Because of the effects of what we call ultra violet light on silver salts he proposed to speak of 'chemical rays'.[106] A major study of properties of both the 'heating rays' and the 'chemical rays' was presented to the Institute by Bérard in 1812.[107] We think of questions about the nature of light as belonging to physics. Yet there was a period of two or three decades when chemists saw light as very much their concern.

One of the distinctive attributes of physics, about which most contemporary authors agreed, was that it was concerned with general laws, and this might seem to provide the basis for a useful distinction from chemistry.[108] Yet it must be more than a coincidence that in the period 1789-1820, say, chemistry too became very much concerned with laws. If one thinks of the elementary laws of chemistry, most belong to this period. Lavoisier claimed that French chemistry had framed the laws accepted by other nations.[109] He himself had enunciated the law of conservation of matter, although he regarded it more as a general principle or even an axiom.[110] Not all authors were bold enough to claim the regularity they had found in the composition or behaviour of matter as a fundamental law of nature. The modest Dalton, for example, presented certain hypotheses about chemical compounds in 1808 in the form of 'rules', which were later developed into three distinct laws: the Law of Constant Composition, the Law of Multiple Proportions and the Law of Reciprocal Proportions.[111] Later, when Davy presented him with the royal medal on behalf of the Royal Society for his discovery of the principle, described as

---

[103] A. Ure, *Dictionary of Chemistry*, 1831, p.576. Probably the source of the hydrogen was water if the silver chloride was damp.

[104] *Mémoires .... de la Société d'Arcueil, 2* (1809), 349.

[105] *Phil. Trans.*, 1800.

[106] J. R. Partington, *History of Chemistry*, vol.4, 1964, p.715.

[107] *Mémoires .... de la Société d'Arcueil, 3* (1817), 5-47 (32ff).

[108] J. B. Biot, *Traité de physique* (4 vols., Paris, 1816), vol.1, p.8.

[109] Lavoisier, *Oeuvres*, vol.4, p.617.

[110] Lavoisier, *Traité élémentaire de chimie*, 1789, pp.140-1; *Elements of Chemistry*, 1790, pp.130-1.

[111] J. Dalton, *New System of Chemical Philosophy*, Part 1, Manchester, 1808, p.214.

'fixing the proportions in which bodies combine', his work in chemistry was compared with that of Kepler in astronomy.[112] Kepler is, of course, best remembered for his laws of planetary motion. But we may put Dalton to one side. Wollaston was explicitly discussing 'laws' of chemical combination of acids and bases in 1808.[113]

For a good example of laws of chemistry we might turn to Berthollet's little book of 1801: *Recherches sur les lois de l'affinité*. Not only Berthollet but his protagonist Proust spoke of laws. For the latter it was 'the law of affinity which presides at all combinations' and results in invariable proportions of the constituents of compounds.[114] In the case of Gay-Lussac, it would not be an exaggeration to claim that he was obsessed with the search for laws[115] and he is remembered particularly for his law of combining volumes of gases (1808). When in 1810 he and Thenard were carrying out a quantitative analysis of vegetable compounds, they presented their results in the form of three 'laws', depending on the relative proportions of hydrogen and oxygen in the compound.[116] It would be possible to find other chemical laws, including Dulong and Petit's Law (1819) but probably enough has been said to make the point. The formulation of most of these laws may be considered a consolidation of the new position of chemistry as a leading branch of physical science.

The astronomer Delambre, in a report on the mathematical sciences drawn up in 1808 and summarising the achievements of the previous twenty years, suggested that mathematical physics was a field which seemed almost exhausted ('presque épuisé').[117] With hindsight such a comment might seem silly but we may compare it with a remark made fifty years earlier by Diderot about mathematics. He had spoken of the sterility and decline of mathematics which he constrasted with the rise of experimental science.[118] This should not be accepted as evidence of fact but rather of feeling. In different generations people became bored with one branch of science and excited by another. Chemistry was to benefit from this excitement around 1800. There are clearly fashions in science as in other human activities.

---

[112] H. Davy, *Collected Works*, London, 1839-40, vol.7, p.97...Dalton should have been honoured unambiguously for his chemical atomic theory but the Royal Society was reluctant to commit itself.

[113] 'On super-acid and sub-acid salts', *Phil.Trans.*, *98* (1808), 96. *'Foundations of the Atomic Theory'* Alembic Club Reprint No.2, 1948, pp.34-5.

[114] J. L. Proust, 'Recherches sur le cuivre', *A.c.*, *32* (1799), 30-1.

[115] Gay-Lussac once remarked that 'if one were not animated with the desire to discover laws, they would often escape the most enlightened attention', *A.c.p.*, *2* (1816), 130.

[116] *Mémoires de la Société d'Arcueil*, *2* (1809), 207-34. In the first paragraph of this memoir he uses the expression 'loi régulière' four times.

[117] *Rapport historique sur les progrès des sciences mathématiques depuis 1789*, Paris, 1810, p.285.

[118] *De l'Interprétation de la nature. Thoughts on the Interpretation of Nature* (1754), para 4.

Delambre felt that there had been little recent research in physics in this period:

> People's minds have turned in a new direction... and this has led to the neglect lately of the various areas of research relating to physics.[119]

and he was ready with an explanation:

> The revolution recently brought about in chemistry could not happen without turning many experimentalists a little out of their ordinary course, when they saw in a neighbouring science a road opened that promised more numerous discoveries.[120]

Around 1800 chemistry had a number of distinct advantages over *la physique*, which it may be useful to list somewhat arbitrarily under ten headings:

1. Chemistry had a clear identity associated with a single word, universally understood, as a subject description.
2. In institutional terms chemistry was the senior science, one of six separate sciences recognised by the Paris Academy of Sciences since 1699. *La physique* did not begin to achieve this recognition until 1785. That it did gain some recognition at this late date was largely due to the efforts of Lavoisier, now recognised as the leading light in the chemistry section. Of course, there was no question of Lavoisier *joining* the new section. He was too closely identified with the new chemistry. His motives in urging recognition for *la physique* probably included a feeling that he should repay his debts for what he had borrowed.
3. Chemistry now had a unifying theory based on oxygen.
4. Chemistry now had a new and completely rational technical language, easy to learn yet sufficiently removed from ordinary discourse to avoid confusion.
5. Chemistry had one of the first specialist journals of any science. The *Annales de chimie* was edited by the leading French chemists who provided a visible example of what chemistry stood for, i.e. the *Annales* provided an important focus.
6. Chemistry had a long history as a laboratory science.
7. Chemistry had developed practical techniques, particularly in relation to analysis and the preparation and examination of gases. These techniques had been enormously successful and had given chemists great confidence of the possibility of further territorial gains.

---

[119] Since this is a particularly free translation, I give here the original French: 'La nouvelle direction des esprits... a dû faire négliger en ces derniers temps les recherches qui constituoient plus particulièrement la physique', *op.cit.*, p.285.

[120] *Ibid.*, pp.31-2.

8. Chemists made themselves the greatest body of experts in the application of galvanism. Galvanic chemistry was a major study in the early years of the nineteenth century before current electricity came to be taken over by physicists.
9. Chemistry had demonstrated its utility in several branches of industry and in war. It could therefore look for greater financial backing, both from private companies and the state.
10. Chemistry more than any other science had exemplified progress in the second half of the eighteenth century. It had become a model science in the way physics was later to become a model science.

Finally we may quote what contemporary writers said about the relative positions of physics and chemistry. The *Observations sur la physique*, in its annual review of the progress of science commented in 1791 that physics proper ('la physique proprement dite') had recently made less progress than other sciences. It attributed this to two factors. In the first place *la physique* now had a narrower meaning than formerly. Secondly it was said that:

> 'Chemistry ... has taken possession of the finest part of physics, all that relates to the nature of water, of air, of earths, of metals, etc.'[121]

It was certainly true that whereas previously in the seventeenth and early eighteenth centuries, only the physical properties of water and air had been studied, the 1780s had witnessed a revolution in the understanding of these substances through chemical analysis.

Fourcroy in 1789 spoke of the boundaries of chemistry expanding:

> 'Now it embraces all the physical sciences'[122]

Of course, if a chemist claims that his particular science is all powerful we might interpret this as no more than a person's natural pride in his own subject, a perennial feature of the academic world. That is why we must take all the more notice of the testimony of the astronomer Delambre in his report to Napoleon on the recent progress of the mathematical sciences. He too spoke of the shrinking domain of physics, but a partial explanation he gave was that many of the main problems of physics such as optical theory and the movement and impact of bodies had now been taken over almost completely by mathematics. Certainly in the early nineteenth century mathematical methods were applied successfully to a variety of physical problems by a succession of French savants beginning with Laplace and Poisson, soon to be followed by Fourier, Fresnel, Ampère and Sadi Carnot.[123] Delambre went on to say:

> 'Galvanism, a subject born in our own time, seemed to be in a position to compensate physics for these losses. Yet the voltaic pile,

---

[121] *Obs.*, *38* (1791), 12-13.

[122] Report of Fourcroy and Cadet de Vaux on Lavoisier, *Traité élémentaire de chimie*, 1789, vol.2, p.651.

[123] T.S. Kuhn, *The Essential Tension*, Chicago, 1977, p.61.

> which it considered one of its most ingenious inventions, has passed into the hands of the chemists'.[124]

Thus, he concluded, new ideas, new fashions had in recent years caused the neglect of research in physics. That is why chemistry has a special importance in this period for all those interested in the development of physical sciences.

[124] *Rapport historique sur les progrès des sciences mathématiques depuis 1789*, Paris, 1810, pp.284-5.

CHAPTER TWO

THE PRINTED WORD: A LEGACY OF FRENCH TEXTBOOKS AND JOURNALS

> There is no science which more eminently deserves to enter into the plan of a good education than chemistry. We may even affirm that the study of this science is almost indispensably necessary to prevent us from being strangers in the midst of the beings and phenomena which surround us. It is true indeed that the habit of beholding the objects of nature may produce a knowledge of some of their principal properties. We may even in this way arrive at the theory of some of the phenomena. But nothing is more proper to check the pretensions of some young persons, who are elevated by such imperfect acquisitions, than to shew them the vast field of which they are ignorant.
>
> (Chaptal, *Elements of Chemistry*, transl., London, 1791, Preface, p.lxv.)

> The study of chemistry continues unceasingly in France and it is the European country where there are the most people who make it the object of their study and where there is the best opportunity to learn it.
>
> (Fourcroy, *A.c.*, *32* (1799), 206.)

1. *The textbook tradition*

Central to the propagation of new chemistry was the publication in the fateful year of 1789 of Lavoisier's *Traité*, as well as several other textbooks, notably those by Fourcroy and Chaptal. But before considering these, contemporaneous with the publication of the early *Annales de chimie*, we should provide some context and historical background. In France, unlike Britain, the publication of textbooks of chemistry has a long history going back to the early seventeenth century. Many of these books were translated into English and

other European languages and thus had a great influence. One of the first of these books by a French author was actually first published in Latin in 1612, Jean Beguin's *Tyrocinium Chymicum*.

Yet prior to any discussion of Beguin we might mention the *Alchemia* of the German Andreas Libavius, published in Frankfurt first in 1597 and then in an expanded form in 1606, since (despite the title) this has been claimed as a turning point in the emergence of chemistry from alchemy and the emergence of the chemistry textbook.[1] It has been shown, for example, that Beguin made some use of Libavius's work.[2] Libavius probably deserves some attention because of his concern to establish a science free from the corruptions of Paracelsus, which were said to have debased alchemy by appealing to magical powers. Libavius claimed to stand for a more rational alchemy, which was not secret and hidden but brought out into the open for the good of mankind. He agreed that chemistry should be of assistance to medicine, but he made strong claims for the independence and dignity of the science, which he hoped to establish as a scholarly discipline.[3] It was for this reason that he wrote his textbook.

Although Beguin used the word 'chemistry' in the title of his book, (the French translation being entitled *Les Élémens de chymie*) the book was as much concerned with pharmacy. The preparation of a number of remedies was clearly described, but this was not always the case. As the author admitted,

> There is such excellence on the part of some of the remedies that it has occasionally been necessary altogether to use concealment and wrappings, lest I be considered by wise men to be casting very precious pearls before unworthy swine[4]

In other words, in Beguin's book, chemistry had not yet emerged fully from the tradition of secrecy associated with alchemy. This is confirmed by looking at some of the terminology, which includes ingredients described as 'the venenate scum of two dragons' and the 'celestial eagle more white than snow'.[5]

Beguin perhaps provides a salutary reminder of the distance in ideas and language between 1600 and 1800. But it was in the early 1600s that an institution was to be founded in Paris, which was to provide a major justification for a long tradition of textbooks. In 1626 the Jardin du Roi was founded as a

---

[1] Owen Hannaway, *The Chemists and the Word. The Didactic Origins of Chemistry*, Baltimore, 1975.

[2] Hannaway accuses Beguin of 'lifting verbatim key definitions from Libavius's *Alchemiae* in the first edition of his *Tyrocinium Chymicum', ibid.*, p.154.

[3] *Ibid.*, p.90.

[4] Preface to 1612 edition of *Tyrochinium Chymicum,* quoted by T. S. Patterson, 'Jean Beguin and his *Tyrocinium Chymicum*', *Annals of Science*, 2 (1937), 243-98 (253).

[5] Beguin, *Tyrocinium Chymicum*, (trans. Richard Russell, London, 1669), pp.89, 117.

place for the cultivation of medicinal herbs. The staff consisted not only of botanists and gardeners, but also a demonstrator in chemistry. For the convenience of his pupils the first demonstrator, William Davisson (or Davidson) published a treatise in Latin called *Philosophia Pyrotechnia* (1635), translated into French in 1651 as *Les Élémens de la philosophie de l'art du feu ou chimie*.[6] This discussed chemical substances according to the classification animal, vegetable or mineral, a classification found convenient by other textbook writers. Like Beguin, Davisson classified products according to similarities in physical properties and method of preparation. He dealt respectively with what he called 'magisteries', 'crocuses' and 'flowers'. He thus described successively the preparation of flowers of sulphur, flowers of sal ammoniac and flowers of antimony, all obtained by sublimation. Deeply imbued with neo-Pythagorean and neo-Platonic mysticism, he attached great significance to the crystalline form of substances.

Davisson was succeeded at the Jardin du Roi by Nicase Le Fèvre (Le Febure),[7] who is notable for having determined to publish a textbook of chemistry in French, *Traité de la chymie*, just as Paracelsus and Glauber had made a point of writing in German. Again this book was largely pharmaceutical chemistry, and Le Fèvre was honest enough to admit that he had not personally tried all the preparations he described, but he did claim to have tried the majority. Here then was the indication of a tradition of textbook writing by copying selections from the work of previous authors. Again there are traces of Neo-Platonism and alchemical allegory, such as the idea that gold, lead and antimony were of the male sex but other metals which dissolve more easily were female.[8] Le Fèvre adopted a theory of five principles: salt, sulphur and mercury with earth and water, thus combining the three principles of Paracelsus with two of the traditional four elements of Aristotle.

The successor of Le Fèvre at the Jardin du Roi was Christofle Glaser, who was the author of a pocket-size book of chemical preparations also entitled *Traité de la chymie*, first published in 1663. Like the previous book of Le Fèvre it went through several editions and was translated into English and German. Glaser, however, was less interested in theory and was at his best in giving fairly clear descriptions of standard mineral preparations. Occasionally Glaser made notes on weight changes in chemical reactions, a rather unusual feature for the seventeenth century. On the other hand alchemical and astrological references were also to be found occasionally.

Having described summarily several of the more important early French chemistry textbooks, we must pause to take a more considered view of the

---

[6] J. R. Partington, *History of Chemistry*, vol.3, 1962, pp.4-7.

[7] *Ibid.*, pp.17-24. The teaching of chemistry at the Jardin du Roi is described in Jean-Paul Contant, *L'Enseignement de la chimie au Jardin Royal des Plantes de Paris*, Cahors, 1952.

[8] *A Compendious Body of Chymistry*, London, 1664, vol.1, p.66.

Cours de chymie of Nicolas Lemery (1645-1715).[9] This book marked a new departure in chemistry texts and it went through numerous editions, at least fifteen in Paris, four in Lyons, two in Brussels, one in Avignon, not to speak of translations into English (five separate editions), Dutch, German, Latin, Italian and Spanish. Appearing originally in 1675 in a pocket-sized 12mo edition it was quickly expanded and reprinted countless times, the last French edition being a large quarto volume of nearly 800 pages appearing in 1757. In the late seventeenth century and the early eighteenth century we may say that not only France but a large part of Europe learned its chemistry from Lemery.

The book was divided into three sections, dealing with mineral (the largest section), vegetable and animal products. Although the organisation of his text closely followed that of his predecessors, Lemery is notable for giving a clear description of the preparation of substances and, where appropriate, of their medicinal uses. He was originally an apothecary and we must not expect him to have broken away from the tradition of iatro-chemistry. Yet it is notable that he made a complete break with the alchemical leanings of many of his predecessors. Instead he introduced a mechanical theory of chemical reaction. Different substances were said to be composed of particles of different shapes and sizes and this theory was used to explain chemical reactions. It is worth reproducing his explanation of the reactivity of acids:

> As the nature of a thing so hidden as that of a salt could not be better explained than by attributing to the parts of which it is composed, figures which correspond to all the effects which it produces, I shall say that the acidity of a liquid consists in the pointed particles of salts which are in agitation; and I do not think that you will contest with me that an acid has points, because all experience demonstrates it, it is only necessary to taste it to come to this conclusion; for it makes pricking sensations on the tongue similar to or very near approaching those which are received from some material cut into fine points; but a demonstrative and convincing proof that the acid is composed of pointed parts is that not only do all acid salts crystallise in points, but all solutions of acid substances with acid liquors take this figure in their crystallisation. These crystals are composed of points different in length and thickness from one another, and we must attribute this diversity to more or less sharp points for the different kinds of acids; it is also this difference in subtlety of the points which makes an acid penetrate or dissolve well a body which another cannot attack; aqua

[9] For a comprehensive bibliographical study of the different editions of Lemery and of eighteenth-century chemical authors see: William A. Cole, *Chemical Literature, 1700-1860*, London, 1988.

> fortis dissolves mercury, and vinegar cannot penetrate it; aqua regis is the solvent of gold and aqua fortis makes no impression upon it.[10]

Lemery's explanation of the activity of acids, alkalis, etc. was really very similar to that given by Robert Boyle about the same time. It constituted an application of the mechanical philosophy which gained favour in the seventeenth century, but which in the eighteenth century came to be regarded as too simple, crude and arbitrary. It may have marked a step forward in so far as it rejected the mysterious influences and 'sympathies' by which previous generations had explained chemical reactions, yet mechanical theories were too *ad hoc* in so far as they could be used in retrospect to 'explain' any known reaction yet they could hardly be used to predict the unknown. Like Le Fèvre, Lemery made use of five principles, which he described as water, spirit, oil, salt and earth. However, he gave 'mercury' as a synonym for spirit and 'sulphur' for oil, so it was essentially the same theory but with the refinement that Lemery admitted that there were some metals from which it was impossible to extract the supposed salt, sulphur or mercury of Paracelsus.

Like his predecessors, Lemery had a section dealing with furnaces and apparatus, but he also said that even more could be learned by the reader going into the laboratory. (This section became standard in most textbooks of chemistry including that of Lavoisier, who, following an eighteenth-century trend, placed it at the end rather than the beginning). In the final part of his introduction, Lemery explained many chemical terms. The number of terms explained increased in succeeding editions and it is worth drawing attention to the difficulty of describing Lemery's book as if it were one static object. Rather it had a life of its own, growing with successive editions during the author's lifetime and even later undergoing changes. By the time of the 1757 edition the editor, Théodore Baron, added extensive foot-notes, explaining, for example, that by 'sulphur' Lemery had meant phlogiston. The introductions to different English editions of Lemery called attention to his gift of clarity of expression compared to his predecessors. Although the *Cours de chymie* is clearly a textbook of chemistry rather than pharmacy, the table of remedies contained in later editions may have tempted people to buy the book as a 'home-doctor'. The popularity of the book was further increased by the inclusion of a number of anecdotes and ingenious explanations of diverse phenomena including the curdling of milk, the explosion of gunpowder and volcanic eruptions. Lemery, although not as original as sometimes supposed, undoubtedly contributed to the popularisation of chemistry.

Because Lemery's book in its various forms was so successful, there is a considerable time gap in the textbook tradition and the next French author of

---

[10] Lemery, *Cours de chymie*, Paris, 1697, pp.23-4.

comparable importance was Pierre-Joseph Macquer (1718-84). It must be mentioned, however, that in the intervening years in Holland, the University of Leyden had become an important centre for medical education and particularly popular were the chemical lectures of Herman Boerhaave (1668-1738). When he found unauthorised versions of his lectures circulating among students he determined to write his own textbook. His *Elementa Chemiae* first appeared in 1732 in Latin and was later translated into English and French.

But to resume with the French tradition, by the mid-eighteenth century Lemery's text was becoming too obviously old-fashioned and Macquer brought out his *Élémens de chymie théorique* in 1749, followed by his *Élémens de chymie pratique* in 1751.[11] These went through several editions, both separately and combined as a single work. Although Macquer used the theory of the four Aristotelian elements he did so with certain reservations. Again in his chemical nomenclature, he made an attempt to replace the traditional names by more systematic ones. Particularly useful was his classification of salts into *sels vitrioliques* (sulphates), *sels nitreux* (nitrates) and *sels marins* (chlorides). He made considerable use of the idea of chemical affinity, drawing on the table of Geoffroy (1718). He did not appreciate the relevance of quantitative work in chemistry. Macquer became professor of chemistry at the Jardin du Roi in 1770.

Perhaps even more important than Macquer's textbooks was his *Dictionnaire de chymie*, first published anonymously in two volumes in 1766. If we discount earlier compilations with explanations of Paracelsian terms we may consider Macquer's dictionary to be the first real dictionary of chemistry. Being purely alphabetical, it left the reader some freedom to explore the subject in the order he wished. Nevertheless, Macquer gave advice on an order to follow but warned the reader that, before using the dictionary, it was essential that he should follow a course of practical chemistry. It was also a good idea to refer to a textbook of the subject.[12] Thus Macquer was suggesting that one could only really learn chemistry by exposure to a variety of different sources. Yet the idea of a journal of chemistry was still far in the future.

2. *Lavoisier's* 'Traité élémentaire de chimie' *and other contemporary textbooks.*

With Macquer we have reached the period of Lavoisier. The brief review given above has served to establish firstly that France had a tradition of writing textbooks of chemistry which was largely related to the lectures on chem-

---

[11] J. R. Partington, *op.cit.*, pp.80-90. There were also several French editions of Boerhaave, c.1750.

[12] A textbook currently available was that of his friend, A. Baumé, *Chimie expérimentale et raisonnée* (3 vols., Paris, 1773-4).

istry given at the Jardin du Roi. Lavoisier himself attended such lectures given by G. F. Rouelle but unfortunately, Rouelle did not publish his lectures and, therefore, does not enter our story directly. Although the French textbook tradition in a way helps to put Lavoisier's *Traité* in a proper context, in another way it raises further questions, since Lavoisier, unlike most textbook writers, did not have a teaching position. It is easy to understand how lecture notes may be developed into a book but if an author has lacked the professional motivation of the teacher, the historian must look elsewhere for motivation.

Lavoisier himself claimed in the introduction to his *Traité* that it developed from the memoir he read to the Academy of Sciences in April 1787 on the necessity of reforming chemical nomenclature.[13] Maurice Daumas, however, has argued that we should not take this claim too seriously.[14] He has shown that at least ten years previously Lavoisier had been planning to write a general introduction to chemistry, which would, of course, have been an introduction to his ideas on the subject. But quite apart from this, Lavoisier had a genuine didactic interest in a logical approach to chemistry as a reaction to what he himself had suffered when he first approached the subject:

> When I began for the first time to follow a course of chemistry, although the teacher I had chosen[15] was accepted as one of the clearest and most able to teach at the level of beginners and although he took infinite pains to be understood, I was surprised to see with how much obscurity the first approaches to the science were surrounded. I had followed a good course on physics, having followed the experiments of the abbé Nollet; I had begun elementary mathematics with some success in the works of the abbé La Caille and I had followed his lessons for a year. I was accustomed to that rigour in reasoning which mathematicians employ in their works. They never claim to prove a proposition until that which precedes it has been demonstrated. Everything is linked together, everything is connected from the definition of a point and of a line to the most sublime truths of transcendent geometry.
>
> In chemistry things were quite different. From the first steps we began to suppose instead of proving, they presented me with words which they did not know how to define or at least which they could only define by drawing on knowledge which was completely foreign to me and which I could only acquire by studying the whole of

---

[13] *Traité élémentaire de chimie,* 1789, Discours préliminaire

[14] Maurice Daumas, 'L'élaboration et la publication du "*Traité de chimie*"', Chapter 4 of his *Lavoisier, théoricien et expérimentateur*, Paris,1955.

[15] This probably refers not to Rouelle but to La Planche.

> chemistry. Thus they began to teach me the science by supposing that I knew it already.[16]

This testimony is interesting in many ways; not only is it evidence of the frustration felt by the young Lavoisier but it is evidence (even if not by an impartial witness) of how muddled chemistry could be around the 1760s. In other words it helps us to appreciate better the 'chemical revolution' of the 1780s. Could a science so obscure really be transformed in little more than a decade into a model science? Also the above passage provides a hint that Lavoisier saw chemistry as a study analagous to mathematics; in other words he saw chemistry as a physical science, a point which will be developed later.

It seems that Lavoisier had originally planned a textbook in the late 1770s but, if this was so, why had he abandoned it? The answer is given by Lavoisier. He had planned it as a joint work with his industrious early collaborator, Jean-Baptiste Bucquet.[17] But Bucquet died prematurely in January 1780 at the age of 33 and Lavoisier did not have the heart to carry on alone. The sentence he used to explain this is of great importance to the theme of this book:

> I lost the help and guidance (*lumières*) of this companion in my work and I admit that I have not found the courage to undertake such an extensive work alone.[18]

No one has taken much notice of this confession since, in so far as it relates to the writing of a textbook, we know that by 1789 Lavoisier was able to gather the energy to produce his own book. But in so far as it betrays the advantages of collaborative work, it relates very much to the *Méthode de nomenclature chimique* of 1787, involving four authors adopting complementary roles and even more to the *Annales de chimie* which we will come to in due course.

We may now turn to the *Traité élémentaire de chimie* as published in 1789. Lavoisier presented the text for approval by the Academy in January 1789 and a favourable report was given by Berthollet and d'Arcet in early February. In March the book was on sale in Paris. Later that year Robert Kerr, a Scottish surgeon, prepared an English translation which was published in Edinburgh in 1790. There were numerous editions of the *Traité* and also translations into German, Italian and Spanish. There is no doubt that it was an important book and arguably a crucial one in consolidating 'the chemical revolution'.

The *Traité* began with a 'Preliminary Discourse', which drew heavily on the writings of Condillac, particularly on the importance of language. Lan-

---

[16] Archives of Academy of Sciences, Lavoisier dossier, cote 1260, quoted by Daumas, *op.cit.*, pp.92-3.

[17] Bucquet published two books, one on mineral chemistry (1771) and one on vegetable chemistry (1773).

[18] Archives of the Academy of Sciences, Lavoisier dossier, No.1259, quoted by Daumas, *op.cit.*, p.99.

guage is an analytical tool and it is important that the language of chemistry should be in conformity with nature. We must ascertain the facts and not be led astray by our imagination. Lavoisier then turned to the theoretical basis of his book. Although many eighteenth-century chemists made use of affinity tables Lavoisier felt that affinities were still uncertain and variable and could not provide a solid foundation for chemistry.[19] Even more he rejected atoms as metaphysical.[20] Nor could he accept the idea of three or four 'elements', of which everything is made. Instead he would base his chemistry on a list of simple substances. These were presented in operational rather than absolute terms; that is to say, they behaved as simple irreducible substances in his laboratory, but this left open the possibility that some might be decomposed later, as indeed was the case when Davy used the new electric battery in the early 1800s to isolate the alkali and alkaline earth metals. In the main part of the book[21] Lavoisier gave a list of 33 'simple substances', headed by light and caloric (soon to be dropped) and including gases such as oxygen and hydrogen, non-metals such as carbon and phosphorus, 'metallic bodies' and five alkaline earths.

In the Preface Lavoisier soon raised the question of language, pointing out how arbitrary and even 'barbarous' some of the traditional chemical names were. He pointed to the greater simplicity of the new nomenclature and consequent greater ease in learning. Although Lavoisier acknowledged that he had not always done justice to his predecessors, especially foreign chemists,[22] he admitted that he owed much to his colleagues in Paris:

> If at any time I have adopted, without acknowledgement, the experiments or the opinions of M. Berthollet, Mr. Fourcroy, M. de la Place, M. Monge, or, in general, of any of those whose principles are the same with my own, it is owing to this circumstance, that frequent intercourse, and the habit of communicating our ideas, our observations and our way of thinking to each other, has established between us a sort of community of opinions, in which it is often difficult for every one to know his own.[23]

Here again is valuable testimony that Lavoisier appreciated the criticisms of his colleagues and saw the value of communal action.

The main part of the book was divided into three parts. The first part, the most important, was an elementary exposition of his theory. The second part, consisting largely of tables, Lavoisier did not claim to be original, while the third part was concerned with operations in the laboratory. The book began

---

[19] *Traité*, p.xiv, *Elements of Chemistry*, Edinburgh, 1790, p.xxi.
[20] *Traité*, p.xvii, *Elements*, p.xxiv.
[21] *Traité*, p.192, *Elements*, p.175.
[22] *Traité*, p.xxvii, *Elements*, p.xxxii.
[23] *Traité*, p.xxviii, *Elements*, pp.xxxii-xxxiv.

with a discussion of gases and the role of caloric. This led on to a discussion of the three states of matter and an analysis of atmospheric air. This was shown, both by analysis and synthesis, to consist of nitrogen and oxygen in proportions which he had found to vary. Although Lavoisier was a strong advocate of quantitative analysis, he admitted some uncertainty in his data for the proportions of gases in the air. In experiments on the combustion of sulphur, phosphorus and carbon he deliberately used oxygen gas rather than atmospheric air. This reduced the experiment to its essentials but it was also indicative that Lavoisier was pushing chemistry towards artificial laboratory conditions well removed from the ordinary world.[24] This experiment produced acids in each case, thus providing evidence for his oxygen theory of acids.[25] The following chapter reinforced the oxygen theory of acidity, a theory which, as we shall see, was soon to be criticised even by some of his associates and notably by Berthollet.

While Lavoisier dealt with oxides he was on stronger ground and the chapter dealing with the decomposition of water (Chapter 8) was also well supported by experimental evidence. When dealing with vegetable compounds in Chapter 11, Lavoisier optimistically assumed that a few simple names would be sufficient. His discussion of the fermentation of grapes prompted him to write one of the first true chemical equations, which might be quoted here in the original French since the English translator did not appreciate Lavoisier's desire to express this in quasi-mathematical terms:

le moût de raisin = acide carbonique + alcool[26]
(must of grapes = carbonic acid + alcohol)

He wrote:

> We may consider the substances submitted to fermentation and the products resulting from that operation as forming an algebraic equation; and by successively supposing each of the elements in this equation unknown, we can calculate their values in succession, and thus verify our experiments by calculation and our calculation by experiment reciprocally.[27]

A notable feature of this part of the book and several other parts is Lavoisier's insistence on reporting many detailed *quantitative* results of his experiments.

Lavoisier ended the first part of the book by saying that he would have liked to add more basic data about salts, such as their solubility in water, etc. but this was not appropriate for an elementary work. He suggested that the gathering of such data was a suitable field to employ the zeal and ability of

---

[24] *Traité*, p.xxviii, *Elements*, pp.xxxii-xxxiv.
[25] Maurice Crosland, 'Lavoisier's theory of acidity', *Isis, 64* (1973), 306-325.
[26] *Traité,* p.141, *Elements*, p.131.
[27] *Traité*, p.151, *Elements*, p.140.

young chemists.[28] Here was evidence of the audience for whom he had written the book. In France it was the book from which the young Ampère (b.1775) among many others learned chemistry. In England the same book formed the basic chemical education of the young Humphry Davy (b.1778).

It is hardly surprising that a very full and favourable review of Lavoisier's *Traité* appeared in the second volume of the *Annales de chimie.*[29] The review was by Lavoisier's collaborator on studies of respiration, Armand Séguin. He took at face value Lavoisier's claim that the book was only a development of his ideas on the reform of nomenclature. Then, concentrating on the first part of the book, he took the reader through the *Traité* chapter by chapter. He confirmed that the second part was compiled from other works, but he attached more importance to the third part on apparatus and operations, which was original:

> It was not sufficient for his glory (*sa gloire*) to have enriched science with a large number of important discoveries, he wanted to enable those who follow the same career to make new discoveries by communicating to them all the details of his procedures.[30]

Two other major text books of chemistry were reviewed in the *Annales*: Fourcroy's *Élémens d'histoire naturelle et de chimie*[31] and Chaptal's *Élémens* (Montpellier, 1790).[32] Neither of these reviews compared in length with that of Lavoisier's *Traité*, which helps to confirm his dominant position on the early editorial board of the *Annales*. Yet the textbook by Fourcroy especially was of great influence, Fourcroy being perhaps the leading French chemistry textbook author of the 1780s.

Fourcroy was a noted lecturer in chemistry. In 1784 he succeeded Macquer as professor of chemistry at the Jardin du Roi. His private lectures had already inspired him to write a textbook. He is especially interesting as a textbook author since the writing of the early editions of his *Élémens* pre-dates his conversion to the oxygen theory. Yet he spoke sympathetically of Lavoisier's work. For example, in the first edition of 1782 he wrote in the introduction that, as regards theory,

> ...my object throughout the whole has been to compare the doctrine of Stahl with the pneumatic doctrine of several modern chemists. I declare that I neither reject the one nor adopt the other.[33]

---

[28] *Traité*, p.187, *Elements*, p.172.
[29] *A.c.*, *2* (1789), 226-47.
[30] *Ibid.*, p.247.
[31] *A.c.*, *1* (1789), 244-55. (anonymous review).
[32] *A.c.*, *6* (1790), 197-204. (review by Berthollet).
[33] *Leçons élémentaires d'histoire naturelle et de chimie,* 1782, p.xxii, quoted by W. A. Smeaton, *Fourcroy, Chemist and Revolutionary*, Cambridge, 1962, p.96.

In the second edition of the *Élémens*, begun in 1784, he tended to favour Macquer's ideas, but with some inconsistencies. In 1785, after election to the Royal Academy of Sciences, Fourcroy came much more in contact with Lavoisier and was won over completely to his ideas. He therefore added a long preliminary discourse, showing how knowledge of gases enabled a new interpretation to be given to chemical reactions and in 1786 the book was finally published. For the third edition of the *Élémens*, published in the winter of 1788/89, he re-wrote much of the text, which now supported the oxygen theory without any of his previous reservations. The book was differently arranged from that of Lavoisier. Three notable differences were: firstly, that Fourcroy gave much more attention to history whereas Lavoisier wanted simply to state the basis of the new chemistry. Secondly, Fourcroy had a greater interest in chemical affinities and included diagrams showing competing affinities, which might be regarded as representing a previous generation of proto-equations. Thirdly, Fourcroy still favoured a natural history approach to chemistry. He gave a classification of minerals according to order, genus, species and variety and also included tables on the classification of quadrupeds, birds and fish. It should be noted that, even in the later editions of his book, the title placed as much emphasis on natural history as on chemistry.

We come finally to Chaptal, who wrote his textbook from the conviction that:

> chemistry is...essentially connected with the reputation and prosperity of the state[34]

He wrote as a chemical manufacturer, who combined his successful business in the Languedoc with a chair of chemistry at Montpellier. He admitted in his Introduction that he had previously taught chemistry according to the phlogiston theory, but he now fully accepted the new theory. Not, however, being one of the four contributors to the *Méthode de nomenclature chimique*, since he lived far from Paris, he was able to make the useful suggestion of substituting the term *nitrogène* for the *azote* used by the Parisian chemists. Unlike Lavoisier he chose to describe the operations and apparatus of the chemical laboratory at the beginning of his book rather than at the end. He then introduced some of the new chemical elements and their compounds. Later in the work earths were discussed and then metals. Having surveyed the mineral kingdom the remainder of the book was devoted to vegetable and animal products.

As the most prominent chemist in the south of France, Chaptal was considered an important convert by Lavoisier, who wrote to him in 1791:

> It is a real pleasure to see you adopt the principles which I was the first to announce. It is the fulfillment of my ambition to win over

---

[34] *Elements of Chemistry*, 2nd edition, 1795, p.iii.

> you, M. de Morveau, and a small number of chemists throughout Europe, and my success exceeds my expectations.... I see only elderly people, who no longer have the courage to start new studies again or who cannot adapt their imagination to a new order of things, who still cling to the phlogiston theory. All young people adopt the new theory and I conclude that the revolution in chemistry is complete.[35]

Fortunately, Chaptal was able to live in Paris from 1797/98, where he was immediately made a member of the editorial board of the *Annales* and, through a fortunate vacancy, also a member of the First Class of the National Institute.

3. *The* Mémoires *of the Royal Academy of Sciences*

Although Lavoisier's text-book was one of the most important single sources for conveying his ideas on chemistry to a wider public, and it continued to be influential even after his death, it represents the culmination of his research activities over nearly twenty years rather than the research activity itself. The best single published source for the historian who wishes to follow that research activity is the *Mémoires* of the Paris Royal Academy of Sciences. Lavoisier had first been associated with the Academy in 1768 as a supernumerary assistant member. His position had been regularised in 1772 when he became a full (associate) member.[36] Already in 1765 he had read a memoir on gypsum to the Academy.[37] In 1769 and 1770 he presented further memoirs on water to the Academy, in which by careful quantitative experiments he refuted the commonly held view that water was partly transmuted into earth by boiling in a glass vessel. A consolidated memoir on the subject was published in the Academy's *Mémoires* for 1770. The same memoir was later republished as the first of several dozen scientific memoirs by Lavoisier, mainly from the Academy publication, in the standard collection of his works.[38]

But what is really of central importance is the series of memoirs relating to the development of the oxygen theory. Thus in November 1774 he read his 'Mémoire sur la calcination de l'étain dans les vaisseaux fermés et sur la cause de l'augmentation de poids qu'acquiert ce métal', which after some

---

[35] Letter quoted by Grimaux, *Lavoisier*, 1888, p.126.

[36] Lavoisier became a senior member (*pensionnaire*) in 1778. He was made *directeur* of the Academy in 1785 and treasurer in 1791. Given the deep involvement of the perpetual secretary Condorcet in politics in the early 1790s, Lavoisier became the effective secretary in the final years of the Royal Academy and took a major part in the vain fight for its survival.

[37] An excellent guide to the dating of Lavoisier's *Mémoires* is Maurice Daumas, *op.cit.*, pp.26ff.

[38] *Oeuvres de Lavoisier* (6 vols., Paris, 1864-93), vol.2, *Mémoires de chimie et de physique*.

changes was published in the *Mémoires* for the year 1774.[39] Lavoisier often took advantage of the delay of two or three years in publishing the *Mémoires* to revise his earlier work in the light of later experience. This was the case in another memoir, originally presented in 1775 but revised in 1778, on the principle which combines with metals in calcination.[40] It would be tedious to list all the memoirs relevant to the development of the oxygen theory, but we might make an exception for the memoir in which he introduced the term *principe oxygine* as the principle of acidity (providing the basis for the name *oxygène* for the gas), published in the *Mémoires* for 1778.[41] Particularly famous is his joint memoir with Laplace on heat, which was published in the *Mémoires* for 1780.[42]

Perhaps the most famous of all was his memoir 'Réflexions sur le phlogistique', published in the *Mémoires* for 1783, but actually read to the Academy in 1785.[43] Some historians have been puzzled that Lavoisier delayed so long in launching a frontal attack on the phlogiston theory (or rather the many *theories* of phlogiston) but it is possible that in the 1770s he saw himself as modifying the old theory rather than replacing it outright. One of the last memoirs published by Lavoisier in the Academy collection was one on the subject of respiration in collaboration with Séguin.[44] The two *savants* had planned an extensive research programme on the subject and it is interesting that the next memoir on the subject was published after Lavoisier's death by Séguin and in the *Annales de chimie*.[45] In a limited sense, therefore, the *Annales* can be seen as the successor to the *Mémoires* of the Royal Academy, at least for chemical papers.

When the *Annales de chimie* was first published, the *Mémoires* of the Paris Royal Academy of Sciences was the leading scientific journal in France. All volumes began with a section called *Histoire*, which was the responsibility of the secretary. Here would be found a summary of some of the work of Academicians, the *éloges* of recently deceased Academicians and reports on prizes. It might be appropriate to look at the volume of *Mémoires* published in 1789, which actually related to the year 1787. The volume contained Berthollet's memoir on prussic acid, a mineral analysis by Sage, several short memoirs by Fourcroy and a memoir by Chaptal on 'oxygenated muriatic acid' (chlorine) by special arrangement with the Montpellier Academy to which

---

[39] *Ibid.*, p.105.
[40] This memoir was, nevertheless, published in the *Mémoires* for 1775, *ibid.*, p.122.
[41] 'Considérations générales sur la nature des acides', *ibid.*, p.248
[42] *Ibid.*, p.283.
[43] *Ibid.*, p.623.
[44] *Ibid.*, p.688.
[45] Lavoisier and Séguin, 'Second mémoire sur la respiration', *A.c.*, *91* (1814), 318.

Chaptal then belonged. However, these chemical memoirs were largely overshadowed by numerous astronomical and mathematical memoirs, Lalande and Laplace being particularly conspicuous for their industry and talent.

The Revolution of 1789 slowed down publication even further and the volume of *Mémoires* for 1788 did not appear until 1791. As for the 1789 volume, although printing of the first sheets took place in 1792, it was not completed until 1793. To be fair one should point out that the *Mémoires* usually included several complex plates and, when authors were supplied with proofs of their work, they had an opportunity not only to correct but also to amend and bring up to date their original ideas, a facility which we have noted was regularly taken advantage of by Lavoisier, thus setting a trap for later unwary historians. Quite apart from the wide variety of different sciences occupying the *Mémoires*, one can see in the regular delay of at least two years an additional justification for the separate publication of a quarterly journal devoted exclusively to chemistry and largely independent of the Academy, although its approval was still necessary for the first few issues of the *Annales de chimie*.

The provincial academies also published volumes of *Mémoires* from time to time. Some volumes of the *Mémoires* of the Dijon Academy included both arts and sciences but the volumes appearing from 1782-85 dealt exclusively with science.[46] In the 1780s the Toulouse Academy was also publishing memoirs.

4. *The* Observations sur la physique *and* the Journal des Savants.

One of the features of eighteenth-century science was the gradual replacement of the book by the memoir as the unit of scientific production. This depended on the founding of an increasing number of journals. One of the most important of these in France was the *Observations et mémoires sur la physique, sur l'histoire naturelle, et sur les arts et métiers*. The *Observations sur la physique*, often known as Rozier's Journal, was originally founded in the 1750s but was taken over by the abbé Rozier as a monthly scientific journal in 1771-72.[47] The abbé François Rozier (1734-93) invited his readers, or at least those he called *vrais savants*, to use his journal as a means of publicising their work, just as in the previous century the Minim friar Marin Mersenne had used his cell in Paris as a clearing house for scientific information. The great advance here was that whereas it was only through private correspon-

[46] Private communication from W. A. Smeaton.

[47] Much useful information on the *Observations sur la physique* may be found in E. W. J. Neave, 'Chemistry in Rozier's Journal', *Annals of Science*, *6* (1948-50), 416-20; *7* (1951), 101-6, 144-8, 284-92, 293-99, 393-400; *8* (1952), 28-45, see also D. McKie, 'The "*Observations*" of the Abbé François Rozier' *Annals of Science*, *13* (1957), 73-89. The latest general account of the *Observations sur la physique* by Anne-Marie Chouillet is to be found in Jean Sgard (ed.), *Dictionnaire des journaux, 1600-1789* (2 vols., Paris, 1991), vol.2, pp.995-8.

dence that Mersenne had disseminated information throughout Europe, Rozier was able to make good use of the printing press. The business of running the journal produced only a very small income but it attracted favourable attention and eventually the king of Poland bestowed his patronage on Rozier.

In his preface to the first volume Rozier felt it necessary to justify his journal. He pointed out that the various learned societies had made known their discoveries in their published *Mémoires*. But there were two major problems. The first was the delay of several years in publication and the second was the use in each country of the vernacular which constituted a barrier for *savants* from other countries. Progress had, therefore, been slow and *savants* might find themselves working on a problem that has already been solved by others:

> These motives led to a desire for a periodical supplied quickly and regularly, which would announce the discoveries which are made each day in the different branches of science, either by short notices or extended memoirs, which contain the development of all the proofs of the discoveries and which at the same time show the advance of the spirit of invention. It has been thought that the most prompt publication of new discoveries will at the same time accelerate the progress of the sciences, which are nothing more than the sum of these discoveries.These then are the occasions which persuaded us to undertake this collection and we present it with as much confidence to the scholar abroad as if it were their own publication. It is written in the language, which is today that of those in Europe, who have received any education.....[48]

The *Observations* was to be a repository of useful information which would cover knowledge of the three kingdoms of nature, and also of medicine and agriculture. One notices the extremely wide coverage. In 1778, apparently under some pressure, Rozier explicitly ruled out specialising in any one branch of science, saying:

> Memoirs can only be printed in their turn and according to the order demanded by the material for each month's issue. An issue that dealt exclusively with chemistry, for example, would displease those who are not initiated into that science, and so on and so forth. It is therefore necessary to diversify subjects.[49]

This comment reveals the intellectual gap between the *Observations* and the *Annales* only ten years later. Yet Rozier insisted that he had standards. He warned that he would reject mere 'undigested compilations' or those which

---

[48] This extract is quoted in the translation by David A Kronick, *A History of Scientific.....Periodicals*, 2nd edn., Metuchen, N.J., 1976, p.108.

[49] *Obs, 11* (1778), Avis essentiel, quoted by J. E. McClellan, 'The scientific press in transition: Rozier's Journal and the scientific societies in the 1770', *Annals of Science*, *36* (1979), 425-449 (437).

offered no more than idle amusement. Rozier had a special interest in agriculture but he did not allow this to distort the balance of the journal, which actually devoted quite a prominent place to chemistry as a consequence of the work of the pneumatic chemists, Black, Cavendish, Priestley and others. In the words of a scholar, who made a special study of the subject,

> The catholicity of Rozier's knowledge made him the ideal editor for a [general scientific] journal of this type. His sound judgement and careful choice of material and contributors assured the success of his Journal.[50]

Rozier edited the journal on his own until 1780, when he invited his nephew Jean-André Mongez (1751-1788) to join him. Mongez was another cleric with a great interest in science, especially mineralogy. He perished as a member of the ill-fated La Pérouse expedition (1785) some time after reaching Australia. It is possible to follow the progress of several sciences and particularly chemistry in the pages of the journal through the 1770s and 1780s. The introductory volume gave French translations of key papers by Black 'On magnesia alba', by Priestley 'On different kinds of air', by Daniel Rutherford 'On mephitic air' and a précis of Jacquin's memoir on the rival theories of causticity of Meyer and Black. The later work of Priestley and Scheele was also published.

The high moral tone of the editor and the monthly publication appealed to many members of the Paris Academy of Sciences, who were glad to have their memoirs published promptly rather than depending entirely on the Academy's own creaking mechanism for publication two or three years after the memoir had been presented. Thus the issue of the *Observations* for December 1774 carried Lavoisier's memoir on the calcination of metals in sealed vessels, which he had read to the Academy on 12 November.[51] Earlier that year it had published two memoirs by Bayen on mercury precipitate, publications which were later to be used by Lavoisier's enemies to undermine his claims to originality. Over the next few years Lavoisier was to be a frequent contributor to the *Observations* but it is notable that he made much less use of it in the 1780s particularly from 1785, when La Métherie took over the editorship.

Lavoisier would often publish a memoir in its original form in the *Observations* before revising it and re-presenting it to the Academy, which would later publish this second version.[52] Thus in April 1775 he read his famous paper 'Sur la nature du principe qui se combine avec les métaux pendant leur calcination et qui en augmente le poids' and it was immediately published in

---

[50] Neave, *op.cit.*, p.419.

[51] Maurice Daumas, *Lavoisier, théoricien et expérimentateur*, 1955, p.34.

[52] Denis I. Duveen & Herbert S. Klickstein, *A Bibliography of the Works of Antoine Laurent Lavoisier, 1743-1794*, 1954, pp.12, 33-34, 38.

the May issue of the *Observations*.[53] Lavoisier then revised the paper, taking into account some recent work by Priestley, and read it a second time to the Academy in August 1778. It was in this revised form that it appeared in the Academy's *Mémoires* misleadingly dated 1775.[54] It was in the *Observations* that Guyton de Morveau published his memoir on the desirability of reforming chemical nomenclature[55] and Berthollet published several important memoirs including one on 'dephlogisticated marine acid' (chlorine) in 1785.[56]

In any history of science publishing in France some mention must be made of the venerable *Journal des savants*. Originally published in January (?) 1665, it has some claim to be the oldest continuously surviving science journal[57] in the world, anticipating by several months the *Philosophical Transactions*, published for the Royal Society of London by its secretary Henry Oldenburg. Yet while *Phil.Trans* was devoted entirely to communications to the Royal Society which were, at least in principle, concerned with scientific matters, the *Journal des savants* was as much a literary journal as a scientific one. In fact it was largely devoted to the review of serious books on all subjects including science. A critic writing in 1704 remarked that such a journal was intended to serve those who were either too busy or too lazy to read entire books; nevertheless, he admitted that it performed a useful service.

In theory the *Journal des savants* was the only periodical devoted to literature and science in France in the late seventeenth and early eighteenth centuries. The privilege granted to it in 1729 covered a wide range of subjects.[58] It had the exclusive right to review books on geography, chemistry, botany, astronomy, architecture, painting, sculpture, numismatics and several other subjects. An examination of the contents showed that at one time 25% of the books reviewed were classified as 'sciences et les arts' (which included medicine and technology), 23% on history, 20% belles lettres and 18% theology. Later in the eighteenth century the proportion of theology declined and new subjects such as political economy appeared. In its early years the *Journal* probably played a significant part in the diffusion of Cartesian science. Later it at least served to keep a general audience in touch with some major scientific publications. However, once the *Observations sur la physique* ap-

[53] *Obs.*, *5* (1775), 429-33.
[54] *Mémoires de l'Académie Royale des Sciences*, 1775 [1778], 520-26.
[55] *Obs.*, *19* (1782), 370-82.
[56] *Obs.*, *26* 1785), 321-5.
[57] The *Journal des savants* appeared in 111 quarto volumes between 1665 and 1792. A brief account of the *Journal des savants* is given in E. Hatin, *Bibliographie historique et critique de la presse périodique française*, Paris, 1866 and a longer account in E. Hatin, *Histoire politique et littéraire de la presse en France*, (6 vols., Paris, 1859), vol.2, pp.151-217.
[58] Claude Bellanger *et al.* (eds), *Histoire générale de la presse française*, vol.1, Paris, 1969, pp.200-206.

tore necessary to diversify subjects

peared regularly in the 1770s, the *Journal* was quite overshadowed as far as science was concerned.

In the seventeenth century a single editor had been responsible for the *Journal* but after 1701 it was felt impossible for a single individual to cover the entire field of book production and a number of co-editors were appointed to be responsible for different areas, one such area designated being medicine and science. The *Journal* continued to focus on the description of recently-published books, often giving suitable extracts, but it declined the responsibility of judging the merits of the books - this was left to the reader. There were several interruptions in publication of the *Journal* and also in its frequency. Thus in 1724 it changed from a weekly publication to a monthly. From 1778 individual articles bore the names of their authors. In 1791 the contents of the *Journal* began to reflect current social and political concerns but publication ceased in November 1792. There was a proposal to revive the *Journal* in 1796 but this came to nothing and it was not published again until 1816, perhaps more as a conscious link with the ancien regime than a reflection of an appreciation of the more specialist interests of the nineteenth century. Biot and Gay-Lussac agreed to be associated with the science side of the journal but the latter found himself in an invidious position because of his editorship of the *Annales* and resigned early in 1817, to be replaced by Dulong.

There were also under the ancien regime several shorter-lived journals which published some scientific work, for example the *Avant coureur*, which operated from 1760 to 1773[59], and there was also the *Journal polytype des sciences et des arts.*[60]

5. *Different types of scientific discourse.*

Although most of the emphasis in the study of the *Annales* will be on its production and contents, one cannot ignore entirely the style of presentation. It may be useful to compare and contrast the style of Lavoisier's textbook of 1789, the *Traité élémentaire de chimie*, with the style adopted in the *Annales de chimie* about the same time. There are some very striking differences and a few similarities.

In the Preface to the *Traité*, Lavoisier placed great emphasis on the order of the presentation of material, particularly in Book 1.[61] He said that in writing the book he had determined

---

[59] W. A. Smeaton, 'L'Avant Coureur. The journal in which some of Lavoisier's earliest research was reported', *Annals of Science*, *13* (1957), 219-234.

[60] D. I. Duveen and H. S. Klickstein, 'Le Journal Polytype des Sciences et des Arts', *Papers of the Bibliographical Society of America*, *48* (1954), 402-410.

[61] *Traité élémentaire de chimie*, Paris, 1789, vol.i, Discours préliminaire, p.xxix.

> always to arrange the facts and the conclusions which are drawn from them in such an order as shall render it most easy for beginners in the study of chemistry thoroughly to understand them.[62]

The author pointed out that in so doing he was departing from the usual order followed in treatises of chemistry, which usually assumed the first principles of the science before they were explained in later chapters. Lavoisier also prided himself on the fact that, unlike his predecessors, he made a practice of defining any new term before using it. He claimed that under the old system it was 'almost impossible to become a chemist in less than three or four years of constant application'. But such difficulties were not inherent in the subject. By introducing what he claimed was a 'natural order' chemistry could be learned much more easily. All this shows that in his *Traité* Lavoisier had given considerable thought to the didactic function of the book. Also Book 3 was devoted to chemical procedures:

> The method of performing experiments, and particularly those of modern [i.e. Lavoisian] chemistry, is not so generally known as it ought to be; and had I, in the different memoirs which I have presented to the Academy, been more particular in the detail of the manipulations of my experiments, it is probable I should have made myself better understood, and the science might have made a more rapid progress.[63]

One could draw several different conclusions from this statement. The main conclusion we would like to draw is the difference in presentation when one is addressing students and when one is addressing one's peers. Lavoisier admitted that some of his memoirs presented at meetings of the Academy of Sciences had not contained sufficient experimental details for any later reader to be able to repeat the experiment.[64] The same may be said of many other prominent men of science, including Newton's first paper on optics to the Royal Society (1672), in which he described in general terms his (now famous) prism experiment. His failure to provide the essential experimental details or a diagram resulted in considerable misunderstanding about the experiment for several years. When he wrote his *Opticks* in 1704 he was able to make good these deficiencies. Similarly Lavoisier, through his text book, was able to give more attention to the experimental details for the benefit of beginners, from whom no background knowledge could be assumed. An interesting feature of the *Annales* was that details of experiments tended to be given increasing prominence in the later volumes. One may conclude that as a matter of experience there had been a number of fruitless controversies due to

---

[62] *Ibid.*, p.xi.

[63] *Ibid.*, p.xxx.

[64] For a discussion of the repeatability of experiments see H.M. Collins, *Changing Order. Replication and Induction in Scientific Practice*, Chicago, 1985, pp.18-20, chapter 2.

difficulties in repeating experiments. Possibly impure reagents, variations in heating and the presence of air or moisture would lead to discrepancies in the results of experiments. Hence a greater specification of laboratory details was desirable.

Of Part 2 of the *Traité*, devoted mainly to the nomenclature of salts, Lavoisier wrote with uncharacteristic modesty:

> This part contains nothing which I can call my own.[65]

He also mentioned in the Preface that, while in the first part of the book he made continual reference to his own experiments, he did not necessarily claim that they were entirely his own. He warned his readers that, as he frequently worked with colleagues such as Berthollet and Fourcroy, and they all discussed their ideas openly, it was possible that he might be making use of an idea that had originally come from one of his colleagues. He spoke of their 'community of opinions' (*une sorte de communauté d'opinions*) in which individual 'ownership' of ideas was difficult to sustain.[66]

This idea of representing the work of a whole school of chemistry rather than an individual may be compared with the style of the *Annales de chimie*. In a sense each volume was the responsibility of the full editorial board, whose names were printed on the title page. Yet the memoirs within the volume were the unique work of their respective authors. Whereas in their text books Lavoisier and Fourcroy were addressing students, even beginners in the science, in their contributions to the *Annales* they were addressing their 'colleagues'. At least this is the pretence which was built up, eminently flattering to the amateur chemist or obscure pharmacist who were to be found among the readers. Through subscriptions the editors were trying to build up a readership which was effectively a scientific community of chemists. Whereas a text-book was written at an introductory level, a paper in the *Annales* was presented as a piece of research. Whether constituting an analysis, a report or even a 'discovery', it provided an example of the work of the chemist. While for some readers an article might be of no more than general interest, for others it might constitute a model of how a chemist should work and report his work. The *Annales* had some importance as a recruiting sergeant. Of course, if any new reader were to take up the *Annales* in mid-series, he would find that (unlike Lavoisier's *Traité*) there was no special order of contents. This might present a difficulty for someone fairly new to the science, who might feel all the more need to purchase the earlier volumes. If he was able to go right back to the first volume, he would find a

---

[65] Lavoisier, *Traité*, p.xxix.

[66] *Ibid.*, pp.xxviii-xxix (my italics).

Preface, which in some ways presented a rationale for the whole work, just as the Preface to the *Traité* did.

In the next chapter we shall discuss the historical precedent for the *Annales* of Crell's *Chemische Annalen*. In our summary of Crell's pioneering chemical journals we shall mention two important new attitudes to the publication of chemical research. One was the request for small units of information. Crell was happy to publish reports of single experiments or of a few analyses. It was no longer necessary to build up a whole programme of research or a new theory such as would fill a book. The second point was Crell's decision to abandon the title of *New Discoveries* (*Neue Entdeckungen*), which might seem too high powered to some potential contributors. It should not be necessary to rank oneself as a genius to publish; it was sufficient to apply standard methods to new materials. The result of these invitations was to produce something like a patchwork rather than a single garment. By encouraging comparatively low-level contributions Crell was eventually flooded to the extent that in 1785 he had to begin a supplementary journal to take the overflow. It is interesting that when the French *Annales* was confronted with an excess of material, the editorial board preferred to reject the lower quality rather than use it in an overflow journal, as proposed by Van Mons.[67]

Sometimes the contents of the *Annales* represented a dialogue.[68] That is to say that a sequence of papers would be published by two authors, each taking up the other's remarks in turn and examining an issue from two different points of view. Sometimes the style was almost conversational. This would often be the case in correspondence and sometimes the editors would reply. In exceptional cases different members of the editorial board might even 'talk' to each other through the medium of the *Annales*. There was certainly a collective ethos adopted in the journal. Rather than an individual author giving his opinion, as in a book, various contributors would refer to each other's work, sometimes criticising, sometimes praising, sometimes challenging. In the case of Guyton's advocacy of chlorine as a disinfectant,[69] the collection of papers echoing the use of the method might almost be described as a chorus.

From its very first issue the *Annales* made good use of abbreviated versions of papers, particularly papers read to the Academy of Sciences, rather than giving the full text. In this way, they were able to provide the essentials of many more papers than if they had insisted on reproducing the text of memoirs verbatim. Indeed the first issue made so much use of abstracts

---

[67] See Chapter 3, Section 5.

[68] For a discussion of the style of some early scientific journals see Peter Dear (ed.), *The Literary Structure of Scientific Argument. Historical Studies*, Philadelphia, 1991, Chapters 1 and 2.

[69] See Chapter 7, Section 7.

('extraits') that its publication in 1789 may almost be considered to mark a stage in the history of publication. The abstract had the further advantage that it did not affect the possibility of the Academy publishing the paper in its *Mémoires* in due course. This would not consitute duplication.

Volume one began with an 'extrait' in 13 pages of a memoir on tin chloride read to the Academy by Adet in 1788. There were also abstracts of memoirs by Berthollet and Fourcroy and an Academy report by Lavoisier and Berthollet on a memoir by Chaptal. In the case of a short memoir by Lavoisier on the oxides of iron, this was given in full, not only because it was by Lavoisier but also because it was short. 'Extract' (*'extrait'*) did not have its literal meaning of the reproduction of the original words, but rather a summary. Style was less important than information. The term 'extrait' was used a dozen times in the titles of articles (and letters) in volume one, making it clear to readers that the editors had tried to convey the basic information in the minimum of space.

In the subsequent volumes of the *Annales* one finds the term 'extract' used in a very loose sense not only for memoirs and letters but even for a book review of Lavoisier's *Traité*. The principle of compression, however, continued. In volume two it was applied in a new way by giving in one article an abstract of *several* memoirs by Coulomb on electricity. Again volume three began with an 'exposition abrégé' of Haüy's theory of the structure of crystals. This was based not only on his book on the subject, but also referred to more recent memoirs he had presented to the Academy. The most regular abstracts, however, were from foreign journals, most frequently Crell's *Annalen*. Although the original German authors would often have used a phlogistic nomenclature in the 1790s, the summaries that appeared in the *Annales* would usually be translated into the new nomenclature.

Although 'Extract' was a favourite title, particularly in the early volumes, a general study of the titles of papers shows the frequent occurrence of other key words in the titles of papers: Memoir, Report, Notice, Note, Letter, Analysis, Researches, Essay, (New) Experiments, Observations, etc. Unlike a book, the contents of each volume of the *Annales* would have a miscellaneous character, which precludes some neat generalisation about style. The list of contents would be displayed at the end of each volume in the traditional French manner and it would be left to the reader to select those items of special interest to him. In other words, unlike a book, it would not be expected that the reader would start at the beginning and read through the whole systematically. There was a varied menu to suit a variety of tastes but all presented as a part of chemistry or at least related to it.

6. *Texts and authority*

Looking at the various contributions to the *Annales*, one occasionally finds the personality of the author shining through. The modern scientific paper normally makes use of the passive voice, thus reducing the personal role of the author in the work reported, which in a sense could be by anyone.[70] On the other hand in the early *Annales* it was quite common to use the active voice and the first person singular. In a report to the Academy use would be made of the third person, as also when someone reported the contents of a letter he had received. But many articles included a mixture of styles. Thus Dietrich reported on a mineralogical society at Chemnitz in the third person and then added his personal reflections.[71] Like many other authors, he also used the form '*on*', as in '*on espère*' (it is hoped), which amounts to the use of the passive. Exceptionally in a letter[72] Guyton made use of the second person ('*vous trouvez*') as well as the imperative. There was clearly no editorial policy of adopting a uniform style. For a contribution in a foreign language the editors would take the trouble to provide a French translation and this was enough. Probably there would be discussion from time to time about whether phlogistic terminology should be retained. A rare example of such terminology is an article by Westrumb, originally published in Crell's *Annalen*.[73]

Given the miscellaneous content and range of different styles of the papers, it would not be profitable to try to characterise the typical paper. However, it might be of interest to consider the philosophy of the editorial board of the *Annales*. In the introduction to the first volume[74] there is constant use of the rhetoric of the Enlightenment. This is consonant with Lavoisier's personal philosophy and it is very likely that he was its principal author. The passage begins with the hope of bringing chemistry to perfection and one finds also an expression of a cosmopolitan attitude to international co-operation; above all there is talk of the progress of science. Again, in the prefatory note attached to the reissue of volume one[75], there are two separate references to progress. The idea that all the sciences are connected also belonged to the Enlightenment, receiving its most famous expression in the writings of Condorcet. The Introduction of 1789 ends with a declaration of respect for the opinions of others, in other words, toleration, which fits in well, although it may also be

---

[70] G.N. Gilbert, 'The transformation of research findings into scientific knowledge', *Social Studies of Science*, *6* (1976), 281-306 (285).

[71] 'Avis de M. le Baron de Dietrich sur l'institution de la Société de l'art de l'exploitation des mines établie à Schemnitz en Hongrie', *A.c.*, *1* (1789), 116-142.

[72] 'Lettre de M. de Morveau à M. le president de Virli', *A.c.*, *1* (1789), 106-7.

[73] 'Nouvelles expériences sur la combustion de différens corps dans l'acide muriatique déphlogistiqué (oxigénée)', *A.c.*, *6* (1790), 240-274. This gives translations into the new nomenclature in parenthesis throughout.

[74] Appendix 1, No.3.

[75] Appendix 1, No.5.

seen as a ploy to enroll contributors and/or readers not yet fully converted to the new chemistry. The same may be said about the emphasis on co-operation, which was a good way to enlist further support.

In the same vein some people might want to argue that the emphasis on the applications of chemistry was merely a device to bolster the attraction of the new periodical. People are impressed by ideas which bring tangible results. But surely the last interpretation is too cynical. It would be preferable to explain the concern with applied science as a genuine commitment, especially in time of revolution and war. To speak about the many possible applications of chemistry was not mere rhetoric. Lavoisier himself published two long articles in the *Annales* on applied chemistry, an area of interest to most of his colleagues. The proportion of articles on applied chemistry increased from about 15% in 1789 to nearly 40% in 1793, in time of war, and averaged around 30% in the remaining years of the first series.[76] Such articles would be of special interest to readers engaged in certain branches of industry and commerce. On the other hand the rhetoric of the Enlightenment would have found an echo among other readers of the *Annales*, professional men including physicians, who felt that they should keep abreast with developments in this new science, even though they might not use it directly in their own work.

Apart from the two introductions, there is hardly occasion to study Lavoisier's prose, since we are essentially dealing with an editor rather than an author. Some people might be surprised that, after taking such a prominent part in founding the journal, he hardly appeared at all as a contributor. This may be because a journal provides a public forum for an author's ideas rather than simply a platform.[77] In other words the author exposes himself to criticism and even to possible contradiction. It has been suggested that a fundamental change in group identification occurs when a contributor to a periodical presents his work for the scrutiny of his peers.[78] Lavoisier, the recent author of the didactic *Traité élémentaire*, could no longer adopt the role of the expert informing the uninitiated. Indeed the bulk of his few contributions to the *Annales* were on applied chemistry, relating to saltpetre[79] and to agriculture.[80] As far as theory was concerned, he now left it to his associates to expound. Thus in volume three there is a very long article by Séguin on ca-

---

[76] Evidence supplied by S. Court.

[77] C. Bazerman, *Shaping Written Knowledge*, 1988, p.143.

[78] *Ibid.*, pp.139-40.

[79] 'Mémoire pour déterminer le titre ou la qualité du salpêtre brut', *A.c.*, *15* (1792), 225-266, 'Suite du mémoire sur le salpêtre', *A.c.*, *16* (1793), 3-39. Such long memoirs may be contrasted with a 12-page memoir on the combustion of iron in volume one and five pages on platinum in volume five - his only contributions on pure chemistry.

[80] 'Résultat de quelques expériences d'agriculture', *A.c.*, *15* (1792), 297-316.

loric.[81] This article, with its historical dimension and its long explanatory footnotes, was more like a chapter of a textbook than a contribution to a periodical.

There has been some interest lately in the study of rhetoric in science, a tendency to look less at any new ideas or data than how they were presented. But it is in the early stages of publication of a new theory that presentation is most important. We may recall the difficulties experienced by the young Newton in 1672 in presenting his new and controversial theory of light. The many objections raised by his contemporaries were enough to persuade him not to publish any further research in the new periodical of the Royal Society. His more considered presentation of his work on light came only in 1704 and then in the form of a book. As his fame grew, however, Newton's prose came to matter less than his authority and this authority reached its peak in the century after his death. What he had written was all important; how he had expressed these ideas was now less relevant. Similarly, in a study of Lavoisier, it was in the early stages of his development of the oxygen theory that presentation was most important. Lavoisier's *Traité* represented his last sustained attempt to argue for the new theory. The *Annales* was less concerned with persuasion than reinforcement. After the *Traité* Lavoisier had confirmed his position as the leading chemist of his time, but he did not have to depend on his own personal authority alone.[82] He had increased that authority by winning over to the new theory the other leading French chemists and it was under their collective names that the *Annales* appeared. One of its most important tasks lay in raising the consciousness of readers in the new chemistry. The chemists now constituted a growing scientific community. Unlike their alchemical or artisan forebears, they could hold up their heads as the representatives of a new science, a unified quantitative science with its own nomenclature, a situation which might be regarded with envy by colleagues in some neighbouring sciences.

In some recent studies of the sociology of science particular attention has been directed towards texts[83] on the grounds that their credibility depended principally on the style in which they were written. Of course by around 1800 readers would expect firm experimental evidence clearly set out and based on the use of standard techniques and instruments, but credibility would also de-

---

[81] 'Observations générales sur le calorique et ses différens effets, et réflexions sur la théorie de MM, Black, Crawford, Lavoisier et Laplace sur la chaleur animale et sur celle qui se dégage pendant la combustion; avec un résumé de tous ce qui a été fait et écrit jusqu'à ce moment sur ce sujet', *A.c.*, *3* (1789), 148-242 with corrigenda in *A.c.*, *5* (1790), 191-9.

[82] Thus Prevost argued that some statements in Lavoisier's *Traité* depended more on his authority ('l'autorité dont ce célèbre chimiste jouit dans le monde savant') than any logical claim. *A.c.*, *50* (1804), 59.

[83] E.g. Alan G. Gross, *The Rhetoric of Science*, Cambridge, Mass., 1990.

pend to some extent on the credentials of the author. It would make a difference whether he was, say, a provincial pharmacist, the author of a standard textbook or (particularly after 1795) the holder of a prestigious position in French higher education. But, covering all individual contributions, was the umbrella of prestige and credibility offered by the distinction of the editorial board of the journal in which it appeared. (The status of the papers would have been quite different if they had appeared independently as pamphlets.) As a journal the *Annales* was unique in having all the leading chemists of one country on an active editorial board. The authority of the senior editors was based not only on their position as Academicians and the authors of standard scientific works but was also related to the growing acceptability of the oxygen theory.

The international character of the *Annales* also gave it greater authority. If the periodical had consisted merely of the publications of French (or even Parisian) chemists, it might have been regarded as the house journal of one particular research school (to use modern terminology), or the opinions of adherents to one particular theory. In the introduction of 1789, however, it was claimed that the *Annales* was in principle open to all. Lavoisier and his colleagues wanted to take over from La Métherie's journal the status of being the principal international journal for the publication of chemical research.

By implication the inclusion of an article in the *Annales* meant that the editors considered it of some value. Of course this did not mean that the editors guaranteed the authenticity of all the work described, but one sentence in the introduction to the first volume suggests that they were hoping to repeat some of the more interesting and original experiments described to confirm their authenticity.[84] In practice this was hardly possible; instead they tended to fall back on the authority of reports of the Academy of Sciences, which often involved the repetition of experimental work.[85] Nevertheless, such direct authentication could only apply to a small proportion of papers published.

---

[84] '... ayant formé le projet de répéter les expériences intéressants qu'on aura pu faire, nous présenterons les résultats qu'elles auront eu entre nos mains'. Avertissement *A.c.*, *1* (1789), Appendix 1, No. 3, last paragraph. For a discussion of the repeatability of experiments see H.M. Collins, *Changing Order. Replication and Induction in Scientific Practice*, Chicago, 1985, pp.18-20, chapter 2.

[85] See chapter 8, section 5.

CHAPTER THREE

THE *ANNALES DE CHIMIE*

> Since the time when people began to study chemistry, they have never been involved in so much activity as to-day in order to bring it nearer to perfection. But it will proceed more rapidly and procure for society in a more certain way the advantages to be expected of it if men of science of different countries have greater opportunities to make a reciprocal exchange of their discoveries.
>
> (Avertissement, *A.c.*, *1* (1789) - See Appendix 1, No.3.)

> The *Annales de Chimie* ...[is]... a most admirably conducted work. Unlike the crude and undigested scientific matter which suffices (we are ashamed to say it) for the monthly or quarterly amusement of our own countrymen, whatever is admitted into *its* pages has at least been taken pains with and, with a few exceptions, has sterling merit.....
>
> (John Herschel, art 'Sound' (1830), *Encyclopaedia Metropolitana*, Vol.4, 1845, p.810n.)

1. *Crell's* Annalen: *a precedent in a German context.*

The immediate inspiration of the *Annales de chimie* came from Germany in the form of Crell's *Chemische Annalen*, which deserves a brief review here. But we must also comment on the general situation in Germany, which in the eighteenth century was politically fragmented into many confederate states, including several kingdoms, principalities, duchies, etc.; yet already there was evidence of the rise of Prussia and the city of Berlin, which eventually was to become the national capital city.

The late eighteenth century witnessed a significant growth in book publication in the German states. Even more remarkable was the growth of periodical literature.[1] In the 1780s no less than 1,225 periodicals were launched in

---

[1] Joachim Kirchner, *Das Deutsche Zeitschriftwesen: sein Geschichte und seine Probleme*, Wiesbaden, 1958, Teil 1, quoted by Thomas H. Broman, 'J.C. Reid and the "Journalisation"

German-speaking parts of Europe, which amounted to a doubling of new periodical titles in the previous decade. Admittedly a large proportion of these did not survive beyond the first few years. Many were intended purely for local circulation but there were also some addressed to German-speaking readers throughout central and northern Europe. They included a significant number of medical journals, some for popular consumption, but others addressed to different groups within the medical profession. It is against this existing market for medical and paramedical journals that we must understand the emergence of Crell's journals. For although he came increasingly to stand for the subject of chemistry, a significant proportion of his readers were pharmacists.

Florens Lorenz Friedrich Crell was born in 1745 in the quiet university town of Helmstedt, mid-way between Berlin and Göttingen. He came from a medical family and he in his turn studied medicine. After graduating M.D., Crell set out on a European tour, which included Paris, Edinburgh and London. In 1771 he obtained a post teaching metallurgy but in 1774 he returned to Helmstedt to take up a position teaching medical theory and materia medica. By 1777 he was planning to edit a 'chemical magazine'', which actually took him longer than he had planned.[2]

Volume 1 of his *Chemisches Journal* appeared in 1778. Much of it was written by Crell himself but there was also a section containing extracts from memoirs originally published in the *Philosophical Transactions* of the Royal Society of London and the *Mémoires* of the Berlin Academy. In the Introduction to the volume he boasted of the high reputation of German chemistry. The German states had after all made important contributions to the early history of mining, metallurgy and chemical analysis; also the influential phlogiston theory was largely the work of G. E. Stahl (1660-1734). Yet Crell's fellow countrymen often failed to report their individual discoveries because there was no obvious medium for the publication of a short paper and they usually did not have enough material to make up a book. Young Crell had, therefore, appointed himself reporter of chemical experiments for the German states and he promised to repeat any major experiment in order to help guarantee its authenticity. He also intended to review new books on chemistry.

The preparation of this volume marks Crell's real entry into chemistry. Previously he had been a medical doctor with an interest in chemistry. Now he saw himself as a chemist with a mission. The first volume of the

---

of Physiology', in Peter Dear (ed.), *The Literary Structure of Scientific Argument. Historical Studies*, Philadelphia, 1991, pp.13-42 (18).

[2] Most of the description of Crell's journals is based on Chapter 5 of Karl Hufbauer, *The Formation of the German Chemical Community (1720-1795)*, Berkeley, Cal., 1982.

Chemisches Journal received favourable reviews, but Crell could not long continue on his own. He again launched a call for contributions, appealing to the patriotism of his colleagues. By implication his standards of acceptance of material were not going to be very high. His appeal met with some success and, after the first two annual volumes, he planned to bring out further volumes every six months. From the sixth volume onwards he included extracts from his growing correspondence.

But, given the multiplicity of small German states, there were bound to be rival journals on the horizon, for example, J.A. Weber's new *Physikalische-chemisches Magazin für Aerzte, Chemisten und Künstler*. Crell took advantage of the opportunity of writing an anonymous review of this journal to suggest that it would be better if medical articles were submitted to a medical journal and chemical articles to Crell's journal! In 1779 a journal for apothecaries began publication: *Almanach oder Taschenbuch für Scheidekünstler und Apotheker*. Crell did not regard this as a serious rival so long as it confined itself to a basic educational task.

By 1781 the rate of contributions to Crell's journal had built up sufficiently for him to start quarterly publication. Also his fame had increased and the new Duke of Brunswick appointed him Councillor of mines, a post with a good salary but few duties. Accordingly in 1781 he re-launched his journal with a new title: *Die neuesten Entdeckungen in der Chemie* ('the latest discoveries in chemistry'), which he dedicated to his new patron. Planning to add greater lustre to his journal, he wrote to Joseph Black, whom he had met in Edinburgh, and to Torbern Bergman in Sweden, asking for contributions. Black, however, provided very little and Bergman, although more co-operative, died in 1784. Meanwhile Crell was consciously collecting memberships of different scientific societies at home and abroad, which he proudly displayed after his name on the title page of his journal. By 1784 he had collected twelve.[3]

With contributions coming from all quarters, he was now ready to transform his journal into a monthly and he mentioned that this would help to secure claims of priority. He now considered his journal was a true periodical (*eine eigentliche periodische Schrift*) and he intended to call it his *Chemische Annalen*.[4] He was particularly anxious to encourage young chemists, whose talents might otherwise have remained unknown. The journal also had an edu-

---

[3] By 1789 their number exceeded 20. Yet Crell was not alone in displaying membership of scientific societies on the title page of his publications. Lavoisier's *Traité* shows him as the member of four French and eight foreign societies.

[4] *Chemische Annalen für die Freunde der Naturlehre, Arzneygelahrtheit, Haushaltungskunst und Manufacturen*. This title was chosen to allay the fear in some quarters that, as the title of the quarterly had suggested, he was only interested in publishing important discoveries and new experiments.

cational role. He hoped that it would become usual for 'apprentices of the most considerable branches of chemistry - smelting, pharmacy and chemical manufacturing - to strive for enlightenment and to read chemical publications.'[5]

Within a year of publishing the *Annalen* (1784) the stream of material reaching Crell had turned into a flood. Rather than rejecting a large number of articles or subjecting them to considerable delay, Crell founded a supplementary journal: *Die Beyträge zu den chemischen Annalen*. Three issues of this journal were published in 1785 and 1786 and four in 1787. Then the amount of material subsided and he only needed two issues in 1788 and one in 1789. He was particularly proud to publish major German contributions in his *Annalen*, for example Klaproth's discovery of two new earths in 1789. The *Annalen* continued till 1804 when, after a meeting with A.F. Gehlen and other chemists, he agreed to merge his journal with the *Allgemeines Journal der Chemie*. Here is a reminder that Crell had to cope with competition from chemists at other German academic centres, including Trommsdorff at Leipzig and Göttling at Weimar.

Although Crell's *Annalen* was in some ways the inspiration of the French *Annales*, there were probably more differences than similarities. In the loose federation of German states sharing only a common language Crell fulfilled an important function in bringing together a scattered community. He did this by repeated appeals to patriotism, making great claims for the superiority of German chemistry but hinting that he needed all the help he could get to beat off competition from other countries with 'the fatherland of chemistry'.[6] The decentralisation of Germany may be contrasted with the extreme centralisation of France based on Paris. The editors of the *Annales* were proud to be French but they were much more cosmopolitan and had European perspectives. From the beginning they had great authority and there was no lack of talent on the editorial board. By way of contrast, Crell took sole responsibility for his journal. He started as an unknown, and gradually built up greater authority as German chemists responded to his call for papers. He built his career on their contributions, but he built his authority on his correspondence with leading members of scientific societies from all over Europe, who responded by electing him to membership. These memberships of scientific societies he presented on the title page of his journal as his credentials. While they did not truly represent Crell's eminence as a chemist, they were an indication of his many contacts. He had done much to build up a German chemical community and a network of scientific correspondents in other countries. Crell saw his

---

[5] From a circular published in Baldinger's *Medicinische Journal* (1784) quoted by Hufbauer, *op.cit.*, p.78.

[6] Crell's *Annalen*, 1786 (2), Vorbericht.

mission essentially as consolidating the growing subject of chemistry in the German states. But in the 1780s chemistry was undergoing not evolution but revolution. For the new chemistry we must turn in succeeding sections to the situation in France. It is ironic that Crell, a pioneer of chemical journals and the inspiration of the *Annales de chimie*, should have been an opponent of the new French nomenclature and a chemist, who was most unwilling to accept the oxygen theory. As late as 1796 he argued that it was possible to combine parts of the old and the new theories and he never accepted the whole oxygen theory.[7] It would have been quite inappropriate for such a person to continue as editor of a major chemical journal in the nineteenth century.

One final factor, which may deserve a mention, is censorship,[8] although this affected mainly works considered politically subversive or harmful to morals. The political fragmentation of Germany, that complex patchwork of independent and semi-independent territories, makes it difficult to generalise, since books forbidden in one state were often tolerated in neighbouring states. Censorship was particularly strict in Prussia under Frederick William II (1786-97), but this hardly affected scientific publications. However, the events in France of 1789, which resulted in a great relaxation of censorship there, led in the German states to a reaction, resulting in a greater degree of political censorship.

2. *French periodicals and newspapers: challenges to censorship on the eve of the Revolution.*

There had been a fairly strict system of pre-publication censorship in eighteenth-century France. Censors were particularly keen to ensure that nothing was published which was hostile to the king, the Church or morality.[9] One of the more enlightened instruments of government policy in the mid-eighteenth century was Malesherbes, director of the book trade from 1750 to 1763. Censorship was now less severe than previously and this period witnessed the publication of the great multi-volume *Encyclopédie*, with many articles indirectly criticising the French government. There was, therefore, a policy of qualified tolerance. Controversial authors like Voltaire would make a habit of visiting the censors and taking note of passages in their works that would have been banned. There was, therefore, a certain amount of self-censorship but, after the departure of Malesherbes, authors tended to become bolder and there were more conflicts with the censor. The plot of Beaumarchais' *Marriage de Figaro* (1784) had obvious political implications. Authors, printers and book-

---

[7] J.R. Partington, *History of Chemistry*, vol.3, p.635.

[8] See e.g. Albert Ward, *Book Production, Fiction and the German Reading Public, 1740-1800*, Oxford, 1974, pp.98-102.

[9] Daniel Roche, 'Censorship and the publishing industry' in Robert Darnton and Daniel Roche (eds.), *Revolution in Print. The Press in France, 1775-1800*, Berkeley, 1989, pp.3-26.

sellers could be fined or even sent to prison for contravention of the law. Nevertheless, there was a clandestine book trade in illegal books. Some of these were works on philosophy or politics or theology but many were pornographic. It is interesting to find the code word for all of these was 'philosophical books',[10] a title which might well have been applied more justly to books on natural philosophy or science. There were special censors specifically appointed to scrutinise scientific and medical books, e.g. Macquer, but sometimes the Paris Academy of Sciences fulfilled this role.

It is customary to consider the date of the fall of the Bastille, 14 July 1789, as the 'beginning' of the French Revolution. As far as the press is concerned, more important dates were probably the convocation of the Estates-General in August 1788 and their meeting in May 1789. Between these dates there were a number of serious riots and in February 1789 Sièyes had published his influential book on the significance of the Third Estate, i.e. the great majority of the French people who were neither clergy nor nobility.

When the king announced the convocation of the Estates-General in 1788 to deal with the financial crisis, he called on 'all *savants* and educated persons' to contribute their views. This invitation prompted a flood of unlicensed pamphleteering.[11] More than 300 pamphlets appeared in the months of July, August and September 1788, most of them attacking the system of an absolute monarchy. The stream of (mostly political) pamphlets continued at a rate of about 100 per month and some publications like the *Sentinelle du peuple* appeared every week or so in November/December 1788 and hence may be regarded as a form of periodical or newspaper. Rather less ephemeral was the *Hérault de la Nation*, the first number of which appeared on 1 January 1789. This newspaper lasted until the end of June 1789 and produced 63 issues. There were also a number of pamphlets on the liberty of the press published at the end of 1788 and early 1789. Malesherbes favoured the continuation of a kind of censorship but on a voluntary basis.

In the spring of 1789 lists of grievances (*'cahiers de doléances'*) were drawn up by their (literate) constitutents for the local representatives who were to attend the meeting of the Estates-General. Most of the *cahiers* originating from towns and cities made some references to greater freedom of publication. The *cahier* from the nobility of Lyons expressed the wish

> That in future there should be complete liberty of the press on all matters relating to administration, politics, science and the arts; the only reservation being that the Estates-General should be able to de-

---

[10] Robert Darnton, 'Philosophy under the cloak', in *ibid.*, pp.27-49.

[11] Claude Bellanger *et al.* (eds.) *Histoire générale de la presse française*, vol.1, Paris, 1969, p.409.

> cide what precautions are necessary in order that religion, society and individuals are respected in printed works.[12]

In March 1789 Brissot, who had visited the new United States, and now wanted to play a role in French politics, announced the imminent publication of a newspaper to be called *le Patriote français*. He believed that a periodical publication could have greater influence on public opinion than any book. Unfortunately, the censor agreed with him and formally prohibited publication. Mirabeau was more lucky or perhaps more astute. Taking advantage of the meetings of the Estates-General at the beginning of May, he launched a periodical ostensibly devoted solely to reports of the meetings. This too was temporarily banned, but this action caused so much indignation that the Council of State was forced to change its mind. Accordingly periodical works and newspapers were now formally permitted to report on the meetings of the Estates General, but they were still restricted on comment on what had been said. Nevertheless, a major obstacle to publication had been overcome and a total of 42 periodicals and newspapers appeared between the beginning of May and the end of July 1789.

One of the first projects presented to the National Assembly in July 1789 was one by La Fayette on liberty of self-expression, inspired by the declaration of rights of Virginia. By 20/21 July this had been developed by Sièyes to include the liberty of the press:

> ....everyone is free to write, print or to have printed what seems right to him, the only condition being that he should not interfere with the rights of others.[13]

By the end of August this sentiment had been incorporated by the Assembly as article XI of the Declaration of the Rights of Man and read as follows

> The free communication of thoughts and opinions is one of the most precious rights of man. Therefore every citizen may speak, write or print freely, but may not abuse this freedom in cases stipulated by law.[14]

Possible restrictions indicated in the last sentence of the text quoted above were to occupy politicians and intellectuals for the indefinite future.

Thus although much of what we have said above relates to a political context, it affected the whole question of publication and particularly periodical works. The launching of the *Annales de chimie* in April 1789 and the crucial months of publication of the first few issues can, therefore, be seen as part of a wider context. The history of the *Annales* provides an important example of

---

[12] Bellanger, *op.cit.*, p.420.
[13] *Ibid.*, p.429.
[14] *Ibid.*, p.431.

how the political revolution affected the later stages of the 'chemical revolution'.

3. *The founding of the* Annales.

Having considered separately possible German precedents for the *Annales* and the relaxation of censorship in France in 1789, we are now in a position to understand better the negotiations involved in the founding of the French journal of chemistry. Much of the background to the foundation of the *Annales de chimie* was investigated in the nineteenth century by Edouard Grimaux and we can therefore draw on his work as far as it goes.[15] The first idea for a special French journal of chemistry was not that of Lavoisier but of his young follower, Pierre-Auguste Adet (1763-1834). After taking a degree in medicine, Adet had taken up the study of chemistry with enthusiasm and in 1787 he had collaborated with Hassenfratz in devising a scheme of chemical symbols corresponding to the new chemical names which Lavoisier, Guyton de Morveau, Fourcroy and Berthollet had introduced and explained in their *Méthode de nomenclature chimique*. He was, therefore, publicly associated with the Lavoisier school. Going further, he had the idea in 1787 of publishing a translation into French of the *Chemische Annalen* of Lorenz Crell with a few possible additions. However, under the system of censorship of the old regime any project for such a publication required the approval of the keeper of the royal seals. To obtain this approval he asked for the assistance of Lavoisier, who in turn approached Baron de Breteuil, minister of the King's household, to gain his support. Lavoisier said that, although the Academy had rights of publication over scientific material, he did not want to engage in such an enterprise without the full support of Miroménil, the keeper of the royal seals. This, of course, raises the question of whether in 1787 Lavoisier had sufficient support within the Academy to pursue any alternative strategy. His support was to grow in subsequent years.

Despite the help of Baron de Breteuil, who intervened personally in support of Lavoisier, the keeper of the royal seals was willing to grant permission for no more than a simple translation of Crell's *Annalen* and insisted, moreover, in those unsettled times that this should not appear more often than quarterly. Although tempted to abandon the idea of a French journal completely, Adet was persuaded to make a second approach for permission to publish a chemical journal. Lavoisier, for his part, wrote a further letter in September 1787 to Breteuil in support (see Appendix 1, No.1). From the text of the letter it is clear that Lavoisier was not at all happy with the condition

---

[15] E. Grimaux, *Lavoisier, 1743-1794, d'après sa correspondance, ses manuscrits, ses papiers de famille et d'autres documents inédits*, Paris, 1888, Appendice, pp.370-376.

the journal should appear only at three-monthly intervals, since the editors hoped to be right up to date in their scientific reporting. A scientific journal could not in any way be compared to a newspaper, which might be feared by the government as a possible agent of subversion. Nevertheless, if the condition of quarterly publication was insisted upon, Lavoisier was prepared to accept it under protest but asked in return for an extension of the role of the journal, described as the *Annales chimiques*. Instead of simply presenting a translation of Crell's *Annalen* Lavoisier asked for permission to provide in addition regular abstracts of chemical memoirs which had been published in France, Britain, Italy and Germany quite independently of their possible appearance in Crell's *Annalen*. This was, therefore, a much more ambitious plan on a European scale. Lavoisier pointed out that a limitation to Crell would deprive the French journal, which he hoped to launch by subscription, of many important and topical discoveries. Unfortunately, Breteuil was unable to obtain any further concessions and Adet, now completely discouraged, contemplated emigration[16] and the plans for a journal were shelved.

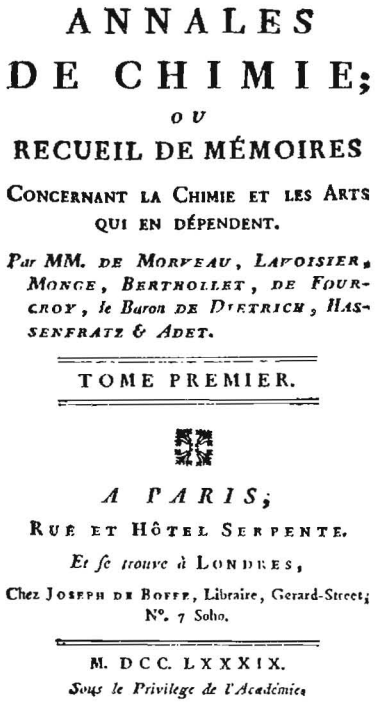
By the spring of 1789 restrictions on publication were relaxed, and it was possible for Lavoisier and his colleagues to launch a chemical journal with fewer obstacles. It was to be published by Cuchet, who had just published Lavoisier's *Traité*. An editorial board was formed, headed by Guyton and Lavoisier and including Monge, Berthollet, Fourcroy, Dietrich and Hassenfratz with Adet as secretary. They put together an octavo volume of 314 pages, prefaced by an introduction (see Appendix 1, No.3) and submitted it for the approval of the Academy. The price for one volume was to be 3½ livres,[17] which compared favourably with the price of most science books. Moreover, as a multi-authored volume it might seem to many readers to represent better value than a book by a single author, all the more so with such a distinguished editorial board. A major selling point of the editors was that each volume would contain extracts from many scattered volumes of scientific memoirs, some foreign, which would have cost an individual reader a great deal of time and money to assemble. Thus, from every point of view, the *Annales* represented good value for money.

It is interesting to find that, although Guyton's name was printed at the head of the list of members of the editorial board, he does not seem to have

---

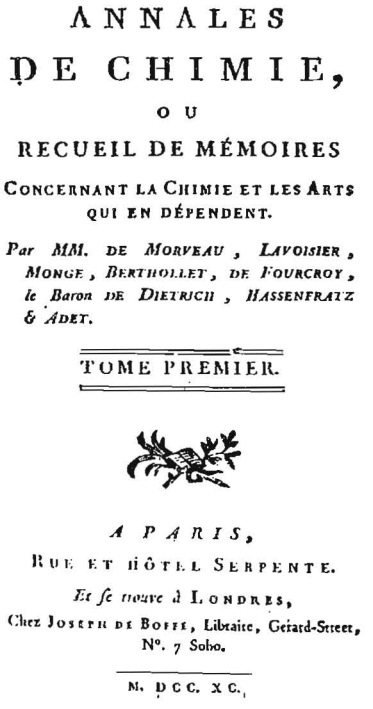
[16] In the end Adet was able to remain in Paris with the aid of money borrowed from Lavoisier and Fourcroy (E. Grimaux, *Lavoisier*, 1888,p.373). Michelle Goupil (ed.), *Oeuvres de Lavoisier, Correspondance, 1787-88*, Vol. 5, Paris, 1993, p.198.

[17] Actually 3 livres 12 sous, where 20 sous = 1 livre. The early 1790s was to experience severe inflation, brought about by the extensive printing of paper money. In August 1795 the Convention introduced the new monetary unit, the *franc*, tied to the value of silver. In many respects, however, the *franc* became the new name for the *livre*.



ANNALES
DE CHIMIE;
OU
RECUEIL DE MÉMOIRES
CONCERNANT LA CHIMIE ET LES ARTS QUI EN DÉPENDENT.
Par MM. DE MORVEAU, LAVOISIER, MONGE, BERTHOLLET, DE FOURCROY, le Baron DE DIETRICH, HASSENFRATZ & ADET.
TOME PREMIER.
A PARIS;
RUE ET HÔTEL SERPENTE.
Et se trouve à LONDRES,
Chez JOSEPH DE BOFFE, Libraire, Gerard-Street; N°. 7 Soho.
M. DCC. LXXXIX.
Sous le Privilege de l'Académie.

FIG. 1



ANNALES
DE CHIMIE,
OU
RECUEIL DE MÉMOIRES
CONCERNANT LA CHIMIE ET LES ARTS QUI EN DÉPENDENT.
Par MM. DE MORVEAU, LAVOISIER, MONGE, BERTHOLLET, DE FOURCROY, le Baron DE DIETRICH, HASSENFRATZ & ADET.
TOME PREMIER.
A PARIS,
RUE ET HÔTEL SERPENTE.
Et se trouve à LONDRES,
Chez JOSEPH DE BOFFE, Libraire, Gerard-Street, N°. 7 Soho.
M. DCC. XC.

FIG. 2

FIGS. 1 & 2: Title pages of the first edition of the *Annales de chimie* (1789) and of the 1790 edition. Note that in the latter case there is no longer any mention of the authorisation of the Academy of Sciences.

played an active part in the production of the early volumes of the journal, now re-titled the *Annales de chimie*. A letter which has come to light from Berthollet to Guyton, dated 15 June 1789 (Appendix 1, No.4) speaks of the editorial collaborators being delighted to have Guyton at their head. Guyton had apparently been pleased with the first volume and Berthollet hoped that he would be equally pleased with the second. Berthollet went further and asked him directly for his help.[18] Indeed there were very few contributions from Guyton to the early volumes of the *Annales*. Guyton's only non-trivial contribution was an article on the thermal expansion of air taken from his article on 'Air' in the *Encyclopédie méthodique*.[19] It was only after the resumption of publication in 1798 that Guyton became a major contributor. His position on the early editorial board was largely a honorary one, in recognition of his position as a senior chemist, actually 6½ years older than Lavoisier and a pioneer in the reform of chemical nomenclature, but Lavoisier was the real leader of the group.

The Academy report on the first volume of the *Annales* presented at the meeting of 3 April 1789, was drawn up by the mineralogist and chemist Jean D'Arcet (1725-1801) on behalf of a commission of three, the other members being the mathematician Vandermonde (1735-96) and the mineralogist, the abbé R. J. Haüy (1743-1822). In 1789 D'Arcet was obviously quite a senior member of the Academy in terms of age (64) compared to the other members of the commission and to Lavoisier (aged 46), although he had only been elected to the Academy in 1784 (*associé chimiste surnuméraire*), as opposed to Lavoisier's election in 1768 (*adjoint chimiste surnuméraire)*. The choice of these three members of the Academy represented a combination of specialised knowledge of the subject matter and neutrality. It is significant that no outspoken critics of Lavoisier's new system of chemistry were included. On the other hand it would clearly have been improper to include anyone too closely associated with the new chemistry to sit in judgement.

The report is a very extensive one, filling nearly twenty pages (ten folios) of the Academy's register.[20] This was considerably longer than most reports on manuscripts submitted for the approval of the Academy and one wonders why it should have been so long. A number of reasons might be given, of which the most objective would be that the commission felt it advisable to describe the complete contents of the volume. As it contained about two dozen different items, this necessarily was a longer task than that involved in dealing with a book with a single theme. But rather than simply *list* the contents,

[18] 'Les coopérateurs ... ont besoin ... de vos secours.'

[19] *A.c.*, *I* (1789), 256-299.

[20] Archives of the Académie des Sciences: *Procès verbaux de l'Académie Royale des Sciences*, Tome 108 (1789), ff.95-104.

D'Arcet felt that he should *describe* them. In fact his report was very much more a description than an analysis. It would, however, have been impossible to present a report that did not include some value judgements. We will attempt to summarise the appraisal included in the report.

Although the majority of articles were merely described, there were a few words of commendation of selected articles in the volume. The first memoir by Adet on a chloride of tin was said to include a 'collection of ingenious experiments'.[21] Again it was said that the memoir was 'written with clarity' and that 'the experiments in it are executed with a great deal of intelligence'.[22] The description of the second article, by Lavoisier on the combustion of iron, concluded with the judgement that it 'contains a collection of fine and precise observations'.[23] The third memoir on prussic acid was by Berthollet; it too received praise.[24] The fourth memoir by Fourcroy was 'very ingenious'[25] and the fifth, again by Berthollet, was spoken of favourably.[26] There was no explicit praise for a further memoir by Fourcroy or a memoir by Chaptal but the seventh memoir, once more by Fourcroy, described the discovery of a new salt - 'a new solvent useful to mankind'.[27] After commendation of two analyses of mineral water by Hassenfratz 'carried out with care and precision'[28] praise had almost been exhausted. D'Arcet did, however, show special favour to memoirs relating to mineralogy such as those by Dietrich and Klaproth.

One wonders whether the concentration throughout on mineralogy and analysis was simply a reflection of D'Arcet's own interests, or whether it was a ploy to suggest that most of the contents of the *Annales* were not controversial. Certainly D'Arcet did not try to force the new nomenclature on the Academy. In describing Adet's memoir, D'Arcet referred to 'vital air, or oxygen, as he calls it'.[29] Berthollet showed that:

---

[21] 'M. Adet fait voir par une suite d'expériences ingénieuses et bien dirigées....' *ibid.*, f.95v.

[22] 'Le mémoire est écrit avec clarté et, comme nous l'avons dit, les expériences en sont dirigées avec bien d'intelligence'. *ibid.*, f.96.

[23] 'Le Mémoire contient une suite d'observations fines et delicates, non seulement sur les faits, mais encore bien importantes, sur la manière d'opérer', *ibid.*, fn.96v.

[24] 'Ce Mémoire est d'ailleurs remarquable par des rapprochements d'expériences en apparence soignée et pourtant autant justes qu'ils sont frappantes', *ibid.*, f.97.

[25] 'fort ingénieux', *ibid.*, f.97v.

[26] 'la découverte de l'argent fulminant [by Berthollet] qui a fait tant d'honneur à son auteur', *ibid.*, f.98.

[27] 'un nouveau menstrue utile à l'humanité', *ibid.*, f.99.

[28] 'deux analyses faites avec soin et précision', *ibid.*

[29] 'air vital ou, comme il le nomme, oxigène', *ibid.*, f.95v.

> prussic acid is a compound of azote, hydrogen and carbon, or, to express myself in ordinary language, of vitiated or phlogisticated air, inflammable air and fixed air (sic).[30]

Again when he used the neologism 'oxide', he appended the translation 'metallic calx'[31] and the term 'hydrogen' too was immediately explained.[32] As was appropriate in the circumstances, D'Arcet adopted a neutral stance in the question of nomenclature as of theory. He gave praise for careful experimentation rather than for new ideas. The report concluded by recommending the Academy's approval and giving three reasons for support:

> The names of the different authors of these memoirs, which are so well known, the importance of the material, and the approval which their work has already obtained in the body of the Academy, authorises us to conclude that they should be published under its privilege.[33]

Volumes 2, 3 and 4 also appeared 'under the privilege of the Academy' but by the spring of 1790, when volume 5 was published, this was no longer necessary.

4. *An international journal of the new chemistry*

The aims of the new journal are stated most clearly and concisely in the long preface (almost a new prospectus), which the editors inserted in a reissue of Volume 1 of the *Annales* published in the winter of 1790/91:

> The intention of the editors in publishing this work has been to establish communications and active correspondence among all European men of science, to hasten the progress of a science, the dominant study of which sufficiently demonstrates its importance, and to bring together in a useful way [published] work dispersed in a large number of volumes.[34]

These three clear aims were followed by a fourth, which related to the special utility of chemistry, which will be discussed later.

It should be noted that the first aim stated above, and also in the Introduction to the original edition of volume 1, was to facilitate co-operation between *savants* in different countries. Europe is specifically mentioned because

---

[30] 'L'acide prussique est une combinaison d'azote, d'hydrogène et de carbonne (sic), ou pour m'exprimer dans le langue ordinaire, d'air vicié ou phlogistiqué, d'air inflammable et d'air fixe', *ibid.*, f.96v. The translation of carbon as 'fixed air' is, of course, a mistake.

[31] 'des oxides ou chaux métalliques', *ibid.*, f.97v.

[32] 'le gaz hydrogène ou gaz inflammable', *ibid.*, f.102v.

[33] 'Les noms si connus des différents auteurs de ces mémoires, l'importance des matières et l'approbation que leur travail, a déjà obtenu dans le sein de l'Académie, nous autorisent à conclure qu'ils soient publiés sous son privilège', *ibid.*, f.104v.

[34] Appendix 1, No.5.

America did not yet have an established scientific community. The 1789 version speaks of the desirability of 'a reciprocal exchange' of discoveries. This avoids the idea that the journal was to be concerned mainly with French chemistry. Indeed we have seen from the humble origins of the idea of the *Annales* that it might in its original form have been based on a nucleus of chemical publications from the German states. The importance of British contributions was appreciated (not least in the earlier work of the British pneumatic chemists), as was the contribution of Italy. The editors might very well also have thought of Sweden because of its importance in the study of minerals.

But, despite the international aspirations of the editors, there was at least one sense, in which the journal would be French, and that was in the language used for publication:

> It would be useful ... to present a table of new discoveries relative to chemistry and the arts which depend on it in a language familiar to the learned nations of our continent. France, by virtue of its position, can provide the [best] means of communication for the enlightened inhabitants of the different parts of Europe and, by gathering their respective riches, put them in a position to profit from them.

We may notice that the only explicit argument in favour of the French language was in relation to the geographical position of France, which helped communications. Nevertheless, French was the language of diplomacy of the period; it was the language of one of the two great world powers, the *lingua franca*, spoken by educated people in many different European countries. In a way it had come to replace Latin as an international language. It was regarded as a very civilised language at a time when German was often considered a barbaric language. Thus although Frederick the Great allowed members of the Berlin Academy of Sciences to present their work in German if they wished, when it came to publication, the *Mémoires* of the Academy had to be in French.

Thus the *Annales* was clearly intended to propagate chemistry in French, but was it intended to propagate French chemistry? It would be naive to suppose anything to the contrary. Whereas we have quoted the explicit desire to hasten the progress of chemistry, we can take this to mean the *new* chemistry. Firstly, in so far as the *Annales* of 1789 (as opposed to the proposed *Annales* of 1787) was focused on French chemistry, the majority of articles now supported the new chemistry or reported something neutral like chemical analysis. Secondly the very use of the new chemical language, of *hydrogen*, *oxides*, *sulphates*, and so forth assumed the validity of the new chemistry. A century earlier the Cartesian secretary of the Paris Academy, Fontenelle had warned people that the very use of the term *attraction* assumed the validity of the

Newtonian system, and he was far from happy with this.[35] Similarly to accept a term like 'oxide of mercury' is to accept a theory of chemical reaction involving oxygen (instead of phlogiston) and a corresponding theory of chemical composition. Nevertheless Lavoisier and his colleagues did not want to be accused of what would later be called brain washing. They had, therefore, concluded their original Introduction to volume 1 with the following words:

> We shall make a law of respecting the opinion of everyone, *to allow everyone to keep his original language*, and we shall never be seen, armed with the mark of censure, to criticise the work of an author because he does not agree with us, since we are persuaded that respect is due to all those who are occupied with the search for truth.[36]

Yet despite this claim italicised above, we may look in vain in the *Annales* for any mention of 'dephlogisticated air' or even 'calx'; instead we find *oxygen* and *oxide* respectively. The Index volume to the first thirty volumes of the *Annales* has an entry for *oxide* running to some eleven pages, quite apart from *oxygène* and *oxidation*.

We may easily conclude that the editorial assumption was that the phlogiston theory had been superseded and need no longer be referred to. But this was not entirely the case. Adet gave an extended commentary on Kirwan's *Essay on Phlogiston*.[37] Berthollet provided a long article commenting on Priestley's refusal to accept the new interpretation of water as a compound of hydrogen and oxygen.[38] Berthollet patiently reviewed the whole history of the composition of water going back to Cavendish. He explained the quantitative experiments of Lavoisier and he criticised some of the experiments of Priestley and his ally James Keir. One of the persistent problems at this time was the general lack of understanding of the difference between inflammable air from carbon (carbon monoxide) and ordinary inflammable air (hydrogen), but Berthollet still managed to present a convincing case. He ended with a reminder that he himself had earlier been obliged to abandon his attachment to phlogiston before accepting the 'happy revolution' in chemistry.

Priestley drops out of sight for several years from the readers of the *Annales*. His open support in England of the French Revolution had won him many enemies and in 1791 his house in Birmingham was burned down by a 'Church and King' mob. In 1794 he emigrated to the U.S.A. and, from the remote settlement of Northumberland, Pennsylvania, he resumed his position

---

[35] 'Eloge de Newton', *Eloges des Académiciens avec l'Histoire de l'Académie Royale des Sciences*, 2 vols., La Haye, 1740, vol.2, p.318.

[36] See Appendix 1, No.3 (my italics).

[37] *A.c.*, *7* (1790), 194-237.

[38] C. L. Berthollet, 'Considérations sur les expériences de M. Priestley relatives à la composition de l'eau et sur un article du nouveau Dictionnaire de Chimie de M. Keir', *A.c.*, *3* (1789), 63-114.

as one of the principal defenders in the English language of the phlogiston theory. In 1796 he published a book defending his position, a book which was translated into French with a reply by Adet in 1798. The review of the book in the *Annales*[39] was able to quote from the report on the book which had been made to the First Class of the Institute, a useful tactic often employed by the editors. Once again the tone was moderate. It was accepted that both sides were concerned with finding the truth and the review ended with a list of chemists who still supported the phlogiston theory. It was not a long list but the French chemists were honest enough not to claim that they had won over all their opponents.

Possibly the most important conversion in the history of the *Annales* was that of Joseph Black, since this was announced in a particularly effective way, in a letter written by Black himself to Lavoisier. Black's letter could, I suppose, be taken at face value but it would be more realistic to see it as a brilliant propaganda coup for the *Annales*. Let us remember that Black (1728-1799) was Lavoisier's senior. It was Black who had taken the decisive step in 1756 of distinguishing 'fixed air' (carbon dioxide) from atmospheric air. From now on chemists could study airs in the plural. A full ten years were to elapse before Lavoisier was to begin to look in turn at the four Aristotelian elements. Black was also a pioneer in calorimetry and the discoverer of latent heat. Much of his experimental work was quantitative. From 1766 Black had been Professor of chemistry at Edinburgh University and hence one of the few British chemists of the late eighteenth century with institutional recognition. We may note that when Lavoisier's *Traité élémentaire de chimie* was translated and published in 1790 the imprint was not London but Edinburgh, then at the height of its intellectual eminence, and the British city with the largest number of chemistry students.

It is against this background that we can consider two letters written by Lavoisier to Black.[40] In the first, dated 19 September 1789, Lavoisier introduced himself as:

> one of the most zealous admirers of the profundity of your genius and of the important revolutions (sic) which your discoveries have bought about in the sciences.

It was soon after this that Black began to introduce Lavoisier's chemistry into his university lectures[41] and Lavoisier could not miss an opportunity to capitalise on this fact. He wrote to Black in what may strike us as the most obse-

---

[39] 'Réflexions sur la doctrine de phlogistique et de la décomposition de l'eau par Joseph Priestley ... ouvrage traduit de l'anglais et suivi d'une réponse par M. Adet, Paris, an 6', *A.c.*, *26* (1798), 302-309.

[40] *Report of the British Association for the Advancement of Science*, Edinburgh, 1871, pp.189-192.

[41] Henry Guerlac, art., 'Joseph Black', *D.S.B.*, *2*, 173-183 (180).

quious terms, that Black's approval gave him greater courage to support his new theory and that he regarded the Scotsman as his master. We may note that this was from the pen of a man considered reluctant to acknowledge publicly his debt to others, and notably to the British pneumatic chemists. In the private letter Lavoisier was ready to express his 'admiration' and to include himself among the followers of Black.[42] Finally Lavoisier said that, when he found the time to travel, he would make a point of coming to Edinburgh 'to see you, to hear you and to benefit from your wisdom and your advice'. It has been argued that a plain Scotsman like Black was bowled over by such flattery,[43] assuming it to be sincere, and, therefore, replied to Lavoisier in the most generous terms.

Black's letter, reproduced in Appendix 1, No.6, was sent as a private letter on 24 October and carried to Paris by M. Terray, who had brought his son to study at Edinburgh University. Lavoisier replied in a letter of 19 November 1790, asking for permission to reproduce the letter in the *Annales de chimie*. Black was happy to give his permission in a letter dated 28 December 1790.[44] Lavoisier was delighted to publish the letter reproduced in Appendix 1 as the leading article in the issue of the *Annales* for March 1791.

Black seems to have accepted many of Lavoisier's compliments at face value. He was glad to confirm that he taught his students the principles of the new chemistry and continued:

> I am now beginning to recommend it to them as simpler, more coherent, better supported by the facts than the old system ...[and]... nothing could be more satisfying than the proofs which you have provided. The system which you have founded on these facts is so intimately linked with them, so simple and so understandable that it should be adopted by more people every day.

As if this were not music enough in the ears of Lavoisier, Black went on to say that he had believed and taught the phlogiston theory for thirty years but he had gradually been won over. Lavoisier himself could hardly have written anything better calculated to capture the remaining chemists, who still adhered to the phlogiston theory.

---

[42] 'de me ranger au nombre de vos disciples'.

[43] Sir William Ramsay, (ed.) *The Life and Letters of Joseph Black, M.D.*, London, 1918, p.95. Black had been born at Bordeaux and lived in France to the age of 12, yet he may not have been accustomed to the extravagant literary style adopted by Lavoisier in this correspondence.

[44] D. McKie, 'Antoine Laurent Lavoisier, F.R.S., 1743-1794', *Notes and Records of the Royal Society of London*, *7* (1949-50), 9-13. See also W. P. Doyle, 'Black, Hope and Lavoisier' in A. D. C. Simpson (ed.), *Joseph Black. A Commemorative Symposium*, Edinburgh, 1982, pp.43-46.

5. *Discontinuity in publication*

Looking today at the uniform bound volumes of the *Annales* on the shelves of a university library, it would be only too easy to assume a trouble-free history, the unchallenged product of a movement carried forward from 1789 by its own momentum, producing several hundred pages of text every year. But such an assumption would fly in the face of political history. If the chemists had been left to their own devices, no doubt there would have been regular and uninterrupted publication. Yet the *savants* were part of a wider society. The year 1789 was not the year of the revolution. It merely marked (in traditional historiography) the *beginning* of the revolution, which entered into an increasingly violent phase after the execution of the king in January 1792. The period June 1793 - July 1794 was that of the Terror. France lived under emergency rule with the threat of invasion from foreign enemies. It was governed by a Committee of Public Safety, whose most famous member was Robespierre. Under the control of the Jacobins France passed through a period of extremism including mass executions. The introduction of new paper money or *assignats* led to severe inflation. At a time when the basic necessities of life were in short supply the production of a scientific journal could seem a superfluous luxury. Even without considering the personal problems faced by the editors, it is not really surprising that publication of the *Annales* was interrupted in late 1793.

There is already evidence in Volume 18 of problems of paper supply. In the issue for July 1793 several sheets[45] were of a non-matching paper with a slight blue tinge of colour. Again the August issue had to make use of some similarly inferior paper.[46] The September issue, the last before the break, started on standard paper but it too had to fall back on the pale blue paper.[47] This in no way reduced the clarity of the text but it serves as a subtle reminder to posterity of the difficult political and economic situation of the time.

But whereas economic conditions made the continuation of the *Annales* difficult, political developments made it impossible. The September issue of the journal was to be the last issued for several years. Its principal editor Lavoisier had supported the moderate reforms of the early stages of the Revolution but by 1793 men of moderate views were treated as enemies of the Republic. Lavoisier was particularly vulnerable as a member of the former Tax-Farm, now suppressed. On 10 and 11 September he was subjected to a search of his house by two representatives of the local section of the revolutionary

[45] *A.c.*, *18* (1793), 17-64, 81-96.
[46] *Ibid.*, 193-224.
[47] *Ibid.*, 273-288.

committee, who temporarily sealed all his papers except those concerned with the reform of weights and measures which had special protection.[48] The searchers found nothing incriminating but they confiscated a packet of letters in languages other than French, which may have been partly connected with the *Annales*. On 24 November the arrest was ordered of all the former Farmers-General. Lavoisier was taken into custody on 28 November. After the travesty of a trial on 8 May 1794 he and the other tax officials were found guilty of a 'counter revolutionary conspiracy' and sentenced to immediate execution by the guillotine.

Thus France lost its greatest man of science and the *Annales* its driving force. The first seven months of 1794 represented the most repressive period of the Terror, which only ended with the fall of Robespierre on 27 July. A more constructive period followed, although there were still many political disputes and the war continued on several fronts. But to understand the situation in printing and publication it is necessary to go back to the beginning of the revolution. The new freedom of publication after 1789 had produced a flood of political pamphlets and other printed matter, but such absolute freedom was not universally welcome after the declaration of the republic in September 1792. The revolutionary government was not at all happy to accept criticism and a law of March 1793 introduced extreme penalties for political agitation. At the same time the government began taking steps to centralise printing through a government printer. But, even apart from this, the war and inflation had undermined the book trade completely and book production was almost at a standstill. In October 1794 Grégoire in a report on behalf of the Commission on Public Instruction issued a plea for government support for the arts and particularly for pure and applied science. He remarked:

> There are almost no more periodicals to serve as depositories for new inventions and to keep a record of the progress in human understanding.[49]

A consequence of this report was the decision of the Convention to provide funds for publication of certain books and periodicals including some on science.[50] Thus funds became available to buy the plates of Buffon's famous *Histoire naturelle* and we shall see that the Commission was also able to provide financial aid for a few science periodicals including the *Journal de physique*. The *Journal de physique* was the new title given in 1794 to the *Observations sur la physique*. The significance of this change of title will be ex-

---

[48] Douglas McKie, *Antoine Lavoisier, Scientist, Economist, Social Reformer*, London, 1952, pp.283-5.

[49] *Rapport sur les encouragements*, quoted by Carla Hesse, *Publishing and Cultural Politics in Revolutionary Paris, 1789-1810*, Berkeley, 1991, p.150.

[50] *Ibid.*, p.153.

plored later. If the *Annales de chimie* had had an active editorial board in the winter of 1794/95, it too might have benefited by this temporary largesse.

By 1794 G.J. Cuchet, the proprietor of the *Journal de physique*, was making an enormous loss on the finances of the journal, which he claimed amounted to 17,000 francs per annum, and one way he proposed to deal with this problem was to raise subscriptions. The subscription would have to be doubled with immediate effect from 30 francs to 60. He therefore asked subscribers to provide the money in order to make possible the production of future issues. There was no question of profit. The proprietor was desperately trying to avoid bankruptcy. He pointed out that the price of paper of reasonable quality had increased as much as 700 per cent. More surprisingly Cuchet went further and issued a general plea for interest-free monetary loans from his subscribers, giving the supposed value of back numbers of the journal as a provisional security. We will never know how much financial help Cuchet received from his readers, but in those difficult times we may doubt that it was substantial. Nevertheless, eventually he was able to produce a few more issues, although it seems that the issue bearing the date 'December 1794' was only published in 1797.[51]

In March 1795 Cuchet published a personal letter apologising for delays in publication but assuring subscribers that they would receive eventually the twelve issues for which they had paid.[52] He referred to the scarcity and the recent steep rise in the price of paper and of labour but he assured readers that his love of science was sufficient for him to continue publication of the journal from his own resources, even though the number of subscribers had now dropped below 150. In December 1793 he had petitioned the Commission of Public Instruction to subsidise the journal by taking out a subscription for local libraries and institutions of higher education.[53] Surprisingly this plea met with a favourable response in November 1794, when the Committee on Agriculture ordered 1500 copies on the recommendation of the Commission of Public Instruction.[54]

Cuchet commented in 1795 that there was much less scientific work being done at that time and little correspondence between *savants*. Nearly all learned journals had ceased publication because 'their proprietors did not have

---

[51] A notice to subscribers, bound in some copies of the *Journal* at the end of volume 2, says that the December issue completed the half year of 1797, which was owing to the subscribers of 1794. This issue contained meteorological observations for 1796 and reviews of books published in 1797, confirming that the printed date was no more than a token.

[52] Le Citoyen Cuchet, Libraire, Propriétaire du *Journal de Physique, de Chimie, d'Histoire naturelle et des Arts* aux Citoyens Souscripteurs et Lecteurs de ce Journal, 4pp.(bound in some copies of the *Journal)*.

[53] This is confirmed by Archives Nationales, F./17/1240/B, pièces 346-8.

[54] Archives Nationales, F/17/1214, dossier 12, 23 November 1794, cited by Hesse, *op.cit.*, p.153n.

the same devotion as myself'. A new journal called the *Magasin Encyclopédique* had recently appeared with the claim that it would replace all other journals which had been abandoned. Cuchet assured readers that the *Journal de physique* would continue, even though it might be necessary to publish several months' material together. This had been the case in 1794 when a single issue was dated to cover the four months, April - July.[55] Considering that these were the months of the height of the Terror, including the execution of Lavoisier in May and culminating in the execution of Robespierre in July ('Thermidor'), it is remarkable that the issue was published at all and it is very probable that it actually appeared some time later.[56] The *Journal de physique* ceased publication with that volume. When it resumed publication in January 1798 it had passed into the hands of a newly-established publisher, Dugour,[57] who described himself as the successor to Cuchet, whose business he had bought up.[58]

In 1796 several publishers claimed to be specially concerned with 'sciences and arts' and it has been suggested that by this time that expression had become a new catch phrase in the book trade for works supported by the republican government.[59] In the calmer days after the Terror the government of the Directory was prepared to spend large sums of money to promote stability and moderate republican values. The policy was to woo the public away from the passions of politics and romance towards more rational pursuits such as science and philosophy and works of public utility. This policy became even more explicit by laws of September/October 1797, which imposed a stamp tax on all periodicals with the exception of monthly periodicals relating exclusively to 'arts and sciences'.

Returning to the *Annales*, which only resumed publication in 1797, it might seem surprising that it ceased publication for so long. After all the most violent period of the Revolution had ended in July 1794. In 1795 action was taken to re-establish something corresponding to the old Academies under the name of the National Institute and this began to meet in the winter of 1795-96. About the same time new institutions of higher education were being founded. If in such a changed climate there was no move to resume publication of the *Annales*, it might seem to confirm that it had been after all very much Lavoisier's journal and his death had left his former colleagues dispirited and disor-

---

[55] The issue beginning on p.325 of Vol.44 is dated: 'Floréal, Prairial, Messidor et Thermidor an 2e'.

[56] Internal evidence again suggests that the printed dates should be treated with great caution.

[57] Dugour published only two volumes of the *Journal de physique*. Fuchs subsequently became the publisher, and later, Courcier.

[58] Hesse, *op.cit.*, p.157.

[59] Hesse, *op.cit.*, p.156.

ganised. Yet was their morale so low that it took three years to recover? The minute book of the *Annales* shows that a handful of members of the former editorial board first came together on 27 December 1796, in order to discuss the resumption of publication. The four people present were Guyton, Fourcroy, Vauquelin and Pelletier.[60] They said that other (surviving) former members were away from Paris on government business and this was certainly true of Berthollet and Monge, who were on official business in Italy. Berthollet had left Paris in May 1796 and did not return until November 1797.[61]

The preliminary editorial meeting of December 1796 resulted in a contract being drawn up with a new publisher, Laurent Mathieu Guillaume in January 1797. The contract lasted for one year and when a new contract was drawn up exactly twelve months later, that is at the beginning of another calendar year, its terms were similar in many respects. Several features, however, of the 1797 contract not present in the 1798 version, reproduced in Appendix No.1, may be mentioned. In order to publicise the *Annales* after the long interruption in publication it was proposed in 1797 to give away as many as 100 free copies. Although a few free copies distributed in the right place would probably have been good for business, 100 copies seems excessive on a tight budget. Secondly the editors seem to have been confident of an immediate large circulation, since the publisher was not required to pay the authors until 600 copies had been sold. (This clause was probably inserted to encourage the publisher.) Finally there was an interesting mention in 1797 of the possibility of a second edition. Although 1,600 copies of the *Annales* were to be printed, this was described as a first edition. Allowance was optimistically made for the fact that this number might not be sufficient and the publisher was given some rights in the production of a second edition. There had certainly been occasions earlier in the history of the *Annales* when more than one printing was called for but this had been when the original print run must have been well below 1,000 copies.

The minute book shows that there was a flurry of activity in the editorial board between 27 December 1796 and 26 January 1797. This was sufficient to ensure publication of volumes 19 and 20, dated simply 'year 5 or 1797' and devoted entirely to material of the missing years. The editors were also able to produce volumes 21-24, made up of numbers published at approximately monthly intervals covering the whole of the year 1797. Judging from the printed volumes, which reproduce the old style of the *Annales*, there was no problem; yet the minute book reveals a hidden crisis. After 26 January 1797

[60] St. Léonard, G.L. 59, f.1.

[61] M. Sadoun-Goupil, *Le Chimiste Claude-Louis Berthollet, 1748-1822. Sa vie, son oeuvre*, Paris, 1977, p.41.

there were no more formal meetings of the board until February 1798. The secretary Pelletier, on whose shoulders so many duties lay, was suffering from an advanced state of consumption, from which he died in July 1797. Although a few informal meetings may have been held, it would seem that Guyton took responsibility for putting together the material for the remainder of 1797, a task which was the normal responsibility of the secretary. The fact that the minutes give special prominence to Guyton after the break suggest that he had effectively become the editor-in-chief and acting secretary[62] in 1797.

The 1797 contract had only been for six volumes (two retrospective plus four ordinary volumes), so a further contract with the publisher was needed in January 1798. This was also an opportunity to enlarge the editorial board. They began by nominating Van Mons and Chaptal, who had contributed material to the earlier *Annales* but were not resident in Paris. They also recruited Prieur, who immediately joined the meeting.[63] By now both Berthollet and Monge were back in Paris and their names appeared as members of the new editorial board, although they did not attend meetings, being shortly summoned by Bonaparte to join the Egyptian expedition. It was only on Berthollet's return to Paris at the end of October 1799 that he finally attended a meeting of the editorial board.

6. *Translations and abstracts*

An English translation of the *Annales* was begun in 1791 but was not a successful commercial venture and thus only one volume was published. The existence of this extremely rare publication was first brought to the attention of the present writer by a review in *The Monthly Review* for June 1792. Extensive enquiries have led to the location of only two remaining copies in university libraries, one at Yale[64] and the other at Göttingen.[65] The volume (which is described as Volume 1) consisted of 240 octavo pages, and was published by Johnson in London at a price of 3s. 6d., being a translation of volume 1 of the French *Annales* of 1789.

We will refer to the review to judge its potential reception by the English-speaking public. The anonymous review began on a rather critical note, but soon became more appreciative:

---

[62] Although of the remaining three editors, Vauquelin had junior status, he was very closely associated with Fourcroy and might not, therefore, have been very acceptable to Guyton as a replacement secretary.

[63] The junior status of Prieur and his attachment to Guyton would have made him an ideal candidate for the post of secretary.

[64] *The Annals of Chemistry; or a Collection of Memoirs relating to Chemistry and the Arts with which it is connected*, Vol.1, translated from the French. (No more published)

[65] I owe news of this location to Professor Christoph Meinel.

T H E

ANNALS OF CHEMISTRY;

O R, A

COLLECTION OF MEMOIRS

RELATIVE TO

C H E M I S T R Y,

AND THE

ARTS WITH WHICH IT IS CONNECTED.

B Y

MESSRS. DE MORVEAU, LAVOISIER, MONGE, BERTHOLLET, DE FOURCROY, BARON DE DIETRICH, HASSENFRATZ, AND ADET.

V O L. I.

TRANSLATED FROM THE FRENCH.

L O N D O N:

SOLD BY J. JOHNSON, NO. 72, ST. PAUL'S CHURCH-YARD.

M,DCC,XCI.

FIG. 3: Title page of the excessively rare English translation of the *Annales* (1791) (by kind permission of the Beinecke Rare Book and Manuscript Library, Yale University).

> These Annals are more comprehensive in their objects, than the title page would lead to expect. Beside several *original* Memoirs in each Number, by the editors themselves or their correspondents, they give a compendious view of the labours of others, and of all the discoveries successively made in chemistry, and in the chemical arts and manufactures, throughout Europe. It is likewise a material part of their plan, to repeat the interesting experiments of others, and to give an account of the results that take place in their own hands.
>
> The importance of such a work is obvious to everyone; and the execution of it has hitherto done credit to the well-known abilities of the gentlemen who have undertaken it.[66]

The review went on to summarise individual articles by Adet, Lavoisier ('on the combustion of iron in vital air'), Berthollet ('on the prussic acid'), Fourcroy, Morveau and Hassenfratz. The review concluded with a broad hint that something more was required than simply translation into English of the contents of successive volumes of the *Annales*. Some editing and selection would be necessary to make the journal of greater interest. The translator saw the *Annales* as the journal of the new chemistry but was equally aware of the *Journal de physique*. He was not in favour of the expense of a full English translation of both but suggested that 'by judicious abstracts and selections, the interesting parts of them might be reduced to a very moderate compass'.

So whereas there might have been a market for some personality in British science to present a selection of French chemistry based on the *Annales*, there was not a large audience for an anonymous translation *in extenso* of the *Annales*. The fact is, of course, that many British chemists were quite capable of reading French, not only rendering any translation superfluous but also interposing a further passage of time in receiving chemical news from France. The Scottish philosopher Dugald Stewart could claim in 1806 that

> A knowledge of French .... is quite universal in Scotland among all who turn their attention in the smallest degree to the sciences.[67]

The need for an English translation of the *Annales* was all the less, as from the very beginning, the journal had made plans for distribution in London as well as in Paris. There was a French bookshop in Gerard Street, Soho, owned by Joseph de Boffe, who already had some dealings with the *Observations sur la physique*. If the *Annales* was intended to be more than a purely French journal it made sense to make it directly available in the capital city of an important neighbouring country with a potential chemical readership. Accordingly the title page of the first volumes of the *Annales* proclaimed that it was

---

[66] *Monthly Review*, N.S. *8* (1792), 169-172.

[67] Quoted by C. W. P. MacArthur, 'Davy's differences with Gay-Lussac and Thenard', *Notes and Records of the Royal Society of London*, *39* (1985), 207-228 (217). Yet there was a steady demand in Britain for English translations of French chemistry books.

published not only at the Rue et Hotel Serpente in Paris but also that it was available from de Boffe in London. The *Bibliothèque britannique* was later to make use of de Boffe's not inconsiderable experience in importing French publications.[68]

If the ability of many educated British readers to understand French was one reason for the collapse of the projected English edition of the *Annales*, the unfavourable comments in *The Monthly Review* were an additional discouragement. Most important was the delay caused by translation in addition to any delay caused by poor communications. A time interval of two years between the appearance of the original French and the English translation was hardly encouraging for a publication concerned with chemical *news*. The most seriously interested reader would want to have access to the French publication at the earliest possible moment, even if, without help, he could understand only a part of what was written. Then one must think of the sheer labour of translating the complete text of all the articles, some of which represented no more than a preliminary report on work in progress. As the anonymous reviewer said, some serious editing was called for. Much more useful would have been a summary of some of the articles as a part of the contents of an existing journal and this happened, for example, with Nicholson's *Journal*.

William Nicholson began his *Journal of Natural Philosophy, Chemistry and the Arts* in 1797. As the title suggests, it was intended to provide a wide coverage of science and technology but the *Annales de chimie* was the main French journal from which he drew. Nicholson frankly acknowledged his sources and in successive issues we can find as many as half a dozen articles translated from a single volume of the *Annales*.[69] Nicholson's *Journal* began as a fairly formidable quarto publication. When sales were poor the editor blamed this not on the format or contents but rather on general economic problems of the time. In 1802, however, he began a new series in octavo format, which was more successful. Nicholson prided himself on putting his own name on the title page and on taking personal responsibility for the contents of his *Journal*, yet he was not very well known except as an author and translator before 1800. It was then that he and Carlisle used Volta's electric battery to decompose water. His new fame greatly helped improve the sale of his *Journal*.[70]

A German translation of the *Annales*, edited by Crell, was published at Helmstedt in 1801:

---

[68] See David Bickerton, *M.-A. and C. Pictet, the Bibliothèque Britannique (1796-1815) and the Dissemination of British Literature and Science on the Continent*, Geneva, 1986, p.338.

[69] E.g. Vol.21. The only other French journal to be referred to at the time was the *Journal de l'Ecole Polytechnique*.

[70] S. Lilley, '"Nicholson's Journal" (1797-1813)', *Annals of Science*, *6* (1948), 78-102.

Auswahl vorzüglicher Abhandlungen aus der sämmtlichen Bänden der französischen Annales der Chemie; zur vollständigen Benutzung derselben durch Ergänzung der von ihrem Anfange an der chemische Annalen einverleibten Aufsätze für deutsche Scheidekünstler.

Although it was described as 'volume 1', it was in fact the only issue to appear. It was a very slim small octavo volume of 214 pages, which provided translations of what the editor considered the most important articles in volumes 16, 17, 18 and 19 of the *Annales*. It was certainly an improvement on the English translator's idea of providing the entire contents of a single volume of the *Annales*, putting ephemera side by side with articles of more lasting importance, yet there was no real market for it. The German states had a tradition of publishing their own journals and did not feel the need for an exclusively French publication. Indeed, as an indication of the standing of German chemistry, in the 1790s there had been an English translation of Crell's *Annalen* (3 vols., 1791-93), which also included some Swedish chemistry (there was considerable interest in Scheele). Yet the title: *Crell's Chemical Journal*, was followed by a sub-title which spoke of 'extracts from various foreign transactions' and 'occasional additions'. Indeed, if one studies the contents of the first volume, one finds two translations from the *Annales de chimie* (vol.7). In the third volume the anonymous editor announced that the previous title seemed too exclusive and he was planning a series which would regularly include 'some account of the principal memoirs in the *Annales de chimie*'[71] in addition to the German journals.

There was also to be a 'Belgian' dimension to the *Annales*. Van Mons, born in Brussels, became friendly with the French chemists after the French occupation of what had previously been the Austrian Low countries and was later (1831) to become the modern state of Belgium. He had been in contact with the *Annales* since the early days and from volume 12 onwards he became a regular contributor, including translations from Brugnatelli's *Giornale fisico-medico*. He defended Lavoisier's theory of calcination and confirmed (contrary to the opinion of some German chemists) that red precipitate of mercury when heated evolves oxygen. It is not surprising, therefore, that on the resumption of publication in 1797 he was invited to join the editorial board. When, however, he suggested that a monthly supplement to the *Annales* should be published, containing memoirs deemed unsuitable for that journal,[72] this suggestion was rejected by his colleagues and he decided to publish on his own. They wrote him a letter in November 1801 assuring him

---

[71] *Crell's Chemical Journal*, *3* (1793), Advertisement, p.vii.

[72] He may have been influenced by the precedent of Crell publishing a second journal to take the surplus material.

of their goodwill and regretting his decision to cease collaboration;[73] his contribution to the *Annales* earlier in that year was to be his last.[74] Another factor, which may have widened the split was Van Mons' increasingly independent views on chemical nomenclature.

Having decided to act independently of the French chemists, Van Mons issued the first part of his journal in October 1802 with a title which tried to bathe in the reflected glory of the *Annales de chimie*:

> *Journal de Chimie pour servir de complément aux Annales de Chimie et autres Ouvrages périodiques français de cette science.*

Despite the title, which paid a double compliment to specifically French periodicals, there was very little French material in the first part, but much material taken from the journals of Trommsdorff and Brugnatelli, together with material by British authors. Volume one consisted of three parts issued at monthly intervals. When volume two appeared in January 1803, it was with a new title:

> *Journal de chimie et de physique ou Recueil périodique des découvertes dans les sciences chimiques et physiques tant en France que chez l'étranger.*

One notices here not only the change to an equal emphasis on chemistry and physics and also the reduction of the importance of France. Accordingly we find in this volume articles by Davy, Wollaston and Brugnatelli. But more striking than any possible change in content is the marked reduction in the number of pages. So although the journal continued publication up to volume 6 (January 1804), we may note that signs of decline had appeared much earlier. Neither the name of Van Mons nor the place of publication were sufficient to recruit subscribers. Brussels, not yet a national capital, was no more than a provincial city in the French empire and quite unable to compete with Paris.

---

[73] J. R. Partington, *History of Chemistry*, vol .3, p.491. A. Quetelet, 'Notice historique sur J. B. Van Mons, membre de l'Académie Royale', *L'Annuaire de l'Académie Royale des Sciences et Belles Lettres de Bruxelles*, 9e année, 1843, 187. The *Annales*, which normally was willing to give publicity to new journals in related fields, made no mention of Van Mons' independent venture.

[74] The name of Van Mons continued to appear on the title page of the *Annales* until 1804.

CHAPTER FOUR

THE EDITORIAL BOARD: BUSINESS, IDEOLOGY AND PHARMACY

> Mr Lavoisier has had the felicity of being joined in the support of his theory by associates of distinguished ability, among whom are Messrs. Berthollet, Morveau, De la Place, Monge, De Fourcroy, and others, who have united their labours in establishing this new system, which, with such a combination of talents, could not fail of being exhibited with every advantage.
>
> (James Keir, *First Part of a Dictionary of Chemistry,* Birmingham, 1789, Preface p.vi.)

> 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 parts of science.
>
> (Chaptal, *Elements of chemistry*, transl., London, 1791, Preface, p.lvii.)

1. *The formal organisation of the editorial board.*

The Société des Annales de chimie was both a scientific society, like the Société Philomatique (and later the Société d'Arcueil), and a business association. In so far as the subject matter of science (usually chemistry) was discussed, the group performed a useful function of passing on news, advancing knowledge and benefiting from private criticism. We know that at some of the

meetings memoirs were read, almost as in the Academy of Sciences, although of course the proceedings were much more informal and off the record. But we cannot pretend that it was all done for love of science rather than money. And indeed, if one judges by the minutes of meetings, the business side was dominant. But this may be a reflection of the need felt by the secretary to record the financial side, notably the payments to be made to members out of the profits of sales of the *Annales*. Payment was to be made firstly for attendance at meetings, thus encouraging regular attendance. In this they were following the precedent of the Royal Academy of Sciences and they even used the Academy's *jetons* as tokens for later exchange for cash. But we would be mistaken if we thought that attendance at meetings was simply a token affair. Article 2 of the regulations stated that meetings should last between 1½ and 2½ hours.[1] Again the specification of the length of a meeting seems unusual for an informal society and can only be explained as being based on the regulations of the Academy of Sciences. Regulations were taken to the extreme of excluding latecomers from receipt of *jetons* (Article 3) and only distributing them towards the end of the meeting, thus discouraging anyone from leaving early. It is doubtful whether such regulations would be enforced for very long, particularly in a period of political and social revolution.

The original constitution of the *Annales* insisted (Article 4) that all material for the *Annales* should first be read at a meeting, excluding only memoirs already published elsewhere and translations. Again it is very doubtful if it was possible always to follow this regulation strictly, although it was admirable in principle. The alternative for a memoir previously published elsewhere was that one of the members of the Society should read it and certify its value. Thus we have the basis of a comprehensive refereeing system, which must have done much to raise the standard of the *Annales* above that of many other journals of the time. Of course, there would be occasions when there was lack of agreement on the acceptability of an article. Such differences of opinion could be put to the vote. There was even provision for a secret ballot if members felt strongly enough (Article 5).

The *Annales* differed from many journals in that the members of the editorial board were expected to contribute to the journal. Indeed after about 1806 the editorial board often spoke of itself as the 'Société *des auteurs* des annales'. To encourage contributions, payment was offered to members of the board on the basis of the number of printed pages contributed. This, therefore, brings us to the business side of the journal. Here we have a view of the new chemistry not so much as an ideal as a business enterprise. It certainly helped the first secretary Adet, who was looking for employment. It was

---

[1] For the 1789 constitution see Appendix 1, No.2.

agreed (Article 6) that he should be paid 8 francs per 'sheet' (16 pages). For this he would not only take the minutes of meetings but also take responsibility for all correspondence and proof-corrections of printed material. Since the first volumes of the *Annales* only appeared quarterly with about seven 'sheets' per volume, Adet's income would have been very modest, but any income was welcome to him at that time, as he already owed money to Lavoisier.

But payment did not stop with the secretary. Members of the editorial board were encouraged to contribute to the *Annales* by the offer of 32 francs for every 16 pages and corresponding payment *pro rata*. Translators would be paid a minimum of 6 francs for 16 pages (Article 7).

In 1789 it was agreed that the Society should meet at least once a fortnight (Article 1). When the *Annales* was revived in 1797 the revolutionary calendar had been introduced and the week of seven days had been replaced by the *décade* of ten days. It was, therefore, thought appropriate that the Société should meet once every *décade*. By May 1802, however, it was decided to revert to two meetings a month.[2] We also know that from 1807 advantage was taken of the fact that many members of the editorial board were members of the First Class of the Institute to propose that the board should meet at the Institute every fortnight before the official meeting.[3] Indeed the regular Monday meetings of the First Class provided unparalleled opportunities to find experts on all the main branches of science at one location in Paris. Fortnightly meetings fitted in well with regular monthly publication of the *Annales* but there were occasions, such as the problems arising from the bankruptcy of a publisher when weekly meetings were sometimes called for.[4]

Turning now to the location of meetings, from the resumption of publication in 1797 the committee met in the private house of one of its members:

> The Society ... will continue to assemble on the seventh day of each decade at six o'clock in the house of the member who has the ledgers and boxes containing material for future issues, correspondence and financial matters.[5]

We should not be surprised to learn that Guyton's house was a regular meeting place. On Pictet's visit to Paris in 1798 he wrote:

> Humboldt called on me to take me to Guyton Morveau's house for a meeting of the *Annales de chimie* committee ... We were among the first to arrive ... The others came one by one; Fourcroy, Chaptal, Vauquelin, Adet ... and others. They drew up the list of contents of future volumes of the *Annales*. Everyone signed the minutes and Adet fulfilled the duties of secretary... Fourcroy read a memoir

---

2 St Léonard, G.L.59, f.28v.
3 M. Crosland, *Science under Control*, 1992, p.110.
4 As in 1814 and early 1815
5 St Léonard, G.L.59, f. 5v. (17 March 1798).

> which he is preparing for the *Annales* in reply to a memoir of Mr Pearson in the *Philosophical Transactions* ...[6]

From this and other testimony it is clear that, as a scientific society, meetings were open to visitors with an interest in science (not necessarily chemistry). At a meeting in 1791, Lavoisier had spoken favourably of Pictet's *Essai sur le feu* and the Society resolved to obtain a copy for its library.[7] Yet the meetings were dominated by business and the main business was always the planning of forthcoming volumes of the *Annales*.

Although *in principle* all members of the editorial board were resident in Paris, meeting regularly to discuss the contents of future issues of the *Annales*, in practice this was not always the case. Two early examples may be provided concerning senior members of the editorial board. Considering that the name of [Guyton] de Morveau was printed first in the list of editors from volume one - even before the name of Lavoisier - one might well assume that he was one of those most involved in Paris in the production of the series. Yet, as we have seen previously,[8] Guyton made very little contribution to the *Annales* while Lavoisier was still alive. Guyton, at this stage was, therefore, only nominally at the head of the '*coopérateurs*' because he was the senior chemist. The combined names of all the leading chemists were intended to give extra authority to the journal. The board had not yet, however, enrolled another important chemist, Chaptal, then living at Montpellier. On the resumption of publication at the beginning of 1797, after an enforced break, the board invited Chaptal to join them - even though he was not able to take up residence in Paris until March 1798.

We have explained that all members of the editorial board were expected to contribute articles to the *Annales* and this worked quite well in the first few years after the foundation of the journal and again on the resumption of publication in 1797 (see Table 1). One finds, however, a marked decrease in editorial contributions after the first few years. It might be charitable, if not entirely true, to say that the growing reputation of the *Annales* brought it so many articles from outside that the editors did not feel the same obligation to appear as authors.

2. *The working of the editorial board.*

The main source of information about meetings of the editorial board is a folio ledger covering the period December 1796 to February 1815, which be

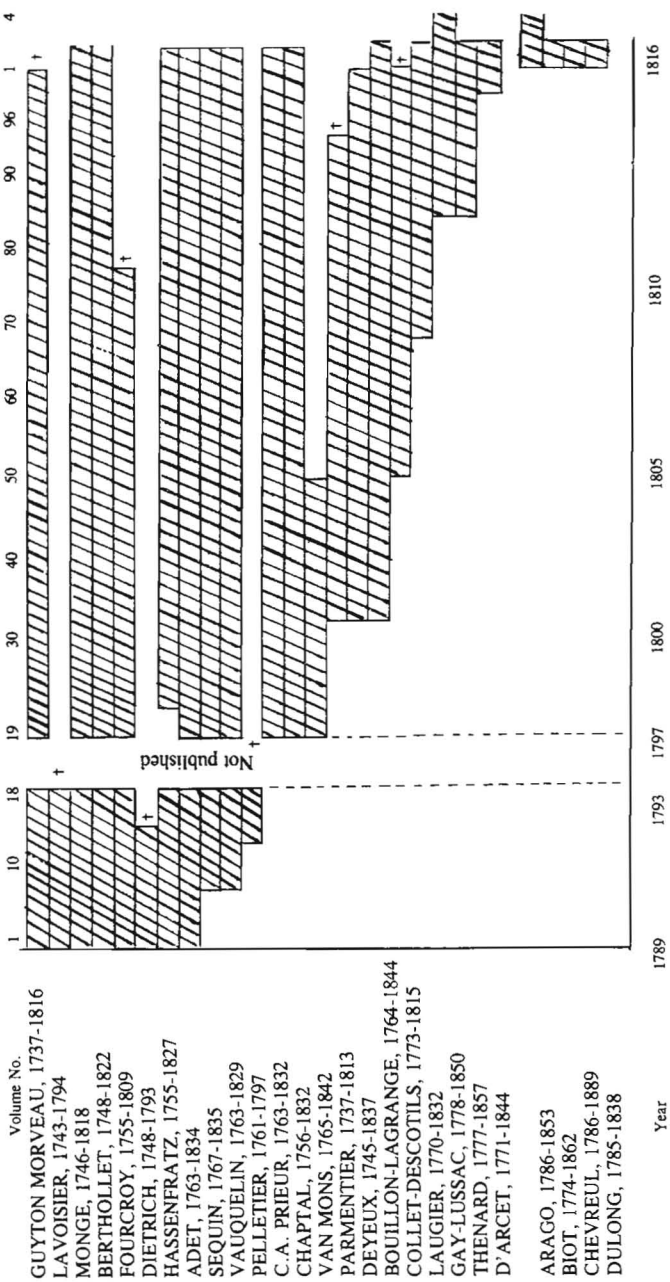
---

[6] Geneva, Papiers Rilliet, notebook 27, entry for 4 August 1798, quoted by D. Bickerton, *Marc-Auguste and Charles Pictet, the 'Bibliothèque Britannique' (1796-1815) and the Dissemination of British Literature and Science on the Continent*, Geneva, 1986, p.234.

[7] Letter from Dr Belcombe to Pictet, 20 January 1791, quoted by David Bickerton, *op cit.*, pp.103-4

[8] Chapter 3, section 3.

TABLE 1 The Editorial Board of the *Annales de chimie* (First Series)



came the property of Gay-Lussac, who in turn used the blank pages as a laboratory notebook. The ledger begins with the first meeting of the board after the break. The Terror had come to an end in July 1794 and a more constructive period had followed, which witnessed the foundation of a number of major institutions, of which the most important for science was probably the National Institute. It was not until December 1796 that the editorial board of the *Annales* came together to hold a formal meeting to arrange for the resumption of the journal. As previously mentioned, only four members were present on 7 nivôse year 5 (27 December 1796): Guyton, Fourcroy, Vauquelin and Pelletier. It was explained that the other members were absent on government business. Berthollet and Monge had been sent to the Italian states as trustworthy commissioners who would help organise the collection of works of art and other war booty to enrich French museums. It was in Italy that they were to meet General Bonaparte and establish an important connection with the future head of state.[9] The minutes made no mention of baron Dietrich, who had been executed in December 1793, nor of Lavoisier, who had suffered a similar fate in May 1794.

With the removal of some of their former colleagues, it was appropriate that the 'editorial core' should consider augmenting the membership of the board. It was most unfortunate that Pelletier, the secretary they had appointed, should already have been suffering from pulmonary tuberculosis, from which he died on 21 July 1797. This left a gap in the organisation, which is reflected in the minutes, which are not resumed until February 1798. Even then it is not clear who was acting as secretary, although by 1798 the former secretary Adet was back on the editorial board with Hassenfratz. Chaptal, now in Paris, was also able to be present and the register was also signed by Descotils and Tassaert, who provided regular translations from the German. We reproduce below the total contributions made by the various members to the first six volumes since the resumption of publication in 1797.[10] It may be useful to list names in order of their total earnings, which represented their respective contributions to the *Annales* and in some cases (but not all) are an index of their commitment to the journal:

Guyton	621 francs
Hassenfratz	554
Prieur	504
Vauquelin	459
Fourcroy	414
Pelletier	288
van Mons	279

[9] M. Crosland, *The Society of Arcueil*, 1967, pp.57-62.
[10] St Léonard, G.L.59, f.5.

Chaptal	171 francs
Bouillon Lagrange	171
Descotils	72
Tassaert	72
Gruvel	63
Berthollet	36
Monge	36
Adet	27
Séguin	27

Half of the above sums of money was immediately payable in cash, the other half was covered by a promissory note.

The name of Guyton at the top of the list is certainly indicative of his leadership by example at this time, and no doubt he encouraged Prieur to be as productive as possible. But some of the work of Prieur, notably on the thermal expansion of gases, was poorly executed[11] and in the end, of course, quality is more important than quantity. This comment applies even more to Hassenfratz. Here then is a weakness in the organisation of the *Annales*. For someone like the mediocre Hassenfratz it provided an important source of income and his colleagues on the editorial board may not always have been strict enough in their role as referees. In fact many of Hassenfratz's contributions were not memoirs by him but were described as 'extraits'. He performed a useful function by regularly summarising the contents of books and memoirs by other *savants*.

On the other hand the occurrence of the names of Adet and Séguin at the bottom of the list might seem an index of their indifference to the progress of the *Annales,* now that their friend and patron Lavoisier was dead. Yet the fact that both Berthollet and Monge are shown near the bottom of the list is quite irrelevant to their attachment to the *Annales,* since during most of the period covered we have said that they were absent from Paris on government business. This was also the case with Adet, who was to take up a career in politics and administration.[12] After positions in Marseilles and Geneva, he was appointed plenipotentiary minister to the U.S.A. in 1795. Having returned to France in 1797, he became a member of the Tribunate under the Consulate. From 1803-1809 he was prefect of the Nièvre department and, therefore, mostly away from Paris. Despite his other duties, he did not entirely abandon chemistry, since in 1804 he published a *Cours élémentaire de chimie*.

It may be worth reproducing a second table which records the state of affairs in 1800.[13] This table has the advantage that it records not only the

---

[11] *A.c., 1* (1789), 256-299. Gay-Lussac later criticised this work with some justification.

[12] J. Balteau *et al.* (eds.) *Dictionnaire de biographie française*, vol.1, 1933.

[13] St Léonard, *op. cit.* f.21, 7 frimaire year 9, (28 November 1800).

number of pages contributed by respective members (this time in strictly alphabetical order) but also the number of times they had attended meetings of the editorial board. This table, therefore, provides a more reliable index of commitment to the *Annales*.

Name	*Pages contributed*	*Attendance*
Adet	-	6
Berthollet	28	26
Bouillon Lagrange	123	33
Chaptal	84	8
Deyeux	61	19
Fourcroy	221	21
Guyton	172	35
Hassenfratz	83	24
Monge	11	1
Parmentier	34	24
Prieur	54	29
Van Mons	172	0
Vauquelin	142	28

Again we find Guyton at the head of the list of attendances. He was also a frequent contributor, although at this time he did not supply quite as many pages as Fourcroy.

There is no mention in this second list of Séguin. When in 1804 the editorial board had serious problems with the publisher Fuchs, the members unanimously supported legal action against him, pointing out that the only signature missing from their document of complaint was that of Séguin who, they said, had not attended a single meeting of the editorial board over the past five years. In fact Séguin, after developing a rapid method for the tanning of hides, had acquired the exclusive privilege of supplying the republican army with hides and had become very wealthy. He seems, therefore, to have abandoned science for business. Yet he never formally resigned from the board of the *Annales* and in 1813 he began contributing again to the *Annales*, making contributions to the five successive volumes, 88-92, some of these memoirs representing joint research he had carried out on respiration with Lavoisier in the early 1790s.

In discussing the composition of the editorial board, there are three anomalous cases, which deserve to be mentioned. In principle the names of all the members were displayed on the title page of successive issues and, considering that most of the members were distinguished men of science, this helped to give authority to the publication. At one of the meetings of the editorial board after resumption of publication in 1797, we find the names of Gruvel and Tassaert among those present. Gruvel soon disappeared but Tassaert regularly contributed translations from the German from volume 21 to 28 and

again in volumes 51, 52 and as late as 71 (1809). Tassaert was clearly valued as a translator, who performed invaluable service in making available to French readers articles which had originally appeared in the journals of Crell, Scherer, Klaproth, etc. and the inclusion of his signature in the minutes of 1798/99 suggests that in some respects he was considered a full member of the editorial board. It may be recalled, however, that the rate paid for translations was considerably lower than that paid for original articles.[14]

The other anomalous case was in a very different position. J. J. Berzelius (1779-1848) was a distinguished Swedish chemist, who became friendly with Berthollet and was glad to have his work translated into French and made available to a wider audience. Traditionally Swedish scholars had closer affinities with the German states and, without Berthollet's help, Berzelius's work would probably only have been known abroad through German translations. Berzelius's early professional life had been plagued with financial difficulties, but these were reduced in 1807 when he was appointed professor of medicine and pharmacy in Stockholm. When he began his regular correspondence with Berthollet, however, in 1810 the Frenchman was aware of Berzelius's low income and suggested to the editorial board that the Swedish chemist should be paid for contributions on the same scale as members of the board.[15] It was not until 1818 that Berzelius, as secretary to the Swedish Academy of Sciences, achieved a comfortable income. Meanwhile he did much important work, encouraged not only by the approval of his peers but by the prospect of a small but steady income from France, some of which he used to buy books on chemistry published in France.[16] He was able to write quite good French prose but for most of his articles the editorial board preferred to employ a translator from the Swedish. Although Berzelius had contributed a few articles previously, it was only in 1811 that he became a major contributor to the *Annales* on a regular basis. His long memoir on definite proportions in inorganic compounds was published in 12 parts, beginning with volume 78 and ending with volume 83. It may be noted that Berthollet, appreciating the analytical skills of his Swedish colleague, encouraged this publication, even though it went against his own earlier ideas about *indefinite* proportions. He had to pacify Berzelius, who was not too happy with the prospect of having his work spread so thinly.[17] The editorial board needed to take into consideration the interests of readers, who would

---

[14] See Appendix 1, No.2, Art.7.

[15] *Jac. Berzelius Bref*, ed. H.G. Söderbaum, Vol.1, Part 1: *Correspondance entre Berzelius et C. L. Berthollet*, Uppsala, 1912, p.6. Although Berthollet offered such payment in 1810, it was not until 18 February 1811 that it was formally agreed by the board, St. Léonard, *op.cit.*, f.51.

[16] *Ibid.*, p.25.

[17] *Ibid.*, p.26.

expect a wide range of subjects in each issue of the *Annales* rather than concentration on a single subject.

When the bankruptcy of Klostermann in 1814 produced a crisis for the *Annales*, Berthollet insisted that, although the editorial board in Paris might receive no income for some time, it owed a debt of honour to Berzelius. A study of the manuscript sources has, therefore, shown that one of its foreign contributors had the effective status (or at least income) of a member of the editorial board, although this was never revealed publicly. The importance of this conclusion relates mainly to the European aspirations of the journal. Linguistically the *Annales* was French but in its aspirations and circulation it was European. Berthollet regularly forwarded one of his own copies of the *Annales* to Berzelius.

3. *Problems with the publishers.*

As the *Annales* had exceptional difficulties with publishers and printers in the period 1789-15 it is worth while pausing to consider why this should have been so. Of course the major discontinuity in publication over the years 1794-96 was related to the arrest and subsequent execution of Lavoisier, but this is only a part of the full publication saga. First we must go back to the ancien regime. Not only had there been problems of censorship but the number of printers was severely restricted. In the first four years of the Revolution a new generation of little printers had entered on the scene. Many were former printing shop workers who were taking advantage of the new declaration of freedom of the press to buy a few presses and join in the production of political pamphlets and other ephemera.[18]

It has been shown that an extraordinary expansion of the printing trade occurred in the decade 1789-99 and this was due to the proliferation of small printers rather than the expansion of the established printers. This was to produce a very unstable situation. By far the greatest expansion came in 1797, the year of resumption of publication of the *Annales*. Similarly the number of new publishers increased sharply in that year.[19] In the decade up to 1799 the number of independent printers in Paris more than quadrupled from 47 to 223. Yet by 1810, when the Napoleonic administration undertook a detailed survey, the number of printing shops in Paris had already declined to 157. As Napoleon was concerned to introduce greater order and control into printing, he insisted that only those printers, who owned at least four presses (together with the corresponding type to run them) and who would swear allegiance to his regime, would be allowed to continue in business. This reduced the

---

[18] Carla Hesse, *Publishing and Cultural Politics in Revolutionary Paris, 1789-1810*, Berkeley, 1991.

[19] *Ibid.*, two graphs on p.169.

number of printers to 80 and effectively squeezed out many small printing shops. An analysis of the specialisation of the printers surviving in 1811 reveals that periodical publications had become the single most important source of employment in this new printing world.[20]

We are now in a better position to appreciate the difficulties of the *Annales*. If the main subject recorded in the minutes of the editorial board was the division of money between the various members, the second most prominent subject was relations with the publishers and printers. This is to be expected since the successful running of the operation depended on a steady flow of manuscript material to the printers and the regular transformation of these manuscripts into printed pages. We shall see that relations of the editorial board with the publishers and printers were often difficult and several changes of publisher had to be made in the revolutionary and Napoleonic periods.

It was the publisher who dealt with sales of the journal and subscriptions. From 1791 an annual subscription of 18 livres[21] had been introduced and, after sales of several hundred, the publisher would soon have had enough money to pay his own expenses and reward the members of the editorial board, who had supplied material in proportion to their respective contributions. Payment would not be immediately in cash on publication but would be in the form of promissory notes payable in a year's time, later reduced to six months. In the original constitution of 1789 Lavoisier undertook to make cash advances to authors in case of need.[22] The early volumes of the *Annales* do not display on the title page the name of the publisher in Paris but merely stated that they were published in the 'Rue et Hôtel Serpente'. A later edition, however, gives the name of Cuchet, and a guide to publishers and printers in Paris shows that from 1789 to 1794 G.J. Cuchet was operating from the Hôtel Serpente.[23] Cuchet was an old established publisher, who was later to suffer from the collapse of the traditional book trade and get himself into very serious trouble by publishing counter-revolutionary pamphlets.[24] As we have seen, he was also the publisher of the *Journal de physique* up to 1794.

From 1797, according to a contract with a new publisher and printer, Guillaume, the *Annales* were to appear monthly and the annual subscription was to be 15 francs for 12 issues, making up four volumes.[25] The printer agreed to produce issues on good paper with a specified type. In addition to the text he

---

[20] *Ibid.*, p.176.

[21] This was equivalent to 4½ livres per volume, a slight increase on the 3½ livres charged in 1789-90.

[22] Appendix 1, No.2, Art.9.

[23] Paul Delalain, *L'Imprimerie et la librairie à Paris de 1789 à 1813*, Paris, 1900, p.347. The second edition of volume 1 of the *Annales* also refers subscribers to Cuchet at the Hôtel Serpente.

[24] Hesse, *op.cit.*, pp.174-5.

[25] St. Léonard, *op.cit.*, f.3.

would be required to produce a maximum of two plates per volume. He would only print material supplied by the editorial committee and he would have the issue ready on the last day of the month. The editorial board for its part agreed to produce legible copy not later than the 15th day of each month. The authors would correct proofs as soon as these were ready.

Although a second contract with Guillaume was signed in 1798, in early 1799 there was some discussion with another publisher, Fuchs, who was to print an Index for the first 30 volumes. The possibility was also discussed of Fuchs taking over the publication of the *Annales* and in April 1799 the contract was formally transferred from Guillaume to Fuchs on the same terms as before. This meant that, when the *Journal de pharmacie* was incorporated in 1800, Fuchs was the publisher. Yet he soon proved to be slack in paying his dues and in November 1801 a formal document was drawn up by the editorial board demanding that Fuchs should meet his obligations. It is interesting that in this case the signatures were headed by Chaptal, who at the time held the prestigious government position of Minister of the Interior. The editorial board was reminding the publisher of the important people he was dealing with! Yet the board continued to complain about Fuchs and in particular about his persistent delays in paying the authors.

It is not surprising, therefore, to find that on 2 May 1804 a new contract for printing the *Annales* was drawn up with another publisher, Bernard. Fuchs was furious and refused for some time to hand over money or even the list of subscribers. For many years the board tried to get back from Fuchs the money he owed them. When they took him to court, he was ordered to pay 1,254 francs in debts, but he resisted payment; eventually they had to be content with a smaller amount from the sale of Fuchs's property. The truth is that Fuchs was now bankrupt.

A study of printing finances in the Napoleonic period has shown that between 1799 and 1806 at least 42 publishers, printers and booksellers declared bankruptcy, that is nearly one fifth of the publishers in Paris. Not only was this an exceptionally bad period for bankruptcies but the total amount involved came to more than 5 million francs, thus constituting a crisis of unprecedented proportions. Among these was Fuchs, publisher of the *Annales*, who owed more than 200,000 francs in 1804.[26] Things would not have been much better if the *Annales* had stayed with Guillaume because he too was soon to become bankrupt.

An interesting feature of the new contract with Bernard was that it was for nine years but with the possibility of earlier termination if necessary. This provided a contrast with the 1797 short-term contract with Guillaume. Guillaume might well have complained that this did not give him enough security

---

[26] Hesse, *op.cit.*, p.206.

ANNALES

DE

CHIMIE,

OU

RECUEIL DE MÉMOIRES

CONCERNANT LA CHIMIE,

ET LES ARTS QUI EN DÉPENDENT,

ET SPÉCIALEMENT

LA PHARMACIE;

Par les Cit. Guyton, Monge, Berthollet, Fourcroy, Adet, Hassenfratz, Seguin, Vauquelin, C. A. Prieur, Chaptal, Parmentier, Deyeux, Bouillon-Lagrange et *Collet-Descostils.*

30 GERMINAL AN XII.

TOME CINQUANTIÈME.

A PARIS,

Chez BERNARD, libraire de l'École Polytechnique et de celle des Ponts et Chaussées, quai des Augustins, n°. 31.

AN XII.

FIG. 4

ANNALES

DE

CHIMIE,

OU

RECUEIL DE MÉMOIRES

CONCERNANT LA CHIMIE,

ET LES ARTS QUI EN DÉPENDENT,

ET SPÉCIALEMENT

LA PHARMACIE;

Par les Cit. Guyton, Monge, Berthollet, Fourcroy, Adet, Hassenfratz, Seguin, Vauquelin, C. A. Prieur, Chaptal, Parmentier, Deyeux, Bouillon-Lagrange et *Collet-Descostils.*

30 GERMINAL AN XII.

TOME CINQUANTIEME.

A PARIS,

Chez Fuchs, libraire, rue des Mathurins, maison de Cluny, n.° 334.

AN XII.

FIG. 5

FIGS. 4 & 5: The title pages of the two rival editions of volume 50 of the *Annales* (April 1804). The editorial board had just changed publishers from Fuchs to Bernard because the former was persistently in arrears with his payments with a large sum outstanding. Yet Fuchs insisted on producing a copy of Bernard's edition in a vain attempt to continue his business.

and the 1804 contract was intended to remedy the situation. Bernard was a good publisher, who specialised in science. He already had a contract with the École Polytechnique to publish its journal and from 1804 he was able to describe himself in advertisements as:

> Libraire de l'École Polytechnique et de l'École impériale
> des Ponts at Chaussées, éditeur des Annales de chimie.....

Bernard raised the subscription for the *Annales* from 15 francs (Paris) to 18 francs, which compares with 27 francs for the quarto *Journal de physique*. By 1804 the number of subscriptions had risen above 600 and, although the editorial board continued to ask for payment of 36 francs for every 16 pages, they added a clause to the effect that, if the number of subscriptions should reach 750, Bernard would be required to increase this payment to 48 francs. Although this might seem reasonable from the point of view of the editors, it may have constituted a disincentive for Bernard to work too hard on increasing subscriptions.

Unfortunately Bernard died in 1808, when his wife took over the business, but with only limited success. At the end of 1809 she sold out to J. Klostermann fils and in 1810 a new agreement was drawn up with Klostermann; but these were years of economic hardship in France, and in 1811 he asked to reduce payment to the authors. The board pointed out that one way the publisher could manage with limited capital was to economise on paper by printing no more than 500 copies as a first print run. In 1813 Klostermann was bankrupt; by March 1814 this bankruptcy had been officially registered. The editorial board eventually found that this bankruptcy had cost it the large sum of 4,796f. But meanwhile Guyton tried desperately to find another publisher. In April 1814 he was negotiating with Madame Peronneau and later he approached Crochard, who took over the publication from volume 91 (July 1814). In a later chapter we will discuss the unexpectedly fruitful consequences of the crisis but at the time it almost seemed that the *Annales* was doomed to extinction.

4. *Conflicting personalities and ideologies.*

Since the *Annales* was effectively edited by a committee, it is worth pausing to consider whether all members would have necessarily acted in harmony and thought alike. Certainly some would have been more active than others, some would have been more outspoken and they would have had differing political views. We might consider Hassenfratz and Fourcroy to have been politically much to the left, while Berthollet and Chaptal were more moderate. But at least they all supported the revolution which had replaced an absolute monarchy with a republic. It would, however, be too facile to suppose that, because they all accepted the oxygen theory, they all had the same conception of

chemistry. While Lavoisier was alive, he provided leadership, but most of the history of the *Annales* belongs to the period after Lavoisier's death. To cite a fanciful parallel, just as after the death of Newton, different strands of 'Newtonianism' began to emerge, it is quite possible that after the death of Lavoisier in 1794 his associates might tend to pull in different directions. They would not disagree that oxygen provided a satisfactory explanation of combustion, but they might disagree about caloric, and we may recall that, even before Lavoisier's death, Berthollet had indirectly challenged the oxygen theory of acidity. This challenge was later to be taken further by his protégé, Gay-Lussac. Lavoisier had presented chemistry as a physical science, whereas Fourcroy tended still to see it as a branch of natural history.

In the old days when a king died his sons would sometimes divide up his kingdom. In other cases they would accept the authority of the eldest son, often living in the uneasy state of truce, but perhaps looking for some opportunity to take over the kingdom. Such a state of affairs may provide some analogy with the situation in the *Annales,* in which the chief contenders for leadership all recruited followers to increase their power. We shall see that all four authors in turn of the *Méthode de nomenclature chimique* either came to direct the *Annales* or managed to change its policy fundamentally.

It is clear that in the first few years of the *Annales* Lavoisier was the leader, both in determining editorial policy and in business matters. While Adet was the secretary this meant that the burden of day-to-day management would fall on his shoulders but policy was decided by the editorial board under Lavoisier's chairmanship. Unfortunately, this chapter of the journal's history came to an end in November 1793 with the arrest of Lavoisier and the closure of the *Annales*.

Now, although Lavoisier had been the principal agent of the new chemistry, he was not actually the senior chemist among his valued collaborators. That position was occupied by Guyton de Morveau (1737-1816), who was 6½ years older than Lavoisier (1743-1794). Next of the senior collaborators came Berthollet (1748-1822), while the youngest of the four was Fourcroy (1755-1809). As a resident of Dijon, Guyton had been a prominent member of the Dijon Academy but only a corresponding member of the Paris Academy of Sciences (1772). A prolonged visit to Paris in 1787 and contact with Lavoisier had converted him to the oxygen theory and, having long been an advocate of a more rational chemical nomenclature, he was a natural collaborator of Lavoisier in the *Méthode de nomenclature chimique* of 1787. When elected to the National Assembly in August 1791, he moved to Paris permanently and divided his life between his scientific and (moderate reformist) political interests. In 1792 he was elected a deputy to the National Convention. A lawyer by training, he was a good administrator and at the newly-formed École Polytechnique he served not only as professor of chemistry, but was twice

director of the school (1798-99, 1800-04).[27] While Lavoisier was alive, however, Guyton had made little contribution to the *Annales*. He had really been an editor in name only.

Yet there is no doubt that it was Guyton who took the lead in an attempt to revive the journal in 1796/97. Also present at the first meeting in December 1796 were Fourcroy and his protégé Vauquelin, who had a common interest in pharmacy and animal chemistry, very different from Guyton. Guyton, therefore, decided to strengthen his position by proposing as an additional member of the editorial board Claude-Antoine Prieur (1763-1832), often described as Prieur de la Côte d'Or (the region of Dijon) to distinguish him from another person called Prieur, who was a deputy for the Marne department. C. A. Prieur was an army officer, who had acquired a taste for science.[28] From 1785 he had learned chemistry from Guyton, who subsequently entrusted him with several projects, one being a study of the thermal expansion of gases, which Guyton hastened to publish in the very first volume of the *Annales*.[29] Prieur also had a political career, being elected to the Legislative Assembly and then to the Convention, and becoming subsequently a member both of the Committee of Public Instruction and the powerful Committee of Public Safety, whose best known member was Robespierre.

For a short time Prieur provided moral support for Guyton, balancing the pharmacy/natural history bias of Fourcroy and Vauquelin. However, as we explain in the following section, the incorporation of the *Journal de pharmacie* in 1800 brought with it a reinforcement of the pharmacy element, with the addition of Deyeux, Parmentier and Bouillon Lagrange to the editorial board, particularly as the latter became the new secretary. This might be interpreted as no more than a business arrangement to incorporate an ailing journal. A more radical interpretation would be to see it as a bid to turn the *Annales* into a pharmacy journal, helped not only by expanding the title to include pharmacy, but also by changing the balance of the editorial board. There may have been moments in the year 1800 when it was felt that Fourcroy had almost taken over the *Annales*.

Yet Fourcroy was kept very busy by his work on the Council of State and was several times away from Paris on government business.[30] Guyton, on the other hand, was not now involved in politics and he remained the president of the committee, and minutes usually began with: 'M. Guyton announced that....', often a report on dealings with the publishers. Thus in the early 1800s we may consider there to have been a period where there were *two* dominant figures: Guyton and Fourcroy. Certainly when Fourcroy delivered a

---

[27] W. A. Smeaton, Art. 'Guyton', *D.S.B.*, vol.5., pp.600-604.
[28] Georges Bouchard, *Un Organisateur de la victoire. Prieur de la Côte d'Or*, Paris, 1946.
[29] *A.c.*, *1*(1789), 256-
[30] W. A.Smeaton, *Fourcroy*, 1962, pp.80-84.

lecture on the relation between pharmacy and chemistry there was no question that it would be published in the *Annales*, and at length.[31] In what proved to be the final two years of Fourcroy's life he managed to get his protégé Laugier accepted as a member of the board.[32]

We have said little about a fifth senior figure, Chaptal, for, although as Minister of the Interior from 1800-1804, he was a person of great political importance, he obviously had little time during these years to devote to the *Annales*. His presence on the board helped to remind his colleagues of the importance of applied chemistry, particularly chemical industry and agriculture. Yet he never took the lead. The same might be said of Berthollet, although a better interpretation might be that he was biding his time. With the death of Fourcroy in December 1809 he was able to introduce his protégés Gay-Lussac and Thenard on to the board. The minutes of the relevant meeting read as follows:

> The Society of the *Annales de chimie*, assembled on Thursday 5 April 1810 ...[made] the observation that the title page of the quarterly volume which was about to be sent for printing could no longer bear the name of M. Fourcroy, who has been removed from science in the course of a career which he followed with so much success. It was proposed to admit to the Society and to inscribe on the list of its co-workers Messrs. Gay-Lussac and Thenard, whose works have already so often enriched the volumes of this collection, [a proposal] that was adopted unanimously.[33]

In due course, Gay-Lussac was to emerge as a key figure in the history of the *Annales*. As for Thenard, the irony here was that he had originally been bottle-washer to Vauquelin, the associate of Fourcroy, and might well have come to represent the latter's ideal of chemistry if he had not been won over in 1804 by Berthollet, subsequently becoming one of the select members of the Society of Arcueil, which published its first volume of *Mémoires* in 1807 when Fourcroy was still a dominant figure in the *Annales*. Perhaps if Berthollet had felt that he counted for more in the organisation of the *Annales* in 1807 he would not have sponsored what might appear as a rival publication in so far as chemistry was prominently represented in the contents.

With the addition of Gay-Lussac and Thenard to the editorial board of the *Annales*, Berthollet began to take its meetings more seriously. His attendance shows a marked increase after 1809. Yet he had no wish to challenge the presidency of Guyton. It was only with Guyton's serious illness and absence from the meeting of the editorial board in December 1815 that Berthollet took

---

[31] *A.c.*, *21* (1797), 294-333.

[32] Laugier had the qualification of having contributed several papers to the *Annales* a few years earlier.

[33] St. Leonard, G.L.59, f.49.

the initiative of proposing a new series with a different emphasis. Guyton died on 2 January 1816 and, at the meeting of 15 January, Berthollet officially became president of the editorial board. Thus in the meetings of 1815/16 Berthollet was able to exert sufficient influence to turn the *Annales* in another direction. In 1800 it had been steered towards pharmacy. But Berthollet's interests were more towards what would later be called 'physical chemistry'. He was interested in the way in which physical conditions such as temperature and concentration affected chemical reactions, a subject discussed in his *Essai de statique chimique* of 1803. Under the influence of Laplace he wanted to steer chemistry in the direction of physics. We shall see in Chapter 8 how he was able to do this.

5. *Pharmacy*

The place of pharmacy in the *Annales* is a matter of some interest, not only for its own sake but because it illustrates significant changes in editorial policy. If Lavoisier had not fallen a victim of the Terror, it is unlikely that pharmacy would ever have played more than the most minor role in the history of the journal. The close association of chemistry with pharmacy was more a feature of seventeenth-century France, as in Nicolas Lemery's *Cours de chymie*, than of the situation around 1800. Yet the year 1800 was to witness the absorption of a pharmacy journal into the *Annales de chimie*, a situation which will require some explanation.

The key character here was Fourcroy. In the revolutionary period Fourcroy showed a deep concern with the application of science and he had a longstanding interest in pharmacy. During Lavoisier's life-time, however, he would not have the opportunity of adding this dimension to the contents of the *Annales*. But, as a man of great energy, who had qualified in medicine before turning to science as a career, he felt that science had much to offer medicine and in January 1791 he accordingly founded his own journal with the title: *La médecine éclairée par les sciences physiques*.[34] Pharmacy figured prominently in the journal.[35] Fourcroy attacked some of the more complex traditional remedies, which were still used and suggested that recent discoveries in chemistry could be applied to improving pharmacy. Of chemistry itself he wrote:

> This science, which may be regarded as completely new, since the work of the modern school could alone fill a large part of this journal.[36]

---

[34] *La Médecine éclairée par les sciences physiques, ou Journal des découvertes relatives aux différentes parties de l'art de guérir*, 4 vols., Paris, 1791, 92.

[35] Susan Court & W. A. Smeaton, 'Fourcroy and the *Journal de la Société des Pharmaciens de Paris*', *Ambix*, *26* (1979), 39-55 (43).

[36] *La Médecine éclairée par les sciences physiques*, *1* (1791), 18.

Yet, given the existence of the *Annales de chimie*, there was no good reason to fill another journal with chemistry memoirs. Pharmacy, on the other hand, had no journal of its own, and its practitioners had reason to be grateful to Fourcroy for advancing their cause. There is no doubt that Fourcroy's support helped raise the status of pharmacy in relation to the other branches of medicine. Yet these were difficult days for publishers and after 1792 the journal ceased publication.

After the Terror there was still considerable upheaval in the medical profession. What concerns us here, however, is the rising aspirations of the pharmacists (*pharmaciens*), a name which they now preferred to the traditional trade description of apothecary. In August 1796, a large group of Paris pharmacists came together to found the 'Société libre des Pharmaciens de Paris' and soon they were considering founding a journal specifically concerned with pharmacy. Fourcroy showed some interest in the new society and in April 1797 the society was to appoint him as editor of its journal. Originally this was planned as a fortnightly journal but it soon became a monthly publication.

Fourcroy was now closely associated with pharmacy. His election to the new society in December 1796 made him the only non-pharmacist to enjoy that honour. It was, of course, as much an honour for the society, since Fourcroy was not only a senior man of science but a person prominent in public life. A former member of the Convention and the Committee of Public Safety, he was now a member of the *Conseil des Anciens*. On 5 January 1797 Fourcroy took the opportunity to deliver a speech to his new pharmacy colleagues on the 'union of chemistry and pharmacy'. The speech was published as a pamphlet. It was also decided to publish it in the *Annales de chimie*, where it occupied no less than 40 pages.[37] In its original context the speech constituted a powerful plea to pharmacists to benefit from the new chemistry. For the chemical audience of the *Annales* it was making a case for chemists to recognise the close links of their science with pharmacy. There was, of course, the historical link. But Fourcroy was advocating a 'union' of the two. Chemistry with its new superior status should not be too proud to acknowledge its ancestry. In such operations as the analysis of the vegetable kingdom there had been considerable overlap between the two. Fourcroy deplored the tendency of the new chemistry to follow 'a severe and mathematical method'[38] and to become 'more physical' (*'plus physique'*)[39] and urged chemists not to despise pharmacy. He even invoked the name of Lavoisier,

---

[37] 'Extrait d'un discours sur l'union de la chimie et de la pharmacie', *A.c.*, *21* (1797), 294-333.

[38] *Ibid.*, p.304.

[39] *Ibid.*, p.309.

who had once apparently spoken of earning a living as a pharmacist if he were spared by the revolution.[40]

In this speech Fourcroy was showing clearly where his sympathies lay. Such strong advocacy of pharmacy would not have been permitted in the *Annales* during Lavoisier's editorship, but Fourcroy's other senior editorial colleagues did not try to censor him. They did not realise that they were opening the door to a new alliance. In 1799 the *Journal* was facing many difficulties, reflected first in a change of the editorial board (but still leaving Fourcroy in charge) and a change in the title to the more saleable *Journal de pharmacie*. It also seems that insufficient contributions were being received[41] and there were growing financial problems. The issue for 6 December 1799 carried the news that this was the last that would be published. The *Journal* was to be amalgamated with the *Annales de chimie* and subscribers would receive the combined journal until their subscriptions expired.

We reproduce in the Appendix[42] the text of the meeting of the editorial board of the *Annales* on 18 December 1799, at which it was agreed to take on board the ailing *Journal de pharmacie* as well as two of its assistant editors, Deyeux and Parmentier (both members of the First Class of the Institute) and the younger Bouillon-Lagrange. From the beginning of 1800 the title page would carry a special reference to pharmacy:

> *Annals of chemistry or Collection of memoirs on chemistry and the 'arts' which depend on it* ***and especially pharmacy***.[43]

The public explanation to be printed in the *Annales* did not, of course, speak of the difficulties faced by the *Journal*.[44] Instead a brave face was put on the affair by speaking of the difficulty often found by the editors in deciding on the boundaries of chemistry and pharmacy, which were so interrelated. A good selling point was made (to which we shall later return) of the

---

[40] *Ibid.*, pp.305-6. Fourcroy was here referring to a statement by J. J. Lalande, who commented that, when Lavoisier was arrested and it seemed that all his property would be confiscated, his thoughts turned to the possibility of earning a living by taking up a new career. 'I think it was the profession of pharmacist that he would have favoured as the nearest to his knowledge and the great reputation he held.' E. Grimaux, *Lavoisier*, p.263, quoting from Lalande, 'Notice sur la vie et les ouvrages de Lavoisier' in *Magazin encyclopédique*, *5* (1795), 174-188. Lavoisier apparently thought that confiscation of property would be the fate of all the tax-farmers but their punishment was to be more drastic.

[41] The quality of contributions was also a problem. Court & Smeaton (*op.cit.* p.47) refer to a long tedious memoir by a provincial pharmacist ,which was published but with extensive editorial criticism.

[42] Appendix 1, No.10.

[43] (My emphasis.) The full original title of the *Annales* had simply referred to chemistry and 'les arts qui en dépendent'. A fuller explanation of what this meant was given in the Preface to volume 1. These 'arts' were 'la métallurgie, les teintures, les procédés pharmaceutiques, etc.' Thus pharmacy had clearly now been given much greater prominence.

[44] *A.c.*, 32 (1799), 332.

desirability of pharmacists understanding chemical principles. There was also one major article published in the next volume of the *Annales* which was specifically on pharmacy.[45]

But although the potential readership of the *Annales* was increased by this move, it was at the price of disharmony within the newly enlarged editorial board. The young chemist Thenard (not yet a member of the editorial board), who held the post of demonstrator in chemistry at the Ecole Polytechnique, wrote an article for the *Annales*, in which he praised the courses in chemistry now available in Paris and sharply criticised the traditional method of training pharmacists by apprenticeship, followed by attendance at one or two courses at which they would obtain at best only a 'superficial knowledge' of chemistry.[46] This article immediately drew a strong protest from Delunel, a member of the Society of Pharmacists. He accused Thenard of being completely out of touch with pharmacy. The editors of the *Annales* at first refused to publish Delunel's reply, saying that they wanted to avoid polemics, but official representation from the Society of Pharmacists made the editors relent.[47] Delunel was able to quote support previously given by Fourcroy to the apprenticeship system, something hardly calculated to bring harmony to the editorial board since Thenard's article probably had the full support of Guyton, the Director of the Ecole Polytechnique and the effective editor- in - chief of the *Annales* at this time.

Although after 1800 three or four editors were concerned primarily with pharmacy, the direct pharmacy content remained surprisingly slight. In fact it would be difficult to infer from the contents that the title of the journal had been amended to lay special stress on pharmacy. The *Annales* did, however, contain several small pharmacy items, such as references to pharmacopoeias and a report on the annual public meeting of the Paris Ecole de Pharmacie, for example, that was held in 1806, presided over by the Minister of the Interior, with Fourcroy presenting the prizes.[48] Even after Fourcroy's death in 1809 the *Annales* continued to report the annual prize-giving - an easily accommodated gesture towards pharmacy. The justification for the pharmacy claim really depends on three factors, of which only the first is the direct pharmacy content. Secondly one must consider the space given to topics such as (beet) sugar, wine, and vegetable and animal (i.e. proto-organic) chemistry, an area of particular interest to pharmacists. Finally pharmacists were keen to emphasise that they were concerned with science as well as with medicine.

---

[45] Bouillon-Lagrange, 'Réflexions sur les réformes à faire dans les pharmacopées françaises', *A.c.*, *33* (1800), 232-69.

[46] 'Sur la necessité de réunir la pratique à la théorie de la chimie, pour en faire d'utiles applications aux arts', *A.c.*, *34* (1800) 106-110.

[47] Delunel, 'Observations sur le discours de Thenard', *A.c.*, *35* (1800) 76-83.

[48] *A.c.*, *57* (1806), 105-6.

Fourcroy after all had assured them that pharmacy was intimately linked with chemistry. Chemical theory was, therefore, relevant to pharmacy.

On the other hand the pharmacy faction realised that the *Annales* could never be primarily a journal of pharmacy and in 1808 plans were made to publish a new journal, the *Bulletin de pharmacie*, of which the first part was published in January 1809. The *Bulletin* was published in the last year of Fourcroy's life, when his health had seriously deteriorated and he could not be expected to take on any new responsibilities. The editors, all members of the Société de Pharmacie, spoke of him with great respect - '*notre célèbre Fourcroy*'[49] and he was quoted at length. The name of Parmentier, a member of the Institute and one of the editors of the *Annales* since 1800, was given special prominence on the title page but C.L. Cadet was probably the most active member of the editorial committee.[50]

The editors had an explanation of why there had not been more pharmacy in the *Annales*:

> The *Annales de chimie* admits some memoirs on pharmacy from time to time; but the importance of the physical sciences absorbed and stifled these observations. Many very respectable pharmacists did not dare place in the *Annales* the modest fruit of their practical experience side by side with the learned analyses of Vauquelin and Thenard or the abstract theoretical ideas of Berthollet, Guyton and Fourcroy. They were afraid of seeming ridiculous in speaking of the modifications of an electuary or an ointment in the same journal where grand questions were discussed, such as the decomposition of alkalis, equilibrium between affinities, the formation of meteorites.[51]

But to explain the appearance of the *Bulletin de pharmacie* purely as a receptacle for specialised articles on pharmacy unsuitable for the *Annales* is only to tell a part of the story. The *Bulletin* must not be considered in purely negative terms. It was concerned primarily with furthering the interests of French pharmacy *as a profession*, something that the *Annales de chimie* could never do. The lead article in the new journal looked forward to a time when 'pharmacists, united in the interests of their reputation and their income' would 'leave the merchant class' and take their place among the 'useful professions'.[52] The practice of law was taken as an example of a profession and a pharmacist had even more claim to this status because the life of a patient

---

[49] C. L. Cadet, 'Considérations sur l'état naturel de la pharmacie', *Bulletin de Pharmacie*, *1*, No.1, January 1809, p.6, c.f.p.7 - 'l'illustre auteur du *Système des connaissances chimiques*'.

[50] Court & Smeaton note that the *Bulletin* follows the example of the *Annales* in being published by a private company, *loc.cit*; p.50.

[51] *Bulletin de pharmacie*, *1* (1809), 12.

[52] *Ibid.*, p.11.

might rest in his hands. Bonds should be established between all men who cultivated this branch of the art of healing.[53] Cadet was worried that 'so many usurpers had invaded the domain of pharmacy',[54] people like grocers and confectioners, and implied that a monopoly was desirable for the practice of pharmacy. In the very first issue Cadet wrote a brief article on 'Charlatans'[55] and this problem worried the editors so much that they regularly devoted a special section of the journal to it. Correspondents and editors felt that there should be a restriction on the number of pharmacists and even that the existing numbers should be reduced.[56]

However, the *Bulletin* was concerned as much with status as with income and Cadet complained that pharmacists, who aspired to be recognised for their knowledge of science, were finding themselves 'despised by chemists, who are concerned only with theory'.[57] He was, therefore, proud to point out that many important figures in the history of chemistry had been pharmacists and there were contemporaries like Vauquelin, Parmentier and Proust, who were respected in both communities.[58] Ideally pharmacy should not be estranged from the progress of science[59] and the *Bulletin* accordingly had a regular section on scientific news. Thus the *Bulletin* provided a perfect complement to the *Annales*. From 1809 there was no good reason why the *Annales* should contain more than the occasional pharmacy article, since these would be most appreciated in the *Bulletin*. On the other hand the *Bulletin* carried many articles on the sort of chemistry of special interest to pharmacists as well as other 'scientific news'. It would carry information, such as a report on Humphry Davy's electrochemical experiments, which was of no obvious utility to the working pharmacist but served to persuade him that he was in contact with the world of science. Such an enlightened policy of the *Bulletin* (which began a second series in 1815)[60] must have put an effective end to the claim of the *Annales* to a large share of the pharmacy market. Yet we shall see that the *Annales* was undoubtedly to benefit by its claim to be relevant to pharmacy.

6. *Government support*

The pharmacy dimension of the *Annales* was eventually to affect its status as a journal worthy of government support. In Britain the commercial viability of the publication of any book or journal would normally depend entirely on the

---

53 *Ibid.*, p.12.
54 *Ibid.*, p.10.
55 'Du Charlantisme', *ibid.*, pp.42-43.
56 *Bulletin de pharmacie*, *2*, no.4, April 1810, 147-157.
57 *Bulletin*, *1*, No.1, January 1809, p.11.
58 *Ibid.*, pp.5-7.
59 *Ibid.*, p.12.
60 From 1814 it was retitled: *Journal de pharmacie et des sciences accessoires*.

state of the market, that is to say on the number of people prepared to buy or subscribe to the publication. In nineteenth- century France on the other hand the government adopted the practice of subsidising selected publications by taking out multiple subscriptions. This might be interpreted in several ways. In the first place it obviously helped the government to control publication by a more subtle method than outright censorship.[61] Obviously, only approved material would be supported, and some authors and editors would alter their text accordingly.

But intervention was also related to the role of the state in education. The government would support works of educational or cultural value, particularly if it was so erudite as to have little popular appeal. Thus the Ministry of the Interior placed a permanent order for 36 copies of the *Annales* of the Muséum d'Histoire Naturelle, which undoubtedly helped to keep going a research journal devoted to the work of the staff of the Muséum. Compared with this the government subscription in 1804 to three copies of the *Annales de chimie* must be interpreted as purely token support.[62] The invoice covering several years amounted to a mere 100f. This may be compared with the annual budget of 100,000f. set aside by the Napoleonic government for the purchase of books, pictures and statues. This money was used primarily as a subsidy for the graphic arts but in so far as a fraction related to books and a smaller fraction to science books, this might have been largely devoted to lavishly illustrated books on natural history.

Official support for the *Annales de chimie* must also be seen against the background of the printing of official material by the *Imprimerie nationale* (formerly the *Imprimerie royale*), which would be concerned not only with government circulars but such ambitious undertakings as the publication of the cultural history of Bonaparte's expedition to Egypt, the *Description de l'Egypte*. The publication of the *Annales de chimie* may also be compared with the publication of a parallel technological journal of similar format, the *Journal des mines*, paid for by a government agency, the Conseil des Mines, and therefore able to be given away for many years rather than sold.[63]

The *Annales de chimie*, therefore, appears marginal within the system of generous state subsidies available to some other publications. But we have not yet taken into consideration the claim of the *Annales* from 1800 to be of special interest to pharmacists. That this was a definite selling point can be seen, for example, in a book catalogue issued by Bernard in July 1807, which heads the section on chemistry and physics with a full description of the *Annales de*

---

[61] Control of the press in Napoleonic France was largely confined to political comment. From 1805 formal censorship was introduced but did not affect scientific publications.

[62] Archives Nationales, F./17/1023, dossier 12, note to Minister of the Interior dated brumaire an 13 (October 1804).

[63] For a discussion of the *Journal des mines* see Chapter 5.

chimie.[64] The text claims that chemistry is intimately linked with both physics and pharmacy. It continues

> This journal today becomes a necessity according to the new law which establishes juries for medicine, surgery and pharmacy.

But what was this 'new law'? After the chaotic state of professional medicine in the 1790s, a new law to regulate the practice of medicine was enacted in April 1803. In addition to physicians, surgeons and pharmacists trained at a few national centres, there was recognition of a lower grade of practitioner for country districts, called *officier de santé*.[65]

These 'second-class doctors' would only be able to practise in the district in which they were registered. To qualify, the candidate had to serve an apprenticeship, follow a course of study, and pass an examination before an examination board or jury to be set up in the principal towns of each department of France. In addition to the main centres of medical education, Paris, Montpellier and Strasbourg, *Ecoles secondaires de médecine et de pharmacie* were established in many provincial towns, usually in association with the local hospital, and from 1806 to 1809 these 'secondary schools' were integrated into the national system of medical education. They were permitted to teach the first two years of the normal four-year programme of medical education, which was considered sufficient for the purely local *officier de santé*.

Parallel to the training of second-class doctors was that of second-class pharmacists (*pharmaciens du 2me classe*). They were expected to have served an eight-year apprenticeship or to have followed a course in pharmacy supplemented by practical experience in a pharmacy. They were required to pass examinations before a local jury:

> There will be three examinations: two theoretical, of which one will be on the principles of pharmacy, and the other on botany and the natural history of simple drugs. The third examination will be practical and will last for four days and will consist of at least nine chemical or pharmaceutical operations chosen by the schools or the juries....[66]

The examination seems to have been very rigorous, even though these pharmacists, like the *officiers de santé*, were restricted to the region in which they passed the examination. The candidates would be young men from the

---

[64] This catalogue of 31 pp. is bound in W. A. Smeaton's copy of L.B. Guyton-Morveau's *Traité des moyens de désinfecter l'air*, 3rd edn., Paris, Bernard, 1805. I must thank Dr Smeaton for providing me with a photocopy of the relevant pages.

[65] Robert Heller, 'Officiers de santé: The second-class doctors of nineteenth-century France', *Medical History*, *22* (1978), 25-43. Maurice Bouvet, *Histoire de la pharmacie en France des origines à nos jours*, Paris, 1937, pp.336ff. George Weisz, art. 'Paris Faculty of Medicine' in E. L. Newman (ed.) *Historical Dictionary of France from the 1815 Restoration to the Second Empire*, New York, 1987, vol.2, pp.776-7.

[66] Loi du 21 germinal an 11 (11 April 1803), Art XV.

district, not wealthy or ambitious enough to go to the national centre in Paris and study full-time for several years. Instead they could earn a living and study in their spare time from suitable books.

That is where the *Annales* came in. Even though the standard of much of the journal was at the level of research, it was claimed that, by consulting the *Annales*, provincial medical and pharmacy students could keep up to date with the latest discoveries. But it is not likely that provincial students would have gone beyond the student text-books without some official encouragement. It is, therefore, a matter of great interest to find a circular of 1806 from Champagny, the Minister of the Interior, to the prefects of each department of France, drawing their attention to the existence of the *Annales de chimie* and making claims that a knowledge of chemistry, such as was contained in that journal, was necessary for pharmacists and *officiers de santé*.[67] The text of this circular may be compared with an earlier draft found in the Archives Nationales.[68] Addressed to the respective prefects of the various departments of France, it began by invoking the authority of the Emperor himself, 'convinced of the necessity of enlightenment in the professions and especially in the healing art'. It then invoked the laws of 19 vendemiaire and 25 thermidor year 11 on juries concerned with medicine and pharmacy.

As can be seen in Appendix 1, the actual circular distributed invoked only the authority of the Minister of the Interior but, of course, this was sufficient for it to be taken seriously. Such a circular was clearly going far beyond the normal concern of a minister and our suspicion that he was responding to pressure from the editors of the *Annales* is supported by the existence of a letter from Fourcroy to the Minister on 15 January 1807, thanking him for obliging him in this way.[69] In fact, Fourcroy was a powerful force behind the scenes, since the important law of 1803 on medical qualifications was largely his work. It is doubtful whether provincial pharmacy students would necessarily have benefited much in examination terms from reading the *Annales* but the Minister's circular probably gave a boost to the circulation of the journal in the provinces. It also helped to strengthen the image of the nineteenth-century French pharmacist as potentially something of a *savant* rather than merely a shopkeeper.

7. *Circulation of the Annales*

Sometimes the circulation figures of a periodical publication are a closely guarded secret. This is information which must be withheld at all costs from

---

[67] Appendix No.1, No.11.

[68] F/17/1147, dossier 22.

[69] .... 'Je la prie d'agréer mes remerciements et intêret qu'elle prend à cet ouvrage et à la science et de la communication obligeante qu'elle a daigné me faire en cette matière', Archives Nationales, F/17/1023, dossier 13.

business competitors. Even when this did not apply, circulation would only be publicised if it were exceptionally high. Yet, partly from their elusiveness, circulation figures are of special interest to anyone studying the history of a journal. Two recent specialists in the study of eighteenth-century French periodicals write:

> The size and composition of the journal-reading audience in eighteenth-century France remains something of an unanswerable question. Without sufficiently detailed postal records or extensive collections of publishers' business records, it is difficulty to say anything definite about the subject.[70]

Fortunately we do know something both directly and indirectly about the circulation figures of the *Annales*. To be more specific, we have evidence from time to time of (a) the number of copies printed and, (b) the number of subscribers.

If we had to rely entirely on published sources one could make use of the estimate made by the nineteenth-century French bibliographer Hatin. He quoted circulation figures for various French journals sent through the post from Paris to the provinces in 1803 and gave the number for the *Annales de chimie* as 112.[71] He estimated that about a third more would be sold in Paris, that is approximately 150. Making some allowance for a few copies sent abroad, this would hardly bring the total up to 400. Probably the Parisian sales would be an underestimate, so we might guess a figure around 500 for the total sales.[72]

Yet guessing is hardly satisfactory and we are fortunate to have a copy of the contract signed by the editorial board with the printer Guillaume in 1798, which mentions a print run of 1,600 copies.[73] We therefore have a major discrepancy between the two sources and at one time the present author was tempted to believe that the phrase 'seize cent exemplaires' in the contract was a misreading for 'six cent exemplaires', i.e. 600 copies. However, later evidence has shown that there was always a major difference between the number of copies printed and those sent immediately to subscribers. In other words, the editorial board had learned from the experience of the first few volumes of the *Annales*, which had to be re-printed, that it might be more economical to

---

[70] J. R. Censer and Jeremy D. Popkin, 'Historians and the press' in their *Press and Public in Pre-Revolutionary France*, Berkeley, Cal., 1987, p.21.

[71] E. Hatin, *Bibliographie historique et critique de la presse périodique française ou catalogue ... de tous les écrits périodiques*, Paris, 1866, p.313. The figure of 112 for the *Annales* may be compared with 76 for the *Journal de physique*.

[72] This may be compared with a circulation of approximately 700 for Crell's *Annalen*. (Hufbauer, *op. cit.*, Appendix III). The order of magnitude is the same. The main difference would be in the pattern of distribution, since the German states had no national centre of activity to compare in any way with Paris.

[73] See Appendix 1, No.8, Art.9.

order a large print run than to pay for a second printing. The records show that the numbers printed in the nineteenth century always greatly exceeded the number of subscribers. In other words, the editors were hopeful of selling a substantial number of volumes off the shelf in bookshops and they had particularly high hopes of selling a large number of back numbers over the next few years. In 1806 the minutes of the editorial board reveal that 1,000 copies of the *Annales* were printed when there were 600 subscribers.

We pass on now to the second series, which was edited jointly by Gay-Lussac and Arago. Their business ledger reveals that in 1817 and 1818 they were optimistic enough to order a print run of 1,250, yet the number sold for these two years amounts only to 525 and 583 respectively. The new editors, who had enlarged the title of the journal to *Annales de chimie et de physique*, were obviously hoping on a matching increase in circulation. We also know that they were soon making a good profit. By modern standards a circulation of around 600 seems very modest indeed, but we know that in the case of newspapers, which also had a comparatively low circulation, each copy would be likely to be read by many people. The printed word was treasured in those days rather than taken for granted, as in modern society which suffers from a surfeit of information of all kinds. It is likely, therefore, that many copies of the *Annales* would be read by several people, thus increasing its *effective* circulation.

The circulation of the *Annales* was certainly less than that of the major chemistry textbooks of the time which, if one adds the different editions, might run to several thousand. But this is hardly a fair comparison. First a textbook is written for beginners. No previous knowledge of the subject is presupposed and no subsequent commitment is implied. On the other hand, subscription to a journal presupposes some previous knowledge of the subject treated and implies some on-going commitment to that journal. A specialist journal is obviously intended for a smaller readership than the general literate public. This more exclusive readership would be centred on the growing community of chemists. A subscriber to the journal might well feel that, *as a subscriber*, he had become part of that community. As regards comparison with textbooks, if one wanted to add the number of copies of *different editions* appearing over a number of years, the only fair comparison would be to add the total number of issues of a journal produced over several years, although the exercise would hardly serve a useful purpose. Our conclusion seems fairly obvious: a periodical which assumes some basic familiarity with a science is likely to have fewer readers than an introductory book explaining the science at an elementary level. Yet the periodical brings us much closer to the chemical community. Its influence should be thought of less in terms of quantity and more in terms of the quality of the readership.

CHAPTER FIVE

OTHER FRENCH SCIENTIFIC JOURNALS, c.1800

> Periodical works save the irksome task of multifarious epistolary correspondence. Every discovery is published as soon as made, fruitless labour is spared, and emulation is kept up and increased by the mutual discoveries of different individuals, by the jarring of opinions, and the clashing of different interests.
>
> (Thomas Thomson, *Annals of Philosophy*, *1* (1813), 2.)

> Chemical literature is not to be found in books; it is contained in journals. In books the individual author's opinion dominates and his judgement is without appeal. However, in journals there is a defence, there is justification, and because of the necessity of a mutual neutralization of opinions, we approach the common goal of science.
>
> (J. Liebig (1834) in J. Volhard, *Justus von Liebig*, Leipzig, 1909, vol.i, p.326, quoted by W.H. Brock, *Fontana History of Chemistry*, London, 1992, pp.436-7.)

To appreciate properly the contribution made by the *Annales* in the 1790s and early 1800s to the advancement of science we need to have some perspective. We need to know how it compared with other French scientific journals of that period. What subjects did they cover? What sort of journals were they? Did they possibly have as much trouble with their publishers and printers as the *Annales*? To answer these questions will entail a general survey of leading scientific journals to provide some background, followed by a more detailed study of one journal, the *Journal de physique,* which was the main competitor and rival to the *Annales*. The rivalry in the field of chemistry was highlighted at the beginning of 1794 when, without warning or any explanation to readers, the title of the journal was suddenly changed from: *Observations sur la physique, sur l'histoire naturelle et sur les arts et métiers* to: *Journal de physique*, ***de chimie***, *d'histoire naturelle et des arts*. Given the closure of the *Annales,* following the arrest of Lavoisier in November 1793, the *Journal de physique* in the perilous year of 1794 thus temporarily became

the *only* French journal with chemistry in the title. But soon the *Journal de physique* too was forced to close. When both journals reappeared the fierce rivalry was resumed.

But before going into any detail on the history of the *Journal de physique* we should consider some of the other journals, beginning with the most prestigious, that produced by the official body of science. We shall see that, however great the prestige of the sponsoring body, it did not necessarily imply efficient publication, thus encouraging the emergence of several other journals, most of which appeared more frequently and thus provided more useful means of keeping readers up to date with recent scientific developments. There is also the question of specialisation in science. Up to this time most scientific journals would try to cover a wide spectrum of science. Perhaps the publication of the *Annales de chimie* shows that the time had come for separate journals for the different sciences? There are obviously both advantages and disadvantages in focusing exclusively on one science. On the other hand in the *Mémoires* of the Society of Arcueil there was a deliberate policy of concentration on *two* main sciences, chemistry and physics, and this close association of these two sciences may have established a precedent to be taken up later by the *Annales* itself.

1. *The Mémoires of the First Class of the Institute*

We may recall that under the ancien régime the *Mémoires* of the Paris Royal Academy of Science had been the principal repository for major scientific papers by Academicians, including Lavoisier. The Royal Academy of Sciences, together with other Academies, was closed down in 1793, and it was only towards the end of 1795 that the National Institute was founded as a replacement. There was no doubt that the *Mémoires* of the First Class of the Institute was potentially the most prestigious French scientific journal after the revolution. As the successor to the *Mémoires* of the Royal Academy of Sciences it could claim a certain distinction because of the high quality of the memoirs in that publication. After all, publication in these journals was confined to a scientific elite, those who had been elected to the respective institutions. The membership of the First Class consisted of six members of each of the ten recognised sections, which included pure mathematics, mechanics, physics, chemistry, botany and medicine.

In chemistry the six original members of 1795 were: Guyton (de Morveau), Berthollet, Fourcroy, Bayen, Pelletier and Vauquelin. But Pelletier died in 1797 and was replaced by Deyeux; Bayen died in 1798 and was replaced by Chaptal. We see here a majority of chemists closely associated with Lavoisier; although Bayen had not actively supported Lavoisier, he had long abandoned the phlogiston theory. Yet in the First Class chemistry was merely

one of the recognised disciplines. It could not claim special privileges, although it is interesting that, with the enormous growth of chemistry in the nineteenth century, many more chemists later managed to find a place in the official body of science than was strictly permitted.[1]

We must return to the *Mémoires* as a key journal of science. Inevitably there were delays in its publication, as there had been with its predecessor. The first volume did not appear until August 1798 and the second a year later. The third volume, appearing in June 1801, was several years in arrears and the delay in publication continued until 1806, when the First Class resolved not only to put its house in order but to follow the Royal Society of London in publishing its *Mémoires* every six months. The First Class could be proud of its record in the years 1806 and 1807, but then things slipped back again. Thus the second part of the volume for 1810 was not published until 1814. More understandable was the fate of material for the final years of the Napoleonic regime. There was a combined volume for the years 1813, 1814 and 1815, but it was not published until 1818! Meanwhile the First Class had become the Royal Academy of Sciences of the Institute, which justified the start of a further series of *Mémoires*.

Perhaps no less important than delay was an unreasonable restriction that was placed on the size of the *Mémoires*. The political masters of the Institute insisted that there should be equality between the publication of its three sections or 'Classes'. Thus the First Class, concerned with science, was not allowed better facilities than those available to the Second Class (concerned with social science) or the Third Class (devoted to the humanities and arts). This was taken to the extreme of equality in the number of printed pages permitted.[2] Thus it was not appreciated that, by its very nature, science generates an enormous quantity of *new knowledge*, which has a good claim to special consideration above the claims of those reflecting on history or literature. This meant that members were lucky to have their memoirs published at all. The inclusion of a seventy-page mathematical memoir by Laplace in volume 1, though fully justified in terms of quality, meant the exclusion or drastic abbreviation of other more descriptive memoirs. The early years of the First Class may be considered as a period of organisational experimentation, and, when volume 2 appeared, it was with a reversion to the section labelled *Histoire*, which included prizes, works presented and *éloges*, a practice maintained in subsequent volumes. In the *Mémoires* we find the inclusion of a report by two members on work submitted to the First Class, which was thus

---

[1] M. Crosland, *Science under Control. The French Academy of Sciences, 1795-1914*, Cambridge, 1992, p.74.

[2] This regulation was in force until 1803; see *Mémoires présentés à l'Institut ... par divers savants, 1* (1805), Preface.

presenting itself as a judge of scientific merit. Such reports were to become increasingly common in later publications of the First Class.

In 1800, when the question was raised of members of the First Class occasionally publishing directly in the government newspaper, *Le Moniteur*, a commission of the First Class welcomed the opportunity of greater publicity and more rapid publication,

> like certain other journals already enjoy, such as that of chemistry [the *Annales de chimie*] of mines [the *Journal des mines*], the Société Philomatique, the *Decade philosophique*, etc.[3]

The commission comforted itself with the thought that scientists would always want to look at the *Mémoires* of the First Class to find a description of the details of experiments. What is particularly interesting is that the commission by implication freely admitted the shortcomings of its own official publication. Only with the publication of the weekly *Comptes Rendus* from 1835 would these criticisms be met.

Before leaving the official body of science, some correction is necessary of the statement made above that the *Mémoires* were reserved exclusively for members. Under the old regime there had been a parallel series for non-members: the *Mémoires des savants étrangers* and the First Class was to have a similar series. Although the Institute had been founded in 1795, the first volume in this parallel series was not published until 1805, with a second volume published in 1811. This delay was all the more serious in as far as the Academy recommended the best memoirs submitted to it by non-members to be published in this series. Clearly many never received this honour and had to look elsewhere for publication. Again from 1812-26 there were no volumes published in this series, which shows that it cannot be taken very seriously as a medium for publication.[4] At least the main series of *Mémoires* for members had a better track record than this.

2. *The* Bulletin *of the Philomatic Society.*

Another important source of scientific publication was that provided by the *Société Philomatique* or Philomatic Society.[5] A society of very modest be-

---

[3] *Procès-verbaux des séances de l'Académie des Sciences*, 10 vols., Hendaye, 1910-22, vol.2, pp.113-14.

[4] Only from the late 1820s (probably with the use of money from the legacy of Baron Montyon) was the Academy able to ensure fairly regular publication of the *Mémoires des Savants Etrangers*. The precise title of the early nineteenth century volumes was: *Mémoires présentés à l'Institut....par divers savans, et lûs dans ses assemblées. Sciences mathématiques et physiques*.

[5] An excellent study of this institution is that of Jonathan Mandelbaum, *La Sociéte Philomatique de Paris de 1788 à 1835*, Doctorat du 3e cycle, 1980, Ecole des Hautes Etudes en Sciences Sociales, Paris, University Microfilms Int. 8270086. See also M. Berthelot, 'Sur les

ginnings, it hardly compares with the Royal Academy of Sciences, yet it would be a mistake to ignore it, since in several ways it was nicely able to complement the activities of the Academy and, later, of the First Class of the Institute, both with their severely restricted membership. The Philomatic Society was founded in December 1788, when half a dozen earnest young men met together to discuss a means of self instruction in the main branches of contemporary science. The inspiration came from two recently qualified physicians, Riche, who was not to live very long, and Sylvestre, who succeeded Riche as secretary and, having gained administrative experience over the years 1791-1802, subsequently became secretary of the Société d'Agriculture de la Seine.

The rules of the Society required members to be active in contributing reports on scientific books and periodicals and in presenting memoirs at the weekly meetings. The level of these memoirs was not usually very high but quality would improve with time. The Society admitted corresponding members, who were at first kept in touch by circulating manuscript notes of meetings. By November 1792 the finances of the Society had improved sufficiently for it to publish its own journal, the *Bulletin des sciences*. At first this was little more than a newsletter consisting of a few quarto pages. In theory it appeared monthly, but sometimes several months elapsed between issues.

After a slow start in 1788-9, the Society began to acquire a steady stream of new members in 1790-91 including the young chemists Vauquelin and Séguin, although a large proportion of members were associated with the medical profession. The Society would have continued with a membership entirely of obscure young men at the beginning of their careers if the Revolution had not impinged on the official body of science. In August 1793 the Royal Academy of Sciences together with other Academies was suppressed. Lavoisier and his colleagues found the doors of the Academy of Sciences sealed. Could they continue to meet regularly to discuss scientific matters in some other venue? The fact that members of the Philomatic Society had been in previous contact with the Academy, allowed, for example, (as a special favour) to attend meetings, made this inoffensive society known to Academicians. Unlike the Academies, it could not be accused of enjoying special privileges and might serve as a suitable meeting place. Its scientific interests were multi-disciplinary, mirroring those of the Academy. Accordingly in September 1793 we find among the new members Lavoisier, Berthollet, and Fourcroy and also several non-chemists, including Vicq d'Azyr, Lamarck and Laplace.

---

publications de la Société Philomathique et sur ses origines', *Journal des Savants*, Aug.1888, 477.

Thus for a short time the membership of the Society was completely transformed by the admission of several senior French *savants*, and this association, however brief, was to help put the Society on the scientific map in the later period. Lavoisier's membership, though a crucial one, was short-lived, since on 28 November 1793 he was imprisoned and was subsequently executed in May 1794. There is no record of any active part taken in the proceedings of the Society by Berthollet or Laplace but several other former Academicians did contribute, including Fourcroy, both alone and in conjunction with his younger collaborator and protégé, Vauquelin. Yet the Society was not to be immune from the effects of the Revolution. After 1793 meetings became very irregular. The foundation of the Institute at the end of 1795 encouraged some revival of activity.

In 1797 the Society decided to expand its *Bulletin*, previously confined to members only, by putting it on public sale at the modest price of five francs annual subscription, thus making it affordable to young students, who would in this way be kept up to date with a range of different sciences at minimum cost. The publisher was Fuchs, who may well have used his knowledge of the trade to advise his new patrons about possible provincial outlets for the journal.[6] The full title of the journal was: *Bulletin des sciences par la Société philomathique (sic) de Paris* and it appeared monthly as an 8-page quarto publication from 1797 to 1805. Despite initial optimism and the low price, the number of subscribers was low. After a slow start it reached a maximum of 114 before falling to about 60-80 in the years up to 1814.[7] Although all contributions were made without charge, the receipts were hardly enough to pay printing costs. The Society hoped to recoup costs by selling complete sets of back numbers but such sales were not helped by many changes of publisher. Fuchs only lasted until 1804, to be replaced by Courcier; by April 1805 the low number of subscribers obliged the Society to suspend publication until October 1807, when publication was resumed under the title: *Nouveau bulletin des sciences par la Société philomathique de Paris*, which continued up to 1814. Published first by Bernard, it passed in 1809 to Colas, who published it until 1810 when it was given to Klostermann.

Another reason for the difficulties of the journal was the failure of the editorial committee to continue to give time regularly to reviewing books and memoirs. To begin with, it had been run by an anonymous collective. From 1797 individual members of the committee signed articles with their initials[8]

---

[6] Mandelbaum, *op.cit.*, p.77.

[7] *Ibid.*, p.80.

[8] Jonathan Mandelbaum has identified the authors of these articles and has listed the total contribution of each member of the editorial board. This shows that the main contributors were Biot, A.B. Brongniart, D.C. Candolle, G. Cuvier and Duméril, but there were also

and only in 1807 did the *Nouveau bulletin* publish the names of the editorial committee at the front of each volume on the model, one might suggest, of the *Annales de chimie*. Among the members of the editorial board were Descotils, already associated with the *Annales de chimie*, and also Gay-Lussac and Thenard, soon to join the *Annales*. Different members of the editorial committee became involved with other journals, thus providing a conflict of loyalties. With the declining participation of his colleagues, the secretary Léman had to take on an increasing amount of editorial work.

Although the biological sciences were most prominent among the interests of members, chemistry was always a significant science in the *Bulletin*. The presence of physical science in the Society is illustrated by the activities of the young Gay-Lussac. Thus when Gay-Lussac read his first memoir at the Institute on the thermal expansion of gases, this was published not only in the *Annales de chimie*[9] but a summary was also published in the *Bulletin*[10], although Gay-Lussac was not to become a member of the Society until 1805. It seems that it was Berthollet, proud of the work of his protégé, who wanted to give him further publicity.[11] In 1804 further work by Gay-Lussac was briefly noted in the *Bulletin*. He was proposed for election in November 1804 but, for some unknown reason, neither he nor anyone else was elected until March 1805, by which time he had left Paris on a European tour with Humboldt. Not long after his return Gay-Lussac was elected to the Institute (December 1806) and in the summer of 1807 he was briefly president of the Society. This was a period when the Society of Arcueil was at its height of activity and Gay-Lussac did not contribute much to the Philomatic Society. Indeed his only important contribution was his memoir on the combining volumes of gases, presented on 31 December 1808. The fact that this was not presented at Arcueil is easily explained, since the meetings at Berthollet's country house were suspended during the winter months.

It is interesting that Gay-Lussac should have read his memoir a second time at the First Class on 23 January 1809, illustrating the fact that these other societies were used by young men to try out new ideas before daring to appear on the very public stage of the Institute. From its early days the Society saw itself as having a wide range of scientific interests, in many ways parallel to those of the First Class but at a much lower level. It was the ambition of the Society's members to be admitted to meetings of the First Class, and a regulation of 1800 formally recognised their right to be present. Some of its more ambitious members regarded their participation as a first step towards entering

several contributions from Descotils, two from Thenard and one from Berthollet. *Ibid.*, Annexe F, pp.535-7.

9 'Sur la dilatation des gaz et des vapeurs', *A.c.*, *43* (1802), 137-75.

10 *Bulletin*, *3*, no.65 (August 1802), 132-3.

11 Mandelbaum, *op.cit.*, p.82.

the First Class and certainly this was the experience of its most talented members. The Society even came to be described as the 'antichamber to the Institute'. Thus by speaking at the meetings of the Philomatic Society and contributing to its journal young scientists were effectively serving their apprenticeship.

3. *The* Mémoires *of the Society of Arcueil*

Although Berthollet had begun to attend meetings of the editorial board of the *Annales* when he returned to Paris in October 1799, he did not show much commitment to the journal in the early 1800s. In what might almost have seemed like a plot, Fourcroy had managed to link the *Annales* with pharmacy, which had never been one of Berthollet's interests, and which, with natural history, represented the opposite wing of chemistry to the one he favoured. Guyton, with his strong Ecole Polytechnique connections, might seem to have been much more sympathetic to a mathematical or physical approach to chemistry. Yet, from about 1801, he became obsessed with his method of acid fumigations. The use of chlorine to disinfect hospitals and such places has much to recommend it, but Guyton was not prepared simply to make his case and let the public draw its own conclusions. It is true that he permitted criticisms of his ideas to be published in the *Annales* but, to counter-balance this, he felt justified in filling the pages of the journal with further evidence supporting his ideas. From 1803 right up to the very last issue in 1815 a succession of articles on acid fumigation hammered home the point. (See Chapter 7, section 7.)

Berthollet could have resigned in protest; instead he quietly absented himself from most of the editorial meetings. Shortly after his return from Egypt in 1799 he had bought a house at Arcueil, a village just outside Paris, where he established a laboratory. He encouraged several young men to work there, including his son Amédée and his protégé Gay-Lussac. When in 1806 his friend Laplace bought the adjoining property at Arcueil, the stage was set for the foundation of a private scientific society, which might be considered one of the most important of the nineteenth century in proportion to its small size.[12] Berthollet was able to encourage the study of chemistry not in association with pharmacy or natural history or medicine but with physics, most ably represented by Laplace, who was anxious to construct a neo-Newtonian science, regularly depending on young experimenters to confirm theoretical

[12] The membership of the Society as announced in 1807 consisted of Berthollet, Laplace, Humboldt, Biot, Thenard, Gay-Lussac, A.P. De Candolle, Descotils, Amédée Berthollet. Shortly afterwards they were joined by Malus, Arago, Bérard, Chaptal, Dulong and Poisson. Thus the total membership of the Society never exceeded fifteen.

calculations. In 1807 the Arcueil group described itself as the 'Society of Arcueil' and published its first volume of memoirs:

Mémoires de physique et de chimie de la Société d'Arcueil

Laplace had happy memories of an earlier collaboration with Lavoisier on thermochemistry.[13] In his mature years he was undertaking a further collaboration, which might prove even more fruitful.

The publication of a journal under the authority of 'the Society of Arcueil' served to give publicity to this small group which had been meeting for several years at Berthollet's country house on summer week-ends, usually on Sundays. In so far as this was partly a social occasion, an opportunity to leave the congestion of Paris for a few hours of country air in the company of friends, in so far as Madame Berthollet and Madame Laplace would often be part of the gathering, and refreshments would be served, it might well be considered as no more than a *salon*. Often advice would be given by the senior members to their protégés and careers would be discussed as at other scientific salons.[14] Indeed the group could well have existed profitably both for its members and possibly for French science without the publication of a journal. This brings us back to the question of why the journal was published, a question which has never been thus bluntly put.

The answer we must give is Berthollet's dissatisfaction with the running of the *Annales*. Having gathered a small group of extremely talented young men, he wanted to encourage them in their research which would, of course, require an outlet for publication. It is profitable to regard the Arcueil group as an early research school with a programme of research laid down by Berthollet and Laplace. Berthollet had become increasingly interested in the physical conditions for chemical reactions and favoured an alliance between chemistry and physics. When Laplace was drawn into this circle, he largely abandoned his earlier research on theoretical astronomy, and began a programme of research, which involved the investigation of physical phenomena, such as the reflection and refraction of light and also capillarity in terms of short-range forces. In a way he was transferring his lifetime studies of Newtonian attraction from the macro-world (astronomy) to the smaller-scale world of physics. Thus while Berthollet encouraged the work of younger chemists, notably Gay-Lussac and Thenard and later Dulong, Laplace built up a neo-Newtonian school of physics helped by Biot, Malus and, later, Poisson.

With a chemistry laboratory, a *cabinet de physique* (collection of apparatus) and library at Arcueil, conditions were ideal for the pursuit of research in chemistry and physics. In the introduction to the first volume of *Mémoires*

---

[13] Henry Guerlac, 'Chemistry as a branch of physics: Laplace's collaboration with Lavoisier', *Historical Studies in the Physical Sciences*, 7 (1976), 193-276.

[14] Crosland, *op.cit.*, (1992), pp.44-9.

Berthollet spoke of the close relationship between physics and chemistry and of the necessity to arrive at reliable data and greater precision. He referred to the advantages of collaborative work and the benefits of receiving advice and criticism. No paper would be published in the *Mémoires* without having first been discussed at one of the fortnightly meetings of the Society, but the author alone would be responsible for his opinion.

Volume 1 opened with an important joint paper by Humboldt and Gay-Lussac on magnetic observations systematically made on their recent European tour of France, Switzerland, Italy and Germany.[15] Although it had been presented to the First Class in September 1806 it had not yet found a publisher, the authors apparently being unwilling to send it to the *Journal de physique* under the control of the reactionary La Métherie (see sections 6, 7, 8). Another notable paper was one by Gay-Lussac on temperature changes in gases which are allowed to expand, thus throwing light on their relative specific heats.[16] This information was of interest to Laplace, who earlier had commissioned Biot to study the effect on the velocity of sound of the temperature variations which accompanied the expansion and compression of air. This was required to provide data to correct Newton's fallacious calculation of the velocity of sound. As if to balance these physical concerns, the volume also contained several purely chemical memoirs by Thenard on esters.

The second volume also had several purely chemical memoirs but was particularly notable for some memoirs on light, one by Laplace and two by Malus, in which he described experiments on the polarisation of light, a phenomenon he had himself recently discovered.[17] Malus followed the Laplacian programme in explaining polarisation in terms of a corpuscular theory of light.[18] Also of note is Gay-Lussac's presentation of his law of combining volumes of gases.[19] It is ironic that Berthollet's protégé should have discovered a regularity in accord with *fixed* proportions in compounds when his mentor had been arguing with Proust for years about the *variation* in proportions. In the same volume Gay-Lussac and Thenard published a summary of memoirs they had read at the First Class on a variety of chemical topics, including the newly-discovered elements sodium and potassium, and boric and

---

[15] 'Observation sur l'intensité et l'inclination des forces magnétiques, faites en France, en Suisse, en Italie et en Allemagne', *Mémoires de la Société d'Arcueil, 1* (1807), 1-22.

[16] 'Premier essai pour déterminer les variations de température qui éprouvent les gaz en changeant de densité, et considérations sur leur capacité pour le calorique', *ibid.*, 180-214. See Donald Cardwell, *From Watt to Clausius. The Rise of Thermodynamics in the Early Industrial Age*, London, 1971, pp.131-3.

[17] 'Sur une propriété de la lumière réflechie', *Mémoires de la Société d'Arcueil, 2* (1809), 143-158.

[18] 'Sur une propriété des forces répulsives qui agissent sur la lumière', *ibid.*, 254-67.

[19] 'Mémoire sur la combinaison des substance gazeuses, les unes avec les autres', *ibid.*, 207-234.

hydrofluoric acids.[20] Several of these memoirs were published in full in the *Annales de chimie* but, now that Berthollet had his own house journal, he did not want to pass over an occasion to give further publicity to the recent research of his associates.

A third volume of *Mémoires* was ready for publication in 1813/14 but a combination of problems with the publisher and political uncertainties prevented the volume appearing before 1817.[21] Malus was now dead but there were several optical memoirs by Biot, conforming to the neo-Newtonianism of the Arcueil group. There were also several important chemical memoirs by Dulong. The final memoir published was a recantation by Berthollet of the view that chlorine was a compound of oxygen and muriatic acid.[22] He had previously opposed Gay-Lussac's opinion that it was a simple substance, thus leaving to Davy the unambiguous claim that chlorine was an element. Berthollet was now at the end of his career and he was prepared to make a public admission of his earlier mistake.

4. *The* Moniteur *and the* Journal des mines

In this review of journals relating to science it may be appropriate to say a few words about the leading newspaper of the time, which occasionally included scientific articles, and also to mention a technical journal with some relevance to chemistry. To link together, however briefly, a newspaper and a technical periodical may seem unusual. It could only be acceptable if, despite their different readerships, frequency of publication and format, they had something important in common. The common feature was government subsidy. In rather different ways they were both agents of government policy.

The *Moniteur* was founded in November 1789 by C. J. Panckoucke, the original publisher of the *Encyclopédie méthodique* (1782 onwards). The paper had an unusually large folio-size format at a time when it was still common to print newspapers with quarto or even octavo pages. The *Moniteur* prided itself on the accuracy of the information it contained rather than on any analysis of the political scene. Panckoucke was a moderate in politics, favouring the constitution of 1791, opposing any return to the ancien regime but even more hostile to the violence of the Revolution. After Bonaparte's seizure of power in November 1799 the *Moniteur* became the '*journal officiel*' and described itself as such on the title page. Bonaparte felt that he needed to keep a tight

---

[20] 'Extrait des mémoires lus à l'Institut national depuis le 7 mars 1808 jusqu'au 27 février 1809', *ibid.*, 295-358.

[21] The delay enabled the volume to include Humboldt's important geographical memoir on isothermals, *Mémoires de la Société d'Arcueil, 3* (1817), 462-602.

[22] 'Note sur la composition de l'acide oximuriatique', *ibid.*, 603-11. This corrected his earlier memoir of 1811 published in the same volume: 'Observations sur la composition de l'acide oximuriatique', *ibid.*, 171-9.

rein on the press and a decree in 1800 stopped the publication of 60 political journals circulating in the Seine Department (i.e. the Paris region), leaving only thirteen, including the *Moniteur* and the *Journal des débats* (later renamed the *Journal de l'Empire*).[23] These remaining papers were threatened with suppression if they published anything critical of the government. Increasing control was exercised on the press until 1805 when formal censorship was introduced. This meant that the entire contents of a newspaper had to be approved before publication. In 1811, the number of Paris newspapers was reduced to four, headed by the *Moniteur*.[24] Its subscription cost 100 francs p.a. but many copies were given away gratis. The readership grew as other newspapers were suppressed; the circulation of 2,450 in 1803 rose to approximately 6,000 at the end of the Empire.

The *Moniteur* had the privilege of publishing government decrees. The archives of that newspaper were destroyed by fire in 1858 but not before a French historian had discovered that many articles had been written by Napoleon himself. Some of these were on the movement of the army, including false information to mislead the enemy. Also bogus letters were published, giving the occupation rather than the name of the supposed author, but really written by government agents. Napoleon took an obsessive interest in the press as a propaganda weapon.

From what has been said, the *Moniteur* might be thought to have been a purely political journal, but such a view would overlook Napoleon's cultural politics. He saw science and the arts as potentially useful to his regime. But whereas the arts could be subversive as, for example, a play which satirised the government, he could see nothing but good in the sciences. Some science might be of direct use, but pursuit of even the most abstract science could only throw credit on his regime. As the usurper to the throne of the Bourbons, he wanted French science to shine even more under his rule than under the ancien regime. The *Moniteur* was, therefore, brought into the ideological battle. John Davy described it as 'the journal of science as well as of war'.[25]

In fact the Institute received an official letter announcing that:

> The *Moniteur* is the journal adopted by the government to make known to Europe not only political, military and administrative information relating to its wisdom and its authority but also everything

---

[23] C. Bellanger *et al*, (eds.), *Histoire générale de la presse française*, Paris, 1969, vol.i, chapter 8. André Cabanis, *La Presse sous le consulat et l'empire (1799-1814)*, Paris, 1975.

[24] Suzanne Tucoo-Chala, *Charles-Joseph Panckoucke et la librairie française*, Pau, 1975, pp.475ff.

[25] Humphry Davy, *Works*, ed. John Davy, London, 1839-40, vol.5 p.3n.

> in literature, science and the arts which contributes to national glory.[26]

Maret, the secretary of state, therefore asked members of the Institute to send to the *Moniteur* any article that might be of interest. He emphasised that special care would be taken with the accuracy of the text - not something one could normally rely on in a newspaper! Offprints would be sent to authors.

This proposal was examined by a commission of the First Class which recommended that the offer to publish in the *Moniteur* should be accepted when members wanted, for example, to publicise a new discovery. It would cost nothing, and it would provide a means of rapid publication. Such a facility, the commission noted, was enjoyed by several journals such as the *Annales de chimie*, but could not be compared with their own *Mémoires* which had a more leisurely timetable. Yet the promptness of publication in the *Moniteur* compared with the *Annales* would be as different as the gap in time between publication of the *Annales* and the *Mémoires* of the First Class. In other words no *monthly* journal like the *Annales* could compete with the *daily* publication of a newspaper. Claims of priority in scientific discovery were now regarded as being dependent on prior publication. Hence a member of the Institute might be able to use the *Moniteur* to claim priority over a non-member. This happened notably in the rivalry which existed between Gay-Lussac and Humphry Davy.

When Davy visited Paris in November-December 1813, he was shown a curious new substance, which had some similarity in its chemical properties to chlorine. He began investigating it about the same time as Gay-Lussac.[27] Each worked independently, and on 6 December Gay-Lussac announced to the First Class of the Institute that the new substance *iode* combined with hydrogen to form a hydracid. But Davy claimed the same discovery in a memoir dated 10 December and sent it to the Royal Society in London. In fact Davy did not make his ideas public until the next meeting of the Institute on 13 December. Meanwhile Gay-Lussac had published his own work on iodine in the *Moniteur* of Sunday 12 December, thus securing priority, at least in French eyes. The new substance had not actually been discovered by either Gay-Lussac or Davy but the former was the first to publish a general account of the properties and to claim for it the status of an element. With rival claims of prior discovery it is not totally clear whether one of these chemists was helped by the other, but some may consider Gay-Lussac to have had an unfair advan-

---

[26] *Procès-verbaux des séances de l'Académie des Sciences*, vol.2, p.113 (25 February 1800).

[27] M. Crosland, 'Collaboration and rivalry', Chapter 4 of *Gay-Lussac, Scientist and Bourgeois*, Cambridge, 1978, pp.84-5.

tage as regards publication. In fact, Davy's memoir, dated 10 December 1813, was not read to the Royal Society until 20 January 1814.[28]

Gay-Lussac's memoir was published in the *Moniteur* (where it occupied two full columns of small print), exactly as it would have been presented in a scientific journal.[29] A memoir by Malus, given more than three columns, was equally technical but devoid of mathematics.[30] Although many scientific memoirs were published in their original form, sometimes memoirs were reported on and their authors described in the third person.[31] Also some reviews of scientific books were written in an introductory style, suitable for the 'general reader'.[32] All these publications served to reinforce the view among readers that the French were in the forefront of scientific advance.

Turning briefly to the *Journal des mines*, the discussion of the mineral wealth of France had seemed such an important subject to the Agence (later Conseil) des Mines that, from its inception in 1794, a large number of copies were distributed free to mine owners and *savants* throughout France as well as to many foreign men of science.[33] In so far as the journal contained general information about mining and the texts of all government legislation relating to French mines, this apparent liberality may have seemed justified. Yet the journal was also concerned with the scientific basis of mining, particularly mineralogy and inorganic chemistry. There was, therefore, some overlap with the *Annales de chimie,* and a chemist like Vauquelin found himself a contributor to both journals. Another chemist with a foot in both camps was Descotils. A graduate of the Ecole des Mines, Descotils held the post of curator of chemicals and director of the laboratory of the Conseil des Mines in Paris. Of the large number of mineral analyses carried out by Descotils, some were published in the *Journal des mines* and some in the *Annales de chimie*.

Yet to receive such a journal free of charge might seem unfair competition for other related scientific journals, and in 1801, after an interruption of more than a year, the journal was relaunched with a new policy at the instigation of Chaptal, appointed Minister of the Interior in November 1800. The journal was now to have an annual subscription of 15 francs for 12 monthly issues. In other words it was to compete on the open market with other journals. It was not intended to make a profit but simply to use the income from subscriptions to pay the printing costs. An earlier journal in the same field had been the

---

[28] *Phil. Trans.*, 1814, 74.

[29] *Moniteur*, 1813 (2), pp.1384-5.

[30] *Moniteur*, 1811 (1), pp.588-9.

[31] E.g. Report on Memoir by Gay-Lussac and Thenard to the Institute. *Moniteur*, 1810 (2), p.231.

[32] E.g. Review of Berthollet's *Statique chimique*. *Moniteur*, 1804-5, pp.248-9.

[33] *Journal des mines*, publié par le Conseil des Mines de la République *55* (1801), 'Continuation du Journal des mines', iii-xii.

Journal du mineur et du naturaliste, launched in 1791 by two enthusiasts for the mining tradition of Saxony and Hungary: Henri Struve and J. P. Berthout van Berchem. They were particularly keen on the mineralogical ideas of Werner and in some ways this journal could be seen as the mouthpiece of a particular school. At any rate the *Annales de chimie* was happy to publicise the new journal.[34] The explanation given by the *Journal des mines* of why certain German territories were so advanced in mining was not so much because of their rich mineral resources but rather the constant protection offered by their governments[35] - an obvious hint. Thus from 1801 the journal was perched uneasily between the worlds of private enterprise and government protection.

We may also note the emergence after the Revolution of institutional journals. The Ecole Polytechnique, financed entirely by the state, decided that it should have its own journal, which would publish articles about teaching and research in mathematics and the physical sciences both by staff and, later,by some of the more brilliant students. The first few issues were published in 1795 and Guyton was a prominent contributor. The *Journal de l'Ecole Polytechnique* continued publication a little irregularly throughout the Napoleonic period with the majority of copies being distributed free to government officials and educational institutions. A small proportion of the contents only were on the subject of chemistry but it does raise the question of divided loyalties from those who were associated both with the *Annales* and the Ecole Polytechnique. The same may be said about the *Annales du Muséum d'Histoire Naturelle*, founded in 1802 on the initiative of Fourcroy for the publication of research by the professors of the Muséum. Although the emphasis was very much on the biological sciences, the Muséum did have two chairs of chemistry, one held by Fourcroy until his death in 1807, and he demonstrated his loyalty to the institution which employed him by publishing several articles in its journal. Vauquelin and Laugier also published there, thus providing further evidence that Parisian chemists had some choice in deciding where they published their research. Of course, publication in one French journal did not exclude absolutely the possibility of publication in a second journal but multiple publication of an article without some change tended to be the exception.

---

[34] *A.c.*, *10* (1791), 221-4. The *Journal* was published in Lausanne.
[35] *Loc.cit.*, p.viiin.

5. *The Bibliothèque britannique*[36]

Finally, before confronting the *Journal de physique,* we must look at another journal published in the French language but, exceptionally, not only from outside Paris, but even partly outside the boundaries of France. Actually Geneva was incorporated into the French state over the years 1798-1813 but even then it had a certain intellectual independence as a long-established cultural centre. It was in 1795 that Marc-Auguste and Charles Pictet together with F. G. Maurice issued a prospectus about a journal they planned to launch, intended to bring news of Britain in science, agriculture and literature to the continent of Europe. Between 1796 and 1815, 144 volumes of the *Bibliothèque britannique* were to appear, comprising 60 volumes on literature, 60 volumes on science and technology, 20 volumes on agriculture and 4 index volumes. It is, therefore, not unreasonable to claim that it was 'one of the weightiest periodical publications of its time'[37] and indeed the equivalent of several periodicals put together.

Our sole concern, however, is with the series *Sciences et arts* and within this we have a special interest in chemistry and physics. A careful analysis of the contents of this series has shown that the greatest number of pages was devoted to medicine, followed by physics and chemistry. Very little space was given to astronomy, natural history, geology or physiology.[38] Chemical articles amounted overall to 11% of the contents, with a particularly high proportion in the years 1809, 1813 and 1814. Even in other years, however, there would be several chemical articles in each volume. Of course, the articles were derivative, being mainly extracted from British books and journals, but Charles Pictet in particular had a good understanding of physics and chemistry and was the author of a book on heat and hygrometry. He had lived for a time in Paris, often attended meetings of the First Class, and was a friend of Berthollet. Indeed he was so often in Paris in the early 1800s and so friendly with Berthollet, Laplace, Biot and Gay-Lussac that he might almost be considered an associate member of the Society of Arcueil.[39] However, his editorship of his journal constantly obliged him to return to Geneva.

The importance of the *Bibliothèque britannique* for our purposes lies in the fact that the Genevans were able to obtain British material, imported on the continent via Hamburg during a period of very poor communication in time of war between Britain and France. The gap was made even wider by Napo-

---

[36] This section is based almost entirely on the work of David M Bickerton: *Marc-Auguste and Charles Pictet, the Bibliothèque britannique (1796-1815) and the Dissemination of British Literature and Science on the Continent*, Slatkine, Geneva, 1986.

[37] *Ibid.*, p.206.

[38] *Ibid.*, Table 6, p.411.

[39] M. Crosland, *The Society of Arcueil*, 1967, pp.138-140.

leon's 'Continental system', designed to prohibit all British imports to France. Considering that the war lasted almost continuously from 1793 to 1815[40] this meant that throughout most of the history of the first series of the *Annales* the *Bibliothèque britannique* was often able to get hold of British material at least several months before it was known in Paris. Indeed it was often known in Paris *through* its prior appearance in the Genevan publication. But this communication was not brought about without effort. Pictet visited Britain in 1798 and again in 1801 to arrange his supply of material from different sources. In addition to various private sources, London correspondents agreed to provide copies of certain periodicals on a monthly basis, together with a choice of other suitable material.[41] This provides a contrast with the *Annales*, which, with less business acumen, largely relied on the importance of Paris as a centre of scientific excellence, particularly through the First Class, and also on the reputation of its editorial board and the friendship of individual members. Of course, British chemistry was only a small part of the *Annales* but, with the growing reputation of Davy after 1807, it must have been rather disconcerting to the Parisian chemists to receive news of his work often only at second hand through the *Bibliothèque britannique*.

We have hinted at a certain rivalry between the two journals, but Berthollet in particular had a keen appreciation of the value of the *Sciences et arts* series. In the November 1801 issue of the *Annales* he wrote:

> Among works of great interest for those who cultivate the sciences the *Journal britannique* (sic) merits a particular mention and, although it is widely known, the editors of the *Annales de chimie* who wish their collection to possess all possible utility, will in future give a list of all the articles in this journal which relate to chemistry.[42]

Accordingly, for the next two years a review of articles from the *Bibliothèque britannique* regularly appeared in the *Annales*, sometimes occupying several pages.

Yet when in 1800 Pictet had praised Cruickshank for his discovery of carbon monoxide (which had previously been confused with hydrogen, which also burned with a blue flame) he was imprudent enough to comment:

> It is undoubtedly to the rarety of scientific communications between the two countries [Britain and France] that we must attribute the error of some French chemists on this subject and their silence about the fine discoveries of Mr. Cruickshank.[43]

---

[40] Apart from the Peace of Amiens in 1802 Napoleon was of course first deposed in 1814 before his final defeat at Waterloo in 1815.

[41] Bickerton, *op.cit.*, p.313.

[42] *A.c.*, *40* (1801), 166.

[43] *Bibliothèque britannique*: *Sciences et arts*, *18* (1800), 136 quoted by Bickerton, *op.cit.*, p.569.

But Guyton would not let him get away with this. He replied angrily that Pictet, by speaking of 'some French chemists', was obviously referring to the editors of the *Annales de chimie*, who were fully aware of the work in question.

6. *La Métherie's editorship of the* Journal de physique.

Since La Métherie was probably the most persistent critic of Lavoisier's new chemistry throughout the period of the first series of the *Annales* it is worth devoting some attention to him.[44] Moreover, since the means he used to attack the new chemistry was a major scientific journal, he has a special relevance to the story of the *Annales*. Jean-Claude de la Métherie (1743-1817) was originally destined for a career in the church but on the death of his elder brother, who had followed the family tradition of a career in medicine, he switched to medicine and even qualified. He soon realised that he had no real vocation, whereas he had always been interested in philosophy and speculation about the natural world. In 1778 he managed to find a publisher for a little book on natural philosophy, in which he reviewed the different opinions of various writers. About 1780 he decided to devote himself entirely to the study of philosophy and came to Paris. He was able to have some of his speculative articles accepted by the journal *Observations sur la physique* and became friendly with the new editor, the abbé Mongez. In 1785, Mongez decided to accompany the ill-fated La Peyrouse on a world voyage and left the *Journal* temporarily in the hands of La Métherie. Unfortunately, some time after reaching Australia, disaster befell the expedition and there were no survivors.

La Métherie, therefore, found himself permanently in charge of a journal which provided him with a modest income and great power. He built up an international network of correspondents and in the late 1780s he became well known and even respected. Yet in our story he features almost as the villain of the piece. There is no doubt that he was an indefatigable author and editor. Although his scientific opinions were often based more on his personal feelings than on a careful study of the available data, he usually gave an honest opinion. The trouble was that his opinion became a dogma and any observation or experiment was represented as a 'truth'; *verité* was one of his favourite words. He was always ready to criticise others. While some criticism was undoubtedly justified, one particular case represented almost a pathological hatred, which went far beyond the bounds of reason. It all seems to have

---

[44] An invaluable source is H. de Blainville, 'Notice historique sur la vie et les écrits de J. C. Delamétherie', *J. de phys.*, *85* (1817), 78-107. See also Kenneth L. Taylor, art. La Métherie, *D.S.B.*, Vol.7, pp.602-4.

stemmed from a meeting that La Métherie, as the new acting editor of the *Observations sur la physique*, had had with Lavoisier, who had apparently treated him with disdain.[45] La Métherie felt that Lavoisier had too high an opinion of himself and too much influence on French science; he consequently sought to undermine Lavoisier's position, a goal from which he was in no way diverted by the death of the *savant* in May 1794. In so far as Lavoisier's ideas lived on, La Métherie felt that he had a mission to show their falsity. He felt this all the more as he himself received little recognition of his own talents. He would dearly have loved to have been a member of the First Class of the Institute but, quite apart from his mediocre talent, he refused to canvas votes. The only official recognition he received was his appointment as assistant professor of mineralogy at the Collège de France, the holder of the chair being Cuvier.[46]

He had in fact published an edition of Bergman's book on mineralogy. Possibly better known was his book on gases, published in 1785, which shows that he had a good grasp of the subject.[47] In this he discussed the work of several chemists including Lavoisier but it is noticeable that he hardly ever referred to the latter by name. Going beyond the chemistry and the mineralogy, La Métherie as editor believed that he could keep up with all branches of natural science and in the *Journal* he made a creditable attempt to comment on most fields of science which did not involve mathematics. It was all the more remarkable that he did this entirely on his own. Only in 1812, when he suffered a stroke followed by partial paralysis, did he acquire the zoologist Blainville as an assistant. Blainville, who wrote a very frank obituary of his colleague, explained that he had been sorry for him and pointed to his many good qualities, for example, his willingness to sacrifice his own meagre financial resources for the benefit of his family or his friends. It was not only in science that he was outspoken. In the dangerous days of the Revolution he had had the courage to speak out[48] and he had been thrown in prison. This perhaps made him all the more bitter about those who had prospered in the period after the Terror, when new scientific and educational institutions had

---

[45] 'S'étant un jour présenté chez M. de Lavoisier...il en fut reçu avec une hauteur qui lui déplut beaucoup... Dès lors...il chercha à contre-balancer la grande influence du célèbre chimiste françois...', Blainville, *loc.cit.*, p.83.

[46] La Métherie had hoped to be appointed to the chair himself and was mortally offended to be passed over. It seems, however, that Cuvier established good relations with him and even gave him part of the salary associated with the chair.

[47] *Essai analytique sur l'air pur et sur les différentes espèces d'air*, Paris, 1785, 2nd edn., 2 vols., 1788.

[48] In November 1792 he indulged in a political tirade, out of keeping with a scientific journal and ended: 'Je puis périr du fer des assassins; mais je ne cesserai jamais d'être moi, ami de la verité, ami de la vertu, ami de l'humanité, et ne connaissant que la liberté', *Obs.*, *41* (1792), 394-9 (399).

been founded. He was totally opposed to the new scientific establishment. It was not too difficult for him to see the leading Paris savants around 1800 as part of a giant conspiracy. It was for this reason that he eagerly sought contributions to the *Journal* from outside Paris and outside France, which in his eyes would be free from corruption.

In mineralogy he had a particular interest in the study of crystals and pointed out that Linnaeus, Bergman and Romé de l'Isle had all advocated the use of the crystalline form of minerals in their classification. He insisted regularly in his editorials that Romé de l'Isle was the real founder of crystallography rather than Haüy, who was achieving recognition in the 1790s. Haüy had, of course, gone much further than his predecessors but La Métherie insisted on regarding him as the usurper to the honour rightly due to Romé de l'Isle. This meant that the journal, now re-named the *Journal de physique*, often contained attacks on Haüy, either explicit or indirect. Sometimes they are even to be found curiously mixed with attacks on Lavoisier.[49] From mineralogy La Métherie extended his interests to the emerging science of geology, which was often reported on in the *Journal*. La Métherie's own memoirs on the subject were often related to some of the grand questions of the earth's history and drew on his powers of imagination. In many ways he seems to be a relic from an earlier age when broad perspectives and speculation were more common.

Although the journals are in many ways comparable, there is a lack of symmetry between the organisation and contents of the *Annales* and the *Journal*. In the first place a whole editorial board was matched by a single editor, a man of moderate ability but passionate feelings about science, which will be discussed later. As for contents of the journals, the *Journal de physique* embraced a whole range of non-mathematical sciences, while the *Annales* focused on chemistry. In discussions of chemical theory, as far as the *Annales* were concerned, mention of phlogiston belonged almost entirely to the past. Although La Métherie embraced a theory of phlogiston to his dying day, he was totally ignored by the *Annales*. Taking the very opposite position, La Métherie seems to have considered it a duty to attack the new chemistry every year up to 1817, when the journal passed over completely to Blainville. Yet curiously he claimed impartiality! In a long discussion of combustion and of the two alternative theories of chemistry in 1789, he wrote:

> Endeavouring to make this journal the place of publication of memoirs on this grand process, which is so important in the science, I will continue to publish there with the same impartiality all that is

[49] E.g., *J. de phys.*, *76* (1813), 42. The connection in La Métherie's mind between Lavoisier and Haüy is that neither made sufficient acknowledgement of their predecessors. He printed three times in capitals the admonition: 'Respectez la verité'.

> written for and against without allowing myself to insert any commentary.[50]

It is true that La Métherie published memoirs by adherents of the oxygen theory,[51] (i.e. the majority of chemists from the 1790s) without attempting necessarily to undermine them with critical footnotes, but he reserved for himself a critical weapon of much greater power than any footnote. This was the 'Preliminary discourse', which he wrote every year of publication from 1785 to 1817, giving in his own terms a review of recent science.

The 'Preliminary discourse' may be compared in some respects to the general history introduced by the secretaries of the Academy as a preface to its *Mémoires*. But, whereas the Academy secretary was constrained to report only on memoirs presented to the Academy, the editor of the *Journal de physique* was subject to no restrictions. He could write at length on anything which interested him and pass over areas of science, in which he had little interest or knowledge. Thus in one 'Preliminary discourse' he introduced the heading 'mathematics', which was covered in 10 lines, before devoting 60 quarto pages to 'natural history'.[52] He considered that 'la physique' had been led astray by mathematicians, who wanted to apply mathematics to situations where it was not appropriate.[53] Science, he felt, should be based entirely on observation and experiment and he gave as examples the work of Franklin on lightning, Montgolfier on balloons and also work on gases and galvanic electricity, where mathematics had not been used.[54] He usually devoted a large space to chemistry, adopting a very partisan stance. The preliminary discourse came to fill the entire January issue of the journal and there is no doubt that for some readers it provided a valuable survey of recent work in the main branches of natural science. La Métherie had a further opportunity to give useful information and promote his own ideas in his monthly section entitled 'Nouvelles littéraires', which consisted of notices and reviews of recently-published books.

One final aspect should be mentioned of La Métherie's editorship of the journal, and that concerns the change of title. Three points need to be made: the change in the wording, the timing of the change and its significance. The title *Observations et mémoires sur la physique, sur l'histoire naturelle et sur les arts et métiers* was, as mentioned previously, changed to *Journal de physique, de chimie et d'histoire naturelle et des arts*. At first sight it seems a matter of little importance. The significant addition is that of the word 'chem-

---

[50] *Obs.*, *34* (1789), 40.

[51] His assistant Blainville wrote: 'on ne put jamais obtenir de lui d'insérer les Mémoires de ceux qu'il considéroit comme ses ennemis', Blainville, *loc.cit.*, p.99.

[52] *J. de phys.*, *72* (1811), 7, 9-68.

[53] *Ibid.*, 69.

[54] *Ibid.*, 6.

JOURNAL
DE PHYSIQUE,
DE CHIMIE
ET
D'HISTOIRE NATURELLE,

AVEC DES PLANCHES EN TAILLE-DOUCE;

PAR JEAN-CLAUDE LAMÉTHERIE.

NIVOSE, an 2^e de la Rép. Franç.

TOME PREMIER.



A PARIS,

Chez CUCHET, Libraire, rue & maiſon Serpente,

AN 2^e DE LA RÉPUBLIQUE FRANÇOISE.

FIG. 6: Title page (January 1794) of what was intended to be volume 1 of a new series of the *Observations sur la physique*. What is particularly significant is the timing of the change and the addition of the word *chimie* to the title, as if to assume the mantle of the *Annales de chimie* which had recently ceased publication.

istry' since this first appeared in January 1794, immediately after the suspension of the *Annales*. In other words, La Métherie (or his publisher, Cuchet) was making a bid to take over the subject of chemistry from the now defunct *Annales*. With Lavoisier under arrest at the time he was not tactless enough to make any explicit claim about chemistry. Yet the change of title was considered to be so significant that it justified calling the first volume of 1794 'Tome Premier', as if it was a new journal or at least a new series. The next volume ('July 1794 old style') was presented as volume two. Although the journal was forced to close down later in 1794, largely for financial reasons, when it resumed, the editor described the subsequent volumes as volumes 3 and 4. This attempted launch of a new series has been hidden from casual researchers by the fact that librarians have almost universally preferred to simplify the history of the journal by labelling these bound volumes: volumes 44-47. Indeed La Métherie himself soon returned to the old sequence and historians of science always give references according to this continuous sequence. The only disadvantage in this procedure is that it has obscured the significance of the year 1794 in the history of the journal.

7. *Attacks on Lavoisier and support for Davy.*

La Métherie was particularly critical of the new chemical nomenclature. He gave a long description of the *Méthode de nomenclature chimique* when it came out in 1787, followed by a critical essay that same year.[55] In 1788 he referred readers of the *Journal* to what he had written on the new nomenclature in the previous year, saying,

> I will content myself with adding that the majority of *savants*, whether foreign or French, do not accept it.[56]

He was also happy to publish critical articles on the subject by other authors.

The preliminary discourse of 1788 contained one of La Métherie's more coherent attacks on Lavoisier's chemistry. There were four main points of attack: the composition of water, the supposed simple substances, oxygen as an acidifying principle and the new nomenclature.[57] For the first two points La Métherie was so anxious to join the fray that, instead of simply quoting contradictory evidence from other chemists, he quoted his own experiments. The phlogiston theory could be supported if it could be argued that some of Lavoisier's 'simple substances', particularly the inflammable ones like sulphur, phosphorus and carbon, contained hydrogen.[58] He continually attacked the

---

[55] *Obs.*, *31* (1787), 210-19, 270-85, 270.

[56] *Obs.*, *32* (1788), 23.

[57] A good half of his *Discours préliminaire* was on chemistry. *Obs.*, *32* (1788), 12-24.

[58] *J. de phys.*, *68* (1809), 87. See also *J. de phys.*, *71* (1810), 451-4, which draws on Davy's work.

large number of Lavoisier's elements,[59] correctly pointing out that all vegetable and animal substances seemed to be comprised of only a few of Lavoisier's elements.[60] When Lavoisier's *Traité* was published in 1789 La Métherie could not pass over the opportunity of giving it a critical review and in this he constantly found fault with the nomenclature as well as the theory.[61] The attacks on both the new chemistry and the new nomenclature reached something of a climax in that year with publication of a collection of letters on these subjects[62] as well as other contributions, which we shall see in due course. In 1789 he also gave his own partial account of the earlier history of gases, including the work of Bayen (to be described below) and argued in support of the phlogiston theory.[63] There was no question, therefore, of the *Journal de physique* being a neutral journal as far as chemistry was concerned. It was clearly dedicated to a defence of phlogiston and took every opportunity to attack the new school of chemistry. The foundation of the *Annales* might, therefore, be seen as much as a medium for self-defence as a medium for Lavoisier propaganda.

Another ploy of La Métherie to discredit the new school of chemistry was to argue that some of Lavoisier's basic experiments had actually been anticipated by the editor's former friend, the apothecary Pierre Bayen (1725-98). It is certainly true that Bayen in 1774 had published some work on precipitates of mercury, which overlapped with experiments of Priestley and Lavoisier.[64] He had even openly criticised the phlogiston theory while Lavoisier was still hesitant on the subject. But he had failed to take this work further. La Métherie presented the lack of public acknowledgement of Bayen's work as a conspiracy of silence by the establishment.[65] He was delighted in 1805 to point out an experimental error by Lavoisier. Whereas his great enemy had quoted 28% as the proportion of oxygen in the air,[66] more recent evidence had shown the percentage more correctly as 21.[67] One may, however, note that about this time he began to accept the term 'oxygen' in the titles of his own papers.[68]

---

[59] *J. de phys.*, *68* (1809), 87.
[60] *J. de phys.*, *70* (1810), 88.
[61] *Obs.*, *34* (1789), 304-318.
[62] 'Extrait de différentes lettres sur la nouvelle théorie et la nouvelle nomenclature chimique', *Obs.*, *35* (1789), 75.
[63] *Obs.*, *34* (1789), 19-40.
[64] J. R. Partington, *History of Chemistry*, vol.3, pp.395-9.
[65] 'De l'état actuel de la chimie', *J. de phys.*, *83* (1816), 117-34.
[66] Actually 27% in Lavoisier's *Traité*, p.40, *Elements*, p.38.
[67] *J. de phys.*, *60* (1805), 99.
[68] 'Notice sur une mine de manganèse très oxigénée....', *J. de phys.*, *60* (1805) 473-5. 'De l'oxidation des soudures....', *J. de phys.*, *63* (1806), 252.

As regards the idea of oxygen as the principle of acidity, La Métherie even passed on to readers of his journal the gist of a relevant conversation with Laplace, which (assuming it is to be believed) is worth reproducing, as it is not generally known:

> Laplace told me that he had repeatedly remarked to Lavoisier that he was not entitled to consider pure air as the principle of acidity, since he could not prove that this air was present in muriatic, fluoric and boracic acids.[69]

La Métherie was also able to cite the evidence of Lavoisier's associates that prussic acid and hydrogen sulphide behaved as acids yet contained no oxygen. In the last year of his life he was able even to quote from articles on hydracids by Gay-Lussac in the *Annales de chimie* and the *Annales de chimie et de physique*.[70] Indeed by this time he was drawing very heavily on the *Annales* to review the latest developments in chemistry.He said that Lavoisier had not disproved the existence of phlogiston. On the contrary, although he had banished the word, his *calorique* was essentially the same thing.[71] In his final fling, the preliminary discourse he wrote in the year of his death, La Métherie claimed to have won support for the view that there was an inflammable principle, which might be described variously as phlogiston, inflammable air or caloric, which is present in combustible bodies *and* in pure air.[72]

A very interesting relationship developed between Humphry Davy and La Métherie. Although belonging respectively to two nations at war during nearly all the period in question, they had two things in common. They began with a hostility to Lavoisier. Davy's first published paper had been a challenge to Lavoisier's oxygen theory.[73] Although Davy later regretted that his early speculations had passed into the public domain, he continued to flirt with the phlogiston theory,[74] much to La Métherie's satisfaction. The second important thing that the two men shared was their intellectual and social distance from the Parisian scientific establishment. For the Englishman, this was to be expected, although in 1813 the First Class formally recognised Davy's contributions to chemistry by electing him as a corresponding member. For several years Davy had been working in active competition with two younger mem-

---

[69] *J. de phys.*, *66*(1808), 112.

[70] *Ibid.*, 119-20.

[71] E.g., 'De l'état actuel de la chimie', *J. de phys.*, *83* (1816), 117-34 (p.119).

[72] *J. de phys.*, *84* (1817), 69. This would seem to be a desperate compromise between the usual form of the two theories.

[73] Davy had argued that oxygen gas was composed of light and oxygen, 'An essay on heat, light and the combination of light', *The collected works of Sir Humphry Davy*, 1839-40, vol.2, pp.5-86.

[74] E.g. *Works*, vol.5, pp.89, 132, 203. See also Robert Siegfried, 'The phlogistic conjectures of Humphry Davy', *Chymia*, *9* (1964), 117-124.

bers of the scientific establishment, Gay-Lussac and Thenard.[75] The most brilliant work over these years was probably the isolation by Davy of sodium and potassium from the corresponding alkalis, using the new method of electrolysis. La Métherie was pleased to publicise this work, not only for its undoubted importance, but because it illustrated that the oxides (hydroxides) of metals were alkalis, thus throwing further possible discredit on Lavoisier's oxygen theory of acidity.

La Métherie was happy to accept Davy's flattery when the latter sent him a memoir in 1810 for publication in the *Journal* and said 'I trust to your love of truth and justice'.[76] Henceforth La Métherie used this as a motto in his polemic. The story even went around that Gay-Lussac and Thenard had refused publication of this paper for the *Annales de chimie* 'which they edited'.[77] The trouble is that this rumour has been widely believed and uncritically repeated by modern scholars.[78] It seems to have arisen as a piece of anti-Napoleonic propaganda from Gerrit Moll, when he wrote to defend British science. In fact the relevant memoirs were published in the *Annales*, although, when John Davy prepared an edition of the collected works of his brother, he did not consider them original enough to include. Often Davy's memoirs reached Paris via the *Bibliothèque britannique* and both the *Journal de physique* and the *Annales de chimie* would reproduce the work of the Swiss translator. Exceptionally La Métherie himself translated Davy's English text, while the *Annales* used its own independent translator.[79]

La Métherie considered Davy a valuable ally in his battle with the French establishment. Not only did he publish translations of Davy's memoirs, often unabridged, but he would summarise them in the 'Preliminary discourse' of the following year. In the words of a Davy scholar:

> These retrospective essays guaranteed that Davy's findings were reviewed and re-reviewed sometimes for three or four consecutive years.[80]

---

[75] M. Crosland, 'Collaboration and rivalry', Chapter 4 of *Gay-Lussac, Scientist and Bourgeois*, 1978.

[76] *J. de phys.*, *71* (1810) 43-44n.

[77] June Z. Fullmer, *Sir Humphry Davy's Published Works,* Cambridge, Mass. 1969, p.60. Mrs. Fullmer did not understand the junior position of Gay-Lussac and Thenard on the editorial board of the *Annales*.

[78] Joseph Agassi makes much of this supposed incident and suggests a comparison with Stalinist Russia (*Faraday as a Natural Philosopher*, Chicago, 1971, pp.24-5). See also Fullmer, *loc.cit.* A full discussion is given in M. Crosland, 'Humphry Davy - an alleged case of suppressed publication', *B.J.H.S.*, *6* (1973), 304-10.

[79] Fullmer, *op.cit.*, p.61 refers to Davy's paper on oxymuriatic acid which was translated for the *Annales* by Anatole Riffault.

[80] Fullmer, *op.cit.*, p.3

It was a feature of La Métherie's editorship that anything worth saying was worth repeating many times. This might have been a useful strategy if the readership of the *Journal de physique* had been continually changing but, since many of its readers were regular subscribers, they must have tired of the constant tirades against the new chemistry and the claims of the editor for priority in several new ideas. Most of all, La Métherie presented himself as an incorruptible friend of truth and a genius, whose talents had not been appreciated by those who held the senior positions in French science.

8. *The* Journal de physique *and the scientific fringe.*

As previously mentioned, La Métherie felt a particular duty to defend the work of Romé de l'Isle (1736-90). Romé had begun life as a soldier but at the age of 28 had met the young chemist and mineralogist B. G. Sage and had followed his course on chemistry.[81] In his general views Romé followed Sage and never abandoned the phlogiston theory. It is, however, for his work on mineralogy and crystallography that he is best known. Under the patronage of Sage he catalogued several mineral collections. He became involved in a dispute with Buffon, which did not help his career. The crystallographer Haüy was associated with the Buffon camp and tended to ignore Romé's work, which La Métherie regarded as a grave injustice. Claims on behalf of Romé continued to be made in the *Journal de physique* in the 1800s long after his death.

Another mineralogist who enters our story, since he published extensively in the *Journal de physique*, was Romé's teacher, Balthazar-Georges Sage (1740-1824), although he was never more than a minor scientific figure.[82] Originally a pharmacist, Sage had powerful connections at court, which resulted in his entry to the Paris Academy. Here he was sometimes an embarrassment to his colleagues, for example in his claim to have obtained substantial amounts of gold from ashes. Sage's sole claim to fame was as professor of mineralogy first at the Mint (1778), then at the newly-established École des Mines in Paris in 1783; he later served as director of the school. The school was closed during the Terror and, when it was re-established, Sage was ignored but would not accept his exclusion. As late as 1813 he was publicly asking why he had been rejected by the new Ecole des Mines. His complaints were quoted in a review by La Métherie, who supported him.[83]

---

[81] R. Hooykaas, art. Romé de l'Isle, *D.S.B.*, Vol.11, pp.520-4.

[82] Henry Guerlac, art. B. G. Sage, *D.S.B.*, Vol.12, pp.63-69. He quotes Birembaut, who described Sage as 'un faux savant'.

[83] *J. de phys.*, *76* (1813), 318.

Largely excluded from the *Mémoires* of the Academy, Sage was a regular contributor to the *Journal*.[84] In 1789 there were no fewer than 16 contributions from his pen, nearly all on mineralogy but he also emerged as a critic of the new chemistry and the new nomenclature.[85] He summed up these criticisms in his book of 1810*: Exposé des effets de la contagion nomenclative et réfutations des paradoxes qui dénaturent la physique*. Even later he criticised not only 'la secte lavoisienne' but even the basic work of Joseph Black on 'fixed air' (carbon dioxide).[86] It was perhaps purely out of pity that the First Class of the Institute elected him as a member in 1801.[87] He lived on to the age of 85, an embittered old man with little talent, cherishing the science and the privileges of an earlier age. In December 1802, during the Peace of Amiens, the Anglo-Irish novelist Maria Edgeworth attended one of Sage's public lectures at the Mint and reported as follows:

> We heard a lecture from M. Lesage, the master of the Mint (*sic*), upon chemistry in which he endeavoured to prove the old doctrine of phlogiston and smiled with inconceivable self-complacency when he thought he had settled the minds of his audience on that important subject.[88]

A man of greater talent but lesser preferment was the mineralogist Antoine Monnet (1734-1817).[89] Some of his early field work in geology produced a conflict with Lavoisier.[90] He contributed several articles to the *Mémoires* of the Turin Academy, of which he was a member, and a few to La Métherie's journal in 1787 and 1788 but one biographer remarks that 'after 1790 his persistent and violent adherence to the phlogiston theory and his personal eccentricities isolated him increasingly from the [main] scientific community'.[91] He felt that he should have been elected to the Paris Academy and in his later embittered years he published a book entitled*: Démonstration de la fausseté des principes des nouveaux chimistes* (1798), in which, among other things, he was particularly critical of claims that had been made about the discovery of new acids.

---

[84] La Métherie gave him every encouragement, e.g. 'M. Sage nous a donné plusieurs belles analyses', *Obs.*, *36* (1790), 30.

[85] E.g. 'Sur la nouvelle nomenclature chimique', *Obs.*, *33* (1788), 478. See also *Obs.*, *34* (1789), 66, 138.

[86] Sage, *Mémoires historiques et physiques*, 1817, pp.50-1, quoted by Guerlac, *loc.cit.*

[87] Sage always described himself as 'fondateur et directeur de la première École des Mines'.

[88] C. Colvin (ed.), *Maria Edgeworth in France*, 1979, pp.46-7.

[89] Rhoda Rappaport, art. Monnet, *D.S.B.*, Vol.9, pp.478-9.

[90] R. Rappaport, 'The early disputes between Lavoisier and Monnet, 1771-81', *B.J.H.S.*, *4* (1968-90), 233-44.

[91] Rappaport, *D.S.B.*, Vol.9, p.478.

La Métherie was always happy to publish criticisms of the new nomenclature and he gave space to Marivetz in 1788[92], as well as to the Spanish chemist d'Arejula.[93] We also find in the *Journal* criticisms of the new chemistry by the pharmacist Opoix,[94] who, a quarter of a century later, was still writing memoirs based on the phlogiston theory.[95] A sustained attack on the oxygen theory was contained in three letters from the pen of the dilettante natural philosopher and traveller Jean-André De Luc (1727-1817), writing from London.[96] Many memoirs supporting the phlogiston theory were published, for example, by Priestley up to 1792[97] and by Wiegleb.[98] Considerable space was given to Lamarck, best known for his contributions to the biological sciences but also a declared enemy of the new chemistry and someone who was considered something of an eccentric by his professional colleagues. The *Journal* carried a memoir by him criticising fire as an instrument of chemical analysis[99] as well as articles on meteorology.[100] In 1802 the *Journal* published Italian criticisms of Lavoisier[101] and in 1808 favourable treatment was given to a book (*Examen nouveau de la chimie moderne*) by Sigorgne, who felt that Priestley's work had been unjustly neglected.[102] La Métherie's support for the underdog is shown again in a review of the recent history of soda manufacture, in which he claimed, not without some justification, that Leblanc had not received proper acknowledgement.[103]

An example of how the *Journal* came increasingly to represent the work of 'outsiders' is the publication in 1808 of an open letter to the president and members of the First Class of the Institute from the apothecary François Curaudau protesting about a report on a memoir, in which he claimed to have decomposed the element sulphur.[104] Curaudau had for several years been presenting third-rate work to the First Class, which had dutifully appointed commissions to examine what he had done. The commissions had always treated him politely and even given encouragement but their guidance was never sufficient to transform Curaudau into a good chemist. The *Journal* was, however, willing to give him space and indeed La Métherie may have looked

---

92 *Obs.*, *32* (1788), 61.
93 *Obs.*, *33* (1788), 262.
94 *Obs.*, *34* (1789), 76.
95 M. Crosland, *Science under Control*, Cambridge, 1992, p.337.
96 *Obs.*, *38* (1791), 460; *39* (1791), 11, 117.
97 E.g., *Obs.*, *39* (1791), 329 ; *40* (1792), 91. .
98 *Obs.*, *41* (1792), 81, 245.
99 *J. de phys.*, *48* (1799), 345-61.
100 *J. de phys.*, *52* (1801), 296-316; *56* (1802), 114-138.
101 *J. de phys.*, *55* (1802), 317.
102 *J. de phys.*, *66* (1808), 182.
103 *J. de phys.*, *71* (1810), 74-6.
104 *J. de phys.*, *67* (1808), 226-8. Davy had speculated that inflammable elements like sulphur might contain hydrogen.

more kindly on a contributor, who had crossed swords with the official body of science. We, therefore, find further research by Curaudau in the *Journal* on boric acid[105] and on the decomposition of potash.[106] In 1810 the *Journal* gave a sympathetic review to the *Système universel*, a book by the speculative philosopher and member of the scientific fringe, Hyacynthe Azaïs.[107] It was significantly the *Journal* and not the *Annales* which in 1812 published Oersted's speculations that light, heat, electricity, etc. could all be reduced to two forces.[108] Of course, at this time Oersted was an unknown *Naturphilosoph*; his historic experiment on the connection between electricity and magnetism came later.

The picture of the *Journal* as the haven of the unorthodox is confirmed by the history of the memoirs on the specific heats of gases, submitted for the prize competition of the First Class of the Institute for 1812. Two memoirs were submitted, both of a very high standard, one by associates of the Arcueil circle, Delaroche and Bérard and the other by Clément and Desormes. The prize was awarded to the former pair and their memoir was published in the *Annales de chimie*.[109] It is not surprising that the second pair did not win the prize, as the authors had used several concepts alien to the caloric theory as it was understood and widely accepted in France at that time.[110] Nor was it wise for them to contradict the ideas of Gay-Lussac, who was one of the judges. The memoir by Clément and Desormes may never have been published at all if they had not interpreted a paper published by Gay-Lussac in 1818 in the *Annales de chimie et de physique* as an attack on them.[111] It is significant that they chose the *Journal de physique* as the medium for reply. Here they published both the unsuccessful memoir for the 1812 prize competition and then a detailed reply to Gay-Lussac's latest paper.[112] All this time Nicolas Clément (1778?-1841) had lived very much on the fringe of science in Paris.[113] As early as 1802 he had published a paper on carbon disulphide,[114] which Berthollet had interpreted as an attack on himself and, quite out of

---

[105] *J. de phys.*, *68* (1809), 256-60.

[106] *J. de phys.*, *75* (1812), 238 (a report of Curaudau's work by La Métherie).

[107] *J. de phys.*, *70* (1810), 434-5.

[108] *J. de phys.*, *76* (1813), 233-7.

[109] Delaroche and Bérard, 'Mémoire sur la détermination de la chaleur spécifique des différens gaz', *A.c.*, *85* (1813), 72-110, 113-82.

[110] Robert Fox, *The Caloric Theory of Gases from Lavoisier to Regnault*, Oxford, 1971, pp.137-8; see also p.151.

[111] Gay-Lussac, 'Sur le froid produit par la dilatation des gaz', *A.c.p.*, *9* (1818), 303-10.

[112] Desormes and Clément, 'Détermination expérimentale du zero absolu de la chaleur et du calorique spécifique des gaz'. *J. de phys.*, *89* (1819) 321-46.

[113] In 1819, however, he finally obtained a chair at the Conservatoire des arts et métiers.

[114] 'Expériences sur le charbon', *A.c.*, *42* (1802), 121-52 (see pp.141-4 for comment on Berthollet). This work was singled out by Berthollet's son for special criticism: A. B. Berthollet, *Mémoires de physique et de chimie de la Société d'Arcueil*, *1* (1807), 304-32.

character, it seems that he never forgave Clément.[115] It is interesting that it was 'outsiders' like Clément who gave the warmest welcome to Humphry Davy when he visited Paris in 1813.

Another person, now famous, but then on the margins of science in more senses than one, was a natural philosopher from Turin, Amedeo Avogadro (1776-1856). A graduate in law, it was only in 1800 that he began to study science. With the benefit of hindsight we can say that it was a triumph for La Métherie to have published Avogadro's famous molecular hypothesis in his *Journal,*[116] but the basic question is why Avogadro should have sent it there rather than to the *Annales*. Part of the answer[117] is implied in the beginning of Avogadro's memoir, where he presented his work as a development from Gay-Lussac's recent memoir on the combining volumes of gases published in the '*Mémoires*' of the Society of Arcueil. This was a private society which only published the work of its own members, so Avogadro could not send it there. He could have sent it to the *Annales*[118] but even Gay-Lussac, who was now on the editorial board, had not published his famous memoir there. The long-established *Journal de physique* was known in Italy and, moreover, the very title suggested that it was as much concerned with *la physique* as with chemistry. Avogadro, wishing to communicate with a French audience, therefore, probably felt that this was the most appropriate journal. Hence because of Gay-Lussac's dual loyalties around 1809 the *Annales* lost not one but two great classical memoirs in the history of chemistry.

In the case of Avogadro we may see how La Métherie's low standards of acceptance for his journal, and the welcome extended to foreign contributions, paid off. It could be argued that a journal containing much low-grade science is not too high a price to pay if it can catch the occasional contribution of genius. A formal refereeing system might have led to the rejection of work which was too original. But the main difference between the *Journal* and the *Annales* was that the former was from the very beginning always wider in its coverage of science. We have emphasised what was relevant to chemistry, but there was also much included under the heading of 'natural history' and the almost equally miscellaneous 'physique'. As far as chemistry is concerned, it would be an exaggeration to claim that all opponents of the new chemistry flocked to the *Journal* but, led by its editor, it certainly served as one major

---

[115] Jacques Payen, art. Clément, *D.S.B.*, Vol.3, pp.315-17.

[116] 'Essai d'une manière de déterminer les masses relatives des molécules élémentaires des corps, et les proportions selon lesquelles elles entrent dans ces combinaisons', *J. de phys.*, *73* (1811), 58-76.

[117] Avogadro had already published several papers in the *Journal* and it might be argued that it was natural for him to continue.

[118] It is interesting to reflect that if Avogadro had sent his memoir to the *Annales* and it had been accepted, it would probably have been split into two parts because of its length.

focus of opposition. One notices more generally La Métherie's code of opposition to the scientific establishment. Yet the *Journal* also carried much orthodox science and, in the case of Laplace, it went out of its way to review all his principal publications, thus providing a useful service to readers. If a reader was not too irritated by La Métherie's constant attacks on the new chemistry and particularly by their repetitious nature, as well as the editor's claims for personal recognition, he might have found the general coverage of non-mathematical science of some considerable value. It did well, for example, in geology. It is only when one takes a purely chemical perspective that the *Journal* emerges as generally inferior. But even then it drew on a wide range of published material and it might be claimed that, for example, in its coverage of Davy's work it was actually superior to the *Annales*. Thus it would be a mistake to write off the *Journal*. Nor was the *Annales* entirely free from fault, as we shall see.

CHAPTER SIX

THE RANGE AND CONTENTS OF THE *ANNALES*

> Next to the establishment of institutions having ..... the promotion of science in general, for their express object ..... nothing has exercised so powerful an influence on the progress of modern science as the publication of scientific journals, ... The quick and universal circulation of these, places observers in all countries on the same level of perfect intimacy with each other's objects and methods, and serves to direct the course of general observation, as well as to hold out in the most conspicuous manner models for emulative imitation.
>
> (Sir John Herschel, 'Of the causes of the actual rapid advance of the physical sciences', *Preliminary Discourse on the Study of Natural Philosophy*, London, 1830, pp.351-2.)

> There is no doubt that posterity will not look with indifference on this precious collection, in which the founders of the science have placed the materials, which have been used to raise the imposing edifice of modern chemistry. They will take pleasure in following the relationship of the work and discoveries, which have finally led to a period which will be for ever famous in the history of the eighteenth century.
>
> (*Table générale, tomes 31-60*, 1807, p.ii.)

1. *The wide range of subject matter*

It would be only too easy and completely understandable if readers of the present day were to characterise the *Annales de chimie* as purely a journal of chemistry. It obviously had a chemical focus, but its terms of reference extended well beyond the subject matter of any one science. It focussed on chemistry because this was the latest exemplar of a successful experimental science. In some ways the *Annales* may be seen as a journal of physical science but, although this represents one aspect of Lavoisier's perspective, it omits entirely the medical and pharmaceutical dimension, which at various

times was quite prominent. Therefore, it is helpful to see the *Annales* more as a journal of science than as a narrow specialist chemical journal, such as might be thought appropriate around the year 2000. A first tentative hypothesis might be that it was more like a journal of general science, but with a strong bias towards chemistry.

Certainly during the first few years the *Annales* represented a rather wider interest than chemistry, and we wonder whether the wider terms of reference of the rival journal, La Métherie's *Journal de physique*, might not have had some influence. Thus volume 2 of the *Annales* began with a summary of Coulomb's research on electrostatics,[1] which one thinks of as a part of the emerging science of 'physics'. Again volume 3 began with a long and important memoir by Haüy on crystal structure[2] and volume 5 began with a long memoir by Monge on meteorology.[3] Some memoirs clearly reflected the personal interests of Lavoisier. These included one memoir of nearly a hundred pages by Lavoisier's collaborator, Séguin on caloric,[4] another by Lavoisier's protégé, Adet on respiration[5] and a further philosophical memoir by Séguin, which discussed the sensations, particularly those of hot and cold.[6] This would have been of special interest to the *idéologues*.

One subject with a chemical basis, but of interest to a wide range of readers outside chemistry, was the analysis of mineral waters. The eighteenth century had witnessed the growth of a fashion for taking mineral waters as remedies for a whole variety of medical complaints. Fortunately the development of chemistry in the same period put it in a position to provide useful analyses of the waters, thus contributing a scientific basis for a rationale of the supposed therapeutic value of the different waters. The *Annales* regularly published these analyses and from 1809 onwards almost every volume contained at least one memoir on mineral waters. Although naturally the majority of waters analysed were French, the *Annales* was happy not only to publish Black's analysis of mineral waters of Iceland[7] but also Pearson's analysis of the famous waters of Bath[8] and Westrumb's analysis of German sulphurous mineral waters.[9]

Another subject involving chemical analysis, but with implications outside chemistry, was the study of meteorites. The view of many eighteenth-century men of science, including Lavoisier, of reports of stones falling from the

---

1 *A.c.*, *2* (1789), 1-22.
2 *A.c.*, *3* (1789), 1-28.
3 *A.c.*, *5* (1790), 1-71.
4 *A.c.*, *3* (1789), 148-242.
5 *A.c.*, *8* (1791), 211.
6 *A.c.*, *8* (1791), 183-210.
7 *A.c.*, *16* (1793), 46-63; *17* (1793), 113-4.
8 *A.c.*, *10* (1791), 190-3.
9 *A.c.*, *62* (1807), 182-192.

heavens had been that this was no more than superstition.[10] Within a decade of Lavoisier's death, however, there was good scientific evidence of the physical reality of this phenomenon. The turning point in France came with the decision of the First Class of the National Institute in 1803 to send one of its younger members, J. B. Biot to the Orne department to examine the evidence of a shower of stones that had landed there and to question eye-witnesses. Biot's report was thought sufficiently important to be printed and distributed to all the members of the First Class. It was also published in the *Annales*.[11] There were several other papers published in the *Annales* in 1803 (and later) on meteorites, often giving chemical analyses. The most interesting question, of course, was whether these 'stones' came from other parts of the solar system and whether their chemical composition was similar to that of terrestrial bodies.

Very many people were interested in ascents in balloons, and Gay-Lussac gave a full report of the ascent he made in September 1804, in which he reached a record height, collected samples of air and made magnetic, temperature and hygroscopic measurements.[12] There was also a report of a balloon ascent by Robertson and Sacharoff, which lasted throughout the night and included tests of respiration and pulse rates.[13] Monge's very long memoir on meteorology[14] gave rise to controversy in an article by J. A. de Luc.[15]

Most general of all were several articles on the natural features or crops of a number of distant places, which it would have been impossible for readers to visit in time of war. There was an article on cochineal in France's American colonies,[16] on sugar cane in San Domingo,[17] on Senegal,[18] and on the botanical results of an earlier African expedition.[19]

Of more domestic interest were a number of articles on fire-fighting, discussing, for example, whether salt water was more effective than fresh water in extinguishing fires.[20] In a paper on the dangerous gases associated with cesspits the desirability was pointed out of the government taking responsibil-

---

[10] 'Rapport sur une pierre qu'on prétend être tombée du ciel pendant un orage'. Lavoisier, *Oeuvres*, vol.4, pp.40-45. The commission concluded that the stone could not have come from the sky and referred to such reports as 'fabuleux'.

[11] 'Relation d'un voyage fait dans le department de l'Orne pour constater la réalité d'un météore observé à l'Aigle le 6 floréal an 11', *A.c.*,*47* (1803), 320-33. In England Howard had carried out a chemical analysis of such stones in 1802 - *Phil.Trans.*, 1802, 168-212.

[12] *A.c.*, *52* (1805), 75-95.

[13] *A.c.*, *52* (1805), 121-43.

[14] *A.c.*, *5* (1790), 1-71.

[15] *A.c.*, *8* (1791), 73-103.

[16] *A.c.*, *5* (1790), 107-37.

[17] *A.c.*, *6* (1790), 51-64.

[18] *A.c.*, *18* (1793), 241-310.

[19] *A.c.*, *53* (1805), 91-107, 328-41.

[20] E.g., *A.c.*, *51* (1804), 27-36; *54* (1805), 138-45.

ity for a general sewage system.[21] Chaptal was the author of articles both on cheese and wine.[22]

One scientific subject of very general potential interest was the new metric system, and the editors of the *Annales* saw it as their duty to promulgate the system and emphasise its virtues. The first article, published in 1793,[23] simply explained the choice of units of measurement, but the closing down of the *Annales* prevented any further discussion until 1797. It is significant that one of the first volumes to appear after the closure should have given prominence to articles on the metric system. The editors announced their policy of publicising the new measures[24] and then reproduced an article by Prieur, which emphasised the care that had gone into all the procedures. There were further articles in volume 20 on the verification of standards and the fixing of units. There was even an extract from a political speech on the obstacles encountered in trying to establish the new system in the minds of a general public, which was largely indifferent, preferring to continue using the old measures. The editors could be seen in a way as government agents, doing their best to foster the new system by emphasising its merits and encouraging its use.

The remainder of volumes 19 and 20 were devoted to government reports, which had been prepared by men of science (including members of the editorial board) and first published during the years of crisis since 1793. Although again the editors might appear as government agents, an alternative explanation of what they were doing is that they were illustrating the important part played by men of science, including a disproportionately high number of chemists, in work of national defence in the years of crisis.

Throughout the first series of the *Annales* there were a number of medical articles. Although these would be of special interest to the substantial number of medical practitioners among readers of the journal, they may also be considered as examples of chemistry in a wider context. Medicine is, after all, a subject of potential interest to the general public, provided it is not dealt with in a very technical way. Also the late eighteenth century was a period when public expectations from medicine had risen appreciably. The Enlightenment had encouraged the view that diseases could be cured and that science might have a major part to play.

In the early volumes there were a number of articles on the uses of gases in medicine, particularly for lung complaints such as phthisis, later known as pulmonary tuberculosis. Fourcroy was very interested in applying chemistry to medicine and he contributed an article on the medical uses of oxygen.[25]

---

[21] *A.c.*, *5* (1790), 86-121.
[22] *A.c.*, *4* (1790), 31-62.
[23] *A.c.*, *16* (1793), 235-50.
[24] *A.c.*, *20* (1797), 189-90.
[25] *A.c.*, *4* (1790), 83-94.

Chaptal and Parmentier too contributed ideas on the use of gases in medicine. Nor did the *Annales* neglect to give publicity to the work of Thomas Beddoes,[26] who had established his Pneumatic Institution near Bristol specifically to treat patients with different gases.

As examples of later articles of medical interest, we may take a random sampling of the contents of the *Annales* by looking at the Index under the letter D, where we find in the period 1807-13: Decandolle on the medicinal properties of plants,[27] Delorme on a contagious disease in prisons,[28] a report to the Paris Faculty of Medicine on the use of zinc in kitchen utensils,[29] an article by Dumas on chronic illness,[30] an article on respiration[31] and a report by Dupuytren on gold preparations used in medicine.[32] But, in case this looks like the contents of a specialised medical journal, we should perhaps point out that these articles are to be found among many papers on chemistry, including industrial chemistry, vegetable chemistry and the research of Humphry Davy.

2. *Chemistry as a basic science.*

Having surveyed some of the wide range of subject matter of articles, we might conclude, according to our first hypothesis, that this reveals the *Annales* as a journal of general science. Certainly there are articles that would interest readers beyond the chemists. But there is an alternative hypothesis to explain the wide range of subjects, an alternative that becomes more plausible when one recalls that, however divergent, nearly all the general articles after the first few years were related to chemistry in some way or other. The articles on meteorites might now be considered as a part of astronomy, but they were included in the *Annales* because of their chemical content and the relevance of the increasingly powerful tool of analysis to establish this. Plants would be discussed in relation to pharmacy, and galvanic electricity would be included both because of the chemical means used to produce the current and the use to which this was put in decomposing chemical compounds. In other words, the editors saw the subject of chemistry as having the widest implications. It was a core subject at a time when physics had hardly achieved that status.[33]

---

[26] T. Beddoes 'Considérations sur l'usage des airs factices dans la médecine', *A.c.*, *22* (1797), 211-18. T. Beddoes and J. Watt, 'Considérations sur les airs factices', *A.c.*, *26* (1798), 29-34.

[27] *A.c.*, *61* (1807), 83.

[28] *A.c.*, *63* (1807), 88.

[29] *A.c.*, *86* (1813), 51.

[30] *A.c.*, *83* (1812), 333.

[31] *A.c.*, *63* (1807), 35.

[32] *A.c.*, *78* (1811), 38.

[33] Of course mechanics was a well-established branch of science in the seventeenth century, but although the term *la physique*, which included mechanics, came to be used increasingly in

There were hardly any limits to the enthusiasm and ambition of converts to the new chemistry.

Since many modern scientists, particularly physicists, may find this situation difficult to appreciate, it may be worth reviewing the history of science and claiming two periods when chemistry (or something like it) could claim to be not simply an important subject but *the fundamental science*. For the first period we must go back to the time of alchemy. In the sixteenth and early seventeenth centuries, before the rise of the 'mechanical philosophy', the view of the world derived from ancient Greece, the general philosophy of Aristotle and the medical theory of Galen was challenged by an alchemical view, reinforced by the ideas of Paracelsus and his followers.[34] The world was to be understood in alchemical terms, involving sympathies and antipathies and transmutations. The key processes in nature were essentially chemical: solutions, distillations and sublimations, which could be imitated in primitive laboratories, using a diversity of glass apparatus and a range of different furnaces. It would be an exaggeration to claim that it was all 'experimental' or even 'science', yet it was a practical craft with some theoretical basis, which was later to develop into a science.

In the seventeenth century alchemy was gradually transformed into an early form of chemistry which, following Robert Boyle, we may describe as 'chymistry'. In some ways the rise of a mechanical world view with the work of Galileo and Descartes squeezed out alchemy, yet Boyle happily combined a mechanical view with some ideas inherited from alchemy. But alchemy was not simply proto-chemistry. It embraced a philosophy which included a much wider view of the world, incorporating perspectives corresponding to several modern sciences from geology to meteorology. In so far as it was a branch of early chemistry, it laid claims to the real understanding of matter. When other philosophers were content to study the outsides of bodies, alchemists could consider and sometimes extract their very essences. Yet their claims for the greater understanding of the natural world were often expressed in a mysterious language, which seemed to cultivate obscurity in order to conceal ignorance. The alchemical tradition made extravagant claims but it had little concrete to deliver. If one takes a long term view, however, it built up a valuable practical knowledge of processes and materials that it was able to bequeath to early chemistry.

---

the eighteenth century there was disagreement about what studies belonged to it. 'Physics' needed *a unifying principle*, which only came in a definitive form in the 1840s with the principle of conservation of energy, although the Laplacian neo-Newtonian programme, from c.1807 onwards, did something to provide earlier coherence.

[34] See the writings of Allen Debus, e.g. *The Chemical Philosophy: Paracelsian Science and Medicine in the Sixteenth and Seventeenth Centuries*, 2 vols., New York, 1977.

The chemists of the early eighteenth century were much humbler than the alchemists. Many were essentially artisans, who had a good practical knowledge but little theory. Some were essentially pharmacists; that is to say that they saw the total justification of chemistry in the preparation of medicines. Yet the status of chemistry both socially and intellectually was to undergo an important change in the second half of the eighteenth century. Not only was its alchemical ancestry forgotten but chemical knowledge was offered as the solution to a wide range of social and economic problems. The new understanding of the atmosphere meant that chemists could offer advice on public health based on analysis of samples of air. The understanding of chemical composition meant that chemists could provide essential information on new materials and suggest improvements and even substitutes. In this way Lavoisier made important contributions to the extraction of nitre and the manufacture of gunpowder, so necessary if France was to maintain her status as a great power. The utility of chemistry was never shown to greater effect than in the Revolutionary war.

Chemistry was a core science because it contributed to other sciences. There was probably a more active chemical community than in any other branch of experimental science. It was the zeal of chemists which at this time advanced studies of heat and some parts of electricity and other studies which might be thought to be the territory of physics. Lavoisier's most important contribution to the biological sciences was to explain respiration as an example of oxidation. This would encourage his successors to explain other physiological functions, such as digestion, in chemical terms. As far as medicine is concerned, we have seen that the discovery of gases had led to the idea that they might be applied, particularly in diseases affecting the lungs. More importantly the chemical analysis of the atmosphere was related to public health and thus to the economy. Lavoisier was interested in agriculture, and agricultural chemistry was to be a field of special concern to Humphry Davy.[35] In his studies of respiration Lavoisier had considered the question of food, and had reached the semi-political conclusion that a manual worker required more food than a person who was physically inactive.[36] Finally, at the end of the eighteenth century, chemistry was making a growing contribution to technology and industry. For example, the soda required to make glass and detergents, the mineral substances, which were beginning to replace wood, notably iron, were problems, to which chemists could make the most relevant contributions. The chemists were particularly prominent in higher education.

---

[35] Morris Berman, *Social Change and Scientific Organisation. The Royal Institution, 1799-1844*, London, 1978.

[36] 'Premier mémoire sur la respiration des animaux' (1790). Lavoisier, *Oeuvres*, vol.2, pp.688-714 (698).

In the Ecole Polytechnique chemistry was a core subject in the curriculum[37] and students were taught chemistry in their first, second and third years, whereas, with hindsight, we might want to argue that future engineers should have had a larger proportion of physics.

Lavoisian chemistry had a prominent place in the 1790s and early 1800s as a new and very successful science. Lavoisier provided a philosophical basis to the science, which distanced it from its artisanal heritage. Of course ideas of the Greek philosophers relating to the four elements had long been a part of chemistry and even alchemy, but Lavoisier injected a new approach, largely based on the philosophy of Condillac (1714-1780). Lavoisier accepted that knowledge depends ultimately on sensations. This led to a rejection of metaphysical speculation and a renewed emphasis on laboratory experience. In the first place, therefore, Lavoisier advocated rigour of experimental proof. Thus his analysis of water (by dripping water down a strongly heated iron gun barrel) had to be confirmed by synthesis. Secondly he tried to reduce chemical reactions to a kind of algebra.[38] This thinking led finally to the writing of a chemical equation:

> We must always suppose an exact equality between the elements of the body examined and those of the products of its analysis.[39]

It was, however, in constructing a new chemical language that the influence of Condillac was most direct and explicit. Lavoisier and his colleagues wanted to give chemistry a truly rational nomenclature, in which simple names were given to simple substances, and compounds were given names which indicated their constituent elements. Lavoisier expressed this philosophy both in his contribution to the *Méthode de nomenclature chimique* of 1787 and in the introduction to his *Traité* (1789).

Because of its utility, because of its new structure with a philosophical basis, but most of all *because of its success*, it would hardly be an exaggeration to claim that by 1800 chemistry had become a model science. It certainly provided a model for many of those working in the life sciences. Its new emphasis on the quantitative approach was something that had a special appeal for Cuvier. There can be no doubt that he was referring to the new chemistry when he gave the following description of good scientific method:

> Experiment alone, precise experiment carried out with weights and measures, calculation and comparison of all the substances employed

---

[37] Janis Langins, *La République n'a pas besoin de savants*, Paris, 1987.

[38] For an early example, see his 'Considérations générales sur la dissolution des metaux dans les acides', Lavoisier, *Oeuvres*, vol.2, pp.509-545.

[39] *Traité*, vol.1, p.141, *Elements*, p.131.

> and of all the substances obtained, this today is the only legitimate way of reasoning and demonstration.[40]

The anatomist Bichat too was inspired by the recent reorganisation of chemistry to suggest in 1801 a close analogy between it and his own science:

> Chemistry has the simple bodies, which, by the various combinations they admit of, form the compound ones; these are caloric, light, hydrogen, oxygen, carbon, azote, phosphorus, etc. Anatomy, in like manner, has its simple tissues which, by their combinations, form the organs properly so-called.[41]

It is contemporary arguments and attitudes such as these, which demonstrate that around 1800 chemistry had a unique status. It was not simply one of the main branches of science. For many it *was* science. Hence a journal of chemistry at this time was so much more than a specialist publication devoted to one branch of science.

3. *Chemistry, the war effort and public service.*

We have referred in a general way to the utility of chemistry and it must be emphasised that this was not simply rhetoric. Utility had been one of the arguments used by apologists for the early Royal Society[42] but, if one excludes the relevance of basic astronomical knowledge to navigation, it did not really amount to very much. The early Royal Society was concerned with curiosities of all kinds, and attempts at applying science played a very minor role. In the eighteenth century, however, one branch of science was to begin to play an increasing role in the economies of both France and Britain and that was chemistry. Admittedly early work in bleaching, dyeing and the preparation of alkalis depended much more on practical skills than theoretical knowledge. By the end of the century, however, the new chemistry was beginning to provide a helpful theoretical base for the different branches of the infant chemical industry. Some discussion of these will be given in the next chapter, since the category of 'applied science' was a major permanent constituent of the *Annales*.

Chemistry, however, had a very special role to play in the war effort, and particularly in the period of crisis of 1793-94, when France was in danger of being overrun by foreign enemies, hostile to the newly-declared Republic. Chemistry was the science most relevant to the manufacture of munitions, and the chemists and their friends showed their fellow-countrymen how to make better steel for swords, better cannons and gunpowder. Much of this work

---

[40] Cuvier, *Rapport historique sur les progrès des sciences naturelles depuis 1789 et sur leur état actuel*, Paris 1810, p.390.

[41] M.F.X. Bichat, *General Anatomy Applied to Physiology and the Practice of Medicine*, trans., London, 1824, vol.1, p.li.

[42] Thomas Sprat, *The History of the Royal Society*, 1667.

was published as 'Instructions' for the public and, having served its purpose, might well have been largely forgotten a few years later in a period of rapid change. It was very much in the interests of the chemists, however, once the threat of invasion had passed, and the more stable period of the Directory arrived, to remind their compatriots of the work they had done. Of course, the *Annales* had closed down at the height of the Terror but, once publication resumed in 1797, the first two volumes (19 and 20) were devoted almost entirely to the patriotic work of the scientists. One may note that this was given preference over news of pure chemistry in the intervening years.[43]

In the Introduction to volume 19 to explain the gap of three years in publication the editors spoke of 'the necessity of devoting themselves entirely to the defence of the Republic.'[44] They also made a reference to 'the events of the Revolution' and their work for the government ('les fonctions publiques'). But, they said, this should not necessarily be seen as time lost for science:

> Chemistry above all has been cultivated with an activity and a success, which has been witnessed by all citizens; for the defence of the motherland it has created resources and means which were not to be expected. Its immediate utility for the most pressing needs of society make it more precious and more important than ever....

The Introduction went on to claim the future benefits of chemistry as applied to industry but an important feature of volumes 19 and 20 was that they were not based on pious hopes for the future but on concrete achievement of the recent past.

The first article in volume 19 was a summary of the Instructions drawn up in 1794 by Vandermonde, Monge and Berthollet on the manufacture of steel.[45] They discussed the effect of the carbon content on the quality of the product. Yet it must be admitted that these attempts to improve the quality of French steel had only limited success, and an article published in 1800 claimed that German steel was still greatly superior.[46] (This was said to be largely due to the presence of manganese as an impurity in the French ore.) Equal prominence was given at the beginning of volume 20 to a report by Pelletier and D'Arcet on the subject of extracting copper from bell metal.[47] The copper was needed first for coinage and later for cannon and, although it was present in the alloy used to make church bells, the bell metal was too

---

[43] The only concession to pure science was a brief summary at the end of vols.19 and 20 of the contents of Crell's *Annalen* for 1792-94.

[44] The full text of the Introduction to vol.19 is given in Appendix 1, No.7.

[45] *A.c.*, *19* (1797), 13-46.

[46] *A.c.*, *36* (1800), 61-71.

[47] The majority of Catholic churches would have bells and this was a tempting source of copper when some of these buildings fell into disuse after the civil constitution of the clergy in 1790. The confiscation of the bells throughout France was ordered in 1793.

brittle for military use. The government authorised the confiscation of church bells throughout the country[48] and it was the task of the chemists to use these and increase the proportion of copper in the copper-tin alloy by heating the metal in contact with air. The tin was oxidised first, thus increasing the proportion of copper in the alloy. It is interesting that this method had been described by Fourcroy and others before the war,[49] but had only been put to use when there was a sudden demand for copper, which could no longer be imported because of the war.

Saltpetre was the principal constituent of gunpowder, and a report by Chaptal on artificial nitre beds was published[50] as well as instructions on the refining of saltpetre.[51] Related to this was an article by Perthuis on increasing the amount of potash available in France by extraction from the ashes of certain plants.[52] There was an equally large demand for soda, which before the outbreak of war had been imported from Spain. When these supplies were cut off, the government ordered an enquiry into methods of obtaining soda from sea water. This was published in July 1794, by order of the Committee of Public Safety and a summary 100 pages long was reproduced in the *Annales*.[53] Fortunately this problem had been investigated before the war, when the Royal Academy of Sciences had offered a prize on the subject. The most famous solution was that proposed by Leblanc, who had proposed first treating the salt with concentrated sulphuric acid and then (to use modern nomenclature) treating the resulting sodium sulphate with calcium carbonate to produce sodium carbonate. The *Annales* account was able to describe Leblanc's factory (recently nationalised) and also several other alternative processes. Among many uses, soda was employed as a detergent, and there was also a long article on soaps.[54]

The army had great need of large quantities of leather for boots, saddles, etc. and Séguin made an important contribution in devising a method of tanning hides in a few days rather than months.[55] Among the other contributions of chemists to the war effort was the supply of hydrogen for balloons.[56] The hydrogen was generated by Lavoisier's method of passing steam over heated

---

[48] *A.c.*, *20* (1797), 1-14.

[49] *A.c.*, *9* (1791), 305-52. See also W. A. Smeaton, *Fourcroy, Chemist and Revolutionary*, Cambridge, 1962, pp.120-1.

[50] *A.c.*, *20* (1797), 308-355.

[51] *Ibid.*, 356-369.

[52] *A.c.*, *19* (1797), 157-194.

[53] 'Extrait d'un rapport sur les divers moyens d'extraire avec avantage la soude du sel marin' par les citoyens Lelièvre, Pelletier, Darcet et Giroud. *Ibid.*, 58-156.

[54] *A.c.*, *19* (1797), 253-354.

[55] Lelièvre & B. Pelletier, 'Rapport sur les nouveaux moyens de tanner les cuirs proposés par le citoyen A. Séguin', *A.c.*, *20* (1797), 15-78.

[56] See the reference to 'l'aérostation' in the Introduction to volume 19 (Appendix 1, No.7).

iron. A captive balloon was used as an observation post in the battle of Fleurus (26 June 1794) and contributed to the French victory.[57] Of course, it could never be shown that the contributions of the chemists was crucial in the turn of the tide. Probably it was not, although it obviously made a contribution. What was relevant is that the chemists could *claim* that they had made an important contribution to national defence at the hour of France's need. They were not intellectuals living in an ivory tower. In war they had produced substitutes for substances previously imported. In peace they would equally serve the national economy. In retrospect the truth is sometimes less important than what at the time may seem plausible. Men of science were posing as national heroes.

The concern of the editorial board with wider issues than chemistry extended beyond mere utility to ideology. This is illustrated by the importance attached in volume 20 to the metric system. More than 100 pages were devoted to this question. Work on the much-needed reform of weights and measures went back to the early days of the Revolution and already in 1793 there had been two articles published in the *Annales* explaining the choice of new units of measurement[58] and the nomenclature of the metric system.[59] The metric system provides an interesting case study of the interaction of ideology, government action and scientific work. The ideology related to the desire to escape from arbitrary and extremely varied systems of measurement current under the ancien regime and replace them with truly 'natural' and potentially universal units. The government commissioned a group of scientists to find such natural units, define them precisely and construct standards. Eventually the government would pass the legislation needed to make the new system official. A commission of the Paris Academy of Sciences decided that the most appropriate natural unit of length would be one related to the size of the earth, measured from the equator to the north pole along the Paris meridian. The new units of mass and volume would be related to the unit of length, and all would be divided according to a decimal system.[60]

The government approved this system and, according to article 1 of the law of 18 germinal year 3 (7 April 1795), citizens were invited to give proof of their support of the Republic by making use of these new measures. Yet they found very little public support. Accordingly the editors of the *Annales* con-

---

[57] M. Crosland (ed.), *Science in France in the Revolutionary Era Described by Thomas Bugge*, Cambridge, Mass., 1969, p.131.

[58] *A.c.*, *16* (1793), 235-50.

[59] *A.c.*, *18* (1793), 137-163.

[60] The unit of length, the *metre*, was to be equivalent to one ten-millionth part of the meridian arc between the north pole and the equator. The *litre* was to be the capacity of a cube of sides one tenth of a metre. The *gram* was to be the mass of a volume of one cubic centimetre of pure water at the temperature of melting ice (later at its temperature of maximum density, c.4°C.) See G. Bigourdan, *Le Système métrique des poids et mesures*, Paris, 1901.

sidered that they were fulfilling a public duty when, on the resumption of publication in 1797, they decided to give further publicity to the metric system in the hope of encouraging its general adoption.[61] A long article by Prieur, a former member of the Committee of Public Safety, who had played a prominent part in establishing the metric system and who had just joined the editorial board, emphasised the care with which the system had been set up.[62] He explained the new language of measurement and how it was related to the old weights and measures. The verification of the new standards was also discussed. Yet the articles in the *Annales* were not all technical, since the editors decided it was appropriate to reproduce a message from the Directory, which explained the various attempts that had been made to establish the new system in the minds of the general public.[63] This included the display of the new measures in public places and the distribution of models, together with tables relating the metric system to other systems of measurement. A previous attempt had been made in the *Moniteur* newspaper to publicise and popularise the metric system with units which were explicitly labelled '*républicain*'. This publicity had met with little success and it is interesting that the editors of the *Annales* were persuaded (possibly by Prieur) that it had a similar duty with its more specialised audience. The editors claimed that the system possessed the marked advantage of making calculations easier, particularly in the physical sciences.[64]

4. *The* Annales *as a journal based in Paris.*

We should not overlook the physical location of the *Annales* at the centre of a capital city and what was arguably around 1800 the world capital for science and medicine. This meant that in normal times Paris would receive a constant stream of visitors, many bearing news from their home towns and from other places they had visited. Yet the 1790s were hardly normal times. In the Terror of 1793-94 there might have been positive advantages for the *Annales* if it had been based in some quieter provincial town with access to a printing press. Also the period 1792/93 - 1815 was largely a period of war, when the normal movement of visitors was severely restricted. The only major respite came with the Peace of Amiens in March 1802, which lasted until May 1803. During this period a number of visitors did take the opportunity to visit Paris

[61] 'Recueil de pièces relatives aux nouveaux poids et mesures de la République Française. Avertissement', *A.c.*, *20* (1797), 189-90.

[62] *A.c.*, *20* (1797), 191-252.

[63] *Ibid.*, 294-8. It was said that in the Seine Department the police had been told to check that merchants were using metric standards (p.296) - a vain hope!

[64] *A.c.*, *20* (1797), 190.

and several wrote down their impressions.[65] However, Napoleon's 'Continental system', which was intended to block continental markets to British trade, was also bad for communications. We have seen in Chapter 5 how scientific news from Britain sometimes reached Geneva before it reached Paris.

Yet one feature of French life, which was hardly affected either by the military conflict or the economic war, was centralisation based on Paris. What was already a feature of France of the ancien regime was reinforced during the Revolutionary and Napoleonic periods. This applied not only to government and general administration but also to education and other aspects of intellectual life. There was, therefore, an exceptional concentration of talent in Paris, which provides a contrast with many other European countries, and particularly the German states, with their dispersed university centres. This helps to explain how the *Annales* was able to boast such a distinguished editorial board *sur place*. The names on the title page of the journal were not remote colleagues, expressing some sympathy with the aims of the journal and occasionally called upon to render some small service. They were nearly all in principle working editors in an exceptionally talented scientific and cultural milieu.

Although Lavoisier's laboratory at the Arsenal was one centre for the informal discussion of chemical problems, the Paris Royal Academy of Sciences was the main focus for French science under the ancien regime. The leading members of the editorial board: Lavoisier, Berthollet, Fourcroy and Monge were all members of the Academy,[66] and they needed the cooperation of the Academy to launch the *Annales* in the first place. Lavoisier had been particularly prominent in the affairs of the Academy, being largely responsible for the reorganisation of 1785. Although the Academy was divided into sections, and Lavoisier was obviously a member of the chemistry section, he had friends in other sections, particularly among the mathematical sciences.[67] Indeed he found the mathematicians more open-minded about the new chemistry than his colleagues in the chemistry section, who could only think of reactions in terms of phlogiston. The Academy was an obvious centre of news, and this would have been invaluable to editors of a journal concerned not only with chemistry but also with neighbouring sciences.

---

[65] E.g. William Shepherd, *Paris in 1802 and 1814*, London, 1814, Henry R. Yorke, *Letters from France*, 2 vols., London, 1814. A bibliography of accounts by foreign visitors to France in this period is given in M. Crosland (ed.), *Science in France in the Revolutionary Period, Described by Thomas Bugge*, Cambridge, Mass. 1969, pp.216-19.

[66] Guyton, still living in Dijon, was only a corresponding member in 1789. Dietrich was an *associé libre*.

[67] He was specially close to Laplace and Monge.

Under the ancien regime the Paris Academy was the most prominent of several French academies concerned with science. After the Revolution its successor, the First Class of the National Institute was to be the only official body of science for the whole of France.[68] Its location in Paris was a further example of centralisation.[69] Anyone, who wished notice to be taken of his contribution to science, had to communicate with the First Class. It therefore acquired a virtual monopoly of high level science together with - it must be admitted - a fair proportion of mediocre or even pseudo science.[70] Yet it was usually not too difficult for the appropriate experts within the First Class to sift the wheat from the chaff. Again, the senior members of the editorial board of the *Annales* (including Guyton but now minus Lavoisier) were members of the First Class.

An extension of the role of the First Class as the recipient of news was its role as the recipient of books. There were few scientific authors, both inside and outside France, who would not be proud to send a copy of their book to the central French scientific agency. If the book was a chemical one, the editors would make it their business to provide a review in the *Annales*. In addition, of course, they would often receive books addressed to them personally.

The closest association of the *Annales* with the First Class is seen in the large number of official Reports that it published. Sometimes there would be as many as two or three Reports in one volume. These Reports often showed the best side of the Institute. They were drawn up by a committee of experts, taking full advantage of the range of different disciplines represented. Thus, although a committee reporting on a chemical memoir submitted to the First Class would naturally contain one or two chemists, it was quite usual for a physicist or a mineralogist or a member of some other section to be included, if there was the possibility of using his expertise. The Report would constitute an authoritative judgement of the value of the work submitted and might contain suggestions for modifications of procedure or even further research. In its early years the First Class took seriously the duty of compiling Reports and indeed began to include them in its published *Mémoires*. Yet the *Mémoires* only had room for a select few Reports, thus leaving the *Annales* with the opportunity of publishing high quality surveys of various pieces of recent research. Naturally the *Annales* favoured chemical Reports, but there were also Reports related, for example, to heat, galvanism and medicine. Reports on

---

[68] M. Crosland, *Science under Control. The French Academy of Sciences, 1795-1914*, Cambridge, 1992.

[69] Originally the First Class tried to represent provincial men of science as 'non-resident associates' but these were soon designated 'correspondents' and always had a much lower status than the full members resident in Paris.

[70] Crosland, *op.cit.* (1992), Chapter 10.

other matters such as pencils,[71] stoves,[72] glass bottles,[73] writing ink,[74] and lighthouses[75] may have been of interest to a wider audience.

The weekly meetings of the First Class provided an excellent opportunity for the editorial board to meet. Even if some of the members of the board were not members of the First Class, they could still meet their more distinguished colleagues in an ante-room before the official meeting. In December 1807 the editorial board formally resolved to meet there on the first and third Monday of every month at 2 p.m. They obviously found this preferable to their previous practice of meeting at the home of one of the members. Thus, in this rather indirect way, the *Annales* became even more closely tied up in the affairs of the Institute. There was no formal connection, but the journal was able to benefit enormously from its close contact with what some would have considered the scientific hub of the universe. The editors were able to draw on material not only from their distinguished colleagues but also from outsiders from all quarters, who regularly communicated with the Institute.

5. *Correspondence as a feature of the* Annales.

It would be so easy to characterise the *Annales de chimie* as a French journal, and assume that articles would consist of contributions from the privileged elite in Paris, supplemented by a miscellaneous range of contributions from the provinces. But what we find is a journal with European aspirations, built on a foundation of articles, not simply by Parisian chemists, but specifically by members of the editorial board. Unknown to most of its readers, the editorial board had a strong financial interest not only collectively in the success of the journal but individually in making a maximum number of contributions or at least of filling a large number of pages. Any other French chemist, who made substantial contributions to the journal, would represent something of an anomaly. One way of dealing fairly with anyone living in Paris, who had good material to contribute, was to elect him to the editorial board. This is what happened eventually in the respective cases of Descotils, Gay-Lussac, Thenard and finally D'Arcet. But surely able younger chemists should have been able to contribute to the *Annales* without committing themselves to regular contributions?

This raises the question of contributions in the form of letters. Certainly a letter might be the appropriate form in which to express a claim for priority, and we find, for example, a letter from Hachette in 1808 claiming certain work on magnetism and electricity which overlapped with research recently

---

[71] *A.c.*, *20* (1797), 370.
[72] *A.c.*, *32* (1799), 270.
[73] *Ibid.*, 307.
[74] *A.c.*, *75* (1810), 194.
[75] *A.c.*, *96* (1815), 59.

reported from Germany.[76] Again Chevreul wrote to comment on a memoir recently published in the *Annales* and to claim priority.[77] But Ampère was encouraged by Berthollet to send in a substantial memoir on combining proportions in the form of a letter.[78] Ampère claimed that he was working on a memoir on subjects which he had not had time to complete but, as Berthollet had expressed an interest, he was setting down his ideas, in this case at considerable length. In this way a letter could be seen as providing news of work in progress, that is to say, it brought readers into more immediate contact with current ideas than would otherwise have been the case. Perhaps an idea expressed in a letter to the editor might be regarded as 'pre-publication' rather than full official publication?

Letters, therefore, had a special place in the *Annales*. Some, like that of Ampère, were largely artificial constructs, which seem to have bolstered the system of patronage and, at the same time, helped to present an image of the *Annales* as the centre of a great correspondence network. Of course, there was considerable genuine correspondence, which will be discussed shortly, but what is particularly interesting is the policy of the editorial board of making correspondence more prominent than it need have been. From the point of view of the historian this may seem to be putting back the clock.[79] It is, for example, reminiscent of the very early issues of the *Philosophical Transactions of the Royal Society*, edited by Henry Oldenburg, who encouraged *savants* throughout Europe to write to him about their work. Although Oldenburg was happy to publish these letters *as letters*, the subsequent policy of the *Phil. Trans.* was to edit any letter received to transform it into a memoir. Certainly the *Mémoires* of the Paris Academy would not normally have published communications in this form and one wonders whether perhaps the *Annales* was reacting against the early impersonalisation of scientific communication, a movement which has reached its extreme limit in some twentieth-century scientific journals. On the other hand, the form of the letter has been given special encouragement in some twentieth-century periodicals, such as *Physics Letters* and *Tetrahedron Letters* (for organic chemistry) as a means of securing rapid publication of recent advances and, in particular, as a means of securing priority claims for the authors for new discoveries. In the first series

---

[76] *A.c.*, *65* (1808), 211.

[77] *A.c.*, *95* (1814), 73.

[78] 'Lettre à M. le comte Berthollet sur la détermination des proportions dans lesquelles les corps se combinent....', *A.c.*, *89* (1814) 43-86. See also L. de Launay, *Correspondance du grand Ampère*, 1936, vol.2, p.467, where Ampère explained the circumstances in a letter to a friend in Lyons.

[79] See A. J. Meadows, *Communication in Science*, 1974, e.g. p.67 and A. J. Meadows (ed.), *The Development of Science Publishing in Europe*, 1980.

of the *Annales* letters were more often occasions for spreading news than for claiming priority.

The *Annales* probably felt that it would help the sense of a genuine scientific community to publish regularly communications in the form of letters to senior members of the editorial board. There was a more personal touch in a letter, and also perhaps a sense of immediacy. Also the publication of letters would implicitly constitute an invitation to other readers to write in, as is the practice in many modern newspapers. Although the title page of the *Annales* represented the authority of most of the leading French chemists, the editors' authority was not in dispute. They, therefore, felt able to complement their contributions with others, which might inspire a genuine feeling of participation by readers. Provincial and many foreign correspondents might well be flattered to see that their names and views were being immortalised by publication side by side with those of the great Parisian chemists.

The correspondence falls into three main categories. First we have mentioned a few memoirs, which were presented in the form of letters. As regards genuine correspondence, there were letters, often from complete strangers, addressed collectively to the editors. Then there were many letters addressed personally to one of the editors, most often Berthollet. We may add a fourth miscellaneous category, which might include letters originally addressed to persons outside the *Annales,* which were, nevertheless, thought worthy of being reproduced. To take this last category first, Proust had written a number of letters to D'Arcet, who passed them on to Adet, who summarised their contents for the benefit of readers.[80] It was in this way that some news of minerals in the Spanish American colonies reached readers of the *Annales*. Exceptionally one of the editors would write an open letter in reply to a critic. Thus Fourcroy's reply to Giobert on the subject of the urinary calculus was in the form of a letter,[81] as was Gay-Lussac's reply to Clément.[82] The *Annales* even sometimes published a letter written by one member of the editorial board to another.[83] Thus the first series of the *Annales* consistently pursued a policy of encouraging correspondence. The principal motive must have been to encourage a sense of participation by readers and to create a gulf between the *Annales* and the formal *Mémoires* of state-sponsored Academies, which represented the semi-official wisdom of an elite. To express this in political terms, the *Annales* wanted to be seen to be more democratic.

There was a total of approximately 20 French provincial correspondents, whose letters were published in the period 1789-1815. Those whose occupa-

---

[80] Adet, 'Extrait de plusieurs lettres de M. Proust', *A.c.*, *1* (1789), 194.

[81] *A.c.*, *30* (1799), 57.

[82] *A.c.*, *95* (1815), 311.

[83] E.g.Hassenfratz, *A.c.*, *63* (1807), 287; *67* (1808), 309; *70* (1809), 145; Prieur to Guyton, *A.c.*, *66* (1808), 188.

tion was given seem to fall into four main occupational groups. As educators there was Bartholdi, teacher at the école centrale at Colmar, De la Croix, professor of mathematics at the artillery school at Besançon, Schurrer, professor of chemistry and physics at the artillery school at Strasbourg, and Vitalis, professor of chemistry at Rouen. Pharmacy was represented by Boudet, pharmacist in chief to the 3rd corps of the Grand Army, Henry, head of the central pharmacy, Hecht of Strasbourg, Résal of Remiremont in the Vosges and Vignon of Toulouse, while those who gave their profession as physician were: Bard from Beaune, Bidault of Saulieu near Dijon, Delaville from Cherbourg and Gesnouin, a naval doctor, first class from Britanny. Finally, as representatives of applied science were: Chaptal (before he joined the editorial board),[84] Delorme, an engineer from Chartres, the important chemical manufacturer, Descroizilles from near Rouen, Dufard, director of works at Montalaire (near Creil) and Robin, who was in charge of the gunpowder factory at Essone. One may note the importance of Strasbourg, Colmar[85] and Rouen, each of which provided at least two correspondents.

It is indicative of the status of the *Annales* as a truly European journal that the French correspondents were greatly outnumbered by the correspondents from other countries. The total number of correspondents from the German states alone was approximately equal to the internal numbers from France.[86]

As regards Britain, we have mentioned already the publication by Lavoisier in the *Annales* of a letter from Joseph Black,[87] which we may regard as a propaganda coup. When Black had received several books from Lavoisier in 1790, he had promised to send him in return a memoir on the analysis of mineral waters from Iceland, which he was in the process of writing. Black kept his promise and the paper was published in two parts in the *Annales* for 1793.[88] It was also published in Edinburgh but not until 1794,[89] although it had been presented in 1791. The memoir is of little importance in itself, being one of hundreds on the subject in the late eighteenth century, but it is interesting as a rare example of Black actually publishing research. From Lavoisier's point of view it was an extension of his earlier triumph. Not only had one of Britain's most famous chemists acknowledged his theory, but he was honouring the *Annales* with an account of his own labours. He was all the more

---

[84] Letter to Berthollet from Montpellier, 1 September 1789, *A.c.*, *4* (1790), 21-4.

[85] Haussman of Colmar did not give his profession but he was the owner of a dye works and his correspondence with Berthollet was mainly on the subject of dyeing.

[86] Although only 17 names from the German states have been found, many of these, notably Crell, Gehlen, Klaproth, Scherer and Trommsdorff were frequent contributors.

[87] *A.c.*, *8* (1791), 225-9; see Appendix 1, no.6.

[88] J. Black, 'Analyse des eaux de quelques sources chaudes d'Iselande', *A.c.*,*16* (1793), 40-63; *17* (1793), 113-40. These papers by Black were summarised in *Obs. Phys.*, *43* (1793), 457-9.

[89] *Trans.Roy.Soc.Edin.*, *3* (1794), 95-127.

pleased as the *Annales* was receiving so little correspondence from Britain compared with other countries.

The fact that there were comparatively few other British correspondents, may be attributed largely to the war. In 1790 Charles Taylor of Manchester had written to Berthollet on the subject of bleaching[90] and, around this time, a number of anonymous letters were written to Berthollet, giving an account of anything chemical that had transpired at recent meetings of the Royal Society of London.[91] One of Blagden's letters to Berthollet was published.[92] The most interesting (though hardly favourable) report from Britain came in the form of a letter from an unnamed correspondent in 1799.[93] It was claimed that there were not more than ten people in England seriously involved in chemistry. Charles Hatchett (1765-1847) the future discoverer of 'columbium' (1801) was described as the most hard-working chemist. George Pearson was the only chemist in London to give a course of lectures with a sizeable audience. Cavendish, Howard, Rumford and the Irishman Kirwan were also mentioned.

The most frequent correspondents were the Germans, although, in providing the following list, it must be admitted that, although a majority of letters were addressed to one or more editors of the *Annales*, a few were simply reproduced from other journals. In alphabetical order the correspondents were: Achard, Crell (5), Gehlen (7), Gilbert, Girtanner (2) 'G.M.' (doctor of Freiburg), Gren, Jacquin, Klaproth (6), Pfaff, Roloff from Magdeburg, Ruhland from Munich, Scherer (7), Trommsdorff(7) and Wurzer from Bonn. Also within the German orbit were Bienkowski and Microszwski, also Savaresi writing from Chemnitz and Chamseru from Poznan, not to mention the Italian Landriani, writing from Prague. From the Italian states came letters from Brugnatelli from Pavia (3), Cavessali and Duburgua (Lodi). Fabbroni (Florence), Melandri (Milan) Pacciani (Pisa) and Volta (Como). The Netherlands was represented by Berchem, Kastelyn, Lauwerenburgh and Van Marum (7). From Sweden came letters from Berzelius and Hisinger, from Finland Gadolin (5) and from Denmark Abilgaard. There remain to be mentioned several from Russia (mainly St Petersburg): Prince Gallitzin (2) and Mussin Puschkin (2); also Link wrote from Rostock. A copy of a letter from Pezzoni, a doctor in Constantinople, was also included. To complete the international correspondence, we must mention several from Spain, one from the King himself (to Desgenettes), one from Doctor Carbonel and many from Proust, some, purely chemical, addressed to Vauquelin but mostly taken from private letters abstracted by Adet. From the new world Happel-Lachenaye

---

90 *A.c.*, *7* (1790), 244-5.
91 E.g. *A.c.*, *7* (1790); 246-8; *9* (1791), 304; *11* (1791), 63-5.
92 *A.c.*, *4* (1805), 84-6.
93 *A.c.*, *32* (1799), 199-205.

wrote from Guadeloupe, and Humboldt wrote in 1800, when he was travelling in central America. There were also several correspondents, whose location is impossible to identify, and some letters from travelling scientists normally resident in France, including Biot, Gay-Lussac and Humboldt (from Rome).

6. *Joint articles, announcements and book reviews.*

A notable feature of the *Annales* is a growing pattern of publication of papers by more than one author. This was exceptional under the ancien regime,[94] yet it has become the norm in the modern world of science. The practice provides an interesting example of the *Annales* representing not only a landmark but an important transition stage in the history of science. Joint publications would usually be by two people, often representing an informal master/student or senior/junior relationship. Lavoisier's collaboration with Séguin provides an early model, but the best and most enduring collaboration was that between Fourcroy and his protégé Vauquelin. In the first volumes of the *Annales* Fourcroy published frequently and alone, but volumes 10 and 11[95] each include a joint paper by the two authors. It was, however, only after the break and resumption of publication in 1797 that this became a regular practice. By the early 1800s more of Fourcroy's publications were published under two names than one.

The emergence of joint papers suggests that chemical research had reached a stage in France where the traditional pattern of single workers was no longer sufficient. Often there would be a senior figure, perhaps with access to a laboratory,[96] who had a research programme (at least implicitly) but required an additional pair of hands to explore his ideas. The second person would not formally be the research student of the first, since this relationship only began in the nineteenth century; it might be more helpful to consider him rather as the apprentice, developing his skills in association with the master and eventually perhaps succeeding him in a remunerative post.

It is interesting that, despite numerous foreign contributions to the *Annales*, joint papers seemed to be largely confined to French authors.[97] After the first few issues, there were a few such papers each year, with a tendency to increase in the later years. Some of the collaboration was between equals of

---

[94] Obviously excluded are university theses (usually from Faculties of medicine), which might display on the title page both the name of the professor and that of the student.

[95] The first explicit collaboration was in *A.c. 6* (1790), 177-182 (178), where Fourcroy described Vauquelin as 'his student'.

[96] Thus in a memoir by Darracq (*A.c., 40* (1801), 171, he is described as 'élève et aide du cit. Vauquelin à l'Ecole des Mines' and he himself writes: 'Annoncer que mes expériences ont éte faites au laboratoire de l'Ecole des Mines, c'est dire que le cit. Vauquelin m'a aidé de ses conseils'.

[97] An exception would be the group of Dutch chemists: Dieman, Paats, Van Troostwyk, Lauwuenberg, Bondt and Nieuwland.

approximately the same age. The best example would be the joint papers of Gay-Lussac and Thenard in the period of intense rivalry with Davy.[98] Clément and Desormes provide another example of a publishing partnership. All these collaborations were quite independent of the practice of the First Class of the Institute, which regularly appointed commissions of several experts to provide Reports on work submitted by non-members and which were often published in the *Annales*.[99] They were usually drafted by one individual, the *rapporteur*, on the advice of the group and cannot be considered a simple co-authored publication.

The *Annales* also regularly featured announcements, usually fairly short, and in some of these it came nearest to the style of a newspaper. Thus it sometimes reported meetings, particularly the annual public meeting of the Ecole de Pharmacie in Paris. This would include a list of prize winners. There might also be a list of prizes, which the Paris Société de Pharmacie proposed to award. Of more general scientific interest was the announcement of the prizes, which the First Class of the National Institute intended to award. Some of these prize competitions produced work of lasting importance, particularly in physics.

The *Annales* was very generous in announcing the launching of other journals. It was very happy, for example, to announce the existence of the *Journal du galvanisme*, the *Annales de statistique* and the *Bulletin de la Société d'Encouragement pour l'industrie nationale*. Sometimes the contents of journals would be summarised. In none of these cases was there any fear of competition - these journals covered matters complementary to those covered in the *Annales*. We shall be discussing book reviews below. Here it is sufficient to state that the brief announcement of the appearance of a new book, particularly one by members of the editorial board, did not preclude the later publication of a full-length review.

Although it was not a regular feature, the *Annales* covered a few obituaries. A particularly notable one was that for Fourcroy, who had died on 16 December 1809 at the age of 55, and was briefly commemorated by Laugier in the issue for January 1810. Finally we may mention the necessary inclusion of errata from previous issues. Only in one case, that of Berzelius, was the long list of printing errors a potential source of embarrassment.[100]

Book reviews were a particularly useful feature of the *Annales*. They may be divided into two categories: reviews of books by members of the editorial

---

[98] See Chapter 7, Section 5.

[99] The publication in the *Annales* of Reports of the First Class was discussed in Section 4 of this chapter.

[100] *A.c.*, *83* (1812), 128-137. The errata covered a whole series of articles, published in previous volumes. Berzelius' location in Sweden prevented him from exercising more immediate control over the printing of his memoirs.

board and other book reviews. Sometimes journals are run by people who are not themselves at the forefront of scientific research. This has the advantage that they can survey the field reasonably objectively. But the *Annales* was in quite a different position. Its editorial board consisted of the leading French chemists, backed up by enterprising juniors. We have already seen in Chapter 2 the great respect with which Lavoisier's *Traité* was treated, and the large amount of space devoted to it. We were concerned to show how, from the very beginning, the *Annales* propagated the oxygen theory through book reviews not only of Lavoisier's book but also by those of Fourcroy and Chaptal. But despite his many other occupations, Fourcroy did not stop writing textbooks and in November 1800 there appeared his monumental *Système des connaissances chimiques* in 10 volumes. Bouillon- Lagrange was immediately ready with a review for the December issue, but one could not do justice to such a large work in a single issue, so it was reviewed in three successive numbers.[101] Although such a review would obviously be favourable, one must not necessarily associate reviews of books by senior members of the editorial board with sycophancy. Proust published quite a critical review of Fourcroy's *Système des connaissances chimiques* in a Spanish journal. This review was translated into French and published in the *Annales*.[102] Fourcroy took the opportunity of a few footnotes to defend himself on specific points, but he concluded by welcoming such criticism, saying that the comments would be taken into account in a second edition of the work.

Having given considerable attention to Fourcroy in 1800, Bouillon-Lagrange felt that he had an equal duty to Berthollet, and in the same issue of the *Annales* he began an extensive review of Berthollet's recently published monograph: *Recherches sur les lois de l'affinité*. This was an important work, which argued that the course of chemical affinities depended not only on the affinities of reactants but also on other conditions, such as the relative masses and temperature. The reviewer did not find it easy to summarise and said that he would often allow the author to speak for himself. The three parts of the review of this short book in successive issues of the *Annales* occupied more than 75 pages.[103] This was followed by a long article by Berthollet himself in the following volume[104] on the same subject, giving a total exposure of more than one hundred pages within a year to Berthollet's ideas.

There may have been times when readers felt that they were not obtaining very good value. Thus in 1798 a good half of one issue (50 pages) was given up to reproducing a review of a book by another member of the editorial board, Chaptal's *Traité sur les vins*, a review which had originally appeared

[101] *A.c.*, *36* (1800), 318-334, *37* (1801), 94-110, 322-6.
[102] *A.c.*, *42* (1802), 225-272.
[103] *A.c.*, *36* (1800), 302-317, *37* (1801), 151-181, 221-252.
[104] *A.c.*, *38* (1801), 3-29.

in Rozier's *Cours d'agriculture*.[105] This was too easy a way of filling up an issue and represents a blemish in standards rather than the norm. Moreover, as if this was not enough, the following three issues of the *Annales* contained a continuation of the long discussion of Chaptal's book.[106] It was almost as if the book itself was being serialised. Perhaps the editorial board was short of original material for publication?

Guyton for his part should have been more than satisfied with the treatment of his *Traité des moyens de désinfecter l'air*, which was reviewed at length by Deyeux immediately after publication.[107] A second edition eighteen months later was treated almost as a new book in a review by Adet.[108] Thus we find a consistent pattern, in which senior members of the editorial board had the pleasure of having their books reviewed promptly, sympathetically and at length by their junior colleagues. In ordinary circumstances one might ask whether a book or a journal provided the best means of disseminating scientific ideas, but the *Annales* seemed to have had the best of both worlds with its monthly appearance often including very full summaries of books - at least those books written by members of the editorial board.

'Ordinary' books were treated more summarily, but, nevertheless, usefully. They would obviously include books on chemistry in all languages but also some on pharmacy and medicine. Other branches of physical science might be included, for example, a review of Libès, *Traité élémentaire de physique*.[109] Sometimes only the title and author of a recently published book would be given. A useful contribution would be a combination of titles of books, both French and foreign, interspersed with occasional reviews, as provided, for example, by Bouillon-Lagrange.[110]

Contributors to modern scientific journals often value them particularly as a means of making claims for priority. Although this is not how the *Annales* started, it was not long before this dimension emerged. The Royal Academy of Sciences had a procedure, by which a member could hand a sealed note to the secretary, who would sign it with a date and keep it for possible later use. This enabled Academicians at an early stage of their research to make certain claims, but there was not the same urgency to publish them until they had been fully confirmed. Already in 1790 we find an overspill into the *Annales*, although of course this meant going public. Fourcroy submitted for publication in the *Annales* a copy of a note he had deposited at the Academy on 17

---

[105] *A.c.*, *25* (1798), 240-299.
[106] *A.c.*, *26* (1798), 3-49, 113-142, 225-257.
[107] *A.c.*, *39* (1801), 74-103.
[108] *A.c.*, *45* (1803), 286-297.
[109] *A.c.*, *45* (1801), 196-203.
[110] *A.c.*, *26* (1798), 218-224.

April 1790, claiming the discovery of certain facts.[111] He said that over the previous ten years he had mentioned various 'discoveries' in his lectures and subsequently found this information appearing in books by different authors. This had the effect of 'nothing less than depriving a man of all that belonged to him as his own'.[112] The editors' introduction to the first volume had spoken of the *Annales* serving as a medium for the mutual exchange of discoveries[113], but we see that men of science already thought of their work as personal property. They were, therefore, sometimes reluctant to throw it into a common pool. Inevitably in the early 1800s, particularly with the search for new elements, there was some duplication of activity with some recriminations about priority.[114] This did not become a big issue, however, in the first series of the *Annales*.

One of the characteristics of the modern scientific paper is the system of references used, giving the exact location of previous research immediately related to the contents of the paper. Of course the early *Annales* had no such sophisticated system of footnotes, but it was quite usual for authors to begin a memoir by referring to previous work on the same subject. Thus the paper often began with a brief historical introduction, which served to locate the new work on the map of knowledge. In mentioning the work of others, the tone adopted was invariably polite. A previous researcher might have missed a vital observation or drawn a false conclusion, but he was never portrayed as a fool. Berthollet went out of his way to compliment his opponents and it was always a matter of regret for him if he was forced to disagree, as, for example, in reporting the ideas of Priestley.[115]

7. *The Index volumes.*

In addition to the 96 ordinary volumes of the first series, there were three index volumes, each covering approximately 30 volumes of the *Annales*. It is worth reflecting on the significance of these volumes. Not only did they provide a detailed list of contents of the many papers, which made up the *Annales,* and of their authors, but at the time of publication they constituted an invitation to look back over the series and perhaps buy earlier volumes missing from one's collection. The Index is, therefore, worth considering not so much as a library tool (i.e. our present perspective) as a recruiting device to tempt later subscribers to buy selected earlier volumes or, more hopefully, to

---

[111] *A.c.*, *6* (1790), 177. Altogether five 'facts' (*'faits'*) are listed.

[112] 'rien moins qu'à priver un homme de tout ce qui lui appartient en propre'.

[113] Appendix 1, No. 3, first paragraph.

[114] Thus volume 22 (1797) of the *Annales* contains two independent papers by Vauquelin and Chaptal respectively on the analysis of alum. For Chaptal's claim for priority, see *A.c.*, *23* (1797), 222-4.

[115] E.g. *A.c.*, *3* (1789), 63-114. See also Appendix 1, No. 4: 'Ce qui me fait de la peine ...'

complete their personal holdings of the series. Any single volume would provide no more than a random dip into chemistry - an account of a few pieces of recent research, but a complete collection would be a potentially valuable source of reference on the whole field of chemistry and beyond. The great *Encyclopédie* of Diderot had encouraged the educated public to think of knowledge as something to be found in a series of complementary volumes and in some ways the *Annales* was hoping to benefit from this view.

Reference to the contents of earlier volumes was a way of encouraging new readers to buy them, since one must think of the first years of any new journal as potentially perilous ones, where survival depends largely on a continual increase in the number of subscribers. It is unfortunate that circulation figures for the early years of the *Annales* have not survived, but it is reasonable to surmise that it was the constant concern of the editors not only to increase the number of readers but, more importantly, the number of subscribers, who would show greater commitment to the journal and, all being well, continue their subscription the following year. The appearance of an Index would be a reminder to recent subscribers that they had missed important earlier papers, and gave them encouragement to go back to complete their collection. This was usually possible on the basis of existing stock but occasionally a further print run of earlier volumes was called for.

In fact the first attempt at a review of the contents of earlier volumes came long before the publication of the thirtieth volume. As early as the winter of 1790/91 the editors took advantage of the publication of a second printing of the first volumes of the *Annales* to review the contents of the first six volumes, as well as to set out for a second time the purpose of the journal.[116] The contents were divided into broad subject areas, beginning with 'physics' (*physique particulière*) including the expansion of gases, electricity, heat, cold and light, followed by the largest category, described simply as 'chemistry', followed by mineralogy, applied chemistry and finally medical chemistry. It may be noted that, under Lavoisier's leadership, publicity for the *Annales* tended to emphasise physical science, while no mention was made of pharmacy.

A restatement of the aims of the editors was felt necessary as a complement to the review of the contents. They said that they hoped to establish a network of communication among *savants* throughout Europe.[117] They repeated the justification of the *Annales* as being intended to bring together memoirs dispersed in many different collections. They were concerned both with the progress of pure chemistry and its applications. A major shift in editorial policy announced was a change from quarterly to monthly publication, begin-

---

[116] *A.c., 1* (1789, second edition, 1791), 1-4.

[117] See Appendix 1, No.5.

ning in January 1791. They aimed to produce an issue for the 15th day of each month, which was intended to improve communication and opportunities for correspondence from readers. Men of science throughout Europe were invited to contribute.

The publication of volume 10 in July 1791 was the occasion of a further attempt to interest new readers in the contents of earlier volumes by devoting 15 pages to an alphabetical list of their contents.[118] The editors were not to know that, before the *Annales* could reach volume 20, it would be forced to close. Yet it had done all that it could to lay secure foundations for a lasting publication.

When the *Annales* resumed publication in 1798 the first priority was to catch up for the missing years. In April 1798, however, the question was raised of preparing an index of the first 25 volumes by sharing out the work between different members of the editorial board.[119] Thus Fourcroy agreed to prepare an index of volume 1, Hassenfratz of volume 2, Guyton of volume 3 and so on. This method had the advantage of not imposing too great a burden on any one individual but it was totally impractical to expect a good index to result from the separate efforts of the different members of the board. The attempt was, therefore, abandoned and it was only when they reached volume 30 in April 1799 that the question of an index was again raised.[120] A separate index volume was finally published in 1801 as a book of approximately the same length as an ordinary volume of *Annales*. This contained a very full subject index (370 pp.), followed by an author index (57 pp.), which included not only authors of articles but also authors cited in memoirs. The editors could feel a certain satisfaction with the appearance of this volume. They were now able proudly to present the contents of the first thirty volumes of their journal successfully spanning a period of maximum civil disturbance. In the calmer years of Bonaparte's Consulate they could look forward to the regular production of many further volumes. The *Annales* had now established itself as a permanent part of the French scientific scene and of the international chemical calendar.

Since the first thirty volumes had seemed to provide a convenient length for an index, a second index volume was planned when volume 60 was reached in October 1806. This was published by Bernard in 1807 with a congratulatory preface by L. Biet, M.D. Dr Biet was able to review the progress of chemistry over the past seven years, also referring to related subjects in-

---

[118] *A.c.*, *10* (1791), 337-52. This was not a proper index.

[119] St. Léonard, G.L.59, f.5v. (17 germinal year 6).

[120] On 27 floréal year 7, Fourcroy announced that 'Citoyenne Tigny' had completed an index of the first ten volumes. This seems to have been a trial run, for a year later (7 frimaire year 8) he was able to report that Madame Tigny had completed an index for the first 30 volumes. St Léonard, *op.cit.*

cluded in the *Annales*, ranging from galvanic electricity to medicine. Representing the view of Fourcroy and several other members of the editorial board, he claimed that the study of pharmacy was inseparable from that of chemistry.

As for the third index volume to complete the first series, if we recall the political and military crises of 1814-15 and the severe problems faced by the *Annales* in these years, it is not surprising that there was a delay in its publication. When it appeared in 1821 it was really the fulfilment of an obligation to an earlier age. There was no longer a question of recruitment. Rather the *Annales* had become a major scientific institution, and it was the duty of the editors of the new *Annales de chimie et de physique* to fill a potentially embarrassing gap. Posterity need now have no cause for complaint.

CHAPTER SEVEN

CHEMISTRY AFTER LAVOISIER

> There is now before us a boundless prospect of novelty in science; a country unexplored, but noble and fertile in aspect; a land of promise in philosophy.
>
> (Humphry Davy. John Davy, *Life of Sir Humphry Davy, Works*, 1839, vol.1, p.117.)

> The applications of ...[chemistry]... are so numerous, that there are few circumstances of life in which the chemist does not enjoy the pleasure of seeing its principles exemplified. Most of those facts, which habit has led us to view with indifference, are interesting phenomena in the eyes of the chemist. Every thing instructs and amuses him; nothing is indifferent to him, because nothing is foreign to his pursuits; and nature, no less beautiful in her most minute details than sublime in the disposition of her general laws, appears to display the whole of her magnificence only to the eyes of the chemical philosopher.
>
> (Chaptal, *Elements of chemistry*, transl., London, 1791, Preface, pp.lxi-lxii.)

1. *The oxygen theory, respiration and oxidation.*

We must now focus on the chemical contents of the *Annales*. Rather than provide a catalogue, it would be desirable to discuss the question thematically and, in the first place, to consider whether the journal was a vehicle for the continuation of Lavoisian chemistry or whether the 'chemical revolution' was effectively complete, and the chemical contents of the journal merely reflected miscellaneous new knowledge. The answer is that both are true. It seems appropriate to begin by considering some lines of particular Lavoisier influence before discussing the more general contents of the journal. This will necessarily involve a certain amount of recapitulation.

Lavoisier's greatest achievement was undoubtedly his oxygen theory. We may consider two distinct aspects of this, firstly composition and secondly reaction. Probably Lavoisier's most famous claim was that the air we breathe is a mixture of two gases: oxygen and nitrogen, the latter being previously described by Lavoisier as *azote*. In his historic memoir, read to the Academy in 1777, he described how he had heated a few ounces of mercury in 50 cubic inches of air, of which 8 or 9 cubic inches had combined with the mercury. He, therefore, estimated that about one-sixth (more accurately one-fifth) of the atmosphere consists of 'the most salubrious part of the air', later called oxygen.[1] Having shown that air, one of the Aristotelian 'elements', was in fact a mixture of at least two gases, Lavoisier went on to demonstrate that another of the Aristotelian 'elements', water, was a compound of hydrogen and oxygen. His quantitative analysis, carried out in collaboration with Meusnier, gave the gravimetric proportions as 15:85[2] (more accurately 11:89). Another important aspect of chemical composition was the assertion that what had previously been described as the 'calx' of a metal (and had been thought of as a simple substance), was a compound with oxygen or *oxide*. It is understandable that this new interpretation of chemical composition,[3] which involved turning the old views on their head, should have given supporters of the phlogiston theory quite a headache. But Lavoisier was also conscious that elements can form more than one oxide. Also Lavoisier believed that, given enough oxygen, many elements would be converted from oxide into acid, as happens in the case of sulphur.

Chemistry, however, is concerned as much with reactions as with composition and this is the second aspect of the oxygen theory that must be considered. The most important simple chemical reaction, which Lavoisier explained by his new theory was, of course, combustion. Like his predecessor Stahl, he considered the change which takes place in a metal when it is strongly heated as 'combustion', just as much as the burning of wood. By careful use of the balance he was able to show that, when a metal like tin or lead is heated strongly in the air, it gains in weight.[4] Thus, far from losing 'phlogiston', as had previously been argued, it actually took in something from the air. By a careful series of experiments he was able to show that it combined with oxygen in the air.

---

[1] 'Expériences sur la respiration des animaux', *Mém.Acad.*, 1777, 185, *Oeuvres*, vol.2, pp.174-183 (175-7).

[2] *Traité*, vol.i, p.100, *Elements*, p.94.

[3] R. Siegfried and B. J. T. Dobbs, 'Composition, a neglected aspect of the chemical revolution', *Annals of Science*, *24* (1968), 275-93.

[4] February and November 1774, M. Daumas, *Lavoisier*, 1955, pp.32-3.

He later extended his theory of combustion to explain respiration.[5] This was a major step in the history of science since he was able to give a satisfactory explanation of a life process *in purely chemical terms*. Previous attempts at biological reductionism in the seventeenth century had tried to reduce life processes to mechanics; in such a framework the lungs would be viewed as bellows, the veins and arteries as pipes, etc. But now, using the new chemistry, Lavoisier pointed out a close analogy between the combustion of a candle in a bell jar and the respiration of a guinea pig, an analogy which was based on the following similarities:

i both used up oxygen
ii both produced carbon dioxide
iii both gave out heat
iv both left a residue of nitrogen

The main difference seemed to be that in combustion a large amount of heat was produced in a short time, whereas in respiration the heat was only produced slowly. Respiration was, therefore, a *slow* combustion.

There were many articles on respiration in the first series of the *Annales*, but none were more important that those by Armand Séguin, Lavoisier's one-time collaborator in respiration experiments. It was Séguin who was responsible in 1797 for providing a report of experiments, which had been carried out in the previous decade and presented originally to the Société de Médecine in 1790.[6] After paying a brief tribute to his former colleague,[7] Séguin summarised Lavoisier's work on the composition of air, his experiments on respiration, the change of colour of oxygenated blood, animal heat, etc. Soon after this Séguin lost interest in the *Annales*[8], and he made no contribution until the end of the Napoleonic period.

It is perhaps significant that, immediately after the Restoration of Louis XVIII in March 1814, Séguin seems to have taken up again his old interests to the extent of publishing in the issue of the *Annales*, dated 30 April 1814 a joint memoir by Lavoisier and himself on transpiration.[9] Séguin himself had been the subject of one long experiment, in which he had spent several days in a chair, which formed one arm of a stout balance, so that changes in body weight would be recorded in the tradition of Sanctorius. In accordance with the new political climate, this memoir was presented as having been read to

---

5 'Premier Mémoire sur la respiration des animaux' (1790), Lavoisier, *Oeuvres*, vol. 2, pp.688-703. For a very full study of Lavoisier's work on respiration see Frederic Lawrence Holmes, *Lavoisier and the Chemistry of Life. An Exploration of Scientific Creativity*, Madison, Wis., 1985.

6 'Mémoire sur la respiration et la chaleur animale', *A.c.*, *21* (1797), 225

7 'Lavoisier, auquel les sciences sont si redevables....' *ibid.*, p.226.

8 Because of business interests - see Chapter 4, section 2.

9 'Second mémoire sur la transpiration par Lavoisier et A. Séguin', *A.c.*, *90* (1814), 5-28.

the Royal Academy of Sciences in 1792. It seems that the editors were keen to display some royalist credentials. The following issue of the journal (31 July 1814) contained a second memoir on respiration by Lavoisier and Séguin, which readers were told had been read to the Royal Academy of Sciences in 1791.[10] Having associated themselves in this way with the ancien regime, the editorial board must have been embarrassed by the (albeit temporary) return to power of Napoleon in March 1815. Of course they were not the only ones caught out in this bewildering alternation of political regimes.

Séguin gave a summary history of the French work on respiration:

> First Lavoisier undertook the analysis of atmospheric air. Soon after he recognised in turn that the volume of air, which one breathes out, is always less than the volume of air that one breathes in; that at every expiration there goes out from the lungs a certain quantity of carbonic acid gas, which did not exist in the inspired air; that the volume of gas is always less than the volume of vital air changed; that a part of its oxygen combines with hydrogen in the blood to form water; that during the production of carbonic acid and water the vital air loses part of its caloric, which, combining with the blood, maintains the temperature of the system at an approximately constant and uniform temperature, whatever changes of temperature may take place in the surrounding medium.[11]

There followed a brief description of the memoir by Lavoisier and Laplace on heat. Thus, in addition to the contribution to science, Séguin was making a powerful contribution to maintaining a Lavoisian presence in the *Annales* some considerable time after his death. Some of the research on respiration had been published in the *Mémoires* of the Royal Academy of Sciences but, by including it in the more widely available *Annales*, Séguin was contributing to the fame of his master in the next century.

However, we should not think that research on respiration had come to an end with Lavoisier and Séguin. There were several other articles published in the *Annales*, for example by Gren[12] and also a report on work by Dupuytren.[13] The subject of respiration was given a boost after 1800 by the publication of Davy's research on the physiological properties of nitrous oxide and

---

[10] 'Second mémoire sur la respiration par Lavoisier et Armand Séguin' *A.c.*, *91* (1814) 318-334. The promised continuation of this article in the *Annales* never appeared.

[11] *Ibid.*, pp.319-20.

[12] *A.c.*, *24* (1797), 196-8.

[13] *A.c.*, *63* (1807), 35-48.

this prompted several articles[14] some of which combined excitement about Davy's work with reference to the earlier work of Lavoisier.[15]

The most general kind of reaction involving oxygen gas or oxygen compounds was oxidation. This could explain many reactions, including one of the oldest chemical reactions known to man - the fact that when wine is exposed to air it gradually turns to vinegar. An important application of the theory of oxidation was the theory of the manufacture of sulphuric acid. The process for the manufacture of sulphuric acid was carried out in the mid-eighteenth century by John Roebuck in Birmingham by burning sulphur in a lead chamber; the door of the chamber was opened periodically 'to sweeten the chamber'. It had also been found empirically that the yield was vastly improved if a small quantity of nitre was added to the sulphur, but no-one understood the part played by the nitre. In a paper read to the Institute in 1806 and published in the *Annales*[16] Clément and Desormes interpreted the reaction as one in which nitric acid fumes or 'nitrous gas' [NO_2] was produced, which acted as an oxygen-carrier, giving up its oxygen to the sulphurous acid gas formed to convert it into sulphuric acid. They concluded that nitrous gas was what would later be called a catalyst:

> Thus the nitric acid [from the nitre] is only the instrument of the complete oxigenation of the sulphur; it is its base, the nitrous acid [i.e. NO] that takes oxygen from the atmospheric air to present it to the sulphuric acid in a state suitable for it.

This was a comparatively early example of the enlightenment of technology by science. Since the function of the nitre was essentially to transfer oxygen, it was not used up in the same way as the sulphur. Once it was understood that only small quantities of nitre were necessary, this served as an economy measure.

In fact Lavoisier used the twin concepts of oxidation and 'disoxidation'[17] which would later be called reduction. In the form of the theory used by Lavoisier, oxygen itself was necessarily involved but later, with the development

---

[14] E.g. *A.c.*, *45* (1802), 98; *A.c.*, *56* (1805), 243.

[15] E.g. Pfaff, 'Nouvelles expériences sur l'air atmosphérique, principalement par rapport à l'absorption de l'azote et sur la respiration du gaz oxide d'azote' (sent to First Class of the Institute), *A.c.*, *55* (1804), 177-90.

[16] 'Théorie de la fabrication de l'acide sulfurique', *A.c.*, *59* (1806) 329. *Journal of Natural Philosophy*, *17* (1807), 41-6. The basic reaction could be represented by the modern equations:

$$S0_2 + N0_2 + H_20 = H_2S0_4 + N0$$

and: $N0 + [\frac{1}{2}0_2] = N0_2$

See John Graham Smith, *The Origins and Development of the Heavy Chemical Industry in France*, Oxford, 1979, pp.64-5.

[17] Lavoisier used the complementary verbs, *oxygéner* and *désoxygéner*, e.g. *Traité*, vol.1, p.150.

of the electrochemical series, oxygen would be classified as one among a number of electro-negative elements and the addition of any one of these, for example, chlorine, would be regarded as a case of oxidation.

2. *Quantitative analysis: organic and inorganic.*

One of the most useful applications of oxidation was in organic analysis. Indeed it was this method which opened up the whole science of organic chemistry in the nineteenth century. In 1785 Lavoisier had carried out a series of quantitative experiments, in which he had ignited a number of inflammable substances, including spirit of wine, olive oil and wax in a bell jar over mercury in the presence of an excess of oxygen.[18] If he knew how much oxygen was used up and how much carbonic acid and water were formed, he could say what proportions of carbon and hydrogen were present. But this simple method would only work with inflammable organic substances. For others Lavoisier proposed to use potassium chlorate[19] which is, of course, a powerful oxidising agent.

Lavoisier's method of organic analysis was to be extended in the next generation by Gay-Lussac and Thenard. Although their memoir of 1810 on vegetable and animal analysis was published in the *Annales*, it has to be said that it was first published in the rival periodical, the *Journal de physique*. That this should happen would seem to be a reflection of the fact that *at the time* Gay-Lussac and Thenard had no official connection with the *Annales* and that La Métherie was enterprising enough to seize good material when it was available. The memoir had been read at a meeting of the First Class of the Institute on 15 January 1810. It was published in the March issue of the *Journal de physique* and, when it appeared in the issue of the *Annales* dated 30 April 1810, it was with an acknowledgement to the previous publication. It must be more than a coincidence that, at a meeting of the editorial board held on 5 April that year, both Gay-Lussac and Thenard were invited to join the editorial board,[20] which was a wise step to ensure the future primary loyalty to the *Annales* of such able young potential contributors.

In their memoir[21] the authors announced that they had used potassium chlorate as an oxidising agent and had applied it successfully to the analysis of 16 vegetable and four animal substances. However, since the oxidising

---

[18] 'Mémoire sur la combinaison du principe oxygine avec l'esprit du vin...', *Mém. Acad.*, 1784, *Oeuvres*, vol.2, pp.586-600.

[19] This work was unpublished but was known to Gay-Lussac and Thenard.

[20] St. Léonard. GL.59. f.49. The other event, which helps explain the election of Gay-Lussac and Thenard at this particular time, was the recent death of Fourcroy.

[21] 'Extrait d'un mémoire sur l'analyse végétable et animale'. *A.c., 74* (1810), 47-64. The text in the *Journal de physique* was similarly only the summary. See also Ferenc Szabadváry, *History of Analytical Chemistry*. Oxford, 1966, p.288.

agent was so powerful, producing large volumes of gas, which tended to break the apparatus, they carried out the experiment in stages, dividing the substance to be analysed into small portions. It was mixed with potassium chlorate and made into pellets, which were dropped into a strong glass tube strongly heated. The gases evolved (carbon dioxide and oxygen) were collected over mercury. The volume of carbon dioxide was found by absorption in potassium hydroxide, whence the original weight of carbon could be calculated. The excess of oxygen was determined by explosion with hydrogen. (The oxygen from the potassium chlorate was, of course, known.) The decrease in the amount of oxygen was assumed to be due to the combustion of the hydrogen content of the organic substance. The two chemists were particularly struck by the ratio of the weights of hydrogen to oxygen in the same proportions as in water in the vegetable substances and presented their results in the form of three 'laws':

> *First law* - A vegetable substance is always acid when the oxygen is to the hydrogen in a greater proportion than in water.
>
> *Second law* - A vegetable substance is always resinous, oily, or alcoholic, etc. when the oxygen is in less proportion to the hydrogen than in water.
>
> *Third law* - Lastly, a vegetable substance is neither acid nor resinous, and is analogous to sugar, gum, starch, ...etc... when the oxygen is [to the hydrogen] in the same proportion as in water.

The third category of substance was to be described by William Prout as *carbohydrates*, thus laying the foundations of food chemistry. Gay-Lussac reduced the violence of the oxidation reaction by using copper oxide as an oxidising agent in his later experiments.[22]

Berzelius adopted the same method as Gay-Lussac and Thenard but introduced some improvements, notably weighing the water formed directly instead of calculating it from the consumption of oxygen.[23] His method was more accurate than that of his predecessors but it was very slow. Liebig complained that Berzelius had taken eight months to carry out 13 analyses. He himself was to carry out hundreds of analyses, using improved apparatus, which became standard. In Liebig's apparatus the heating could be better controlled, the carbon dioxide was absorbed in weighed potash bulbs, and the water absorbed in a tube of anhydrous calcium chloride.[24] Although the apparatus was generally superior to any that had gone before, it was found that in some compounds there was great difficulty in oxidising the carbon. In

---

[22] *A.c.*, *95* (1814), 184, *97* (1815), 53.

[23] *Neues Journal der Pharmacie*, *1* (1817), 130 cited by Szabadváry, *op.cit.*,pp.288-9.

[24] Liebig, *Anleitung zur Analyse organischer Körper*, 1837, cited by Szabadváry, *op.cit.*, p.293.

such cases the chemists tended to revert to Lavoisier's original method of combustion in oxygen gas.

We have mentioned that the first volume of the *Annales* reported various chemical analyses of mineral substances, hardly exciting perhaps, but providing necessary data for the advancement of chemistry. Lavoisier had himself made the quantitative analysis of many inorganic substances the cornerstone of his new chemistry and this view of chemistry was maintained in the *Annales*. Of the very many examples in the journal we will focus on two. In the first, the French chemist Proust, writing from Spain, used his great analytical skills as the basis for a claim to have discovered the law that chemical compounds always contain the same proportion of their constituents. Thus, however humble analysis may appear to some readers, it was a necessary basis to any grand generalisation. Later in the history of the *Annales* the Swede Berzelius was to become a major contributor. His important paper on the combining proportions of elements provided fundamental data on equivalents and atomic weights. The *Annales* was fortunate to be able to benefit from the contributions of such a skilled analyst, who, by the 1830s, was to become one of the most famous figures in world chemistry. We will discuss the case of Proust before describing the work of Berzelius.

Although Proust published many papers in the *Journal de physique*, it was in the *Annales* that he first published his law of constant proportions. In 1797 in a paper on 'Prussian blue', in which he paid particular attention to combining proportions, he showed that iron forms two oxides, containing 27 and 48 per cent of oxygen respectively and said:

> I shall conclude by deducing from these experiments *the principle* I have established at the commencement of this memoir, viz. that iron, like many other metals, is subject to *the law of nature which presides at every true combination*, that is to say that it unites with *two constant proportions* of oxygen. In this respect it does not differ from tin, mercury and lead and, in a word, almost every known combustible.[25]

Two years later, as a result of his analysis of native copper carbonate, he wrote in an almost mystical way:

> We must recognise that invisible hand, which holds the balance for us in the formation of compounds, and which fashions their attributes according to its own wishes. We must conclude that nature does not operate differently in the depths of the earth than it does on the surface or in the hands of man. These proportions are always invariable,

[25] *A.c.*, *23* (1797), 101. English translation from J. R. Partington, *History of Chemistry*, vol.3, 1962, p.647 (my italics).

> these attributes constant which characterises true compounds of art or those of nature...[26]

This is a very clear and confident claim on the basis of rather limited evidence.[27] The main problem that arises is that Proust was later driven to *define* true compounds as those having fixed proportions,[28] hence producing a circular argument.

Although Proust arrived at his result on the basis of careful analysis, his conclusion was not as original as might be supposed. It had been largely *assumed* by many eighteenth-century chemists, complications arising only when two elements formed more than one compound by being able to combine in different proportions. Although we may give due credit to Proust for his great analytical skills and, in a simple sense, for being 'right', problems arose in the case of solutions, alloys and other aggregates, which were really mixtures. Berthollet's visit to Egypt in 1798-9 had shown him that in the natural formation of *trona* (basic carbonate of soda) the accepted laws of chemical affinity could be reversed. In this case common salt seemed to have reacted over a long period with moist sand impregnated with carbonate of lime.[29] The great difference from laboratory conditions lay in the enormous scale of the reactants.

Realising the importance of *quantities* in any chemical reaction, Berthollet then went on to consider other factors such as temperature. In 1801 he published his *Recherches sur les lois d'affinité*, which he developed further in his two-volume *Essai de statique chimique* (1803).[30] He was able to show experimentally that many chemical reactions are reversible and thus introduced into chemistry the idea of chemical equilibrium. One consequence of this new understanding of chemical reaction was a less absolute view of chemical composition than had been claimed by Proust. The debate went on intermittently until 1807, mainly in the *Journal de physique*. This in itself may be considered evidence that the *Annales* was not yet Berthollet's journal. It is gratifying to be able to report that the debate was carried out in the most courteous way and, although by 1807 most chemists were convinced by the careful analytical evidence of Proust, Berthollet did not bear any grudge. On the contrary it was he who later sponsored Proust's nomination and election to a coveted place in the First Class of the Institute.

---

[26] 'Recherches sur le cuivre', *A.c.*, *32* (1799), 26-54 (30-31).

[27] Satish Kapoor, 'Berthollet. Proust and Proportions', *Chymia*, *10* (1965), 53-110 (86-7).

[28] 'A compound... is a privileged product to which nature assigns fixed proportions', *Journal de physique*, *63* (1806), 568. See also M. Crosland, *The Science of Matter*, 1971, pp.151-160.

[29] An appropriate modern equation would be: $2NaCl + CaCO_3 = Na_2CO_3 + CaCl_2$.

[30] It may be noted that in the early 1800s, although Berthollet was a member of the editorial board of the *Annales*, he was sufficiently distant from its direction that he preferred to publish his ideas in the form of books rather than as memoirs in the *Annales*.

Proust, skilful analyst as he was, was probably surpassed in the next generation by Berzelius. In April 1811 the first of a series of articles by Berzelius appeared in the *Annales*[31], concerned with the quantitative analysis of inorganic compounds. He had studied combining proportions and, aware, in the light of the recent history of the subject, that he was treading on delicate ground, he began with a brief history, referring to Berthollet as 'one of the most distinguished chemists of our century', who had carried out 'ingenious researches' on affinities. Proust, however, had shown that Berthollet was wrong in supposing that elements could combine in an indefinite series of proportions according to the conditions. Proust had shown that elements might sometimes combine in two proportions, but he had not investigated multiple proportions any further.

Berzelius had begun to investigate this question when he came across Wollaston's experiments of 1808, in which he had reported a few experiments which seemed to support a law of multiple proportions. Nevertheless, Berzelius set out to confirm this as a general law, based on a wide-ranging and painstaking series of chemical analyses, which occupied many years. In some cases analyses were repeated 30 times before Berzelius was satisfied with the results. Starting with analyses of the oxides of lead, copper and iron, he showed that, when two bodies A and B combine in different proportions, they are as follows: A + B, A + 1½B, A + 2B and A + 4B. (He could find no example of A + 3B). He also found simple proportions in many other cases and enunciated one form of the law of reciprocal proportions. His work could also be seen as confirmation of Dalton's atomic theory. Even more important was that it laid the basis for Berzelius' several tables of atomic weights which, in their later revisions, were generally accepted as authoritative. Thus the data generated by Berzelius in the *Annales* and elsewhere provided information of great value to chemistry.

3. *The oxygen theory of acidity: criticism and development.*

Whereas the theory of oxidation generally flourished in the post-Lavoisier period, the idea of oxygen as the universal principle of acidity met with severe challenges from Lavoisier's own colleagues and some of their followers. It is worthy of note that the majority of these challenges should have been published in the *Annales*, thus confirming the position of the journal at the leading edge of chemical research. The fact that some of these challenges should be published during Lavoisier's lifetime in a journal, of which he was the

---

[31] 'Essais sur les proportions déterminées dans lesquelles se trouvent réunis les éléments de la nature inorganique', *A.c.*, *78* (1811), 5-37, 105-132, 217-242; *79* (1811), 113-142, 233-264; *80* (1811), 5-37; 225-258; *81* (1811), 5-36, 278-303; *82* (1812), 5-33, 113-125, 225-272; *83* (1812), 5-35, 117-127. See also J. R. Partington, *History of Chemistry*, vol.4, 1964, pp.153-5.

principal editor, shows that this periodical was open to the publication of experimental evidence of all kinds, and was not confined to some sort of Lavoisier orthodoxy.

It was in his memoir of 1776 on the composition of nitric acid that Lavoisier had first enunciated his oxygen theory of acidity. At this stage he had not yet coined the term oxygen:

> I am in a position to assert affirmatively today that not only air but rather the purest part of the air enters into the composition of all acids without exception [and] that it is this substance which constitutes their acidity.....[32]

The self-confidence reflected in this statement was taken further in 1779, when Lavoisier decided to nail his flag to the mast by coining the term *principe oxygine* (from the Greek *oxus* = acid and *geinomai* = I engender) for the principle of acidity,[33] thus combining his theory of combustion with his rather rashly constructed theory of acidity. When Lavoisier collaborated in 1787 in the reform of chemical nomenclature his colleagues persuaded him that the term *oxygène* was to be preferred.[34]

Again in his textbook of 1789, after considering the cases of sulphur, phosphorus and carbon, Lavoisier showed himself only too ready to generalise that 'the formation of acids is brought about by the oxygenation of any substance'.[35] He also repeated that it was the oxygen principle that they contained that was responsible for their acidity. But already Berthollet in 1787 had carried out an analysis of prussic acid and had concluded that it contained only nitrogen, hydrogen and carbon.[36] When a summary of this Academy memoir was published in the first volume of the *Annales*[37] the above analysis was naturally repeated, but this time it was followed by the following tactful comment:

> If we consider the composition of prussic acid, it seems much less analogous to that of the acids than to ammonia; yet it has too many properties in common with other acids for us not to place it in the same class...

In the second volume of the *Annales* Berthollet was more explicit on the subject of Lavoisier's oxygen theory of acidity. In a memoir on sulphurous

---

[32] 'Mémoire sur l'existence de l'air dans l'acide nitreux', *Mém. Acad.*, 1776 (1779), 671. *Oeuvres*, vol.2, pp.129-138 (130). See also: Maurice Crosland, 'Lavoisier's theory of acidity', *Isis 64* (1973), 306-325 (314).

[33] 'Considérations générales sur la nature des acides', *Mém. Acad.*, 1778 (1781), 536. *Oeuvres*, vol.2, pp.248-260 (249).

[34] According to Fourcroy, *Elements of Natural History and Chemistry*, London, 1790, vol.1, p.147n.

[35] *Traité*, vol.i, p.69.

[36] *Mém. Acad.*, 1787(1789)159.

[37] *A.c.*, *1*(1789), 30-39 (38).

acid, which he had read to the Academy in February 1789, he went so far as to suggest even that the term oxygen might be a misnomer if it were not present in all acids.[38] Yet he defended the term by suggesting that it was not necessary to depend too closely on the etymology of words based on dead languages. Despite what he described as a good analogical argument in favour of Lavoisier's theory, he brought forward some powerful evidence against it:

1. Substances may contain a large quantity of oxygen without being acidic; water provides a striking example.
2. There are still several acids in which there is no experimental evidence for the existence of oxygen - not only muriatic [hydrochloric] acid but fluoric acid, boracic acid and lithic [uric] acid.
3. It seems to me proven that prussic acid does not contain oxygen. Yet what is the property which principally characterises acids? Is it not that of forming compounds [salts] with a certain class of substances? Now why should this property not belong to substances composed of different principles?

In other words Berthollet, by placing later conflicting evidence side by side with the evidence provided by Lavoisier, was seeking not so much to overturn the theory as to broaden it. He was anxious 'not to cast a slur' on Lavoisier's 'fine theory'.

In a memoir on hydrogen sulphide, read to the Institute in 1796 and published in the *Annales* in 1798[39], Berthollet took up the question again and concluded that a solution of the gas behaved in many ways like an acid. He continued:

> I shall not recall here the observations which I have made in opposition to those who claim that acidity is an attribute which belongs only to oxygen. I will only add that hydrogen sulphide contains no oxygen at all and that it is very little different in its acidic properties from carbonic acid, which contains approximately 76% oxygen.[40]

Not that Berthollet was alone among French chemists in casting doubt on the oxygen theory or acidity. In 1796 Fourcroy pointed out that it was only by analogy that muriatic acid was regarded by the new school as a compound of an unknown radical with oxygen.[41] In other words, there was no direct evidence for it. But it was to be Gay-Lussac, the protégé of Berthollet, who was finally to clarify the limited validity of the oxygen theory of acidity. In its simplest form the new view may be stated in the form of the tautology: 'All

---

[38] 'Suite des expériences sur l'acide sulfureux', *A.c.*, *2* (1789) 54-72 (67-8).

[39] It may be recalled that the *Annales* was not published in 1796 and, when it resumed in 1797, it was faced with a superfluity of material.

[40] 'Observations sur l'hydrogène sulfuré', *A.c.*, *25* (1798), 233-8 (237-8).

[41] Fourcroy, cited by J. R. Partington, *History of Chemistry*, vol.3, p.541.

oxy-acids contain oxygen'. In other words Lavoisier had not been mistaken in his first analyses - some acids *do* contain oxygen but the nineteenth century would draw back from the bold claim that oxygen was the *principle* of acidity. Later in the century chemists would speak of hydrogen ions. Meanwhile the important step taken by Gay-Lussac in 1814 was to divide acids into two main classes: (a) the oxyacids, for which Lavoisier's reasoning had a certain validity, and (b) the new class of hydracids, which definitely did not contain oxygen. This important paper was published in the *Annales,* since Gay-Lussac was now a member of the editorial board.

It was Gay-Lussac's study of iodine in the winter of 1813-14, which opened up again the whole question of acidity. To his important monograph on iodine he was able to add a long appendix on the subject of acidity.[42] Gay-Lussac accepted that oxygen was an acidifying principle, but argued that, in cases of compounds which contained oxygen but were not acidic, the acidic characteristics of the oxygen had been overshadowed by other constitutents. Gay-Lussac went further than other chemists in saying that oxygen was not the *unique* principle of acidity, since this was a property possessed by certain elements including chlorine, iodine, sulphur and phosphorus. (The emerging science of electro-chemistry would have enabled him to speak about the properties of *electro-negative* elements.) Oxygen remained, however, as the '*principal* acidifying substance'.[43] Thus, although Gay-Lussac may appear rather conservative in his views, he had departed significantly from the oxygen-centred chemistry of Lavoisier. His position may be contrasted with that of Berzelius, who long continued to consider oxygen as unique.

A more important contribution of Gay-Lussac was to introduce the concept of 'hydracid', following on his discovery of hydriodic acid. He introduced the term 'hydracid' to describe such substances as hydrochloric acid, hydriodic acid and the acid formed by hydrogen sulphide. Having established the two classes of what we call oxy-acids - what Gay-Lussac referred to as 'real acids' (*'acides proprement dites'*)-[44] and hydracids, he refused to reach any absolute conclusion. Instead he took refuge in an operational definition:

> Considering the word 'acid' in the most general way, acid has for a long time been for me no more than a body, whether containing oxygen or not, which neutralises alkalinity.[45]

Thus chemistry proceeded on Lavoisian lines but with an enlarged horizon.

---

[42] 'Sur l'acidité et sur l'alcalinite', *A.c.*, *91* (1814), 130-152.
[43] *Ibid.*, p.117.
[44] *Ibid.*, pp.147-8.
[45] *Ibid,.*, p.145.

4. *New earths and new elements.*

Lavoisier had drawn up a list of simple substances in his *Traité* and it is reasonable to think of these as the building blocks of the new chemistry. The list might be interpreted as a research programme, even a progressive one, since Lavoisier had presented his list as purely provisional:

> ..... as chemistry advances towards perfection, by dividing and subdividing, it is impossible to say where it is to end; and these things we presently suppose simple may soon be found quite otherwise. All we dare venture to affirm of any substance is, that it must be considered as simple in the present state of our knowledge and so far as chemical analysis has hitherto been able to show. We may even presume that the earths must soon cease to be considered as simple bodies .....[46]

Lavoisier's definition of an element as an undecomposable substance was a purely operational one, that is, it depended on what Lavoisier himself was capable of doing in the laboratory. He anticipated further improvements in analysis and, in the last sentence quoted above, he gave a very strong hint that the inclusion of earths as simple substances was only temporary. Indeed, with the new tool of Volta's battery (1800) it would soon be possible to decompose them as well as the alkalis. Lavoisier himself had said:

> The fixed alkalis, potash and soda are omitted in the foregoing Table, because they are evidently compound substances, though we are ignorant as yet what are the elements they are composed of.[47]

It is particularly in the case of the alkalis and the earths that Lavoisier inspired the next generation to take analysis further than was possible in his time. The other simple substances in his list were generally accepted, with the exception of caloric and light, which were soon appreciated not to be substances at all and were quietly omitted from most nineteenth-century versions of the list. One might think that the existence of such a list would inspire many chemists to try to make their own contribution. Probably it did, but the published records show little more than the continuation of an analytical tradition extending back to the pre-Lavoisier period. This was a tradition, in which German and Swedish chemists made a greater contribution than the French, largely related to their superior mineral resources, although this would not be true of Britain. The story to be told in the *Annales* is, therefore, of the isolation on the international plane of new earths and new elements,

---

[46] *Elements*, p.177, *Traité*, p.194.
[47] *Elements*, p.178, *Traité*, p.195.

mainly metals.[48] It is relevant to ask how quickly the *Annales* was able to report the new discoveries. Was there a significant time-lag between the announcement in the German, Swedish and British journals and the French? Hardly. Not that the French chemists did not make their own contribution and here we must name Vauquelin and Descotils, both members of the editorial board of the *Annales*. It might be appropriate to begin with the work of Klaproth and Vauquelin, since much of their work came before 1800. We will then consider other new elements, ending with those from the alkalis and alkaline earths, since these came rather later.

The brilliant German analytical chemist Klaproth often had his work reported in the *Annales*. Occasionally he wrote directly to Vauquelin, who was one of the best analysts among the Paris chemists. The very first volume of the *Annales* contained no less than three different reports of analyses by Klaproth. In 1789 he investigated pitch-blende and obtained a yellow powder. When he reduced this with charcoal he obtained a black powder, which he thought was a new element, and he named it *uranium* after the recently discovered planet Uranus. This was reported in the *Annales* in a letter from Crell to Hassenfratz.[49] For more than 50 years this was accepted as an element until in 1841 Peligot showed that it was really an oxide of uranium.[50] It was fitting that this memoir too should be published in the *Annales* in a later series.[51]

Another achievement of Klaproth was to recognise that *zirconia* was a substance distinct from alumina, although it has many similar properties. His analytical results were confirmed by Guyton[52] and by Vauquelin.[53] It was not until the 1820s that Berzelius was able to isolate the metal zirconium, albeit in an impure state.[54] Again, it was the *Annales* that gave the news. Another earth examined by Klaproth was also studied by Hisinger and Berzelius, who announced the discovery of a new metal.[55] They prepared the pure oxide (*ceria*), but despite the best efforts of several chemists including Vauquelin, it was not until much later that the metal *cerium* was isolated.

The case of titanium (oxide) is also complicated, since it was recognised as a distinct substance in 1789 by the Englishman William Gregor, who com-

---

[48] Mary E. Weeks, *Discovery of the Elements*, 7th edn., revised by Henry M. Leicester, Easton, Pa., 1968.

[49] *A.c.*, *4* (1790), 162-5.

[50] *C.R.*, *12* (1841), 735-7 (summary only).

[51] *A.c.p.*, [3], *5* (1842), 5-47.

[52] *A.c.*, *21* (1797), 72-95.

[53] *A.c.*, *22* (1797), 179-210.

[54] 'Extrait d'un lettre de M. Berzelius à M. Dulong', *A.c.p.*, [2], *26* (1824),43.

[55] 'Nouveau métal découvert dans le tungstein de Bastnas', *A.c.*, *50* (1804), 245-271. See also *ibid.*, *54* (1805), 28-65.

municated a report on his work to Crell.[56] In 1795, however, Klaproth confirmed Gregor's discovery and proposed the name *titanium*, taken from classical mythology. As this work was done at a time when the *Annales* was suspended, French readers learned of it through the *Journal des mines*.[57] Klaproth was also responsible for the naming of the element *tellurium*, from the Greek for earth. The metal had actually been isolated by Müller von Reichenstein, who recognised it as a distinct substance in 1783. Published in a short-lived local journal,[58] the work was overlooked for 15 years and it had to be rediscovered by Klaproth, who read a paper on the subject to the Berlin Academy of Sciences. A translation promptly appeared in the *Annales*,[59] which provided all the necessary international publicity.

Considering that Klaproth made such a major contribution to the analysis of minerals and the discovery of new elements in the late eighteenth century, one might ask whether it might not have been useful to bring together his separate papers in book form. The answer is that he himself considered publication in book form appropriate.[60] Yet it was important that work such as his should not be isolated. It made good sense to publish the analyses quickly in a perodical, side by side with the work of other analytical chemists.

Vauquelin's discovery of chromium was announced to the First Class of the Institute on 1 November 1797 and published in the *Annales* dated January 1798.[61] Vauquelin said that, as miners dug more deeply in the earth, the discovery of more new substances was to be expected. Even the application of new techniques of chemical analysis to minerals already obtained and displayed in cabinets would probably produce useful discoveries. In 1789 Vauquelin had examined Siberian red lead and had concluded that it was a combination of lead oxide, iron and alumina. He had, however, recently re-examined this mineral and found that it produced an acid with quite distinct properties from anything known. He described experiments to show the acid was different from that obtained from molybdenum. In a second memoir one month later, having worked with a larger quantity of the new material, he was able to give a further description of the new metal and its salts which, on the

---

[56] Crell's *Annalen*, 1791, *1*, 55.

[57] *Journal des mines*, No.19 (1796), 51-6.

[58] *Physikalische Arbeiten der einträchtigen Freunde in Wien*. Full details are given in Mary E. Weeks, *op.cit.*, pp.293, 318.

[59] *A.c.*, *25* (1798), 273.

[60] *Beiträge zur chemischen Kenntniss der Mineralkörper*, 6 vols., Posen & Berlin, 1795, 1797, 1802, 1807, 1810, 1815. An English translation appeared in 1801-4 and in French translation in 1807.

[61] 'Mémoire sur une nouvelle substance métallique contenue dans le plomb rouge de Sibérie et qu'on propose d'appeler *Chrome* à cause de la propriété qu'il a de colorer les combinaisons où il entre', *A.c.*, *25* (1798), 21-32, 194-205. *A.c.*, *26* (1798), 155-169.

advice of Fourcroy and Haüy, he proposed to call *chrome*, a name relating to the bright colour of many of its compounds.

Vauquelin also isolated an earth (beryllium oxide) obtained from the semi-transparent pale green precious stone beryl, and he was happy simply to refer to it as the earth of beril.[62] The editors of the *Annales*, however, added a note to his memoir saying that, as the most characteristic property of the new earth was to form salts with a sweet taste, they proposed to call it *glucina* from the Greek glukus = sweet. They recommended this as a non-trivial name, easily remembered and consonant with the principles of the new nomenclature. One might have thought that the editors of the *Annales* in 1798 carried almost the same authority as the four authors of the *Méthode de nomenclature chimique* of 1787 but, whereas the French had led the world in new chemical theory, they held no monopoly in mineral analysis, where the Germans and the Swedes still headed the field. Klaproth pointed out that the new earth *yttria* also formed salts with a sweet taste and he preferred to call Vauquelin's earth *beryllia* from the name by which the mineral was universally known. The corresponding metal was not isolated until 1828, when Klaproth's proposal was accepted. In France, and sometimes elsewhere, the name *glucinum* was preferred, thus causing some confusion.

Another claim for the discovery of a new metal was made by a wealthy Englishman, Charles Hatchett, who analysed a rock fragment of the columbite sent many years previously from Connecticut to Sir Hans Sloane in London. He made his announcement at a meeting of the Royal Society on 26 November 1802 and called the new element *columbium*. It was published in Nicholson's *Journal* in January 1802[63] and a few months later in the *Annales* in the form of a letter from Chenevix to Vauquelin.[64] Soon after there was an announcement by Ekeberg of another new metal, *tantalum*,[65] obtained from the mineral tantalite from Finland. According to Wollaston, however, tantalum was identical with columbium[66] and this view was widely accepted. It was only some 40 years later that Marignac and Heinrich Rose finally proved that they are two distinct elements.[67]

The chemically similar metals platinum and palladium were discussed in the *Annales*. Platinum had been known for some time but further researches by Guyton[68] and by Proust[69] were published in the *Annales*. A major problem

---

[62] *A.c.*, *26* (1798), 155-177(169n.).

[63] *Journal of Natural Philosophy, etc.*, [2], *1* (1802), 32-4. In 1846 Heinrich Rose claimed the discovery of *niobium* but then found it was the same as columbium. The latter name has now been replaced by the former.

[64] *A.c.*, *41* (1802), 194-6.

[65] *A.c.*, *43* (1802), 276-284.

[66] *A.c.76* (1810), 87-98.

[67] Mary E. Weeks, *op.cit.*, p.323.

[68] *A.c.*, *25* (1798), 3-21.

that arose in the early 1800s was whether the new metal *palladium* was really a compound of platinum with mercury. Wollaston had announced the discovery of palladium in such a mysterious way[70] that doubts were expressed about its identity as a separate element. The young Irish chemist Chenevix, in a number of papers presented to the Royal Society, published in the *Transactions* and appearing finally in the *Annales*, favoured the view that it was a compound of platinum.[71] To complicate the issue, Fourcroy and Vauquelin isolated a new substance which, when mixed with platinum, gave a metal like palladium.[72] Fortunately Smithson Tennant was able to show that the substance they obtained contained two new metals, *osmium* and *iridium,* and was quite distinct from palladium.[73] This, however, still left the repeated claims of Chenevix. Chenevix had argued that a certain combination of platinum and mercury could withstand high temperatures without decomposition and that it was very similar to palladium.[74] The German chemists Rose and Gehlen, however, disputed these results. Berthollet decided that a good way to settle the issue would be to employ the analytical talents of Descotils in his laboratory at Arcueil,[75] and this confirmed the separate identity of palladium. Vauquelin was later able to develop a method of separating the new metals platinum, palladium, rhodium, iridium and osmium.[76]

News of Tennant's discovery of osmium and iridium was published in the *Annales* in October 1804, five months after he had announced his discovery to the Royal Society in England.[77] Yet, because of poor communication between England and France at this time, this was one of the pieces of British news which reached Paris via Geneva and the *Bibliothèque britannique*.[78] Tennant had examined a black powder remaining after dissolving platinum in aqua regia. He found that it contained two new metals. One of the metals Tennant proposed to call *iridium* , because solutions of its salts were of several colours. The other formed a strongly-smelling oxide, and Tennant proposed to call the metal *osmium*. The same issue of the *Annales* also contained

---

[69] *A.c.*, *38* (1801), 146-174, 225-8.

[70] *A.c.*, *61* (1807), 89-111. Wollaston announced his discovery by means of an anonymous handbill, circulated in London, offering the metal for sale.

[71] Chenevix, 'Enquiries concerning the nature of a new metallic substance lately sold in London as a new metal under the title of Palladium', *Phil.Trans.*, 1803, 290-320; *A.c.*, *47* (1803), 151-202.

[72] *A.c.*, *48* (1803), 177-185.

[73] *Phil. Trans.*, *94* (1804), 411.

[74] *A.c.*, *66* (1808), 82-91.

[75] *A.c.*, *67* (1808), 86-90.

[76] *A.c.*, *89* (1814), 150-182, 225-251.

[77] Readers of Nicholson's *Journal* in England had to wait until the following year to learn of the discovery: *Journal of Natural Philosophy, Chemistry and the Arts*, *10* (1805), 24-30.

[78] *Ibid.*, 51-3, Readers of Nicholson's *Journal* were only informed of this discovery in January 1805, *Journal of Natural Philosophy, 10* (1805) 34-42.

news of Wollaston's discovery of *rhodium*,[79] obtained from residues of crude platinum, and so-called from the rose colour of its salts.

5. *Davy's work on the isolation of elements.*

In the previous section we were concerned with a number of new substances, many of them elements, discovered by the careful analysis of minerals in the early years of the *Annales*. They involved chemists of several different nationalities, and the methods used were miscellaneous. It is now time to turn to two groups of elements which were all isolated by a common method, electrolysis, and mainly by one man, Humphry Davy. This was to be his greatest claim to fame. Davy also has claims to have discovered the elementary nature of chlorine and iodine. Naturally the *Annales* was concerned to report Davy's work at the earliest opportunity, despite difficulties in communication at the height of the Napoleonic wars. Considerable additional interest was added to the news of Davy's discoveries by the fact that the French chemists were not reduced to being passive spectators. Gay-Lussac, an exact contemporary of Davy, was anxious to share in Davy's discoveries and he was helped by Thenard. In so far as these two chemists were members of the editorial board of the *Annales* in the period concerned, this meant that, in this case, the *Annales* was not a totally neutral medium for the reporting of scientific news.

Davy's first major paper on electro-chemistry, his Bakerian lecture of 1806, published in the *Philosophical Transactions* for 1807, appeared in the issue of the *Annales,* dated 31 August 1807, and was a translation from the English by Berthollet.[80] Davy made the following prophecy:

> If chemical union be of the nature which I have ventured to suppose, however strong the natural electrical energies of the elements of bodies may be, yet there is every possibility of a limit to their strength: whereas the powers of our artificial instruments seem capable of indefinite increase... This... may induce us to hope that the new mode of analysis may lead us to the discovery of the *true* elements of bodies.[81]

In October 1807 Davy was able to isolate the metal *potassium* by the electrolysis of a small piece of potash, using platinum electrodes.[82] A violent

---

[79] 'Notice sur deux nouveaux métaux découverts dans le platine brut par M. Tennant; communiqué aux éditeurs de la Bibliothèque britannique par un correspondant de Londres, dans une lettre en date de 21 août 1804', *A.c.*, *52* (104), 47-51.

[80] *A.c.*, *63* (1807), 172-224, 225-266. In a footnote Berthollet admitted that he had been forestalled in translation both by the *Bibliothèque britannique* and the *Journal de physique*. He praised the former but criticised the latter. For details of different translations of Davy's memoirs see June Z Fullmer, *Sir Humphry Davy's Published Works*, Cambridge, Mass., 1969.

[81] Davy, *Works*, vol.5, p.54.

[82] *A.c.*, *68* (1808), 203-224, 225-276.

reaction was observed to take place and a few small globules, having a metallic lustre like mercury, were observed. Some burned spontaneously; others soon became covered with a white film. When thrown on water, the new substance reacted violently, and Davy concluded that he had isolated 'the basis of potash'. By a similar method he was able to isolate the metal *sodium* a few days later. Both these results were reported in Davy's Bakerian lecture of November 1807 and almost immediately translated into French in the *Bibliothèque britannique*. This time the editors of the *Annales* were happy to use the translation provided by the Geneva periodical and this appeared in two parts in the issues dated 30 November and 31 December 1808.

Meanwhile, however, Gay-Lussac and Thenard, wishing to share in the new discovery, had reported that they had managed to decompose potash and soda by reduction with iron filings at a high temperature.[83] The advantage of their method was that they had been able to obtain the new metals in sufficiently large quantity to examine their properties accurately. They showed that it was not essential to use the electric battery. Nevertheless, they saw the possibilities of the new tool of electricity, and managed to have a large battery set up in the chemistry laboratory of the Ecole Polytechnique. Gay-Lussac and Thenard, however, were not only rivals with Davy in research but critics of his theory. They at first doubted Davy's claim that he had discovered two new elements and thought that potassium, for example, might be a compound with hydrogen.[84] Several other chemists refused to accept the elementary nature of these substances, including Curaudau, a contributor to the *Journal de physique*.[85] It was only in 1810 that Gay-Lussac and Thenard were won over and then it was by their own research rather than Davy's arguments.

But Gay-Lussac and Thenard had access to other media of publication beside the *Annales*. They reported the results of their experiments on the absorption of hydrogen by heated potassium in the *Moniteur*,[86] as if the cycle of monthly publication of the *Annales* was too slow. Nor did they neglect to make use of the *Mémoires* of the Society of Arcueil.[87] Davy had no means of access to these journals and he, therefore, turned to the *Journal de physique* of La Métherie, who published in the December 1809 issue a reply to the claims of the French chemists. The *Annales* felt that it should reproduce (with

---

[83] *A.c.*, *65* (1808), 325-6.

[84] *A.c.*, *66* (1808), 217. The reasoning is complex but it involved the reaction of potassium with dry ammonia, see R. Siegfried, 'The discovery of potassium and sodium and the problem of the chemical elements', *Isis*, *54* (1963), 247-258 (251).

[85] *Journal de physique*, *66* (1808), 452-6.

[86] *Moniteur*, no.144, 1808.

[87] 'Extrait de [huit] mémoires lus à l'Institut national, depuis le 7 mars 1808 jusqu'au 27 février 1809', *Mémoires de la Société d'Arcueil*, *2* (1809), 295-358, e.g. 'Propriétés du métal de la potasse', pp.302-311.

acknowledgment) Davy's criticisms,[88] so that Gay-Lussac and Thenard could reply to them.[89]

Lavoisier had suggested that the alkaline earths, although provisionally included in his table of simple substances, might well be the oxides of unknown metals and Davy was happy to accept this additional challenge. His paper on the decomposition of earths, read to the Royal Society on 30 June 1808, published in the *Philosophical Transactions* and translated by Prieur, appeared in *Annales* dated 31 May 1809.[90] Davy mentioned several initial failures. But after the Royal Institution had obtained a more powerful battery and he had learned of the experiments of Berzelius, he was able to electrolyse the respective earths with mercury under a protective cover of naphtha. By distilling the resulting amalgams, he was able to obtain small quantities of *barium*, *strontium*, *calcium* and *magnesium* respectively.

One might have thought that the isolation of all these elements was enough for one man but Davy was now roused by the search for new elements. He turned to the gas that had been called 'oxygenated muriatic acid' and, finding that it was impossible to decompose, concluded that it too was an element, which he called *chlorine* from its colour (Greek chloros = pale green).[91] The irony of the Englishman having this result published in the *Annales* was that his great rival, Gay-Lussac, had himself come to a similar conclusion slightly earlier[92] but, as the conclusion seemed so extraordinary to his mentor, Berthollet, he was advised not to make too strong a claim.[93] Credit for the discovery is, therefore, usually assigned to Davy.

An even greater example of competition between the two men relates to the investigation of a new substance found in seaweed. The competition was all the fiercer as Davy actually did his experiments in Paris, which he was visiting in the winter of 1813. Davy had been given an especially warm welcome by a group of chemists outside the scientific establishment, who wanted to see what Davy could make of the new substance. Meanwhile, in the same city, Gay-Lussac was also eagerly investigating the new substance. The detailed story of the rivalry has been told previously.[94] Here we may briefly report that Gay-Lussac again made use of the *Moniteur* to announce experimental results, thus helping to establish priority. But Gay-Lussac's capacity for careful work is shown at its best in a memoir he finally published in the *An-*

---

[88] *A.c.*, *75* (1810), 264-273, etc.

[89] *A.c.*, *75* (1810), 290-316.

[90] *A.c.*, *70* (1809), 189-223, 225-254.

[91] *A.c.*, *76* (1810), 112-158. In the case of this memoir the *Annales* untypically anticipated the *Bibliothèque britannique* in publishing a French translation.

[92] *Mémoires de la Société d'Arcueil*, *2* (1809), 357-8.

[93] *A.c.*, *91* (1814), 97.

[94] M. Crosland, *Gay-Lussac, Scientist and Bourgeois*, Cambridge, 1978, pp.80-87.

nales.[95] This monograph of 156 pages[96] on the element iodine fills the entire issue of the *Annales* for July/August 1814.[97] Most readers would have agreed on the historic importance of this work, which crowded out the usual mixture of shorter papers, abstracts and reviews. It clearly presented the properties of iodine as an element analogous to chlorine. A further analogy with sulphur was suggested, but this would be forgotten when the truly analogous bromine was discovered in 1825/26.

6. *Applied chemistry*

From the outset the title page of the *Annales* proclaimed that it would be concerned not only with (pure) chemistry but also with chemical technology (*'la chimie et les arts qui en dépendent'*). Approximately half of Volume 1 was concerned with pure chemistry, with applied chemistry amounting to about 15%. Yet in the second and succeeding volumes the proportion of pure chemistry dropped sharply, with a corresponding increase in applied chemistry and this continued, so that, by 1793, the proportions of 1789 were almost completely reversed. Here again is a reminder that the *Annales* can only be understood in the context of French political, social and military history. From the summer of 1789 chemists and other men of science become increasingly involved in government business and applied research. In April 1792 France declared war on Austria and in 1793 on Britain and other European powers. Men with knowledge of science were drawn into the war effort and we have seen that the contribution of the chemists was particularly important in the manufacture of munitions.

The *Annales* ceased publication at the end of 1793 and, when it resumed publication in 1797, the editors placed particular emphasis on applied science and industry. They said that chemical theory was of great importance in certain branches of industry, since it would help avoid mistakes and economic loss and ensure the quality of materials.[98] The advancement of technology would require the replacement of a tradition of technical secrets by a practice of clear descriptions of processes related to chemical theory. Such development was needed to make France independent of foreign imports. Thus, whereas applied chemistry had been included from the beginning, the effect of the war in particular was to place much greater emphasis on this aspect. From 1797 to 1815 it occupied an average of 30% of the articles published in the *Annales*.

---

[95] *A.c.*, *91* (1814), 5-160.

[96] Issues were usually of around 100 pages. The following issue was reduced to 64 pages.

[97] The fact that this memoir was read to the First Class on 1 August 1814 is not only indicative of prompt publication but also of the accuracy of the date shown on the cover (31 July 1814).

[98] *A.c.*, *19* (1797), 1. See Appendix 1, No.7.

In considering the range of applied chemistry covered by the *Annales,* it seems appropriate to begin with the early volumes and some of the interests of Berthollet. Since 1784, when he had been appointed to an administrative and research post in the Gobelins tapestry works, Berthollet had a special interest in bleaching and dyeing and these subjects were taken up in the *Annales*. In 1785 he had presented a study of chlorine ('dephlogisticated muriatic acid') to the Academy and was aware of its bleaching action. In 1789 he described in the *Annales* how this could be put to practical use.[99] He described how the gas should first be dissolved in water. The cloth to be bleached should be boiled in dilute caustic potash solution and then placed in the bleaching solution for several hours. This process was to be repeated at least four times and the cloth was then to be washed and finally treated with very dilute sulphuric acid. Berthollet provided all the necessary practical details, showing that the article was intended to be read by manufacturers. He now spoke of the gas as 'oxygenated muriatic acid', thus giving further currency to the oxygen theory.[100] He publicly disagreed with Chaptal who, at this time, favoured the use of chlorine in a gaseous state rather than in solution.[101] Later papers favoured the use of an alkaline solution of chlorine.[102] Other papers dealt with the special problems involved in bleaching silk or wool or paper.[103] Most of the papers in the *Annales* after 1800 dealing with chlorine were concerned with its disinfectant rather than its bleaching properties, which must have been widely known by then.

Berthollet wrote a book on dyeing and provided a summary of it himself for the *Annales*.[104] Most eighteenth-century dyes were of vegetable origin and were normally imported. Because of the war, previously imported goods became scarce, and sometimes substitutes were sought here as well as for other materials. This adds to the importance of the many articles on dyeing. The correspondence between Berthollet and Haussman, the owner of a dyeworks at Colmar, is particularly interesting. Although the chemical understanding of dyeing in this period was minimal, both authors were particularly

---

[99] 'Description du blanchîment des toiles et des fils par l'acide muriatique oxigéné', *A.c.*, *2* (1789), 151-191; 'Supplément...', *A.c.*, *6* (1791), 204-10.

[100] The realisation that chlorine was a simple substance had to wait for the work of Gay-Lussac and Davy. Although we would agree that its bleaching property depended on oxidation, the oxygen came not from the gas but from its reaction with water: $H_20 + C1_2 = HC1 + HC1O$, the latter being unstable.

[101] A. L. Lavoisier and C. L. Berthollet, 'Rapport d'un mémoire de M. Chaptal sur quelques propriétés de l'acide muriatique oxigéné', *A.c.*, *1* (1789), 69-73.

[102] Kirwan, *A.c.*, *18* (1793), 163-225; Chaptal, *A.c.*, *38* (1801), 292-7.

[103] Haussman, *A.c.*, *11* (1791), 237-50; Baumé, *A.c.*, *17* (1793), 156-212; Loysel, *A.c.*, *39* (1800), 137-159.

[104] *Elémens de l'art de la teinture*, 1st edn., 2 vols., Paris, 1791, reviewed in *A.c.*, *9* (1791), 138-157. A second edition was reviewed by Thenard: *A.c.*, *52* (1804), 239-68.

concerned to raise the practice of dyeing from a primitive craft to a rational technology.

From about 1803 the *Annales* carried a number of memoirs on painting. Most paints were subject to fading or discolouration and one method of preserving the colour was to cover the paint with a transparent varnish, although this often introduced serious fire hazards. Boulaye-Marillac claimed to have discovered how to produce colours, which were not changed by long exposure to the atmosphere and a commission of the First Class largely supported his claim.[105] The problem of making France self sufficient in compounds used in painting, notably cinnabar, was discussed by Séguin.[106]

Another attempt to make France self sufficient concerned alum, which was used as a mordant in dyeing.[107] It was generally accepted that the best alum came from Tolfa near Rome, but the nature of alum as a triple salt involving both potash and aluminium sulphate was not recognised until 1797, when Vauquelin and Chaptal simultaneously published papers which gave the same analysis.[108] Thenard and Roard later analysed different samples of alum of French origin, some of which were actually sold as 'alum of Tolfa'.[109] They showed that pure alum made in France was as good as any imported alum. They had to destroy the popular prejudice that Italian alum was essentially superior.

One of the most important aspects of making France self sufficient related to sugar, since the final solution to the problem was to create a major new industry for the nineteenth and twentieth centuries. Because of the war, direct importation of cane sugar from the West Indies was no longer possible, although some supplies did reach France indirectly and at a high price. Various attempts to find substitutes were reported in the *Annales*, including the use of molasses,[110] honey,[111] and particularly grapes. The main advocates of the use of sugar from grapes were Proust[112] and Parmentier. Parmentier was particularly keen on the use of a syrup extracted from grapes, and as a member of

---

[105] 'Extrait du Rapport sur les couleurs inaltérables...', *A.c.*, *77* (1811), 337-42. See also *ibid.*, *92* (1814), 329-33.

[106] *A.c.*, *90* (1814), 252-60, 268-77.

[107] Charles Singer, *The Earliest Chemical Industry. An Essay in the Historical Relations of Economics and Technology Illustrated from the Alum Trade*, London, 1948.

[108] Vauquelin, 'Mémoire sur la nature de l'alun', *A.c.*, *22* (1797), 258-80. Chaptal, 'Analyse comparée des quatre principales sortes d'alun du commerce et observations sur leur nature et leur usage', *A.c.*, *22* (1797), 280-97. Not surprisingly the simultaneous publication gave rise to a priority dispute.

[109] 'Mémoire sur l'alun de Rome comparé avec ceux des fabriques de France', *A.c.*, *59* (1806), 58-90.

[110] *A.c.*, *17* (1793), 111-112.

[111] *A.c.*, *39* (1801), 110-113.

[112] *A.c.*, *57* (1806), 131-175; 225-273.

the editorial board from 1800, he was able to publish no less than six papers on the subject.[113]

With hindsight, however, we know that the most important substitute for cane sugar was beet sugar. The discovery, made by the German chemist Achard, was first described in a letter from A. N. Scherer to Van Mons and published in the *Annales*.[114] Further details were published later, including an abstract of the relevant memoir by Achard.[115] The research was important enough to concern the First Class of the Institute, whose report was also published.[116] There was some initial hesitation about the adoption of the method, and reports of the continual search for alternative sources of sugar up to about 1812, published in the *Annales,* indicate that the use of beet presented many practical difficulties. Some of these problems were discussed in an article by Deyeux.[117] On a large scale the sugar had to be extracted with hot water, rather than with the alcohol used in the laboratory, but still the cost was high and, unless treated expertly, the resulting sugar might be coloured and have a bad taste. However, in 1812 a favourable report was published of the work of the new experimental school of sugar beet at Castelnaudray, near Toulouse; new agricultural methods were proposed.[118] It was Chaptal, however, who eventually provided the most comprehensive account of the beet sugar industry.[119] He was able to describe his own experiments and gave both agricultural and industrial details. As an expert in chemical industry, he saw fit to supply all the relevant information about the costs of materials and the expected yield. He added his own authority to the claim that beet sugar was chemically identical with cane sugar, whereas grape sugar was not.

Partly because of the personal involvement of Chaptal and Parmentier, both members of the editorial board, considerable interest was shown in the *Annales* in wines, which were also, of course, a major French product. Chaptal's book, *Traité sur les vins*, was reviewed at inordinate length in the *Annales*.[120] Chaptal also liked to distribute questionnaires on different aspects of wine-making and on two occasions the *Annales* published the most interesting responses.[121] Chaptal had a special interest in improving apparatus for the

---

[113] *A.c.*, *67* (1808), 173-198; *70* (1809, 126-145; *74* (1810), 113-129, 233-250; *75* (1809), 5-27; *80* (1811), 89-109, 293-314; *82* (1812), 332-4.

[114] *A.c.*, *30* (1799), 299-302. See M. Crosland, *The Society of Arcueil. A View of French Science at the Time of Napoleon I*, London, 1967, pp.33-36.

[115] *A.c.*, *32* (1799), 163-8; *33* (1800) 67-74.

[116] N. Deyeux, 'Extrait du rapport ... par la commission chargée de répéter les expériences de M. Achard sur le sucre de betterave', *A.c.*, *35* (1800), 134-153.

[117] *A.c.*, *77* (1811), 42-63.

[118] *A.c.*, *84* (1812), 211-225.

[119] *A.c.*, *95* (1815), 233-294.

[120] *A.c.*, *35* (1800), 240-300; *36* (1800), 3-50, 113-145, 225-258; *37* (1801), 3-38.

[121] *A.c.*, *30* (1799), 113-152, 225-8; *61* (1807), 1-58.

distillation of wine and he recommended the use of apparatus devised by Edward Adams[122] and Bérard, an issue also discussed by Duportal.[123] Chaptal's interest in wine was rivalled only by Parmentier, although the latter's interests were largely confined to pharmaceutical aspects. He, therefore, wrote about medicinal wines[124] and he was also concerned about the possible use of poisonous substances in wine-making.[125] Parmentier not only contributed his own work to the *Annales* but also provided memoirs by others. Early volumes of the *Annales* included some papers on methods of calculating excise duty on wines and spirits,[126] a subject later taken up for the government by Gay-Lussac.[127] A paper of great potential importance by Gay-Lussac was one on the fermentation of grape juice, in which he showed that after it had been preserved unaltered in a sealed container for a year, it would begin to ferment if poured into another vessel. He, therefore, concluded that: 'oxygen is necessary to start fermentation though not necessary to continue it'.[128] However, as Pasteur showed two generations later, Gay-Lussac's explanation was incomplete.[129]

Not unrelated to food and wine, was the question of poisoning and particularly poisons arising from the vessels, in which food may be stored or cooked. The use of copper-plated pans, and glazes containing lead on cooking pots led to some alarm from Fourcroy,[130] who criticised Proust.[131] Guyton considered that Proust was unduly optimistic about the possible harmful effects and added a number of critical editorial footnotes to his memoirs. The use of various substitutes for copper, such as zinc, also came in for critical review.[132] This developed into the further question of the purity of the zinc, which might contain a small proportion of arsenic.[133] There was further discussion on problems relative to the enamelling of metals.[134]

Space does not permit further detailed discussion of applied chemistry. Suffice it to say that there was some discussion of the refining of gold, silver and platinum and the purification of cobalt and nickel. Among the non-metals phosphorus and its compounds received particular attention and, among or-

---

[122] *A.c.*, *69* (1809), 59-92.
[123] *A.c.*, *77* (1811), 178-225, 225-259.
[124] E.g., *A.c.*, *35* (1800), 158-74.
[125] *A.c.*, *76* (1810), 159-172, 283-290.
[126] *A.c.*, *13* (1792), 243-280; *15* (1792), 37-82, 160-223.
[127] *Instruction pour l'usage de l'alcoomètre centésimal*, Paris,1824, M. Crosland, *Gay-Lussac, Scientist and Bourgeois*, Cambridge, 1978, pp.190-193.
[128] *A.c.*, *76* (1810), 245-68.
[129] Pasteur, *Oeuvres* (7 vols., Paris, 1922-39), vol.2, pp.427-9 (1874).
[130] *A.c.*, *44* (1802), 250-267; *53* (1805), 230-3.
[131] *A.c.*, *51* (1804), 44-75, 117-152, 237-70.
[132] *A.c.*, *86* (1813), 51-63, 113-140.
[133] *A.c.*, *88* (1813), 73-9.
[134] E.g., *A.c.*, *9* (1791), 192-215; *34* (1800), 200-205.

ganic compounds, acetic acid was prominent. Growing chemical industries gave rise to pollution and an important memoir on this subject was published in the *Annales*.[135]

7. *Disinfection*

Under the old regime Guyton's most important contribution to chemistry was probably in connection with chemical nomenclature. He had been a leading advocate of reform long before he began his association with Lavoisier. One of the effects of the Revolution was to make people more conscious of the value of the practical applications of chemistry and Guyton's most important contribution after the Revolution was his work on the disinfection of air. His *Traité des moyens de désinfecter l'air* was first published in 1801. It went through several editions and translations but what is most relevant here is that Guyton used his privileged position as editor of the *Annales* to give constant publicity to his own ideas right up to 1815. Although one might think that the several editions of a book are the ideal way to spread new ideas, there can be little doubt that Guyton obtained even wider publicity - one might almost say notoriety - through the pages of his journal.

Guyton's involvement in the process of disinfection went back to 1773, when he lived in Dijon and the local authorities asked him to give his advice on a serious problem of public health.[136] A part of Dijon had been made uninhabitable by putrid emanations from bodies buried in the crypt of the church of St. Médard. Guyton knew that ammonia ('volatile alkali') was sometimes given off from decaying animal matter and he thought that this might carry with it particles injurious to health. However, as a chemist, he knew that hydrochloric acid ('marine acid')[137] fumes combined with ammonia to form a white solid. He, therefore, suggested that the acid fumes would also cause the miasma to be precipitated. He accordingly heated a mixture of common salt and oil of vitriol to produce the 'marine acid' and left it in the church overnight; the next morning the bad smell had gone and the district seemed to have lost its unhealthy state. Later in the same year he was called upon to disinfect the prison in Dijon, where many prisoners had died, and he applied the same method with apparent success. A report of this work was published in the *Observations sur la physique*[138] and came to the attention of the Paris

---

[135] Guyton and Chaptal, 'Rapport...sur la question de savoir si les manufactures qui exhalent une odeur désagréable peuvent être nuisibless à la santé', *A.c.*, *54* (1805), 86-104.

[136] W.A. Smeaton, 'Guyton de Morveau: a bibliographic study', *Ambix*, *6* (1957), 18-34 (32-3), art. 'Guyton de Morveau' in C.C. Gillispie, ed., *Dictionary of Scientific Biography* (16 vols., New York, 1970-80), vol.5, pp.600-604. Lars Oberg, 'De mineralsura rökningarna. En episod ur desinfektionsmedlens historia', *Lychnos*, (1965-66), 159-180.

[137] After 1782 'marine acid' was called 'muriatic acid'.

[138] *Obs. 1* (1773), 436 and *3* (1774), 73.

Royal Academy of Sciences, which recommended the use of the method in prisons.[139]

By the time Guyton wrote his *Traité des moyens de désinfecter l'air* in 1801 he had come to appreciate that ammonia was not always given off from decaying flesh. He now concluded that the disinfectant action of the acid was due to the oxygen, which was assumed to be in all acids. Thus one simple but erroneous chemical theory of the disinfecting action of hydrochloric acid was replaced by another. The new theory was possibly superior, in so far as it explained why chlorine ('oxygenated muriatic acid') should be a better disinfectant than ordinary muriatic acid.

A long review of Guyton's book was given by Deyeux in the issue of the *Annales* for July 1801. He began by commenting that 'the utility of chemistry had ceased to be a problem',[140] in other words that it was generally accepted, and Guyton's work provided only a reminder of this fact. Guyton was spoken of in the most complimentary way as 'a distinguished *savant* [and] a profound chemist', who had shown courage and patience to make a major humanitarian contribution. The book was divided into several parts, of which the first was historical. Guyton had carried out chemical tests on various types of malodorous air to try and establish a relation between smell and harmful effects. He was convinced that oxygen was associated with good health; moreover oxygen readily combined with many substances. He had, therefore, tried the effect on miasmas of substances containing oxygen and in particular of 'oxygenated muriatic acid' (chlorine). On Guyton's theory of oxidation *all acids* should have beneficial medical effects. He concluded with a survey of these effects; sulphuric acid was too 'fixed' to be useful, nitric acid was potentially beneficial, but the nitrous gas was harmful, hydrochloric acid was superior but chlorine (oxygenated muriatic acid) was the best of all - its effects were rapid and certain. Deyeux concluded his review with more flattering comments about the author. The book deserved great publicity.

Some of that publicity was to come the following year on the occasion of the publication of a second edition of Guyton's book.[141] This time the review was by Adet and began with a couple of pages of high-flown Enlightenment rhetoric. Guyton was now concerned to refute the ideas of the Englishman James Carmichael Smyth that nitric acid was a particularly good disinfectant. Yet it corroded metals and was more difficult to diffuse through the atmosphere. Guyton therefore still preferred chlorine. Yet he felt he had to contribute directly to the publicity of his method. Accordingly, in the issue of May 1803, he published some of the correspondence he had received on the

---

[139] *Mémoires de l'Académie des Sciences*, 1780, 421.
[140] *A.c.*, *39* (1801), 74-103 (74).
[141] *A.c.*, *45* (1803), 286-297.

subject. He was disappointed that general newspapers had failed to publicise his discovery[142] and was particularly sad that the government had failed to appreciate that it offered a means of saving many lives in hospitals, which were currently lost through miasmas. After reporting successful uses of his method in the provinces, Guyton explained how to prepare disinfecting flasks with the appropriate reagents; he also described larger scale apparatus. A further letter from Italy was given publicity in 1803.[143] Of much greater authority was a report on behalf of the First Class of the Institute by Berthollet.[144] This was largely a factual and uncritical summary of the second edition of Guyton's book but, more positively, it ended with the recommendation that the French government should order the regular use of acid fumigation in hospitals and that medical professors should teach the method to their students. This report was also published in the *Moniteur*.[145]

One might have thought that Guyton would now be satisfied, but a few months later no fewer than three contributions on Guyton's method appeared in one issue of the *Annales*.[146] There were still a few medical practitioners who thought the use of acid vapour might be dangerous (hospital patients were not always moved during the process) or who still thought that sweet smells might eradicate disease and Guyton insisted on publishing further evidence of the successful use of his method.[147] One of these gave a description of fumigation apparatus[148] and a later issue of the *Annales* explained where this could be purchased.[149]

By 1807, when Guyton had two further letters to him on his favourite subject published in the *Annales*,[150] he felt it necessary to add a note, asking whether sufficient information about fumigation had not already appeared in the *Annales*.[151] He concluded that it was necessary to provide testimony of its effectiveness, since some young doctors had challenged the value of the method. Guyton never missed an opportunity to publish a letter favouring his ideas. Thus in 1809 he published a copy of a letter[152] from a navy doctor to the local prefect:

> It is with pleasure that I reply to the letter of M. Guyton de Morveau who wishes to see a multiplication of reports on the effects which

---

[142] *A.c.*, *46* (1803), 113-132 (114).
[143] *A.c.*, *48* (1803), 43-65.
[144] *Ibid.*, 313-330.
[145] *Moniteur*, 1 prairial, year 13 (21 May 1805).
[146] *A.c.*, *50* (1804), 81-7, 87-92, 107-113.
[147] *A.c.*, *51* (1804), 311-327.
[148] *A.c.*, *50* (1804), 81-7.
[149] *A.c.*, *52* (1804), 347-52.
[150] *A.c.*, *64* (1807), 172-181, 181-3.
[151] *Ibid.*, 183-90.
[152] *A.c.*, *70* (1809), 64-7.

> doctors obtain by the disinfection processes that he has prepared, because, this famous scientist adds, one still reads every day in the newspapers accounts of the ravages caused by hospital and prison fevers and by epidemics, without any mention being made of disinfecting or anti-contagion fumigation.
>
> The publicity that M de Morveau asked for is all the more useful as there are still sceptics ...

The doctor then went on to give an account of his experience in the United States. Guyton even gave publicity to claims for the *internal* use of a solution of chlorine,[153] almost as if chlorine were being peddled as a universal panacea. By 1811 things had moved in the direction of a personality cult, with talk of 'Guytonian fumigations'.[154] In 1812 a further notice by Guyton was distributed by the Minister of the Interior to prefects for circulation within their respective departments and Guyton included the text in the *Annales*.[155]

One can imagine all this while a certain resentment was building up among Guyton's fellow members of the editorial board, particularly the non-medical wing, about his obsession with his fumigation method and his insistence on inflicting this continually on the readers of the *Annales*. Already in 1813 and 1814 the reports on this subject that had appeared, had been squeezed in on the final pages of issues of the journal. In 1815 things seem to have come to a head and we find a plaintive letter from Guyton to his fellow editors appearing in the *Annales*:

> The Society of the *Annales de chimie*, which has so often accommodated the observations that I have communicated to it on the happy results obtained by my processes of disinfection, will not refuse me the insertion of my reply to two almost simultaneous attacks....[156]

One writer had dared to attribute the idea to his late colleague Fourcroy, rather than to Guyton. This required a long historical self-justification. The second part of the letter was published in what proved to be the final volume of the first series of the *Annales*.[157] Guyton said he had to defend himself against a new adversary. In fact his claims were so ambitious that some criticism was to be expected. It was a sad end to the career of a brilliant

---

[153] *A.c.*, *73* (1810), 330-4.

[154] Descroizilles 'Sur les fumigations Guytoniennes et sur les frictions Bertholliennes' *A.c.*, *79* (1811), 220-9. Descroizilles had already in 1788 begun to describe a solution of chlorine used for bleaching as *lessive de Berthollet* and he later described his instrument for measuring the strength of hypochlorites as a 'Berthollimètre'. This is a further extension of the same principle. Already in 1804 Guyton's apparatus had been described as 'Guytonienne' (*A.c.*, *50* (1804), 81).

[155] *A.c.*, *82* (1812), 205-12.

[156] 'Lettre de M. Guyton-Morveau sur les fumigations désinfectantes et anti-contagieuses', *A.c.*, *95* (1815), 321-331.

[157] *A.c.*, *96* (1815), 5-43.

chemist. His final fling was to reproduce the text of an article in the *Edinburgh Review,* recommending that he be given some (additional) national honour by his government.[158] Yet he was already in failing health and he was to die that winter. In more senses than one, his contribution marked the close of a major chapter in the history of the *Annales*.

[158] *Ibid.*, p.41n. Guyton, like many others, was already a member of the Legion of Honour and had been made a Baron by Napoleon.

CHAPTER EIGHT

PHYSICS AS AN EQUAL PARTNER WITH CHEMISTRY

> Chemistry and physics had long been entirely separate sciences; nowadays it would be difficult to trace the line of demarcation between the two sciences.
>
> (Prospectus bound at end of *A.c.*, *96* (1815) - see Appendix 1, No.12.)

> The praise given by Mr Herschel to the *Annales de chimie et de physique* is undoubtedly well deserved ... It must not be forgotten [however] that France, with her 32 millions of inhabitants, has but readers for one single philosophic journal, which of course has the choice of all the papers which are offered.
>
> (G. Moll, 'On the alleged decline of science in England', 1831, p.6.)

1. *The 1815 crisis and its resolution.*

For any library cataloguer the year 1816 may simply mark an expansion of the title of the *Annales de chimie* to *Annales de chimie et de physique*. But the historian must probe a little to understand what was happening at the time. First, the years 1814-16 were years of great political change. In May 1814 we have the (first) Bourbon Restoration, followed by the re-emergence of Napoleon in March 1815 (the 'Hundred days'), ending with his final defeat at Waterloo in June 1815. This permitted the second more permanent Bourbon Restoration under Louis XVIII. Louis wanted to forget the revolutionary turmoil and the Napoleonic adventure but he could not destroy the valuable institutions founded over the previous twenty years. As far as science was concerned, a cosmetic change of nomenclature was called for, and the First Class of the National Institute became the Royal Academy of Sciences of the Institute from March 1816. That year was to mark the beginning of a long period of peace and it was the start of a new period of economic activity, in which

France tried to catch up with Britain, which had already benefited in many ways for two generations from its 'industrial revolution'.

The final years of the Napoleonic regime were not without their economic as well as military casualties. One that is relevant to the study of the *Annales* was the bankruptcy in March 1814 of the publisher Klostermann. The *Annales* struggled to survive, and the unusually frequent meetings of the editorial board in the winter of 1814-15 are suggestive of a situation of crisis.[1] It was not only a question of finance (there was no money to pay authors) but also of more efficient organisation. The editorial board was again finding the disadvantages of government by committee and on 13 February 1815 it took a positive step by appointing Descotils, a mineralogist connected with the Ecole des Mines and a member of the Society of Arcueil, as secretary of the editorial board with executive powers. Apart from his general ability, Descotils had travelled to Egypt and Italy, and it was hoped that his foreign experience would benefit the *Annales*. His main responsibility was to oversee the printing of the journal and arrange for the translation of foreign memoirs.

An idea of the problems facing the regular publications of the *Annales* in the summer of 1815 may be gained from the text of a letter written by Berthollet to Berzelius at the end of August:

> I am sending you the latest issues of the *Annales*. They go up to the month of June, because the bankruptcy of the printer and also political events have caused great problems in their printing and have caused delays, which will probably increase.[2]

He went on to comment on the effects of the general political, social and financial malaise in the early years of the Restoration.

> The sciences here are in great stagnation. Deprived of all revenue, burdened by charges, afflicted by everything that surrounds us, uncertain of the future, we are unable to devote ourselves to the gentle occupation of study.

Certainly for the Bonapartist Berthollet, 1815 marked the end of an era. We shall see below that it also marked the end of an era for the *Annales*.

Descotils was appointed for one year, in the first instance, but unfortunately he did not last out the year. His untimely death on 6 December 1815 precipitated a further crisis. It seemed as if another energetic and talented younger chemist was needed to take over the duties of executive secretary. The failing health of the aged Guyton, who had contributed more than any other person to the *Annales*, did not bode well for the future of the journal. He was not in a position to play an effective part in discussions about the re-

---

[1] St Léonard, G.L.59.

[2] *Jac.Berzelius Bref*, ed. H.G. Söderbaum, vol.1, part 1, *Correspondance entre Berzelius et C.L. Berthollet*, Uppsala, 1912, p.54.

organisation of the journal because, after 4 December 1815, he was too ill to attend meetings of the First Class, and on 2 January 1816 he died, just two days before his 79th birthday.

Meanwhile an extraordinary meeting of the editorial board was called for 11 December, just five days after the death of Descotils. A member of the editorial board, who is not identified in the minutes, but who was almost certainly Berthollet, made some suggestions. Although Berthollet had not played a very active part in the early history of the *Annales*, he had become more involved after the death of Fourcroy in 1809. With the election of Gay-Lussac to the board in 1810 he had begun to attend more meetings. But what were the suggestions made at the 1815 meeting? First that, as the number of volumes in the series had reached 96, it would be appropriate to begin a new series. More important was the second suggestion, which also has the stamp of Berthollet. As chemistry was now so closely linked with physics, the new series of the *Annales* should deal with both sciences. The committee agreed that there should be two editors, one for chemistry and the second for physics. For chemistry, Gay-Lussac was proposed, which is hardly surprising in view of his position on the board. For physics the name of Arago was put forward and it seems that he was waiting in the wings for his appointment to be agreed although, of course, he had no previous connections with the journal.[3] He was, however, recognised as an able physicist and he was a friend of Gay-Lussac and a member of the Arcueil group. The two friends were given the task of presenting a prospectus for the new series of the journal.

When the committee met again on 15 January 1816, the ailing Guyton had died, and significantly Berthollet was elected as the new president. The new editors explained that the new series was going to be able to include physics, not by reducing the chemical content, nor by having a larger number of pages, which would have added significantly to the cost, but by reducing the size of the type, thus allowing a 30% increase in the material for the same number of pages. Expressed in terms of the number of pages, the smaller print would produce a gain in each issue equivalent to 36 pages of the old *Annales*.[4] To understand the economics of this change one has to remember that paper was relatively expensive, whereas typesetting was cheap, since printers at that time received low wages.

Although the first few volumes of the *Annales de chimie et de physique* appeared following the traditional format of the title page with the names of all members of the editorial board, the printer Crochard asked specifically that the only names appearing on the title page should be those of the two secretary-editors:

---

[3] Unlike, for example, the physicist Biot, who had recently published in the *Annales*.

[4] Appendix 1, No.12. See also No.13.

> The secretaries being named as more particularly responsible, it will become more of a duty for them to keep up to date with all scientific discoveries... Daily experience shows that responsibility becomes nil when it is shared by too large a number of individuals.[5]

Although it was accepted by the editorial board that the two editors must have day-to-day responsibility, the board continued to exercise overall control. In theory nothing could be published without its agreement but, by March, the impracticality of this arrangement was accepted, and the secretary-editors were given full responsibility for what was to be published.

With this concession, the justification for having an editorial board largely disappeared and, at an extraordinary meeting held in December 1816, the title of the *Annales* was made over to Gay-Lussac and Arago 'à leurs risques, périls et bénéfice'. The two friends were to take over all transactions, both with the publishers and with subscribers but, as a gesture to members of the former editorial board, they were each to be given two free copies of the journal. In this way Gay-Lussac and Arago abandoned their role as secretaries of an editorial board and became entrepreneurs on their own account. Beginning with volume 4, the former co-operative ethos of the journal was abandoned in favour of private enterprise. Thus the story of the *Annales* serves to illustrate how some of the idealism and democratic fervour of the French Revolution was gradually weakened and eventually transformed into the modern world of business.

2. *The early years of the new series.*

The Prospectus for the new series[6] reminded readers that the *Annales* had been founded in 1789 because chemistry at that time was undergoing a major revolution ('une grande révolution'). One of the purposes of the journal had been to bring together, at an affordable price, publications relevant to chemistry scattered in many different journals. But now a new dimension was to be introduced. At one time chemistry and physics had been entirely separate, but now they had come together and even overlapped, for example in the study of gases. Galvanic electricity too was on the borderline of physics and chemistry. Physics was, therefore, to be a full part of the new series and there would even be some mathematical physics but not, of course, pure mathematics. Arago's interests were mentioned when the new editors spoke of their intention to include a regular table of meteorological data from the Paris Observatory. What they did not say was that such a table had been a regular

---

[5] It may be noted that , although these sentiments were probably genuinely those of the publisher Crochard, they were actually conveyed to the meeting by Gay-Lussac and Arago, who were obviously interested parties.

[6] See Appendix 1, No.12.

part of the *Journal de physique* since 1800 - they were borrowing the clothes of their old rival! They would further increase the utility of the journal by including monthly reports on the proceedings of the Academy of Sciences.

In an editorial note published at the end of the third volume[7] Gay-Lussac and Arago were able to state that the journal would now be entirely in their hands. They stated that, as they took the liberty from time to time of adding critical remarks about memoirs, they would be happy to publish letters from readers who wished to defend a contrary point of view. This would not only be to the benefit of science,but also perhaps of the journal, if it encouraged a sense of participation from readers. Yet correspondence was to hold quite a minor place in the new series.

It would be difficult to find a chemist more favourably disposed towards physics than Gay-Lussac. One of his first publications had been on the thermal expansion of gases.[8] He had worked for Laplace on a comparison of the air and mercury thermometer.[9] These interests continued into middle-age and, as editor of the second series of the *Annales*, he published memoirs on the expansion of air and the change in the zero point of the mercury thermometer.[10] Ten years later he was still discussing thermometry.[11] As a young man, Gay-Lussac had written an important paper on the lowering of temperature produced by the expansion of a gas.[12] As editor, he continued to contribute his own research on this subject.[13] We should also note that, from 1809 to 1832, he held the chair of physics at the Paris Faculty of Sciences, although he was happy to allow Biot to give the lectures on optics, which were of special interest to him. A large part of Gay-Lussac's lectures was devoted to the area of properties of matter. He never had a special interest in electricity, yet as a member of the physics section of the Academy he would have been well informed on the subject. In 1822 he found himself, as the senior member of the physics section of the Academy, being made responsible for drawing up a report for the government on lightning conductors, since a number of buildings had been recently damaged by lightning, despite their use of lightning conductors. It should be remembered that Gay-Lussac did most of these things when his main research was in chemistry. In other words his situation helps to contradict the picture of the nineteenth-century French *savant* as a narrow specialist. His interests and talents were unusually wide. Thus in collaboration with the physicist Arago, he was able to meet him more

---

7 See Appendix 1, No.13.
8 *A.c.*, *43* (1802), 137-75.
9 Laplace, *Mécanique céleste*, vol.4, Paris, 1805, pp.xxi - xxii.
10 *A.c.p.*, *19* (1821), 436 - 7; *21* (1822), 330 - 5.
11 *A.c.p.*, *51* (1832), 435.
12 *Mémoires de la Société d'Arcueil*, *1* (1807), 180 - 204.
13 *A.c.p.*, *9* (1818), 305 - 310; *21* (1822), 82 - 92.

than half way. Of that generation probably only Dulong resembled Gay-Lussac to the extent of making a reputation for himself in both physical and chemical research.

Although Gay-Lussac managed to contribute to most branches of chemistry: analytical, inorganic and organic, technically his work in physics adds special interest to his work in proto-physical chemistry. He was always concerned with the *general principles* of chemical reactions rather than the details of particular cases. As opposed to chemists like Vauquelin, who emphasised different chemical species, he was more concerned with general laws. Thus he discovered that gases *in general*, when they combine chemically, do so in volumes which bear a simple ratio to each other. At times he almost represented a theoretical approach to chemistry, which might be characterised as 'a chemistry without substances'. When speaking in his lectures about the reactions of bases, he said that it did not matter what base one chose, so long as the equivalent weight was used.[14] This was very much in the tradition of Berthollet, who had emphasised the relevance of quantities in chemical reactions. Gay-Lussac was very much concerned with a *quantitative* approach to chemistry. Going further than some, he was interested in precision of measurement, almost as much as those who could less ambiguously be described as the physicists of the time.

As for Arago, a more detailed account of his research interests will be given below under 'physics'. Here it is sufficient to say that, like Gay-Lussac, he was a graduate of the Ecole Polytechnique. Here he had learned advanced mathematical techniques. Yet in later life he rarely used them. He was much more interested in experimental and observational science. There is an interesting sentence in the Prospectus of the new series, where the editors say that, where necessary, they will include an elementary account of memoirs on mathematical physics, but they will not go into details and they will avoid the too frequent use of mathematical symbols.[15] Thus, apart from being great personal friends, Arago, the non-mathematical physicist found it very easy to work with the physical chemist, Gay-Lussac.

We have noted that, in a time of comparative stability in the early years of the Napoleonic Empire, the circulation of the *Annales* had reached 600. Unfortunately the social, financial and political situation in 1816 was very unstable and the new series of the *Annales* had begun inauspiciously with only 91 copies sold.[16] However, the handing over of the journal to Gay-Lussac and Arago gave it a new lease of life. They decided to make the *Annales* better known to the scientific world in the early Restoration by giving away

---

[14] *Cours de chimie*, Paris, 1828, Leçon 3, p.6.

[15] Appendix 1, No.12.

[16] This is the number reported sold by 5 January 1818. Hence the number sold in 1816 must have been even lower.

copies to selected individuals and institutions. In 1817 they managed to sell 525 copies and this increased to 583 in 1818. To these figures must be added a quantity of back numbers bought by new subscribers, anxious to complete their sets. Thus within two years the enthusiasm of the two new editors had brought the circulation of the *Annales* up to about the same level as the first series. One might guess that one method that could have been used to increase the popularity of the journal would have been to reduce its price. In fact they raised its price in 1816 from 20 francs[17] to 24 francs[18]. Thus price was not a critical factor. The reputation of the editors and the quality of the contents were obviously more important.

Optimistically the editors had 1,200 copies of the *Annales* printed. We are fortunate to have details of printing costs and profits for 1817[19]:

Printer	3 370f.55
Engraver	237 92
Paper	1 600 00
Carriage	23 50
Stamp [duty]	154 00
Art work	35 00
Making up at Crochard's	349 00
	5 770 00
Net receipts from Crochard	11 620 00
Hence profit	5 850 00
For each of us	2 925 00

Thus in the first full year of operating by themselves Gay Lussac and Arago each made nearly 3,000 francs in profit, half the annual salary of a professor of the Ecole Polytechnique. We should remember that this profit was not instead of but *in addition* to the salaries received from various academic posts held by each of the two editors. In 1818 the profits had increased to more than 4,000 francs each and, undoubtedly, it soon topped 5,000 francs. Although Gay Lussac had claimed at the beginning of his scientific career that he could live on a pittance,[20] now, as a middle-aged family man, he was using science to ensure a very comfortable income.[21]

---

[17] The Prospectus for the new series (Appendix 1, No.12) confirms that the subscription price quoted was always that for Paris, which had the greatest number of subscribers. For the provinces the price was 23 francs, and 26 francs for foreign subscribers.

[18] *A.c.p.*, *3* (1816), 355.

[19] Limoges , 'G.L.5'. This MS. may now be in the archives of the Ecole Polytechnique.

[20] 'Le pur nécessaire me suffira toujours', (1803), M. Crosland, *Gay-Lussac, Scientist and Bourgeois*, Cambridge, 1978, p.267.

[21] *Ibid*, p.230.

There were a few problems in the regular production of the *Annales* according to their monthly timetable. As in the first series, publication was often delayed, particularly in the first eighteen months. Using the date of presentation of successive issues of the *Annales* to the Academy of Sciences as a guide,[22] we find that the first issue, dated January 1816, was not ready until March; the May issue was not ready till July and the issue dated November 1816 was not ready until February 1817. It was not until the summer of 1817 that the *Annales* almost caught up, being published only one month in arrears. We have to remember that Gay Lussac and Arago were engaged in many other activities apart from editing a journal. Gay Lussac was professor of chemistry at the Ecole Polytechnique and professor of physics at the Paris Faculty of Sciences. In the years 1815 - 1818 he was particularly active in scientific research[23] and he was also involved in meetings of the Academy of Sciences and its commissions. In the summer of 1817 he made a visit to England and in 1818 he was appointed to a paid position in the Comité consultatif de la Direction générale des poudres et salpêtres.[24] Arago too was a busy Academician and, from 1830, he was to be deeply involved in Academy affairs. Like Gay-Lussac he was a professor at the Ecole Polytechnique. He was also Director of the Paris Observatory, where he lived. He was a member of the Bureaux des Longitudes and he became a leading contributor to the *Annuaire,* which it published. In the early years of the second series of the *Annales*, he was an active researcher, and in 1822 he made a field trip to Britain.

Despite these various problems and diversions the new *Annales* went from strength to strength, all the more so as its main rival, the *Journal de physique* was in obvious decline and ceased publication entirely in 1822. The *Annales* was sometimes considered as a model of what a successful scientific journal should be under the guidance of acknowledged leaders in their respective fields. Thus when in 1823 Brongniart and Audouin were planning to launch a new journal of natural history, they could look on the *Annales* as a model for a scientific journal.[25] The English natural philosopher John Herschel went out of his way to praise the *Annales*:

> Unlike the crude and undigested scientific matter which suffices (we are ashamed to say it) for the monthly and quarterly amusement of our own countrymen, whatever is admitted into *its* pages has at least

---

[22] *Procès-verbaux des séances de l'Académie des Sciences* . . ., 10 vols., Hendaye, 1910-22.

[23] M. Crosland, *op.cit.* (1978), p.116.

[24] *Ibid.*, p.230.

[25] Alexandre Brongniart writing to Audouin, 7 November 1823 in the context of their proposed foundation of the *Annales de sciences naturelles* - Jean Théodorides, *Jean-Victor Audouin (1797 - 1841)*, Mémoires de la Section des Sciences No.6. Paris, Bibliothèque nationale, 1978, p.45.

> been taken pains with, and, with a few exceptions, has sterling merit. Indeed among the original communications which abound in it, there are few which would misbecome the first academical collections.[26]

For a whole generation at least it was very difficult for any other journal to match the authority of the *Annales*. Gay-Lussac and Arago had absolute control over what was published in the journal.

We shall be dealing directly with the subject of editorial control later in this chapter. In general it is not possible to produce direct evidence about articles refused publication, although a few cases depending on indirect evidence have been included in this account. On the other hand, one occasionally finds the inclusion in the *Annales* of material, which might well have been omitted. A striking case, with strong political implications, is the inclusion in 1818 of a letter addressed to Berthollet by former students of the Ecole Polytechnique, asking for support for a subscription for a monument to the memory of his friend Monge, who had just died. Monge had been an ardent Republican during the Revolution and subsequently an active admirer of Bonaparte. Because of his past political record he had been expelled from the First Class of the Institute at the Restoration. The *Annales* was, therefore, risking strong government disapproval by the publication of this letter. As a postcript it may be reported that the subscription met with such great success that the monument to Monge in the Père Lachaise cemetry is today one of the more imposing among many costly monuments.

3. *Physics - as presented by Arago*

One cannot simply characterise the *Annales* as representing chemistry and physics in the abstract - as if these names stood for eternal values. It is necessary to consider their respective meanings at a particular time and place. In the case of the *Annales* it is necessary to take into account the powerful influence of the editors, their background and their interests. Arago, who had no previous association with the *Annales*, was brought in to represent physics. Shortly after graduation he had been nominated as secretary to the Bureau des Longitudes, which was housed at the Paris Observatory, and this was to be his base for most of his professional life. Much of his early research was on optics, for example a study of the refraction of light through the earth's atmosphere, which helped to confirm a formula given by Laplace. His further optical studies on refraction in liquids and solids and the properties of polarised light undermined his faith in the emission theory of the Laplace school and he began to consider an undulatory theory as advocated by Thomas Young in England. His support of Fresnel from 1815-16 will be described

---

[26] John Herschel, 'Sound' (1830) *Encyclopaedia Metropolitana*, 1845, quoted by C. Babbage, *Reflections on the Decline of Science in England*, London, 1830, p.vii.

later. Arago also had an interest in magnetism and electricity, an interest reinforced by Oersted's discovery of a connection between the two in 1820.

Any account of Arago's professional interests would be incomplete without reference to his deep friendship with the Prussian explorer and man of science Alexander von Humboldt, who came to make Paris his home. At the beginning of his career Humboldt had set out on an expedition to the Spanish colonies of Latin America. His aim, in his own words, was:

> To study the formation of the earth and its strata, to analyse the atmosphere, to measure with sensitive instruments its pressure, temperature, humidity, the electric and magnetic charge, to observe the influence of climate.....[27]

Much of this scheme, with the exception of the geological dimension mentioned at the beginning, might equally be applied to the research interests of Arago. In the early nineteenth century this was sometimes described as '*physique du globe*'; it has also been called 'Humboldtian science'.[28] Today we might describe it as 'environmental science'. We shall see that these environmental interests had a considerable influence on the contents of the *Annales*. Arago could have developed the mathematical skills he had learned at the Ecole Polytechnique. Instead he preferred to develop observational and experimental studies of the natural world. In 1810 Arago was asked by the Bureau des Longitudes to make regular observations of magnetic declination at the Paris Observatory, and his first publication on this subject came in 1812. He believed that the laws of terrestrial magnetism could be discovered, if only enough data was collected. As we shall see, this concern for the collection of data was applied equally to meteorology and also affected the contents of the *Annales*.

One branch of *la physique* of special interest to French physicists throughout the nineteenth century was optics. The beginning of the second series of the *Annales* coincided with the emergence of Fresnel as a major figure in the history of optics and a firm proponent of a wave theory of light. The young engineer Fresnel first told Arago of his ideas about light in October 1815;[29] Arago was very supportive and they agreed to collaborate on a study of diffraction. Fresnel had sent a memoir to the Academy of Sciences and it happened to be Arago who was appointed to report on it. Fresnel, temporarily exiled in Normandy,[30] and in any case not having the benefit of a post in Paris, therefore depended doubly on the patronage of Arago. Yet Arago was

---

[27] L. Kellner, *Alexander von Humboldt*, London, 1963, p.64.

[28] 'Humboldtian science', Chapter 3 of Susan Faye Cannon, *Science in Culture: the Early Victorian Period*, New York, 1978.

[29] A. Fresnel, *Oeuvres* (3 vols., Paris, 1867), vol.1, pp.35-37.

[30] Fresnel was a fervent Royalist and had been put under police surveillance in his home town.

not only a senior physicist with a post at the Observatory, which he could use as a base for collaboration with Fresnel; he was not only a member of the Academy of Sciences, in a powerful position either to criticise or to praise Fresnel's ideas;[31] he was also in 1816 to become the co-editor of the leading journal for the physical sciences. That he used his position to promote the work of Fresnel is clear from the succession of optical memoirs by Fresnel, which was to appear in the *Annales* over the next ten years. But Arago was using the journal not only to advance the career of his protégé but also to advance a wave theory of light, in deliberate opposition to the emission theory advocated by the powerful neo-Newtonian school under the leadership of Laplace.[32] Confirmation of Arago's editorial partiality has been found in letters to Arago from the Genevan physicist, Pierre Prévost, who submitted a memoir to the *Annales* on diffraction that was not published - apparently because Prévost in 1820 still made use of the emission theory of light.[33]

There is no doubt that the *Annales* played a crucial role in the dissemination of Fresnel's ideas. Arago's patronage of the unknown young provincial engineer from the very beginning of his career in optics gave Fresnel's work maximum exposure. In 1819 Arago managed to obtain an appointment for Fresnel in Paris and this made sustained collaboration between Arago and Fresnel possible. It was Fresnel's major contributions to optics under Arago's patronage that secured his election to the Academy of Sciences in 1823 at the comparatively early age of 35. More important, it was largely through the medium of the *Annales* that the mathematical and experimental talents of Fresnel were able to find an immediate audience. In the history of science there has seldom been a more effective combination of patron, protégé and publication. Young in Britain had advocated a wave theory of light but it required all the mathematical and experimental genius of a Fresnel to work out that light consisted of transverse waves.

In the 1820s some controversies are to be found in pages of the *Annales*, especially in relation to the wave theory of light. Fresnel had presented to the Academy in 1816 a memoir, in which he criticized Biot's theory of mobile polarisation and showed how various optical phenomena could be satisfactorily explained by the principle of interference between waves of light. Arago had not bothered to present a report on this until 1821 and, when he did, he published the report in full in the *Annales*, giving unqualified approval to

---

[31] For the power of the Academy to make or break, see M. Crosland, *Science under Control*, Cambridge, 1992.

[32] See R. Fox, 'The rise and fall of Laplacian physics', *Historical Studies in the Physical Sciences*, *4* (1974), 89-136.

[33] This is the interpretation of John Cawood, who has examined Arago's correspondence in the archives of the Academy of Sciences. - *The Scientific Work of D.F.J. Arago*, Ph.D. thesis, University of Leeds, 1974, pp.90

Fresnel's ideas.[34] Biot was furious to be the subject of such an open attack and demanded a right of reply, which occupied over 30 pages.[35] Arago, however, took advantage of his editorial position to append an immediate rejoinder.[36] Fresnel too wanted to reply to Biot, which he did in the next issue,[37] independently of his further research, which had been published in the same volume. Readers of volume 17 of the *Annales* would have good evidence for concluding that science was riddled with deep controversies, but this was hardly a representative volume. Yet in 1823 Fresnel was again involved in a controversy with a second leading member of the Laplace school, Poisson. Fresnel actually invited Poisson, who had made a number of criticisms of his ideas, to write these up for publication. Poisson's article was published in the *Annales*[38] and was followed by a reply from Fresnel.[39] More protracted was another dispute between Navier and Poisson on elasticity, which spread through four successive volumes of the *Annales*.[40]

Much of the most important work in physics in the 1820s was on electromagnetism. Up until 1820 magnetism and electricity had been considered as quite separate subjects. Then in July 1820 the Dane Oersted announced that a wire carrying an electric current had an effect on a nearby compass needle. This would later be expressed by saying that the electric current set up a magnetic field. It was Arago who brought news of Oersted's discovery to Paris. The news had first reached Geneva, which Arago happened to be visiting at the time. At the first meeting of the Academy after his return (4 September) he described Oersted's discovery and gave a practical demonstration of the effect at the meeting of the following week.[41]

The *Annales* naturally published Oersted's paper at the earliest opportunity.[42] It was published in the issue dated August 1820, which actually appeared at the beginning of October. The role of the Academy in authenticating the discovery is well known to specialists in this field. What is not well known is the covering note that Arago added when he published the paper. He wrote:

> Readers of the *Annales* will have noticed that in general we do not accept too uncritically announcements of extraordinary discoveries and up to now we have only had reason to congratulate ourselves on

---

[34] *A.c.p.*, *17* (1821), 80-102.
[35] *Ibid.*, 225-258.
[36] *Ibid.*, 258-273.
[37] *Ibid.*, 393-403.
[38] 'Extrait d'une lettre de M. Poisson à M. Fresnel', *A.c.p.*, *22* (1823), 270-280.
[39] 'Réponse de M.A. Fresnel à la lettre de M. Poisson . . .', *Ibid.*, 32-49, 113-122.
[40] Volumes 37-40.
[41] M. Crosland, *Science under Control*, p.251.
[42] Oersted, 'Experimenta circa effectum, etc., Expériences sur l'effet du conflit électrique sur l'aiguille aimantée', *A.c.p.*, *14* (1820), 417-425.

> this reserve; but with regard to the memoir of M. Oersted, however singular the results which it contains may appear, they are accompanied by too many details to give rise to any suspicion of error.[43]

He then gave as supporting evidence the names of several Swiss men of science, who had witnessed an earlier demonstration.

Arago's caution provides a good example of the dangers of writing a Whig interpretation of the history of science. Because Oersted's paper was soon seen as epoch-making, and indeed caused considerable excitement at the time, we should not assume its authenticity was immediately obvious to everyone.[44] Arago's caution may have been related to his earlier decision to publish a short account of a claim that magnets could be used to produce perpetual motion.[45] He had said at the time that it was only because the account had the apparent support of the Edinburgh natural philosopher David Brewster that he included it. In fact John Playfair wrote to protest about the article.[46] But this incident, however apparently trivial, shows that a whole variety of claims were being made about magnets around this time. Fresnel, for example, was soon to investigate the possibility of decomposing water, using magnets.[47]

Oersted's paper was to produce a frenzy of new research, and volume 15 of the *Annales* had the distinction of publishing several major papers on the new subject of electromagnetism. The most famous researcher was Ampère, who studied the forces between two wires carrying an electric current.[48] For publication Ampère's memoir had to be divided into two parts, however, since Arago wanted to report immediately the fact that he himself had discovered that an electric current could magnetise iron filings in the vicinity. Furthermore, in conjunction with Ampère, he was able to show that if a steel needle was placed in a coil carrying a current, it became magnetic. He was thus the discoverer of magnetic induction by an electric current.[49] (This discovery was to lead to the invention of the electromagnet.) Among the many people working in this area at the time was Humphry Davy and it is interesting to find him making the following comment:

> I find by the *Annales de chimie et de physique* for September, which arrived in London November 24, that M. Arago has anticipated me

---

[43] *A.c.p.*, *14* (1820), 417n.

[44] Fortunately the experiments described can be easily repeated with simple apparatus.

[45] *A.c.p.*, *9* (1818), 219-220.

[46] *A.c.p.*, *15* (1820), 91-93.

[47] *Ibid.*, 219-222.

[48] *A.c.p.*, *15* (1820), 59-76, 170-218. This memoir is experimental - the mathematical analysis came later.

[49] 'Expériences relatifs à l'aimantation du fer et de l'acier par l'action du courant voltaique', *A.c.p.*, *15* (1820), 93-100.

> in the discovery of the attraction and magnetising powers of wires in the voltaic current.[50]

A further paper squeezed in at the end of the same issue of the *Annales* was a report of experiments by Biot and the discovery of the law of force in a magnetic field around a long straight wire carrying an electric current ('Biot and Savart's law').[51] In a later memoir in the *Annales* Ampère introduced the word 'electrodynamic'.[52] He was prolific in this new field, contributing one or more memoirs on the subject to the *Annales* every year between 1820 and 1825. The *Annales de chimie*, therefore, constituted one of Ampère's main media for publication, although his more mathematical memoirs would be sent to Gergonne's *Annales de mathématiques*.

Another subject covered by the *Annales* was the study of sound and a major contributor on this subject was Félix Savart (1791-1841), a protégé of Biot.[53] Their joint names are commemorated in the Biot and Savart law of electromagnetism mentioned above. In his early work Savart studied the vibrations of violin strings. He then generalised the study of vibrations. He greatly extended Chladni's earlier work on vibrating plates. His most important memoirs on acoustics are to be found in the volumes of the *Annales* between 1820 and 1840.

Another important contribution published in the *Annales* was a determination of the velocity of sound, sponsored by the Bureau des Longitudes at the suggestion of Laplace.[54] Newton had given a formula for the velocity of sound which was found to be grossly inaccurate. This was largely because in Newton's time the heat factor involved in the study of the vibrations was not appreciated. Early nineteenth-century studies of the specific heats of gases enabled the modern formula to be established. The practical determination was carried out on the outskirts of Paris by firing cannon and comparing the moment of flash with the time the sound reached the observer.

Although the study of heat is now obviously a part of physics, this has not always been the case. In the eighteenth century it was often seen as a part of chemistry and it was Lavoisier who coined the term *calorique* (or caloric) for the matter of heat. Yet from around 1800 there was increasing evidence that heat was not a substance and 'caloric' was quickly dropped from the standard list of simple substances. Nineteenth-century work would show that heat

---

[50] *Phil. Trans.*, 1821, 7-19.

[51] *Ibid.*, 222-3. This was tucked in at the end of an issue because it had only been read to the Academy on 30 October 1820.

[52] *A.c.p.*, *20* (1822), 60n.

[53] See art. 'Savart', *D.S.B.*, *12*, pp.129-30.

[54] [Arago], 'Résultats des expériences faites, par ordre du Bureau des Longitudes, pour la détermination de la vitesse du son dans l'atmosphère', *A.c.p.*, *20* (1822), 210-223. See also Laplace, 'Note sur la vitesse du son', *ibid.*, pp.266-8.

should be considered as a form of energy but, as this concept did not emerge until the 1840s, and then from British and German men of science rather than the French, one must be careful not to anticipate events. One approach to heat, which brought it closer to mechanics, was the brilliant mathematical study of conduction of heat by Fourier, first presented to the Academy of Sciences in 1807. He revised his work for the Academy's 1812 grand prix des sciences mathématiques, which he won. By new methods of mathematical analysis, involving the use of partial differential equations, he was able to advance greatly the study of heat diffusion. His work was published in various versions, including a book published in 1822. Before then, however, a summary of his theory of heat was published in the *Annales*[55] which contained a minimum of mathematics in conformity with the usual style of physics articles in that journal.

Poisson too took up the subject of heat but from a quite different standpoint from Fourier. Some of these researches were published in the *Journal de l'Ecole Polytechnique* and some in the *Annales*, for example 'On the heat of gases and vapours'.[56] Poisson also published memoirs on radiant heat[57] but the person best known for such studies was the Italian refugee, Melloni (1798-1854), who published regularly in the *Annales*.[58]

One of the problems Melloni considered was whether radiant heat consisted of wave motion in an ether in the same way as light. Although they obeyed the same laws of reflection and refraction, Melloni argued that there was an essential difference. Apart from Poisson's work on heat and on optics (previously mentioned), most of his work was on electricity, magnetism and elasticity. As a senior physicist, Poisson's researches were welcomed by the *Annales*, which published some 30 of his memoirs over the period 1816 to 1840, although much less from 1835 onwards when the *Comptes rendus* was available. He also contributed to the *Connaissance des temps* and the *Journal de l'Ecole Polytechnique*. Yet one did not need to be as famous as Poisson to have work published in the *Annales*. For example, it was happy to publish a memoir by 'Mademoiselle Sophie Germain' on elasticity.[59]

The Paris Observatory was the main centre for the collection of meteorological data in France, and Arago regarded this as an important part of physical science. From the beginning of the second series, therefore, every issue contained one closely printed page showing the atmospheric pressure, temperature and humidity in Paris on successive days over the previous month.

---

[55] Fourier, 'Théorie de la chaleur', *A.c.p.*, *3* (1816), 350-375.

[56] *A.c.p.*, *23* (1823), 337-352. This memoir was heavily mathematical.

[57] *A.c.p.*, *26* (1824), 225; *28* (1825), 37-55.

[58] E.g., 'Mémoire sur la transmission libre de la chaleur rayonnante par différens corps solides et liquides', *A.c.p.*, *53* (1833), 5-73.

[59] *A.c.p.*, *38* (1828), 123-131.

Arago also published memoirs on different aspects of meteorology. He decided to collect at the end of each year not only meteorological data collected at the Paris Observatory over that year, but also accounts of related events in different parts of the world, including descriptions of earthquakes, tropical rainstorms, etc., an account which first occupied some 20 pages. This section soon grew to 30 or 40 pages and by 1824 exceeded 60 pages. Nor was this the unique province of Arago. Gay-Lussac included in the *Annales* a description of his portable barometer.[60] Later Gay-Lussac was to be responsible for the Academy report on lightning conductors, which was published in the *Annales*.[61] Yet the meteorological dimension reflected above all the special interests of Arago, and it was not until shortly after his death that a decision was taken to omit from the *Annales* tables showing the daily weather conditions in Paris.[62]

Arago also had a special interest in aurora, normally seen only in northern latitudes but sometimes seen further south. In 1817 an aurora was observed in Paris. The display of 'northern lights' in the night sky could be regarded as a purely meteorological phenomenon. But Arago began to suspect that aurora were related to the earth's magnetic field. He was able also to relate them to sunspot activity. From 1818 until 1848 he kept a catalogue of aurora and extracts were published from time to time in the *Annales*, which in a way became a clearing house for such information.[63] By the 1820s he was convinced that there was a definite relationship between the appearance of aurora and variation in the declination of the earth's magnetic field,[64] although this was controversial, and Lieutenant Henry Foster was awarded the Copley Medal of the Royal Society in 1827 for work which disproved the connection.

For Arago physics was never simply or even mainly a laboratory science. Possibly influenced by his early travels to Spain on a geodesic expedition and his long association with the Paris Observatory, of which he was now Director, Arago also considered observations and field work as an important part of physical science. At the Observatory Arago was involved in the painstaking routine of astronomical observations, which usually meant nightly surveys, measurements, and calculations. But the Bureau des Longitudes was also concerned with geodesy and geophysics, which formed part of what was called '*physique du globe*'. In the 1820s Arago became very interested in geomagnetism and in 1822 he made a trip to England to make magnetic measurements. It was during this visit that he noticed the dampening effect that metals had on

---

[60] *A.c.p.*, *1* (1816), 113.

[61] *A.c.p.*, *26* (1824), 258-297.

[62] The monthly tables ceased to appear after 1857.

[63] See *Tables des tomes 1-30*, 1831, for the list of aurora catalogued by Arago.

[64] 'Influence des Aurores Boréales sur l'aiguille aimantée', *A.c.p. 30* (1825), 423-7. See also *ibid.*, *39* (1828), 369-390.

the oscillations of a magnetic needle. In 1825 he made a journey to Italy, in which he measured magnetic intensity. In November 1825 he described a method of measuring the change in magnetisation of the needles used in magnetometers. He was very much concerned to find the laws of the earth's magnetism and this meant the systematic collection of data over a long period of time. In 1826 he began a systematic programme of daily observations which lasted until 1830. Indeed 1830 marks a turning point in Arago's life, when his political interests began to take over from his scientific research. Most of all, his election that year as secretary to the Academy of Sciences meant that the Academy became the centre of his life. Of course this activity did not shut out the *Annales* completely, and there was even an overlap in the reports the *Annales* published of the Academy's activities.

Not all the physics published in the *Annales* was pure science. When in the early nineteenth century the British were developing the improved Woolf compound steam engine, reports were published in England on steam engine performance and reprinted in the *Annales*.[65] As early as 1816 the engineer Bouvier was claiming that any further improvement of the steam engine required the help of science.[66] Reports on steam engines were regularly published in the *Annales*.[67] As high pressure steam engines came to be more commonly used, there were sometimes explosions. A government enquiry into their safety was established and this produced a report, which the *Annales* decided to publish.[68]

The journal also published several memoirs on advanced water wheels and turbines. Water power continued to be important to the French economy at a time when Britain was capitalising on its superior coal deposits, and it is no surprise that the turbine was a French invention and originally a French word. A report on Burdin's hydraulic turbine was published in the *Annales* in 1824.[69] In 1825 Poncelet presented an important memoir on a new type of water wheel to the Academy. With no chance of immediate publication in the Academy's *Mémoires*, the *Annales* was able to step in. As the memoir was a long one Arago had originally intended to publish an abbreviated account but, on reflection, he appreciated its importance and decided to publish the entire

---

[65] E.g. *A.c.p.*, *3* (1816), 329-30.

[66] 'Note sur les machines à vapeur', *ibid.*, 177-192 quoted by D.S.L. Cardwell, *From Watt to Clausius. The Rise of Thermodynamics in the Early Industrial Age*, London, 1971, pp.173-4.

[67] E.g. *A.c.p.*, *18* (1821), 133-146. Cardwell (*op.cit.*) gives further references.

[68] Dulong, 'Exposé des recherches faites par ordre de l'Académie Royale des Sciences pour déterminer les forces élastiques de la vapeur de l'eau à de hautes températures', *A.c.p.*, *43* (1830), 74-110.

[69] Prony and Giraud 'Rapport sur le mémoire de M. Burdin intitulé "Des turbines hydrauliques ou machines rotatoires à grande vitesse"', *A.c.p.*, *26* (1824), 207-217.

text unabbreviated but in two parts.[70] Although an overshot water wheel had been shown to be more efficient, it was costly both to make and to install. Poncelet hit on a method of vastly improving the efficiency of an undershot wheel by fitting it with curved blades which pointed upstream and shaped so that the water impinged on them without turbulence.[71] This resulted in a great gain in efficiency and Poncelet claimed a figure of 0.67, which compared favourably with the efficiency of a breast wheel. Again, in the field of electricity, the *Annales* made a point of reporting news of the invention of the dynamo by Pixii from the proceedings of the Academy of Sciences.[72]

4. *The chemical content*

Given the precedent provided by the first series of the *Annales*, one would expect the chemical content of the second series to be of a particularly high standard. Of course what was reported was a reflection of what was being done, but there is no doubt that chemistry during the nineteenth century was very much alive. This means that it was developing on all fronts and expanding. The growth of organic chemistry was phenomenal, since more and more compounds were being prepared every year, which raised urgent problems of nomenclature and classification. First, however, came analysis. Nearly all organic compounds contained carbon, hydrogen and oxygen; many also contained nitrogen. A starting point was, therefore, the establishment of the proportions of the respective elements in each compound. At first this was sufficient to distinguish them but not for long. In 1824 Gay-Lussac, as editor, noticed when reporting Wöhler's analysis of cyanic acid, that it was identical with the analysis of fulminic acid, previously studied by himself in association with the young German student, Liebig.[73] Yet these acids had very different properties. Gay-Lussac, therefore, concluded that the elements must be combined in a different way in the two acids - something, he noted, that would require further examination. This was one of the first cases of isomerism to be observed and we may report that, incidentally, it was to be the beginning of a long and fruitful collaboration between Wöhler and Leibig.

The *Annales* made a major contribution to the history of a new class of substances first isolated in the early nineteenth century, the alkaloids. First Gay-Lussac deserves credit for singling out a paper by the German chemist Sertuerner, originally published in Gilbert's *Annalen der Physik*[74] on a powerful poison extracted from opium, which he called *Morphium* but which

---

[70] 'Mémoire sur les roues verticales à palettes courbes, suivi des expériences sur les effets mécaniques de ces roues', *A.c.p. 30* (1825), 136-187, 225-262.

[71] D.S.L. Cardwell, *op.cit.*, p.183.

[72] *A.c.p.*, *50* (1832), 322; *51* (1832), 76.

[73] *A.c.p.*, *27* (1824), 200n.

[74] *Annalen der Physik*, *55* (1817), 56-90.

was translated in the *Annales* as *morphine*.[75] This was the first such alkaline substance of vegetable origin, to be discovered, but Gay-Lussac added a note prophesying that this discovery constituted the opening of a whole new field. The publicity given to this discovery encouraged further research among French chemists into vegetable substances and, by the end of 1818, Pelletier and Caventou were able to announce the discovery of another vegetable alkali, which they eventually called *strychnine*.[76] Seven months later, the same chemists announced the isolation of *brucine*, of which they prepared a number of salts.[77] In 1820 they contributed a further paper to the *Annales,* in which they described *veratrine*.[78] They also read a paper to the Academy of Sciences on a substance from South America, already used in the seventeenth century to treat malaria. There had been earlier attempts to isolate its active principle by the Portuguese chemist Gomès, who obtained something he called *cinchonin*. The final isolation of *quinine* had to wait until 1820.[79] The research of Pelletier and Caventou over these three or four years was exceptionally fruitful and they fully deserved a large prize from the Academy of Sciences. Unfortunately that body was not yet in a position to publish their work, and the *Annales* was to be the beneficiary of this situation. The editors of the *Annales* had sufficient authority to influence the nomenclature of these new substances and, in particular, to insist on a uniform suffix for this group of compounds.

Compared with organic chemistry, the development of inorganic chemistry in the decades between Davy and Mendeléef may seem pedestrian. There were, of course, periodic announcements about the discovery of new elements. The discovery of the metal cadmium by Stromeyer was announced in the *Annales* in 1818.[80] In 1824 the Swede Arfwedson claimed to have isolated the metal uranium, although the brown powder produced was later shown to be an oxide. The original paper in the *Annalen der Physik* was translated into French for the *Annales*.[81] There was always the problem of confirmation of claims. Thus the *Annales* in 1819 reported the discovery of a new metal by Lampadius[82] but a more careful analysis by Stromeyer in the following year of the same mineral found that it contained a mixture of several metals, including nickel, cobalt, iron, copper and lead.[83] A particularly exciting discovery by Thenard of hydrogen peroxide (containing the same

---

75 'De la morphine', *A.c.p.*, *5* (1817), 21-42.
76 *A.c.p.*, *10* (1819), 142-176.
77 *A.c.p.*, *12* (1819), 113-133.
78 *A.c.p.*, *14* (1820), 69-83 (75).
79 'Recherches chimiques sur les quinquinas', *A.c.p.*, *15* (1820), 289-318, 337-365.
80 *A.c.p.*, *8* (1818), 100-1.
81 'Recherches sur l'urane', *A.c.p.*, *29* (1825), 148-175.
82 *A.c.p.*, *11* (1819), 201.
83 *A.c.p.*, *14* (1820), 335.

elements as water) was squeezed in at the end of the issue of the *Annales* dated December 1818, although it was only read to the Academy of Sciences on 18 January 1819.

Yet inorganic chemistry did not consist entirely of disparate discoveries. In December 1819 Mitscherlich presented a paper on isomorphism to the Berlin Academy of Sciences, which was published in the issue of the *Annales* for June 1820.[84] Mitscherlich had found an exact parallel between different salts of arsenic and phosphorus and had concluded that, if salts of different elements had the same crystalline form, they would have an analogous composition. This provided a useful criterion for fixing the formulae of inorganic compounds.

A fundamental way in which inorganic chemistry changed in the early nineteenth-century was through the introduction of electrochemistry, which under the leadership of Berzelius (1779 - 1848) provided a new basic theory. Yet it was not entirely new, since it could be seen as a development of eighteenth-century concepts of acidity and basicity. Acidity, as generally understood, was extreme electronegativity, and basicity was extreme electropositivity.[85] Thus Berzelius' dualism can be considered as an extension of ideas of an earlier age, which had no idea that electricity might be relevant to chemistry. In Lavoisier's chemistry oxygen occupied a special place; it continued to occupy a special place in Berzelius' chemistry as the most electronegative element. With his electrochemical theory and his system of atomic weights Berzelius came to enjoy a position of international eminence in the 1820s and 1830s, only seriously challenged in the final years of his life in the 1840s.

Given the geographical and cultural advantages enjoyed by France, it may not be easy to understand how a Swede was able to enjoy such international authority.[86] Firstly it may be pointed out that his successive tables of atmomic weights[87] were regarded as especially authoritative. But a large part of the answer lies in Berzelius' international connections. We have already revealed that he was a 'secret' co-editor in the first series of the *Annales*. After the defeat of Napoleon he was able to make a year-long visit to his friends in Paris. He had already travelled to Britain and had met British chemists. As regards the German states, it was there that Sweden had the closest cultural links and Berzelius' work was particularly well-known.

---

[84] 'Sur la relation qui existe entre la forme crystalline et les proportions chimiques', *A.c.p.*, *14* (1820), 172-190.

[85] Evan M. Melhado, *Jacob Berzelius, The Emergence of his Chemical System*, Stockholm, 1981, p.146.

[86] Berzelius was able to introduce the modern symbols for the chemical elements, also various general terms such as 'catalyst'.

[87] E.g. *A.c.p.*, *38* (1828), 426-432.

Yet, although the electrochemical theory made a major contribution to the advancement of inorganic chemistry, there would soon be problems with applying it to organic chemistry. It was to be the French chemist Jean-Baptiste Dumas, who was to expose its shortcomings in this field. In a paper published in the *Annales* in 1834, he began to investigate the action of chlorine on different substances and found that an atom of chlorine could replace an atom of hydrogen.[88] This paper may be regarded as the beginning of his substitution theory, but the most famous example came in 1838 when he showed that chlorine could replace one, two or three atoms of hydrogen in acetic acid without fundamentally altering its properties. That a very electronegative element (chlorine) could replace an electropositive element (hydrogen) in this way was a serious blow to the electrochemical theory. Dumas presented this important work to the Academy, which through the *Comptes rendus* now offered immediate publication.[89] Unfortunately Dumas' former student Laurent could claim that he had earlier predicted the existence of chloracetic acid,[90] which did not help good relations between the two.[91] By February 1840 Dumas had developed his substitution theory into a theory of chemical types, substances having similar chemical formulae produced by substitution, and mechanical types, having similar formulae but quite different chemical properties.[92] Acetic and trichloracetic acid would belong to the first class and marsh gas and chloroform to the second. Dumas had shown himself to be in the vanguard of chemical research and he was invited (with several others) to join the editorial board of the *Annales*. The type theory was to make a major contribution to organic chemistry in the mid-nineteenth century.

There were also several articles in the *Annales*, which relate to what would later be called physical chemistry. Gay-Lussac's important memoir on the solubility of salts could be regarded in a purely empirical light.[93] On the other hand he himself related solubility to 'chemical cohesion' and thus the study falls within the tradition of studies of chemical affinity. This is more explicit in one of his last memoirs 'on chemical forces'.[94] Dumas as a young

---

[88] *A.c.p.*, *56* (1834), 113-150.

[89] *C.R.*, *7* (1838), 474; *8* (1839), 609.

[90] *A.c.p.*, *62* (1836), 30.

[91] A full discussion of this issue is given by Leo Klosterman, *Studies in the Life and Work of J.B. Dumas (1800-84): The Period up to 1850*, University of Kent Ph.D thesis, 1976, Chapter 8.

[92] *A.c.p.*, *73* (1840), 73-100, 113-166.

[93] *A.c.p.*, *11* (1819), 296-315.

[94] *A.c.p.*, *70* (1839), 407-434. This memoir is discussed in Michelle Goupil, *Du flou au clair? Histoire de l'affinité chimique*, Paris, 1991, p.230.

man contributed a page ostensibly on the atomic theory[95] but more genuinely to determine molecular weights by means of vapour density, following in the footsteps of Gay-Lussac. Dumas himself preferred not to use the term atom but to think of molecular groups. Generally speaking, discussions of atomic theory were avoided in the *Annales*, although it did publish a memoir by Gaudin, a student of Ampère, on the subject in 1833.[96] Although the term 'catalysis' had not yet been introduced, we may also report the decision of the *Annales* to include in very small type at the end of its issue for August 1823 a report made to the Academy in September by Dulong and Thenard of Döbereiner's discovery that spongy platinum had the property of making certain gases combine. The editors obviously recognised its importance.

Gay-Lussac's own interests in his later years moved increasingly towards applied chemistry and he thought it appropriate to include in the *Annales* papers on the analysis of gunpowder,[97] tests on the purity of commercial potash[98] and measurements of the strength of bleaching powder.[99]

5. *Links with the Academy of Sciences*

One of the changes one notices in the second series of the *Annales* is a much closer relationship with the First Class of the Institute, renamed the Academy of Sciences in March 1816. Indeed regular reports on the meetings of the Academy had been promised in the Prospectus.[100] Thus each issue reported systematically on the main proceedings of the official body of science during the previous month. Each meeting was summarised in several pages of the new small type chosen for the *Annales,* according to its apparent importance and space available. The proceedings would often mention the biological sciences and these were included, despite the primary interest of readers in physics and chemistry. Yet the explicit coverage by the journal of two of the leading sciences discussed in the Academy gave it much more justification for linking itself to the Academy than if it had simply been a specialist chemical journal. In the very first issue of the new series, in addition to the reports, no less than ten pages were devoted to the subject of prizes announced by the

---

[95] J.B. Dumas, 'Sur quelques points de la théorie atomistique', *A.c.p.*, *33* (1826), 337-391. See Alan J. Rocke, *Chemical Atomism in the Nineteenth Century from Dalton to Cannizzaro*, Columbus, Ohio, 1984.

[96] M.A. Gaudin, 'Recherches sur la structure intime des corps inorganiques définis', *A.c.p.*, *53* (1833), 113-122.

[97] *A.c.p.*, *16* (1821), 434-9.

[98] *A.c.p.*, *39* (1828), 337-368.

[99] *A.c.p.*, *60* (1835), 225-260.

[100] Appendix 1, No.12.

National Institute.[101] One of the prizes was to reward the discoverer of a new process for gilding without the danger to health associated with mercury.

The summaries of proceedings of the Academy were sometimes enriched by useful editorial foot-notes. Thus when progress made with Cornish steam engines was reported to the Academy, Arago added a note about Woolf's double-acting steam engine.[102] Arago permitted himself some critical remarks about an ignorant curé who had addressed the Academy on the reform of the metric system.[103]

One of the principal justifications for including reports on Academy meetings was that this would keep readers, who did not live in Paris, up to date with scientific news. From 1816 to 1829[104] the monthly numbers of the *Annales* faithfully reported on the meetings of the Academy during the previous month. From 1830 the *Annales* adopted the practice of only reporting on the annual public meetings of the Academy, when prizes were awarded and subjects announced for future years. In 1831 the *Annales* briefly resumed the practice of reporting on the weekly meetings of the Academy because, it said, of 'the demand of a large number of subscribers'.[105] The editors had hoped that the increase in reporting of meetings in newspapers had made this feature superfluous but these papers did not circulate outside France. Hence it was particularly foreign subscribers who valued the *Annales*' summary. Also newspapers tended to mention only those aspects of greatest popular interest, and often very little space would be given if there was competition with reporting on political events.

After 1833 even reporting in the *Annales* of public Academy meetings ceased, and one can hardly fail to see behind these changes a conflict of loyalties of Arago, who in June 1830 had been elected permanent secretary of the Academy, and obviously wished to avoid any action, which might antagonise his colleagues. Although he had originally served the interests of the Academy, as well as the readers of the *Annales,* by reporting on meetings, the possibility arose in the early 1830s of the Academy publishing its own reports on meetings. With the prospect of a weekly *Comptes rendus*, which actually began in 1835, the *Annales* tactfully withdrew. Previously the *Annales* had given space to many reports of Academy Commissions. The *Annales* continued to publish the text of some of the Academy Reports, which were of outstanding importance, for example, the report on high pressures in steam en-

---

[101] 'Prix proposés au concours par la première classe de l'Institut, dans la séance publique du 8 Janvier 1816', A.c., *1* (1816), 91-100.

[102] *Ibid*, 314-15n.

[103] *A.c.p.*, *2* (1816), 88-9n.

[104] i.e. Vol.42.

[105] *A.c.p.*, *46* (1831), 97n.

gines[106] or Arago's announcement to the Academy of Daguerre's photographic invention.[107]

The appearance of the *Comptes rendus* was to undercut the *Annales* in more ways than one. More important than the failure of the *Annales* to continue publishing reports on the meetings of the Academy was the arrival of alternative means of publication for chemists and physicists. The *Annales*, by its monthly publication, had prided itself that it provided more rapid publication of scientific papers than most alternative outlets. But now the Academy was offering weekly publication. Moreover, the Academy of Sciences, as a government-sponsored agency, had enormous prestige. Few scientists could aspire to become members because of its severely restricted numbers but some kind of consolation prize was available from 1835 - publication of one's own research in its official proceedings. From now on the *Annales* (and several other journals in other scientific fields) had a serious rival. The only consolation for the *Annales* was that space was severely limited in the *Comptes rendus* so that, unless a paper was very short, normally no more than a summary could be published. This led to a procedure which came to be regularly adopted by many scientists, in which they would submit an abbreviated version of their work to the Academy for prompt publication (sometimes thereby securing priority) and then have a full version of their paper with experimental details published in the appropriate disciplinary journal in due course. When Louis Pasteur announced his historical discovery of the relation between the crystalline form of salts of tartaric acid and the effect of their solutions on polarised light at a meeting of the Academy in May 1848 a three-page summary was published in the *Comptes rendus.*[108] A later paper in October was reported only by title.[109] Pasteur, however, had the satisfaction of seeing it published in the *Annales* for that month.[110] Also the *Annales* was able to reproduce figures of crystals, whereas the *Comptes rendus* normally excluded plates. Thus the *Annales* did not lose out completely.

6. *Reporting research from other countries.*

The *Annales* did not want to be purely a journal of French science and, in their note published in 1816, the editors had referred explicitly to their access to foreign journals.[111] They undertook to summarise relevant articles from British and German periodicals but they also commented that they would be very selective because these 'too frequently contain articles of a purely local

---

[106] *Ibid.*, *43* (1830), 74-111.
[107] *Ibid.*, *71* (1839), 313-39.
[108] *C.R.*, *26* (1848), 535-8.
[109] *C.R.*, *27* (1848), 367.
[110] *A.c.p.*, [3], *24* (1848), 442-459.
[111] Appendix 1, No.13.

interest'. Although Italian journals had not been available in 1816, they promised to consult them in future. They said that they had even taken steps to obtain copies of American scientific journals, one of the first mentions of the potential value of reports from the other side of the Atlantic. Thus we find, for example, Professor Benjamin Silliman's papers translated in the *Annales*[112] and later a paper on the electric telegraph by Samuel Morse of Morse code fame.[113]

We will begin by looking at the editor's foreign contacts. Up to the mid-century, control of the *Annales* lay largely in the hands of Arago and Gay-Lussac. Although Arago may occasionally be accused of chauvinism, fervently supporting priority claims of French scientists over those from other countries, his colleague Gay-Lussac had more international sympathies. As a young man Gay-Lussac had travelled extensively, visiting Switzerland and the German and Italian states before travelling to England. He had studied foreign languages and kept in contact with his former student, Liebig, who came to represent the crest of a wave of German dominance in the field of organic chemistry. Gay-Lussac also kept in touch with Berzelius, who had featured as a major foreign contributor in the first series of the *Annales*. Many books by Berzelius as well as his *Jahresberichte* were to be found on the shelves of Gay-Lussac's personal library.[114] Through Gay-Lussac, Berzelius continued to provide material for the *Annales* and indeed he was one of the most important foreign contributors. One of the first memoirs in the *Annales* to make use of the modern system of chemical symbols for elements and compounds was one by Berzelius in 1819.[115] Berzelius was, of course, the originator of these symbols based on the Latin names of the elements.[116] As an example of foreign representation we may cite volume 23, which contained articles by Brewster, Wheatstone and Wollaston, and volume 24 with articles by Döbereiner, Mitscherlich and Liebig. During the 1820s articles by Heinrich and Gustav Rose, Gmelin and Auguste de la Rive are to be found together with the occasional Italian contribution.

Berzelius was quite an important figure in the second series of the *Annales*. Indeed up to the mid-1830s more than 60 per cent of the volumes contained some contribution from the Swedish chemist. As we have seen, he had been a contributor to the first series, yet in the first volume of the *Annales de chimie*

---

[112] *A.c.p.*, *24* (1823), 216-223.

[113] *A.c.p.*, *72* (1839), 220-3.

[114] M. Crosland, 'The library of Gay-Lussac', *Ambix*, *28* (1981), 158-170.

[115] *A.c.p.*, *12* (1819), 12-37. Berzelius was staying in Paris at the time. No explanation was given by the editors of the new symbols and it was some time before they came into general use.

[116] M. Crosland, *Historical Studies in the Language of Chemistry*, 2nd edn., New York, 1978, pp.270ff.

et de physique Gay-Lussac was tactless enough to criticise several of Berzelius' analyses, much to the indignation of the Swede, who was justly proud of his analytical skills. Fortunately the dispute was soon resolved, but Gay-Lussac insisted that, as editor, he had an absolute right to characterise some data submitted to the *Annales* as provisional until it had been verified. In 1817 Berzelius was able to come to Paris where, among many other things, he did important work on the isolation and properties of the new element selenium, which was immediately published in the *Annales*.[117] Most of Berzelius' later papers were published first in Sweden and then translated later into French for the *Annales*, thus making a major contribution to the international standing of the periodical.

The most important German contributor to the *Annales* during Gay-Lussac's editorship was undoubtedly Justus von Liebig. Although some papers were translated from German periodicals, several were sent directly to the *Annales*, written in French.[118] This is a side of Liebig that has not received very much attention. The young Liebig had been attracted to Paris as a centre of higher education in science and at the age of 18 he had joined the throng of students attending Gay-Lussac's lectures at the Faculty of Science. He had been fortunate to secure a personal introduction to the professor, who was impressed by the enthusiasm of the young German and invited him to work in his laboratory at the Arsenal. This was a rare privilege, and from this collaboration there emerged a joint paper on the analysis of silver fulminate, published in due course in the *Annales*.[119] Liebig then returned to Germany and was able to take up a post at the University of Giessen. There he managed to inspire students in laboratory research in organic chemistry and build up a school of international importance.[120] As his power grew, Liebig became involved in quarrels with other prominent chemists, including Dumas, but he never forgot his debt to Gay-Lussac; the *Annales* was to be the beneficiary of the friendship between the two men. In 1832 Gay-Lussac showed his confidence in his German friend by sending his eldest son to study with him at Giessen. When Pelouze went to study with Liebig in 1836, a summary of their research was published in the *Annales*.[121]

Probably Liebig's most important, and certainly the most historic, memoir published in the *Annales* was one that he sent to Gay-Lussac in French in 1831, describing at length the apparatus he had developed to carry out organic

---

[117] *A.c.p.*, *9* (1818), 160-180, 225-267, 337-365.

[118] Liebig sometimes asked his French students to provide French translations of his memoirs, as with Gerhardt (1836-7) and Wurtz (1843-4).

[119] *A.c.p.*, *25* (1824), 285-311.

[120] See e.g. J.B. Morrell, 'The chemist breeders; the research-schools of Liebig and Thomas Thomson', *Ambix*, *19* (1972), 1-46.

[121] 'Extrait de quelques recherches chimiques faites à Giessen', *A.c.p.*, *62* (1836), 438-444.

analyses.[122] Not only was organic analysis a key activity at this time but Gay-Lussac was in an ideal position to appreciate it, having some 20 years earlier made a contribution to combustion analysis. Liebig's apparatus, which became a classic, contained a calcium chloride tube to absorb moisture and potash bulbs to absorb the carbon dioxide evolved in the combustion process.

The leading British chemists, Davy and Dalton, had done nearly all their major chemical research before Gay-Lussac took over the *Annales* but the journal did publish in 1817 a paper by Dalton criticising Gay-Lussac's analysis of the oxides of nitrogen. Gay-Lussac added a note pointing out the lack of agreement between Dalton over various experimental results.[123] A later intention of reproducing another paper of Dalton was cut short by obvious embarrassment about the accuracy of his quantitative work. Gay-Lussac mentioned his respect for Dalton but could not refrain from criticising him.[124]

Michael Faraday, however, belonged to another generation. As a young man he had visited Paris in November-December 1813 in the company of Davy. He made important contributions to both physics and chemistry, which fitted in well with the interests of the *Annales*. Thus, as early as 1821, the *Annales* was publishing one of his papers on electro-magnetism[125], and it also published his paper on the liquefaction of gases,[126] translated from the paper published in the *Annals of Philosophy*. His most famous work was on electromagnetism, a subject to which Arago himself had contributed. It therefore follows that the *Annales* regularly published memoirs by Faraday, often translated from the *Philosophical Translations of the Royal Society* but sometimes sent more directly to France as in the following unfortunate instance.

Michael Faraday's discovery of electro-magnetic induction, communicated to the Royal Society on 24 November 1831, was mentioned in a letter of 18 December by Faraday to Hachette and sent to the Academy of Sciences on 26 December.[127] This aroused immediate interest, especially from Arago and Ampère. It also provoked immediate research from two Italians, Nobili and Antinori, and their research, carried out in January 1832, was published in the delayed issue of the *Annales* dated December 1831.[128] Although a note at the end of this issue[129] referred to the desirability of publishing Faraday's research, the next few issues did not carry the relevant memoirs and the French

---

[122] *A.c.p.*, *47* (1831), 147-197. This memoir was later republished separately as a booklet.
[123] *A.c.p.*, *7* (1817), 36-44.
[124] *Ibid.*, 405-10.
[125] *A.c.p.*, *18* (1821), 337-370.
[126] *A.c.p.*, *22* (1822), 323-6.
[127] *A.c.p.*, *48* (1831), 402-3.
[128] *Ibid.*, 412-30.
[129] *Ibid.*, p.445n.

public had to wait for the issues of the *Annales* for May[130] and June 1832[131] to read a full account of Faraday's research. The fact that the Italian scientists claimed priority over Faraday vexed the latter and on 1 December 1832 he wrote a long letter to Gay-Lussac, setting out the circumstances of his discovery and its publication. Gay-Lussac published this letter in full in the final issue for 1832.[132] It seems here that the editors of the *Annales* were at fault in not publishing Faraday's paper earlier, but at least they allowed Faraday to put forward in full, and without editorial interpolation, his own version of events.

Faraday later regretted what he referred to as his 'hasty letter to M. Hachette [which] in consequence probably of my bad writing, has been translated with some errors. Had it remained private, it would not have been of much consequence but' - he added unfortunately 'it has appeared in three or four languages and forms the text of all subsequent papers on magnetic electricity'.[133]

7. *Later editorial control*

When Gay-Lussac and Arago took over the editorship of the *Annales* they were at the height of their research careers. They were neither young enthusiasts nor very senior scientists, whose active research belonged to the past. They, therefore, commanded great respect from the scientific community and they were in a very favourable position to solicit memoirs they liked and to refuse publication to those they found wanting. As Brongniart said in 1823:

> When Arago and Gay-Lussac put their names to the *Annales de chimie* they communicated a part of their fame to this periodical. Their numerous and profound researches allowed them without too much presumption to declare themselves the judges or if you prefer . . . the *electors* of the memoirs proposed . . . [134]

We have no inside information on memoirs rejected by the editors. As regards those published, once again they had the choice of memoirs presented to the Academy of Sciences which, for members, might have had to wait two years for publication and for non-members might have had to wait as many as ten, even if the memoir had been singled out for special praise as fit to be published in the occasional series, the *Mémoires des savants étrangers*.

For evidence of imposition of certain standards of orthodoxy in chemical theory for articles published in the *Annales* we have to wait until 1840, when

---

[130] *A.c.p.*, *50* (1832), 5-69. Frank James (ed.), *The Correspondence of Michael Faraday*, vol.2, London, 1993, pp.49, 50. Letter of Hachette to Faraday, 18 May 1832.

[131] *A.c.p.*, *50* (1832), 113-162.

[132] *A.c.p.*, *51* (1832), 404-434.

[133] *Experimental Researches*, Vol.2, 1844, 164-5n.

[134] Jean Théodorides, *Jean-Victor Audouin (1797-1841)*, Paris, 1978, p.45.

J.-B. Dumas was one of a number of new editors appointed. One might say that this marked the re-emergence of an editorial board. Arago as secretary of the Academy and editor of its *Comptes rendus* had more than enough work elsewhere and Gay-Lussac, now over 60, was beginning to slow down his activity. Hence, although they were still in charge of the *Annales*, they wanted to take a less active part and they brought in younger men to take over the actual running of the journal. In a letter of 26 August 1840 from Pelouze to Berzelius, the former mentioned that the editorial board had met for the first time.[135] Berzelius had written a paper critical of Dumas, and Pelouze advised that it would have to be shown to Dumas before it could be accepted. Dumas allegedly said to Regnault that, if Berzelius' paper was published in the *Annales*, he would resign. There would probably not be another meeting of the editorial board for two months, since it was the height of summer and everyone, who had the opportunity, had abandoned Paris for the countryside.

At the heart of this dispute was Berzelius' electrochemical theory. The Swedish chemist had made an important contribution to chemistry earlier by classifying elements and radicals as electropositive or electronegative. According to him, therefore, there could be no similarity at all between electropositive hydrogen and electronegative chlorine. Yet in 1838 Dumas had been able to react chlorine with acetic acid and replace three electropositive hydrogen atoms by three electronegative chlorine atoms (releasing hydrogen chloride) to produce a substance not very different from the original acetic acid. Dumas' substitution theory brought him considerable fame but it was a great embarrassment to Berzelius, who imagined some complex formulae, which might explain the reaction without obliging him to modify his own theory.

For further evidence of Dumas' new power over publication in the *Annales* in the 1840s we may turn to consider briefly the career of a prominent contributor in the field of organic chemistry, Auguste Laurent (1807 - 1853). He has been described as a man 'of a very sensitive and nervous disposition, easily discouraged and readily provoked into a quarrel over real or imagined insults'.[136] He was, however, someone with original ideas and also very hard-working. In his doctoral thesis of 1836 he developed his ideas of fundamental and derived radicals in organic chemistry. In the same year he published a total of seven papers in the *Annales*, hoping to use these as qualifications for an academic post. Indeed that was to be the story of his life. In 1837 he prefaced a rather miscellaneous memoir in the *Annales* with the following observation:

---

[135] H.G. Söderbaum (ed.), *Berzelius Bref*, Supplement 2, p.66.
[136] S. Kapoor, art. 'Laurent', *D.S.B.*, *8*, pp.54-61 (55).

> I had hoped that the papers which I had published up to now would open the door of a laboratory where I would have been able to continue my research. With this expectation I had prepared a large number of compounds in order to examine them later.[137]

However, since he was about to lose his laboratory facilities he said that he was hastening to analyse these compounds. This paper ran to nearly eighty pages and was continued in a later issue. An index of Laurent's frenetic activity is the total of ten papers by him published in the *Annales* in 1837. It was not until 1839 that he was offered a post as professor of chemistry at Bordeaux. Although he accepted it, he could not help feeling that he was being excluded from the scientific centre in Paris and for this he blamed his former teacher, Dumas, who had considerable power in making academic appointments.

It has been said that the following years were the most productive period of Laurent's life, yet this is not reflected in papers published in the *Annales*. The reason seems to be related to the appointment of Dumas in 1840 to the editorial board. It is true that Laurent had one or two papers published in the *Annales* in 1841 but a letter of 1842[138] refers to his resolution never to publish there again because of the tyranny exercised by Dumas.[139] It is not clear whether Laurent had actually had a paper rejected by the *Annales* or whether Dumas had insisted on making certain changes to the text. This is quite possible, since Laurent not only developed his own theories independently of anyone else but even made up his own chemical language. Neither of these traits would have endeared him to Dumas. Although Laurent and Gerhardt may have regarded Dumas' control over the *Annales* as 'tyranny', Malaguti told his friend that he had no direct experience of such tyranny. The importance of this letter for the history of chemical periodicals in France in the 1840s is that it provides evidence of the groundswell of discontent with Dumas' new power, thus providing some justification for the launching of a new journal by Gerhardt and Laurent. They not only published there but took full advantage of the availability of the Academy's *Comptes rendus* which, as a summary of papers submitted to the Academy, did not involve a process of refereeing. The above discussion does, however, introduce the question of an enlarged editorial board and it is time we turned to this aspect of the development of the *Annales*.

---

[137] *A.c.p.*, *66* (1837), 136.

[138] See Appendix No.1, No.15.

[139] In a letter to Liebig in July 1840 Laurent's friend Gerhardt had spoken of the *Annales de chimie* exercising 'a kind of despotism' (Munich, Liebigiana 58). Gerhardt too resented the power exercised by Dumas.

8. *Expansion of the editorial board and later series*

For a quarter of a century the second series of the *Annales* continued with the same two editors. But from 1830 Arago became very busy as one of the two permanent secretaries of the Academy of Sciences. As if this was not enough, in 1835 he took on the additional responsibility of editing the newly-founded *Comptes rendus*. Arago's heavy work load must have meant that in the 1830s Gay-Lussac shouldered rather more than his share of the editorial burden. In 1840 it was decided that it would soon be time to start a third series and they felt that they should expand the editorial board and bring in some younger talent. The people chosen were Dumas, Chevreul, Pelouze, Boussingault, Savary and Regnault. One might have expected an equal division between chemists and physicists but these names represent four chemists and not more than two who could be labelled under physics. In fact Regnault had begun his career as a chemist but most of his work in chemistry (mainly organic) belonged to the period 1835 - 39. In 1839 he began a major programme for the study of the specific heats of many solids and liquids. In 1842 he was asked by the Minister of Public Works to determine more accurately all the physical constants involved in the operation of steam engines; this led to his research on the thermal properties of gases, for which he is now best remembered.[140]

But what may be even more surprising than the preponderance of chemists is the personal and political connections between Arago and two of the new editors. Savary seems to have been chosen not simply as an able physicist but because he was related to Arago's wife. He had been elected to the Academy in 1832 with Arago's support and it was on a visit to the Arago family house near Perpignan in 1841 that Savary was to die. Although on the academic side Pelouze had been a protégé of the moderately conservative Gay-Lussac, on the political front he shared Arago's republicanism. He had even fought on the barricades in the 1830 revolution. He was a friend of the radical poet Beranger and had contributed to a journal of Louis Blanc. It is therefore doubtful that he was chosen purely for his knowledge of chemistry. On the other hand Dumas' politics were probably slightly to the right of centre so, although Arago might be accused of political engineering in elections to the Academy in the 1830s and 1840s, it cannot be said that the editorial board as a whole represented a particular political stance. Rather the members covered quite a wide range, more than might be expected from a political journal. The reputation of Chevreul was principally in organic chemistry and Boussingault is mainly remembered for his work in agricultural chemistry.

Gay-Lussac died in 1850, thus bringing to an end the last thread of continuity with the first series of the *Annales*; he was not replaced. The next

[140] R. Fox, art. 'Regnault', *D.S.B.*, *11*, 352-4.

major change came in 1853, when the senior editor Arago was in failing health in the last year of his life. The editors of the *Annales* had for many years been conscious that work of major importance was being done in Germany, particularly in chemistry, and a fair number of translations of articles from German sources had been included.

We have seen that Liebig was a prominent contributor to the *Annales*, yet he was particularly critical of the failure of the French chemists to keep in regular touch with foreign publications:

> In France [knowledge of foreign languages] is something quite unusual. The worst aspect is that they are fortified and supported in this one-sidedness through a most ridiculous and - for a man of science - unnatural arrogance about the advantages and achievements of their nation. Only the older chemists, Gay-Lussac, Dulong, Arago are in a position to read foreign memoirs. So it has now come about that many of our pharmacists with a genuinely scientific education are far superior to the younger French chemists.[141]

From 1853 the importance of international coverage was recognised by adding to the title page the words 'avec une revue de travaux de chimie et de physique publiés à l'étranger par MM. Wurtz et Verdet'. Wurtz was responsible for the chemistry, and nearly all the articles he contributed were from German authors. Verdet's articles on physics were mainly German but also included articles by British physicists such as William Thomson.

When the fourth series began in 1864 Verdet decided that the best method of covering foreign literature was to abstract systematically from major foreign journals, especially Poggendorff's *Annalen*, the *Philosophical Magazine* and the *Proceedings of the Royal Society*. The section of foreign papers was printed separately at the end of each volume. It would comprise 50 or more pages, constituting some 10 - 15 per cent of the volume, but we should add to this the translations of foreign papers published in full in the main part of the *Annales*. In the foreign supplement only abstracts would be given. Verdet's death in 1864 produced a gap in the reporting of foreign physics until 1868, when Bertin was appointed to replace him. On the chemistry side we may mention the inclusion of Kekulé's classic paper, in which he proposed the structure of benzene.[142] This was published in 1866, translated from the *Annalen der Chemie und Pharmacie*, in which it had appeared earlier that year. The contents of the *Annales* were naturally overwhelmingly French. It is, therefore, ironic that one published volume, volume 23, published in the summer of 1871, just after the French defeat in the Franco-Prussian war, should have appeared with a majority of contents by German authors. French

---

[141] *Annalen der Pharmacie*, *2* (1832), 20.
[142] *A.c.p.*, [4], *8* (1866), 177.

TABLE 2 Members of the Editorial Board of Successive Series of the *Annales*

Series	*Dates*	*No. of vols.*		*Editors*
1	1789-1815	96	(a) vol.1 (1789)-	[Guyton] de Morveau, Lavoisier, Monge, Berthollet, Fourcroy, Dietrich, Hassenfratz, Adet.
			(b) vol.19 (1797)-	Guyton, Monge, Berthollet, Fourcroy, Adet, Séguin, Vauquelin, Pelletier, Prieur, Chaptal, Van Mons.
			(c) vol.33 (1800)-	Guyton, Monge, Berthollet, Fourcroy, Adet, Hassenfratz, Séguin, Vauquelin, Prieur, Chaptal, Van Mons, Deyeux, Parmentier, Bouillon-Lagrange.
			(d) vol.74 (1810)-	Guyton-Morveau, Monge, Berthollet, Séguin, Vauquelin, Adet, Hassenfratz, Prieur, Chaptal, Parmentier, Deyeux, Bouillon-Lagrange, Descotils, Laugier, Gay-Lussac, Thenard.
2	1816-40	75	(a) vol.1 (1816)-	Arago, Berthollet, Biot, Bouillon-Lagrange, Chaptal, Chevreul, D'Arcet, Deyeux, Dulong, Gay-Lussac, Hassenfratz, Laugier, Monge, Prieur, Séguin, Thenard, Vauquelin.
			(b) vol.4 (1816)-	Gay-Lussac & Arago.
			(c) vol.73 (1840)-	Gay-Lussac, Arago, Chevreul, (Savary), Dumas, Pelouze, Boussingault, Regnault.
3	1841-63	69	vol.37 (1853)-	(Arago), Chevreul, Dumas, Pelouze, Boussingault, Regnault, *avec une Revue des travaux de chimie et de physique publiés à l'étranger par MM. Wurtz et Verdet.* (Also Sénarmont, 1854-62.)
4	1864-73	30	vol.1 (1864)-	Chevreul, Dumas, Pelouze, Boussingault, Regnault, *avec la collaboration de MM. Wurtz (et Verdet).*
5	1874-83	30	vol.13 (1868)-	Chevreul, Dumas, Boussingault, Regnault, Wurtz, *avec la collaboration de M. Bertin.*
			vol.14 (1878)-	[Berthelot added]
			vol.16(1879)-	[Pasteur added]
6	1884-93	30	vol.4 (1885)-	Chevreul, Boussingault, Berthelot, Pasteur, Friedel, Becquerel, Mascart.
			vol.17 (1889)-	Berthelot, Pasteur, Friedel, Becquerel, Mascart.
7	1894-1903	30	vol.7 (1896)-	Berthelot, Friedel, Mascart.
			vol.9 (1896)-	[Moissan added]
8	1904-1913	30	vol.11 (1907)-	Mascart & Haller.
			vol.17 (1909)-	Haller, Lippmann, Bouty
9	1914-	(Separate publication of *Annales de chimie* and *Annales de physique*.)		

scientists in the preceeding months had had little time to undertake pure scientific research.[143]

The fifth series takes us into the period of reaction to the loss of the war and the firm establishment of the Third Republic. It may be noted from Table 2 that by now it had been decided that 30 volumes was sufficient to constitute a whole series. From now on a new series was launched every ten years but the important editorial changes did not coincide with the purely notional beginning of a series. Editorial changes took place when it was felt necessary to add someone to the board, and particularly as a replacement when someone died. The addition of Berthelot in 1878 may have been a nominal increase on the physics side, since Berthelot had recently been elected to the Academy in the physics section because the chemistry section was very cool towards him. Yet we know him as a chemist. Politically Berthelot was on the left, so the addition of Pasteur to the board in the following year may have been intended to help restore the political balance. More probably the *Annales* was hoping to take advantage of Pasteur's international fame by having his name on its title page. The addition of Henri Becquerel and Mascart to the editorial board for the sixth series was no doubt intended to indicate that physics was being taken seriously. On the chemistry side Wurtz, who died in 1884, was replaced by his protégé, Friedel. As for the editorship of Berthelot, it is preferable to discuss this separately in the next chapter.

[143] On the part played by French scientists (and particularly the chemists) in the siege of Paris see M. Crosland, 'Science and the Franco-Prussian war', *Social Studies of Science*, 6 (1976), 185-214.

CHAPTER NINE

CHEMICAL JOURNALS IN THE LATER NINETEENTH CENTURY

> The immediate instruments employed for the diffusion of scientific and useful knowledge are the periodical publications which exist in such numbers in Britain, France and Germany.
> (Thomas Thomson, *Annals of Philosophy*, *1* (1813), 1.)

> As in all historical work, research in early documents can be prolonged *ad infinitum* and it is fundamentally important to know when to stop.
> (G.M. Dyson in *Searching the Older Chemical Literature*, Advances in chemistry series, 30, Washington D.C., 1961, p.85.)

1. *Rival French chemical journals*

We have seen how, from the beginning, the *Annales* was far from exercising a monopoly in the publication of chemical research. Yet during the first and second series it was undoubtedly the *principal* journal for chemical papers. The situation changed a little in 1835, when the Academy of Sciences decided to take the momentous step of supplementing its ponderous *Mémoires* with a weekly publication, summarising the proceedings of the previous week's meeting: *Comptes rendus hebdomadaires des séances de l'Académie des Sciences*, a quarto publication beginning with some twenty pages per issue.[1] It would have been a major step for the Academy to take responsibility for publishing even a monthly journal but to make this *weekly* constituted a revolution in scientific publishing, only equalled, one may add, in the Anglo-Saxon world by the weekly publication of *Nature* from 1869 - a third of a century later. The relevance of a weekly publication from our point of view is that it was much more frequent than the monthly appearance of the *Annales*. Also,

[1] M. Crosland, *Science under Control. The French Academy of Sciences, 1795-1914*, Cambridge, 1992, pp.288ff. Despite financial constraints there was great pressure to increase the number of pages.

since it was associated with the elite Academy of Sciences, it carried a certain prestige not associated with privately-run journals.

The *Comptes rendus* covered all the main branches of science but its one disadvantage was that it only accepted very short papers or summaries of longer memoirs. Even members of the Academy were told not to exceed a certain number of pages.[2] What one tends to find, therefore, as previously mentioned, is papers published first in summary form in the *Comptes rendus*, thus incidentally ensuring wide publicity, and second, the full text of the memoir with experimental details in a disciplinary journal such as the *Annales*. The *Comptes rendus* should not, therefore, be seen as a direct threat to the *Annales*; it merely complemented it.

Before considering any serious direct competition with the *Annales*, we might mention an ephemeral publication, which included chemistry and physics in its title. We are referring to an ambitious venture of the 1820s when Baron de Férussac decided to launch a *Bulletin des sciences mathématiques, astronomiques, physiques et chimiques*. The first volume appeared in 1824. Opposite the title page was a long list of 'collaborators' for each of the sciences mentioned in the title. For chemistry the names given were (in alphabetical order):

> Becquerel, Berthier, Cagniard de Latour, Chaptal, Chevreul, d'Arcet, Dulong, Dumas, Gauthier de Claubry, Guillemin, Lassaigne, Laugier, Payen, Perdonnet, Thenard.

Each issue of the journal consisted of reviews of recent books and articles on the four sciences. As a sample of the treatment of books we may mention a short review of Döbereiner's *Zur pneumatische Chemie*, published at Jena in 1821, which ended with the comment that it contained more strange ideas than new facts.[3] Here was a warning of the importance to the French of new information as opposed to speculations. This series was only a part of Férussac's bibliographical project and he launched parallel series dealing with medicine, agriculture, military arts, etc. In its detailed coverage of a vast field it was far too ambitious for its period and the *Bulletin* soon collapsed.

It is now time to look for specifically *chemical* journals published in France, which might be seen as potential rivals to the *Annales*. An early example of a rival appeared in 1837, edited by Charles Martin and under the direction of Gaultier de Claubry with the title: *Répertoire de chimie, de physique et d'application aux arts*. This contained an account not only of recent work published in France but also abroad. Yet, as a sign that all was not well, it changed its title to: *Répertoire de chimie scientifique et industrielle*, obvi-

---

[2] Academicians were limited to a maximum of eight (later six) pages for one memoir. Non-members had half of this allowance.

[3] *Op.cit.*, *1* (1824), 62.

ously hoping to attract support from industry. Apparently this support failed to materialise and there was a further change of title: *Répertoire de chimie et mémorial des travaux étrangers*.[4] This latter twist to place emphasis on foreign publications was accompanied by the collaboration of Charles Gerhardt, who was closely in touch with German research, which was beginning to be of major importance. Yet, original though this publication may have been, it failed to establish a readership and only lasted for two years.

Even earlier in Sweden Berzelius had been presenting yearly reports on the progress of chemistry to the Royal Academy of Sciences of Stockholm. Originally in Swedish, their wider potential value was soon appreciated and they were translated into German by C.G. Gmelin (later: F. Wöhler) and were most commonly known by their German title: *Jahresberichte über die Fortschritte der physischen Wissenschaften* (later: *der Chemie*), published from 1822 to the time of Berzelius' death in 1847 and even continued for a further two years by L. Svanberg. In 1837 one volume was translated into French by Demarçay as *Annuaire des sciences chimiques* but apparently had very limited success, since no subsequent volumes were published for four years. From 1841 to 1848 further volumes appeared in French, translated now by Plantamour under the title *Rapport annuel sur le progrès des sciences physiques et chimiques*. The publishers pointed out that the previous *Annuaire* had been a translation from the German, in other words, a translation of a translation. The new series was a direct translation from the Swedish. It had separate sections on mineral, vegetable and animal chemistry. Although it had a certain success, not unrelated to the international reputation of Berzelius, publication ceased with the 1848 revolution.

In France Berzelius' idea of reviewing work of the previous year in chemistry was in a way to be taken up by Gerhardt, who saw this as a powerful means of advancing his own ideas. Before considering his journal, beginning in 1845/46, however, we should review Gerhardt's apprenticeship in the field of scientific journalism. He explained his role as a contributory editor to Quesneville's *Moniteur scientifique* in a letter to Liebig in 1840 and we could not do better than to quote from it:

> Dr Quesneville has informed us that he has assigned me to his journal for the section dealing with chemistry abroad, where more work is done now than in our country. As you promised him to take an interest in its publication by sending him proofs of your memoirs, I have no doubt that the new journal will have a great success from the start. Our columns are open to everyone . . . advocates of all parties are welcomed, for and against you, for and against Dumas, provided that discussions are confined to purely scientific limits . . . I am cer-

[4] According to André in *Bulletin de la Société chimique*, [4], *29* (1921), 637.

> tain that our fellow-countrymen, seeing that you honour us with your powerful protection, will not delay in coming over to us.[5]

We may now turn to Gerhardt's chemical journal. Since Gerhardt and Laurent became convinced of the existence of a plot to keep scientists like themselves of independent and original disposition out of Paris,[6] they thought that they should found their own journal. Gerhardt felt sure that he had the support of Liebig[7] and he thought that the new journal could outflank the *Annales de chimie* by taking a more international approach. Accordingly in 1846 there appeared the first volume of the *Comptes rendus des travaux chimiques*[8] under the joint names of Laurent and Gerhardt. In fact the joint editorship did not work out well. Volumes 2, 3 and 4 appeared under the name of Gerhardt only and it was not until 1850 that he was able to announce proudly the (re)emergence of Laurent as his co-editor. But by then the journal was near the end of its life.

In their opening introduction Gerhardt claimed that many friends had asked to be informed about foreign science, particularly about chemistry in Germany and Britain. If we examine the contents of the first volume, we find a markedly international mix with a distinct German bias, including Liebig, Wöhler, Hofmann, Fresenius and Kolbe. Volume two has an abstract of Faraday's paper on the liquefaction of gases as well as on another paper by Liebig, taken from his *Annalen*.[9] Indeed it is noticeable that nearly all the papers were abstracted by the editors, the only notable exception being half a dozen original articles each by Gerhardt and Laurent.[10] It is not surprising or even reprehensible that the editors should have published their own work. But it lessened the value of the journal that it consisted mainly of abstracts of papers *from the previous year*, with so few original articles. Indeed in later issues of the *Comptes rendus* there was a pathetic note printed on the cover to say that it accepted original articles and inviting chemists to submit their memoirs. There was a marked reluctance of French chemists to do so, although often their previously published work would be reported on in the *Comptes rendus*. This is understandable for an anti-establishment journal. Obviously established chemists would not want to publish there and it would not help the chances of

---

[5] Letter from Gerhardt to Liebig, 9 July 1840. Bayerische Staatsbibliothek, Munich, Liebigiana 58.

[6] Some information on the careers of these two chemists (sometimes referred to ominously as '*les deux*') is given in M. Crosland, *The Society of Arcueil*, London, 1967, pp.444-6.

[7] As we have seen in the letter quoted above.

[8] There were several minor changes of title. Thus while the first volume was headed: *Comptes rendus mensuels des travaux chimiques*, the second and subsequent volumes became the *Comptes rendus des travaux de chimie*.

[9] Liebig's memoir in volume 5 was taken from the *Annales de chimie*!

[10] This is true of volume 1 and obviously varied in successive volumes. In volume 5 Gerhardt had 10 memoirs and Laurent 14, some jointly authored.

younger chemists if they submitted original memoirs to Gerhardt's journal instead of, say, to the *Annales de chimie*. Gerhardt even went as far as to publish a protest against the decision of the powerful Academy of Sciences to award a (further) Paris chair of chemistry to Balard, to whom it had given 35 votes compared with 11 for Laurent.[11] This was followed by a summary of his own credentials for the position!

Yet one should not assume that Gerhardt's journal was mainly antagonistic to Dumas. There were many different schools and factions in chemistry. In his introduction to the first volume Gerhardt had tried to rally all French chemists under his flag against Berzelius. He wrote:

> Every year all our work is submitted to severe censure by a famous northern chemist.

Gerhardt took the opportunity of reviewing the latest volume of Berzelius' *Jahresberichte*.[12] He claimed that Berzelius was especially antagonistic to French chemists. For four years his own work had been criticised by the Swedish chemist. Now he would answer back. Berzelius only favoured work agreeing with his dualistic theory. Once the journal was established, Gerhardt and Laurent said they intended to use their own notation but to add the alternative formula that Berzelius favoured in brackets.[13] They made it clear that it was a journal for the propagation of 'their system' (*notre système*) and in a way it is a wonder that it survived until 1852.

Another chemical journal, which appeared in 1845, was the *Annuaire de chimie* edited by E. Millon and J. Reiset. In their introduction to the first volume, dated January 1845, the editors claimed that chemistry was the dominant science of the age. So much chemical research was being undertaken that several chemical journals were now necessary. Diplomatically they paid tribute to the *Annales de chimie et de physique* which, they said, contained a rich collection of original memoirs. But the *Annales* did not have room to report all the interesting work that was being done in chemistry, and foreign research went largely unreported. This helps to explain the full title of the journal:

> *Annuaire de chimie comprenant les applications de cette science à la médecine et à la pharmacie ou Répertoire des découvertes et des nouveaux travaux en chimie faits dans les diverses parties de l'Europe.*

---

[11] *Comptes rendus des travaux de chimie*, Sixième Année (1850), 1851, 426-7. For further discussion of this incident see M. Crosland, *The Society of Arcueil*, pp.447-8.

[12] *Ibid*, Année 1845, 1846, 63.

[13] *Ibid*, *Cinquième Année* (1849), 1850, Avertissement. In volume 1 Gerhardt had tended to use Berzelius' formulae and add his own in parenthesis where they were different. For a commentary on Gerhardt and Laurent's formulae see Alan J. Rocke, *Chemical Atomism in the Nineteenth Century*, Columbus, Ohio, 1984, pp.205ff.

The editors pointed out that without a journal such as theirs it would be necessary for researchers to consult some twenty journals in several different languages. They offered a service of abstracting and translating and they acknowledged the help of F. Hoefer in translations from the German. This series continued until 1851, by which time seven volumes had been published.

The greatest threat to the supremacy of the *Annales* came from the *Bulletin de la Société chimique*, a journal with humble origins but of great potential influence. The Société chimique de Paris was founded in June 1857 by a group of young chemists, who used to meet informally every week at a café in the Latin quarter to discuss their own work.[14] Most of them were students of Dumas or Deville and about half were non-French. Publicity attracted other young chemists and by the end of 1857 the number had grown from about ten to 24. Wurtz joined the Société in May 1858, his student Friedel being one of the vice presidents. Wurtz, as an older chemist, helped attract the senior chemists, notably Dumas, Balard, Cahours and Sainte-Claire Deville.

By October 1858 Wurtz was using the auspices of the Société chimique to launch his own journal, the *Répertoire de chimie pure*. The sub-title revealed the great emphasis he was placing on foreign publications: *Compte rendu des progrès de la chimie pure en France et à l'étranger*. To emphasise the wide coverage the title page listed the names of his collaborators: Friedel, Girard and Riche for France, Williamson for Britain, Lieben for Germany, Schischkoff for Russia, Rosing for Scandinavia, Frapoli for Italy. It was to be an abstract journal since the introduction stated explicitly that it would accept no original work and would take the greatest care to indicate the source of all articles. The introduction also mentioned that the Société chimique was sponsoring a parallel series devoted to applied chemistry and edited by Barreswil. The idea for such a journal had apparently been suggested to him by Thenard and, when he heard about Wurtz's interest in a parallel journal, the idea became a reality.

Wurtz's journal appeared in monthly issues of approximately 40 pages and continued like this until the end of December 1859. Up to this point the contents had little to do with the meetings of the Société chimique, so it was suggested that the society should publish some account of its meetings. Accordingly, from January 1859, a *Bulletin de la Société chimique de Paris* edited by Wurtz and Leblanc began to appear, associated with the *Répertoire*. The pure chemistry journal appeared in a total of four volumes under the title *Répertoire . . .* from 1858 to 1862. Barreswil's parallel journal appeared in five volumes over the years 1858 to 1863. But 1863 marked the beginning of the

[14] *Centenaire de la Société chimique de France (1857-1957)*, Paris, 1957. See also C. Pacquot, *Histoire et développement de la Société chimique depuis sa foundation*, Paris, 1950. For the Wurtz perspective I have benefited from discussions with my student, Ana Carneiro.

publication of a *Bulletin,* which contained both an account of meetings of the society and abstracts of chemical papers:

> *Bulletin . . . comprenant outre le compte rendu des travaux de la Société, l'analyse des Mémoires de chimie pure publiés en France et à l'étranger.* Par MM. J. Bouis, C. Friedel, F. le Blanc, A. Wurtz, etc.

In 1864 applied chemistry was added to the title and Barreswil, E. Kopp and Scheurer-Kestner to the editorial board. Thus from 1864 the *Bulletin* contained under one cover the three constituents that had hitherto been published separately and it is the 1864 volume which bears the proud title: 'Nouvelle Série, Tome Premier'.[15] By now there were more than 130 resident members and about the same number of non-resident members, both from the provinces and abroad.

Probably with an eye on the *Comptes rendus* of the Academy, the *Bulletin* began with the minutes of the January meeting, followed by a summary of the contents of four memoirs presented at the meeting. Most of the journal, however, was devoted to abstracts of papers under the respective headings of: General Chemistry, Mineral Chemistry, Mineralogical Chemistry, Organic Chemistry (by far the largest section), Physiological Chemistry, Agricultural Chemistry, Dyeing, Metallurgy, Technological Chemistry, Photographic Chemistry. It was indicative of Wurtz's growing influence in the society that in 1864 he was made president. He certainly contributed disproportionately to the early success of the society and its journal.

The Société chimique and its *Bulletin* were to prosper in the later nineteenth century. In order to compare the respective fortunes of the *Bulletin* and the *Annales* it may be convenient to take two dates: 1884, when Berthelot effectively took over the chief editorship of the *Annales*, and 1907, the last year of his life. The year 1907 also had special significance for the *Bulletin,* since it marked the official change of name of the Society from Société chimique de Paris to Société chimique de France. The French government had finally approved this change of title after receiving many petitions from provincial branches of the Society. It was now a truly national society. In 1884 there had been approximately 450 members in different categories in the Société chimique. By 1907 this had increased more than threefold to approximately 1500, with about 100 in each of the categories of benefactors and life members, some 400 resident members and nearly 900 non-resident (provincial) members. At the same time we find a significant increase in the size of the *Bulletin*. In 1884 the two volumes of the *Bulletin* had approximately 600 and 700 pages. In the early twentieth century the journal had expanded so that some massive volumes reached nearly 2,000 pages. The flow of chemical

[15] Yet somewhat confusingly the title page also carried the legend: Sixième année.

papers was almost getting out of control, but such expansion was obviously an index of the continuing development of the subject. The main point to be made, however, is the expansion of membership of the Société chimique, which brought with it a greatly increased circulation of the *Bulletin*. On the reasonable assumption that the circulation of the *Bulletin* was equal to the membership of the Société chimique plus a certain number of volumes for libraries, its circulation in 1884 was less than but comparable with that of the *Annales*. By 1907, however, it was more than twice that of the *Annales*. The circulation of the *Bulletin*, being linked to the membership of the Société chimique, could not help but increase in succeeding years. The *Annales* had no such inbuilt advantage.

2. *The decline of the* Annales

The fifth series of the *Annales* began in 1874; Berthelot joined in 1878, replacing Regnault, who had died earlier that year. Berthelot was officially classified as a physicist, since he had been elected to that section of the Academy in 1873, but everyone knew that he was really a chemist. His work on thermochemistry was as near as he came to physics. The deaths in 1884 of both Dumas and Wurtz was a serious blow to French chemistry and to the *Annales* in particular. They were replaced by Friedel, Henri Becquerel and Mascart. In 1889 came the death of the venerable Chevreul, after an association with the *Annales* of nearly half a century. With his death Berthelot formally became the senior editor of the *Annales*. Moreover, the year 1889 also marks his election as permanent secretary of the Academy of Sciences, a very powerful position indeed. From now until his death in 1907 he was, in an excessively centralised system, to wield great power over the whole of French science, including research and education.[16] It is unfortunate that his influence was strongly conservative and his opposition to atomism in chemistry held that science back. It must also be said that he presided over the decline of the *Annales*.

Berthelot had become the most prolific contributor to the *Annales*. Since his first published paper of 1850, he had been a regular contributor to this journal, although in this early period he also favoured the *Journal de pharmacie*. He had no scruples about publishing a paper simultaneously in two or three French journals, apart from translations in foreign journals. By 1866 he was contributing multiple papers to many volumes of the *Annales*. There may have been a few volumes without a single Berthelot paper but, lest anyone should think that he was idle, he would reappear with a whole string of papers on organic and physical chemistry, often occupying more than 100 pages in a volume of 560 pages. His mammoth memoir or themochemistry published in

[16] See Jean Jacques, *Berthelot, autopsie d'un mythe*, Paris, 1987.

volume 18 (1869) was unusual in exceeding 200 pages but, in stating that he was collecting together work previously published, Berthelot was admitting his lack of concern with multiple publication. Yet he had the affrontery to entitle this paper: 'New researches in thermochemistry'. The introduction to the paper explained that, by collecting together his previous work on the subject, he was hoping to throw new light on chemical reactions. Later footnotes explained that certain parts of the paper were taken, virtually unaltered, from one of his textbooks or from his lectures and had already appeared in another form. For him to publish at least ten memoirs in a single volume of the *Annales* was by no means unusual but the way he divided research into a succession of papers labelled: First memoir, Second memoir, etc., suggests that he was aiming to impress by quantity as much as by quality. Thus his research on oxides of nitrogen[17] was presented as four (consecutive) memoirs instead of one. Two years later he was the author of no less than sixteen different memoirs in a single volume.[18]

Berthelot emerges with little credit in his dealings with the *Annales*. In the first place he took advantage of his position on the editorial board to have published memoirs of his own, often very long memoirs, that had already been published elsewhere. We can see this from the printed record, but there is also a surviving record of a feeling of outrage from his fellow editor Wurtz, who in 1872 confided to Dumas:

> I have written to Berthelot to let him know that, as the Commission of the *Annales* has forbidden the reprinting of texts that have already been published, it consequently requested him to modify his manuscripts in such a way as to give them an original aspect. I have told him that we will be happy to publish them in this rejuvenated form. He will understand and will refrain in future from sending us such manuscripts.[19]

This letter tells us not only something about the standards of the *Annales,* it also helps to explain Berthelot's very large output of memoirs, some of which were simply slight variations on previously published memoirs. Berthelot, however, did not take his rejection by the *Annales* uncomplainingly. He protested to Dumas about various delays in dealing with his memoirs and the summary judgement of their unsuitability.[20] He considered he was doing the *Annales* a favour in allowing it to publish his work! But the *Annales* was not alone in incurring Berthelot's displeasure. He later complained to the Academy of Sciences that, as a very productive scientist, he was being gagged by

---

[17] *A.c.p.* [5] *6*, (1875) 145-208.
[18] *Ibid*, *12* (1877).
[19] Archives of Académie des Sciences, Wurtz dossier, Wurtz to Dumas, 26 January 1872.
[20] Académie des Sciences, Berthelot dossier, Berthelot to Dumas, 23 January 1872.

the Academy's rule, which set a limit to the number of pages accepted for publication in the *Comptes rendus*.[21]

When Berthelot became senior editor, he used his authority to publish his work, which was no longer refereed and hence sometimes contained unnecessary errors.[22] There is no doubt that there was a serious decline in the quality of the *Annales* in the closing years of the nineteenth-century. One might base a judgement of decline on either qualitative or quantitative considerations. Either taken alone may be capable of some other interpretation but, if there is supporting evidence on both fronts, the conclusion seems inescapable. The quantitative evidence is based on the fortunate availability of records of numbers of subscriptions from the time of Wurtz's death up to around 1900.[23] In 1883, the last complete year of Wurtz's life,[24] there were 863 subscriptions. From then onwards the subscriptions fell off, with 850 in 1884, and 817 in 1887, when it was decided to try to stop the rot by giving away 25 free copies to encourage subscriptions, a common stratagem at the launching of a journal but a most unusual step in the middle of a series. It had the effect of bringing the subscription up marginally in 1888 by four copies but in 1889 it had fallen further to 801. Moreover, it should be remembered that this decline in subscriptions came at a time when the scientific community and higher education in science was expanding.

There was a letter from the publisher Masson to Berthelot in January 1891, claiming that a few new subscribers had been gained, although the net increase was no more than two. The file for 1892 makes it clear what was happening. In that year the journal gained a total of 25 new subscriptions, including the Société d'agriculture of Le Mans, the Lycée Buffon, Paris, and Lewis, booksellers in London. But in the same year it suffered 41 cancellations, including the Newberry Library, Chicago and several Spanish subscriptions. A further letter from the publishers to Berthelot dated simply '1894' spoke of a further decline in subscriptions. This was blamed principally on a fall in foreign support. By 1900 the subscriptions had fallen to 690. Thus in 16 years there had been a reduction of 20 per cent in subscriptions.

This cannot have been very encouraging for Berthelot and it was reinforced by the declining profits of the journal. In Wurtz's last year, after paying for printing costs, there was a profit for the editors of 7,215 francs. In the 1890s this had dropped to a half of this sum. Berthelot complained that the printers were making excessive charges for author's corrections but the charges were stoutly defended. The reduced profits were clearly due to some disenchantment of subscribers with the *Annales*. It no longer held the place of honour

---

[21] *Ibid.*, Berthelot to Dumas, 18 April 1882.

[22] Private communication from Prof. Peter Gray, F.R.S.

[23] Collège de France, Archives.

[24] Wurtz died in May 1884.

which it had in the days of Gay-Lussac. Although Berthelot held the reins of power in much of French science, his editorship of the *Annales* provides evidence that he was not as much in control as he might have wished. The decline of the *Annales* could be seen as symptomatic of a decline in French science. Alternatively, it could be interpreted as a consequence of the *Annales* falling into the hands of one particular school of French physical science. Fortunately there were other schools, as we shall see in the next chapter.

One does not want to paint an entirely black picture of Berthelot's editorship. At its worst, the *Annales* had become a journal for the (re-) publication of his own memoirs and those of his students. But the *Annales* could also draw on the talents of other students in Paris. The authors of theses would be flattered to have their work reproduced in the *Annales* and thus widely circulated. The fact that the contents of the theses would have to be divided up for publication and perhaps not even acknowledged as theses did not worry them. Thus it was that Marie Curie's thesis on radioactivity appeared in three successive issues of the *Annales* for 1903.[25] This went some way to reviving an ailing journal.

3. *British chemical journals*

In the nineteenth century scientific specialisation only developed slowly in Britain. In the first place science itself was not necessarily separated from literature and other subjects so that, for example, in the *Edinburgh Review* (founded 1802) all these areas were discussed side by side. Yet there were also, of course, journals devoted entirely to science. We have had occasion to mention Nicholson's *Journal of Natural Philosophy, Chemistry and the Arts*.[26] Although Nicholson had taken the wise step in 1802 of changing from an imposing quarto publication to a more compact octavo format and, although around 1804-06 he was overwhelmed with material for publication, the *Journal* hardly made a profit, and at the end of 1813 it was absorbed in Tilloch's *Philosophical Magazine*. The *Philosophical Magazine* had come to provide an outlet for chemical papers, at least until the mid-century, with the foundation of the *Journal* of the Chemical Society (1847), to be discussed below. From then on the *Philosophical Magazine* was to publish mainly papers on energy, electricity and electromagnetism, incidentally helping to define the character of physics from the mid nineteenth century.[27]

Apart from the financial problems of Nicholson's *Journal* and the editor's failing health, an additional problem in 1813 was the appearance of a

---

[25] *A.c.p.* [7], *30* (1903), 99-144, 145-203, 289-326. The inclusion of this material did not prevent the same volume of the journal containing ten articles by Berthelot!

[26] S. Lilley, '"Nicholson's Journal" (1797-1813)', *Annals of Science*, *6* (1948-50), 78-101.

[27] Mary Jo Nye, *From Chemical Philosophy to Theoretical Chemistry*, Berkeley, Cal., 1993, pp.42, 45.

competitor of a high standard, the *Annals of Philosophy*. As a journal ostensibly concerned with the whole of science, the *Annals of Philosophy*[28] was founded in 1813 by Thomas Thomson. A pupil of Joseph Black, Thomson's first major publication had been a textbook, *A System of Chemistry* (1802), which eventually reached six editions. In 1817 he was appointed professor of chemistry at Glasgow University. Some readers complained that the *Annals* contained too much chemistry and to these he replied:

> Our *Annals* must contain a greater proportion of chemistry, which is making rapid progress, than of those sciences which are in great measure stationary.[29]

Yet Thomson was able to point out that the *Annals* also contained reports on many other sciences, including astronomy, hydraulics, magnetism, meteorology and optics as well as several biological sciences. Thomson gave special prominence to Dalton's atomic theory - almost as if to compensate for the French *Annales*' policy of ignoring it. In fact Thomson had first learned of Dalton's ideas in 1804 and he quickly became the theory's greatest publicist. He even managed to explain the theory in the third edition of his text book of 1807, a year before Dalton published his own *New System of Chemical Philosophy*. In 1813 Thomson was no less enthusiastic and in July he began a very long article divided into eight parts. Because of its quantitative aspect, he described the theory as 'the greatest step which chemistry has yet made as a science'.[30] Thomson himself contributed a very large number of articles to the first series of the *Annals*. Another subject, related to Dalton's theory, of which he approved, was Prout's hypothesis, and in 1818 he demonstrated his commitment by issuing a revised table of atomic weights, many of which were given as integral multiples of the atomic weight of hydrogen.[31] It seems that it was largely through Thomson's advocacy of the theory through the pages of the *Annals of Philosophy* that it gradually came to be accepted in Britain. In 1821 Thomson found it necessary to give up the editorship because of his heavy teaching duties at Glasgow University and he handed over the *Annals* to Richard Phillips, who began a new series in which chemistry was much less prominent.

Now that we have arrived at the 1820s, one of the earliest British journals devoted entirely to chemistry, although short-lived, deserves a brief mention. *The Chemist* was published weekly in issues of 16 pages by Knight and Lacey of Paternoster Row, London and priced at a modest three pence. Each issue

---

[28] Although this was the title on the title page and the title by which it is generally known, Thomson in his preface to the first volume refers to it by the longer title of: *Annals of Mechanical Philosophy, Chemistry, Agriculture and the Arts* (*loc.cit.*, p.iv.)

[29] *Annals of Philosophy*, *1* (1813), iv.

[30] *Annals of Philosophy*, *2* (1813), 32.

[31] *Ibid.*, *12* (1818), 338-350. See also *ibid.*, *6* (1815), 321-330.

contained some illustrations, usually of chemical apparatus. The anonymous editor [Thomas Hodgskin[32]] in his preface spoke of different chemical authorities but declined to choose any one as his guide, although he was tempted to claim to be a follower of Davy. He appreciated that there was a social and intellectual gulf between leading Fellows of the Royal Society and his readers, who included members of the working class and others interested in self-improvement. With hindsight the editor might well have concluded that it would have been better if he had been able to benefit from some high-level patronage.

The level of *The Chemist* was introductory. The first issue on 13 March 1824 gave a description of chemical apparatus and explained how to prepare oxygen gas, saying (p.10): 'we shall not be far wrong . . . in supposing that some of our readers may be totally unacquainted with the science of chemistry'. On the other hand it also gave a summary of a recent paper on the liquefaction of gases by Humphry Davy, taken from *Phil. Trans.* Similarly the issue for 15 May gave a summary of a paper on fulminating silver by Liebig and Gay-Lussac, taken from the *Annales de chimie*. Correspondence was encouraged and there were many brief chatty articles, some historical. The journal hardly survived a year, its last issue being 16 April 1825, thus concluding its second volume. *The Chemist* had represented a brave attempt to combine an introduction to chemical science with news of current research for chemists, but the market for a periodical specialising in one branch of science, overlapping with that of the Mechanics' Institutes being founded in Britain in the 1820s, was a smaller one that had been hoped.

The most important event in British science in the 1830s was probably the foundation of the British Association for the Advancement of Science in 1831. Concerned with the whole of science from a provincial base, 'Section B' was devoted to chemistry and related sciences and there was some opportunity for publication in the *Annual Reports* of the British Association. But for specifically chemical journals we have to wait until the 1840s, when several chemical journals were founded, some as the result of commercial enterprise and one with more official status. In strict chronological order, they were respectively: *The Chemist* (1840), *Memoirs of the Chemical Society of London* (1841-42, 1842-3), and the *Chemical Gazette* (1842-43).

The first of these journals was edited by a lecturer in chemistry, Charles Watt, aided by John Watt junior. The full title was:

> *The Chemist or Reporter of Chemical Discoveries and Improvements and Protector of the Rights of the Chemist and Chemical Manufacturer.*

---

[32] For a discussion of *The Chemist* and its radical editor, see Colin Russell, *Science and Social Change*, London, 1983, pp.139-145.

It is particularly the last part of the title which is indicative of one primary purpose of the journal and an important constituency or rather two constituencies. Part of this is explained by the ambiguity in nineteenth-century Britain of the term 'chemist'. We are reminded of this ambiguity in a very explicit justification of the periodical published in a later issue:

> The journal was established with the view of defending *chemists and druggists* from the agressions and encroachments of the lower ranks of the medical profession and the chemical manufacturer from the schemes of deluded and designing men, by whom they are so often defrauded.[33]

This was not, therefore, a journal intended primarily for men of science. Indeed in the introduction to the first volume, it complained about other journals that contained 'dull and heavy subjects of abstruse calculation'. When it complained that it had been criticised by a 'magazine of philosophy', it was presumably referring to the *Philosophical Magazine*. That is not to say that it lacked any articles of scientific chemistry. Volume 2, for example, contained a translation of a memoir by Dumas and Stas on the exact determination of the atomic weight of carbon.[34] Yet it gave priority to the interests of 'the retail chemist' and the recent introduction of Marsh's apparatus to detect arsenic poisoning[35] would have been of general interest to its readers.

The editors also gave great attention to the work of Daguerre on photography, but added:

> We wish we could boast more English and fewer foreign names among the authors, whose luminous articles adorn this volume.[36]

Yet they were glad that they were able to include translations of several articles by Auguste Laurent. The editors returned to the same theme in volume 3:

> The columns of *The Chemist* teem with the writings of foreigners; few English chemists' names occur; are they ashamed of the comparison? They are bringing discredit on the country of Davy. Nothing can more clearly prove that chemistry is making less rapid advances in England than on the continent than the fact that *The Chemist* - the highest, the only chemical work in existence - derives its supplies entirely from abroad.[37]

This last claim, made in 1842, was not strictly correct. *The Chemist* was no longer the only chemical journal. Chemists other than pharmacists had begun to think of organising themselves.

---

[33] *The Chemist*, *3* (1842), Advertisement, 1.

[34] The editors frequently made use of the chemical memoirs published in the Academy of Sciences' *Comptes rendus*.

[35] *The Chemist*, *1* (1840), v.

[36] *Ibid.*, iv.

[37] *The Chemist*, *3* (1842), Introduction, viii.

The foundation of the Chemical Society of London in 1841 was an important step in the development of chemistry in Britain.[38] A professional chemist, Robert Warington, who was to be the first secretary of the Society, had suggested that it should engage in:

> The reading of notes and papers on chemical science . . . and the discussion of the same. The formation of a laboratory . . . the formation also of a library to include particularly the works and publications of Continental authors.[39]

However, Thomas Graham, professor of chemistry at University College London and the first president of the Society, favoured an academic forum rather than a variety of different facilities serving various interests. In his inaugural address Graham mentioned the support he had received from Dumas and Liebig.

From the very first year the Chemical Society decided that it should publish both *Memoirs* and *Proceedings* of the society. The *Memoirs* were to consist of selected papers, published in full, whereas the *Proceedings* would contain only abstracts of papers. Both series, however, which were published at two-yearly intervals, emphasised the relation of a paper to a particular meeting of the Society, the date of which was published at the beginning. The Society would never publish in full papers which had previously been presented elsewhere, for example, at a meeting of the British Association.[40] This policy explains why the first volumes were dominated by papers from the founders, Graham, Warington and the Scottish analytical chemist John Stenhouse. The first volume was, however, able to boast of one paper from Bunsen translated from the author's manuscript. At the first anniversary meeting it was said that

> The Council is fully sensible that the utility of the Society and its reputation in the scientific world will mainly depend upon its publications.[41]

Yet the standard of the early issues could not be expected to be very high. In the first year 33 papers were submitted to the Council for publication, of which 14 were published in full in the *Memoirs* and the remaining 19 were given in abstract in the *Proceedings*. Many of the papers were little more than reports of routine analysis.[42] Yet in so far as the Society was able to attract occasional papers from foreign (mainly German) chemists the standards were

---

[38] T.S. Moore and J.C. Philip, *The Chemical Society, 1841-1941*, London, 1947. See also Colin A. Russell *et al.*, *Chemists by Profession*, Milton Keynes, 1977, pp.68ff.

[39] R. Bud and G.K. Roberts, *Science Versus Practice. Chemistry in Victorian Britain*, Manchester, 1984, p.49.

[40] *The Jubilee of the Chemical Society of London*, London, 1896, 'Publications', pp.237ff.

[41] *Proceedings of the Chemical Society of London*, 1841-42, 27.

[42] Bud and Roberts, *op.cit.*, p.66.

higher, as is the case of papers by Liebig[43] and A.W. Hofmann, his assistant at Giessen.[44] Soon there would be more important papers by home-grown chemists such as Frankland.

By this time, however, the journal of the Society had been re-named the *Quarterly Journal of the Chemical Society*. It had been realised that in science it was not satisfactory to publish a journal only every two years. Accordingly in November 1847 the Council resolved on more frequent publication and the appointment of a paid editor. Henry Watts filled this function from 1849 to his death in 1884.[45] Yet the *Quarterly Journal* only lasted until 1864, when it was decided that the Society needed a monthly *Journal*. Even more important was the decision by the Council that so much chemical material was available that, from 1871, it should publish regular volumes of *Abstracts*. These were taken both from British and foreign journals and greatly increased the utility of the Society's publications. Yet the Chemical Society was also concerned to report on its own meetings and a separate series of *Transactions* was undertaken, to be published in parallel with the *Abstracts*.

The *Journal* of the Chemical Society remained the main academic chemistry periodical in Britain. Its concern with theoretical issues was occasionally sniped at by more practical journals, such as *The Analyst*, founded in 1876. The latter journal complained that

> a very undue proportion of the space is devoted to papers, the authors of which claim an intimate acquaintance with the exact position of every atom in a compound. This may be very interesting to chemists who, like the authors of these papers, fancy themselves hail-fellow-well-met with every atom under the sun, but it is somewhat tedious to ordinary chemists not on the visiting list of either atoms or molecules.[46]

Yet, while the Chemical Society and its journal were becoming established, competition did not die away. Watt's *The Chemist* continued as far as Volume 8 (1848) and then was re-launched briefly in the 1850s under the amended title:

The Chemist; a Monthly Journal of Chemical and Physical Science.[47]

Yet a third journal appeared on the scene in 1842. Like *The Chemist* it had a practical bent. Its full title was:

---

[43] Liebig's British contacts were greatly extended by his visit to England in 1837 and his attendance at a meeting of the British Association.

[44] *Jubilee*, p.239. In 1845 Hofmann was appointed to direct the newly-founded Royal College of Chemistry in London.

[45] *Ibid.*, p.240.

[46] R.C. Chirnside and J.H. Hamence, *The 'Practising Chemists': A History of the Society for Analytical Chemistry, 1874-1974*, London, 1974, p.82.

[47] Edited by J. and C. Watt, vols. 1-5, 1854-57.

Chemical Gazette or Journal of Practical Chemistry in all its Applications to Pharmacy, Arts and Manufactures.

The editors were William Francis and Henry Croft, who proudly described themselves on the title page as 'late students in the University of Berlin and Giessen'. It was unfortunate that, before the fourth issue appeared, Croft left Britain for Canada, to take up a position as professor of chemistry at King's College, Toronto, thus leaving Francis to carry on alone. Francis explained in the first issue how the journal came to be launched:

> In the early part of the year 1841 in conjunction with my friend Mr Croft, I commenced a series of reports on the progress of chemical science on the Continent, which were forwarded nearly every month from Berlin and subsequently from Giessen, for insertion in the *Philosophical Magazine*, but the space allotted to us in that valuable journal . . . allowed us only to notice the most important discoveries bearing upon theory; and we were compelled to leave wholly untranslated the immense mass of information pertaining to applied chemistry, with which the German journals in particular abounded. Feeling how important it was that the practical chemists of England should be made early acquainted with the improvements and new processes suggested or adapted on the Continent, we resolved on our return to our native country to see how far an attempt to lay these before the public in an English dress would meet with support.[48]

On the completion of the first volume, Francis was able to express satisfaction that the journal had met with approval, not only in Britain but also in north America. Articles were grouped under the following headings: Scientific and Medicinal Chemistry, Analytical Chemistry, Pharmacology, Chemical Preparations, Chemistry applied to the Arts and Manufacturers, Proceedings of Societies, Reviews, Patents. It may be noted that 'scientific chemistry' did not receive even one whole section to itself. In other words it was, as the sub-title proclaimed, very much concerned with the *practical* context of chemistry. The *Chemical Gazette* continued to be published fortnightly up to 1859, at the end of which it was incorporated in a new journal, *Chemical News*, which was to be published weekly, and with greater attention paid to pure chemistry.

In the 'introductory address' to the first issue of *Chemical News*, the editor, William Crookes remarked that there was no weekly journal devoted to chemistry in Britain. In other words, the frequency of appearance of the journal was an important selling point, and distinguished it from the more academic *Journal* of the Chemical Society. The editor was keen to point out the usefulness of *Chemical News* to manufacturers:

---

[48] *Chemical Gazette*, *1* (1842-43), Preface.

> Those chemical arts, which formerly were rudely conducted by the system termed the 'rule of thumb', are now methodically organised and arranged in accordance with the unerring laws of chemistry and the theoretical principles, upon which each art is based, as well as its practice, now receive due attention from the more enlightened chemical manufacturer.

The bias towards commerce and industry is obvious in several of the main sections, into which the journal was divided: Scientific and Analytical Chemistry, Technical Chemistry, Pharmacy and Toxicology, as well as Notices of books, patents, etc. Yet Crookes also gave considerable attention to basic pure chemistry.

Each issue consisted of 12 quarto pages in small type - an indication that this was intended for a readership, which was already committed to chemistry. It contained contributions from British chemists, accounts of the proceedings of the Chemical Society, the Pharmaceutical Society and the Society of Arts and accounts of foreign research. Thus, in the first issue of 10 December 1859, we find the following:

> The *Annales de chimie et de physique* for August last contains a very elaborate article [by Deville and Debray] on the subject of platinum and the metals which accompany it. The results at which they arrive are so important, and they are, moreover, of such interest, that we are induced to lay before our readers a few of the principal facts contained in their memoir.

When Michael Faraday's Christmas lectures 'adapted to a juvenile auditory' were given at the Royal Institution, their contents were transcribed for the benefit of readers and their families. There was also a section on 'Scientific notes and queries' geared more towards students. Correspondence was encouraged but correspondents were warned that

> a scientific journal was not the proper medium for discussions which overstepped the bounds of calm philosophical reasoning; and, therefore, all personalities would be rigidly excluded.[49]

4. *German and other journals*

We discussed earlier the rather complex history of Crell's *Chemische Annalen,* which persisted until 1804, when it merged with another journal. This was A.N. Scherer's *Allgemeines Journal der Chemie*, founded in 1798 as a German voice of the new chemistry, which now became the *Neues allge-*

---

[49] *Chemical News*, *1* (1859-60), 2.

meines Journal der Chemie, with Gehlen as editor.[50] As an illustration of how complex is the history of many of these German journals, with their constantly changing titles, Gehlen decided on a further change in the name of his journal in 1807 to *Journal für die Chemie, Physik und Mineralogie* to embrace his own wider interests. Yet only four years, later, when Schweigger became editor, he decided to omit the word 'mineralogy' from the title. Later volumes in the series were entitled *Jahrbuch der Chemie und Physik* and then *Neues Jahrbuch der Chemie und Physik*. In 1834 it was combined with another journal to become the better known *Journal der praktischen Chemie*, the journal of the Leipzig research school, under the editorship of O.L. Erdmann.

It has been said that at this time in Germany publication was a very personal matter, with many competing university centres of research:

> A prominent scientist would, on the least provocation, commence a journal of his own to effect prompt publication of his researches and those of his pupils.[51]

Going back a generation, a journal contemporary with Crell's *Annalen* was Gilbert's *Annalen der Physik* (1799-1819), which enlarged its title in 1819 to become *Annalen der Physik und physikalischer Chemie*. This was succeeded in 1824 by Poggendorff's Berlin-based *Annalen der Physik und Chemie*, its title seemingly following the French model.

Yet, with the exception of Poggendorff's *Annalen*, most of these journals pale into insignificance when compared with Liebig's journal. Liebig entered the field not through any of the above-mentioned scientific journals but through one of the many pharmacy journals that circulated in the German states.[52] In 1831 the editor of one of these pharmacy journals was seeking a change. Philipp Lorenz Geiger, professor of pharmacy at Heidelberg, was the editor of *Magazin für Pharmazie und die dahin einschlagenden Wissenschaften,* but found the daily management of the periodical burdensome. He, therefore, approached the young professor of chemistry at Giessen, Liebig, asking him to become co-editor. Liebig, who was desperately short of money, agreed at first with some reluctance. He asked that the cumbersome title should be changed to one equally long but indicating that the material published had been checked as far as was practical: *Magazin für Pharmazie in Verbindung mit einer Experimentalkritik* (1831). But almost immediately there was a move to combine the *Magazin* with a second pharmacy journal, the

---

[50] Aaron J. Ihde, 'Chemical publications' in *The Development of Modern Chemistry*, New York, 1964, pp.270-3. William H. Brock, 'The chemical periodical', *Fontana History of Chemistry*, London, 1992, pp.446-454.

[51] G.M. Dyson, 'Searching the older chemical literature' in *Searching the Chemical Literature*, Advances in Chemistry Series, *30*, Washington, D.C., 1961, p.84.

[52] H.S. von Klooster, 'The story of Liebig's *Annalen der Chemie*,' *Journal of Chemical Education*, *34* (1957), 27-30.

Archiv des Apothekervereins in nördlichem Deutschland. Given the cumbersome titles of these two journals, it was decided very sensibly to call the combined journal simply *Annalen der Pharmazie*, although, for the benefit of old-established readers of the separate journals, the new title was printed on the left of the title page, while mentioning the old names on the right.

There were to be further amalgamations with other pharmacy journals in the mid 1830s, including Trommsdorff's *Neues Journal der Pharmazie für Ärzte, Apotheker und Chemiker*. Trommsdorff, therefore, became one of the co-editors, but he died in 1837 and was replaced by another pharmacist, Friedrich Mohr. Liebig temporarily abandoned his editorial responsibilities when he travelled to England in the summer of 1847, passing through Paris on his return. He was not happy with the running of the journal during his absence and he persuaded his fellow editors to resign. Liebig now had complete control of the *Annalen*, although he proudly announced on the title page of Volume 25 (1838) that it was edited 'with the co-operation of M. Dumas in Paris and Graham in London'. He had recently had a friendly meeting with Dumas in Paris, whilst Thomas Graham was a former student of Liebig. These names continued to appear on the title page of the *Annalen* until 1842, when they were quietly dropped.

Meanwhile an active co-editor had appeared in the shape of Wöhler, who was officially connected with the *Annalen* from 1838. Wöhler suggested that the journal could be made more attractive by calling it *Annalen der Chemie und Pharmazie* instead of *Annalen der Pharmazie*, thus giving it a new emphasis on science and playing down its humble origins in pharmacy. The new title was adopted for Volume 33 (1840) and helped to signal it as one of the world's leading chemical journals. Liebig encouraged his many research students to publish their work in the *Annalen*. As they came from many foreign countries, this helped to establish the *Annalen* as a potentially international journal for chemistry. Liebig made a point of publishing regularly articles by French authors in German translation, thus nicely balancing the publication of his own work in the French *Annales*. On the other hand he was a very authoritarian editor, who sometimes turned savagely on those, like Laurent and Gerhardt, with whom he did not agree. In 1851 Liebig invited Hermann Kopp to become an editor. Later editors included other famous German chemists: Erlenmeyer, Volhard, Hofmann and Kekulé.

Following Liebig's death in 1873 the journal was re-titled *Justus Liebigs Annalen der Chemie*, thus at the same time honouring the chemist who had done so much to transform the journal and cutting the final link with pharmacy. From 1878 to 1910 Volhard was the managing editor of the *Annalen*. He only accepted original contributions that had not appeared in print elsewhere, although occasional exceptions were made for Russian chemists so that, for example, he accepted papers from Mendeléeff, Butlerov and

Beilstein. The link with France had been cut with the death of Liebig. Although papers on different branches of chemistry were accepted, the *Annalen* tended to specialise in the field of organic chemistry, to which Germany made such a major contribution in the second half of the nineteenth century. This situation justified the foundation of a separate journal specifically concerned with *inorganic* chemistry, and this explains the foundation in 1892 of the *Zeitschrift für anorganische Chemie*, which became one of the leading journals in the field.

We now turn to another major German chemical journal of the later nineteenth-century, the *Berichte der Deutschen Chemischen Gesellschaft*, the product of the establishment of a German national chemical society in Berlin, a few years before the unification of the German states, with Berlin as a national capital. Scientific and cultural claims by Prussia were not entirely irrelevant to the emergence of the new nation state in 1871. The new society was very much the work of A.W. Hofmann (1818-92). After spending twenty years in England as Director of the Royal College of Chemistry in London, Liebig's former student, Hofmann returned to Germany in 1865 to take up the chair of chemistry at the University of Berlin, where he arranged for the construction of a large chemistry teaching laboratory. The foundation of the laboratory and the students it attracted encouraged the Berlin chemists to call a meeting to discuss the foundation of a national chemical society. Berlin, the Prussian capital, seemed to them the obvious centre for such a society.

A preliminary meeting was called for November 1867, to which not only local chemists but chemists from the different German states were invited and in the end more than a hundred people attended.[53] Hofmann was elected chairman. Recalling his year in England, he spoke of the earlier foundation of the Chemical Society of London, whose meetings he had regularly attended for many years and from which, he said, he had greatly benefited. He saw this as the model for a German Chemical Society, based in Berlin. A committee of twelve was elected to draw up the constitution of the new society; it included Hofmann, Baeyer and Mitscherlich. At a further meeting in January 1868 Hofmann was formally elected president of the new society. He asked that the Society should agree to the election of three honorary members. The names of Liebig, Wöhler and Bunsen were proposed as having had exceptional influence on German chemistry and this was agreed.

From the beginning, the *Berichte* followed a policy of prompt publication, in contrast, for example, to the dilatory *Zeitschrift für Chemie*.[54] On the model of the French Academy's *Comptes rendus* the *Berichte* announced that

---

[53] *Berichte der Deutschen Chemischen Gesellschaft zu Berlin, 1* (1868), 1-9.

[54] Walter Hückel, '100 Jahre Geschichte der Berichte', *Chemische Berichte, 100* (1967), i-xxxix (ii-iv).

it would only accept summaries of research not exceeding three printed pages in length. A second paper with full experimental details might, therefore, be submitted to another journal, such as Liebig's *Annalen*, which favoured memoirs of substance. Yet even one of Hofmann's papers was refused publication there on the grounds that most of it had already been published in the *Berichte*. Another contemporary German journal, the *Journal der praktischen Chemie*, now edited by Kolbe, suffered from the disadvantage that it would have nothing to do with structural formulae, which Kolbe regarded as based on pure speculation. Such formulae gradually came to be accepted by Hofmann for the *Berichte*. After his death in 1892 the *Berichte* was edited by Emil Fischer.

Developments in chemistry north of the Alps did not pass unnoticed in the Italian states, and of course Italian men of science made important contributions, some of which were published in the journals of northern Europe. We have had occasion to mention some of the work of Volta and Avogadro published in the French journals. But there was no good reason why there should not be chemical journals in the Italian language, although one should remember that, what later became Italy, consisted around 1800 of a number of independent states, so that even the best journal would tend to be a regional one and thus not have the benefit of a national circulation.

The first Italian chemical journal was *Annali di chimica*, which began publication in 1790. The year of publication suggests that it was inspired by the French *Annales de chimie* as well as by Crell's *Annalen* and this is confirmed by the preface to the first volume.[55] The editor was Luigi Valentino Brugnatelli (1761-1818), a native of Pavia. At the time of publication of the early volumes of the *Annali* he was a substitute professor of chemistry at the University of Pavia but was promoted to the chair in 1796.[56] In the Introduction to the first volume of the *Annali* he promised to respect the views of all contributors, whether they were followers of Stahl or of the 'pneumatic chemistry' (*la teoria dei Chimici Pneumatici*). He himself favoured the new chemistry as being simpler and more in conformity with nature, although he did not publish a textbook advocating the new chemistry until 1795-97.

The readership of a regional Italian journal devoted exclusively to chemistry must have been rather limited and so the *Annali di chimica* ceased publication in 1802 after the completion of 21 volumes. Brugnatelli's editorial endeavours had not ended, however, and in 1808 he published a new journal, entitled *Giornale di fisica, chimica e storia naturale*,[57] thus widening the appeal by associating chemistry with physics and natural history. This ap-

---

[55] *Annali di chimica, 1* (1790), viii. Brugnatelli had already obtained editorial experience through his previous periodical, *Biblioteca fisica d'Europa* (20 vols., 1788-91).

[56] J.R. Partington, *History of Chemistry*, vol.3, London, 1962, p.492.

[57] Much of the information in this paragraph is based on G.M. Dyson, *loc.cit.*, pp.83-91.

peared in ten volumes between 1808 and 1817. Brugnatelli then decided that even this title was not broad enough and added the words *e medicina ed arte* to the title for a further ten volumes (1818-27). It seems to be the tactics of a man desperate to increase his readership to make a viable journal.

Another way of obtaining a viable readership was to associate chemistry with pharmacy and this was the basis of Cattaneo's journal, published in Milan: *Giornale di farmacia, chimica e scienze accessorie* (19 volumes, 1824-34). But probably Cattaneo's heart was really in pharmacy, for the journal was continued as *Bibliothek di farmacia* (23 volumes, Milan, 1834-45) and later became *Annali di chimica applicata alla farmacia*. In 1845 the journal followed a completely new course under a new editor as *Annali di chimica applicata*. Meanwhile a related journal had begun publication in Milan: *Annali di fisica, chimica e matematica*, edited by Majocchi (28 volumes, 1841-47). But we must go back a decade to report an independent development in Verona, where Sembenini published his *Gazzetta eclettica di chimica farmaceutica* (7 volumes, 1831-39) which was rather more successful than a parallel series he attempted: *Gazzetta eclettica di chimica technologia* (2 volumes, 1833-34). In Mantua two series were published of the *Annuario delle scienzi chimiche, farmaceutiche e medicolegal* (10 volumes, 1840-49), mostly edited by Sembenini. Finally, as evidence that the 1840s was a decade of great activity in Italian chemical publications, we may mention the *Raccolta fisico-chimica italiana*, published by Zantedeschi from Venice (3 volumes, 1846-48). One may notice an early attempt in the title to represent the whole of the Italian peninsula. The most important step forward in this respect was the foundation in 1871 by Paterno of the *Gazzetta chimica italiana*.

We cannot go systematically through every European country but, before concluding this section, it would be appropriate to say something about the United States. In the United States there were very few scientific journals around 1800, although of much more than local importance were the *Transactions of the American Philosophical Society of Philadelphia*, dating from 1771, and the *Memoirs of the American Academy of Arts and Science* of Boston from 1785.[58] Medical journals like Mitchill's *Medical Repository* of New York (1797-1824) would sometimes contain chemical contributions. Most important of all in the early nineteenth-century was probably Benjamin Silliman's *American Journal of Science*, founded in 1818, which covered both pure and applied science. Silliman had a special interest in chemistry and mineralogy. He published several American editions of William Henry's textbook of chemistry as well as his own *Elements of Chemistry* (1831). Some of the better-known American chemists had their papers published in European

[58] Aaron J. Ihde, 'Chemical publications', *The Development of Modern Chemistry*, New York, 1964, pp.270-3.

journals, usually British journals like the *Annals of Philosophy*. For specifically chemical journals we must wait until the second half of the century.[59] Between 1866 and 1880, 14 volumes of the *Boston Journal of Chemistry* were published.[60] From 1870 to 1877 C.F. Chandler of Columbia University edited *The American Chemist*. This activity arose from Chandler's connection with the British *Chemical News*. Reprints of this had been published in New York with a special American supplement by Chandler, who finally considered himself capable of producing a purely American journal.

The most important institutional advance in American chemistry in the nineteenth century was the foundation of the American Chemical Society, founded in New York in 1876.[61] In 1876-7 the *Proceedings* of the American Chemical Society were published as a part of the *American Chemist*. The *Proceedings* were then published separately until 1879.[62] Publication of the *Journal of the American Chemical Society* began in 1879. Unfortunately this was the very year chosen by Ira Remsen of Johns Hopkins University to launch his *American Chemical Journal*, which in the first few years eclipsed the rival publication. However, the quality of the *Journal of the American Chemical Society* steadily improved and overtook Remsen's journal. In 1913 it was sensibly agreed to merge the two. The Society's journal had already amalgamated with another potential competitor, the *Journal of Analytical and Applied Chemistry*, founded in 1887.

5. *Abstracts and surveys of recent advances in chemistry*

Chemistry was one of the first branches of science to feel the need for the publication of abstracts. The majority of the journals we have mentioned gave some place to a summary of the contents of papers originally published in other journals. This was true from the beginning for the *Annales* but obviously it was done on only a very limited scale. Nor would we want to claim that it was the first journal to attempt this. One later journal, Gerhardt's short-lived *Comptes rendus* was largely an abstract journal only because very few chemists offered to contribute directly, despite editorial appeals. For abstracts on a large scale we have to wait for the Société chimique.

We have seen that the Société chimique began in a very modest way in June 1857. In July various members were asked to report on the contents of

---

[59] Ephemeral journals, (e.g. *Memoirs of the Columbian Chemical Society*, 2 vols., Philadelphia, 1813-14) are omitted but mention must be made somewhere of the *Journal of Applied Chemistry*, published between 1866 and 1875.

[60] After 1880 the journal moved towards becoming a journal of popular science. Dyson, *loc.cit.*

[61] Ihde, 'The rise of chemical societies', *op.cit.*, pp.274-5.

[62] H. Skolnik and K.M. Reese, *A Century of Chemistry. The Role of Chemists and the American Chemical Society*, Washington, D.C., 1976, p.100.

certain chemical journals, both French and foreign, for their mutual instruction.[63] By 1858 the ambitions of the Society had grown considerably and the members began to think of publication of the information they had gleaned. This is how the abstracts began. They were an important part of the *Répertoire de chimie pure*, published under the name of the Society. In his introduction to the first volume, covering the period October 1858 to December 1859, the editor Wurtz wrote:

> This journal is intended to put the public of our country in touch with the progress of pure chemistry in France and abroad. A publication of this kind does not yet exist in our scientific literature and seems to meet a real need. *It will accept no original work* but will offer to the reader a summary [of what has recently been published elsewhere].[64]

Wurtz went on to acknowledge the help of other members of the editorial board: Friedel, who was responsible for German publications, Girard for those in English, and Riche for those published in France. The title page also displayed the names of a number of 'foreign correspondents', including Williamson in England and Kekulé in Belgium, but it is doubtful that they participated very actively.

The *Répertoire* was soon replaced by the *Bulletin* as the official organ of the Society and it was the *Bulletin* for 1863 which announced that it was extending the coverage of its abstracts. Yet it also had a duty to report on the proceedings of meetings. There was, therefore, a note of apology rather than triumphalism in Wurtz's explanation:

> In this issue only a few of the memoirs summarised are ones that have been presented to the Société chimique. From February an account of the proceedings of the Society will be followed by abstracts of memoirs published in France and abroad; we hope that these abstracts will be more complete than in the past.[65]

The problem of deciding between the relative merits of publishing its own proceedings and providing an international abstract service was resolved by devoting alternate volumes of the *Bulletin* to these respective tasks. Wurtz was the ideal person to take responsibility for the coverage of chemical journals at home and abroad because of his international outlook and many foreign contacts. He was closely in touch with the German universities and he had research students from many different European countries.

The Société chimique de Paris can, therefore, claim credit for having been the first national chemical society to undertake a systematic abstracting service. There is some truth in its claim that this represented a new kind of chemi-

---

[63] *Procès-verbaux des séances de la Société chimique*, Année 1857, p.6, 28 juillet.
[64] Avant-propos (my italics).
[65] *Bulletin de la Société chimique*, 1863, 3n.

cal literature. The *Annales de chimie* after all was concerned after the first few years primarily with publishing original memoirs and, despite its awareness of the potential importance of memoirs published in foreign journals, it never gathered the resources to compete *in this area* with the *Bulletin*. In Germany, ten years after the French precedent, the *Berichte der Deutschen Chemischen Gesellschaft* (1868) decided that it too should provide a service of chemical abstracts.[66] They were followed by the British, as the Chemical Society of London provided this service from 1871. The American Chemical Society followed suit from 1897 to 1906, ceasing then only because it had taken the historic step of founding a separate journal, *Chemical Abstracts* (1907) to provide a really comprehensive world-wide coverage of the chemical literature. By 1907 it has been estimated that there were more than 60 journals publishing chemical abstracts of some kind, but none had attempted complete international coverage.[67]

Although Germany may not have led the world in publishing abstracts, it was the home of another kind of periodical that was concerned to review the literature. Admittedly the original work had been carried out by the Swede, Berzelius, but his yearly reports on the progress of chemistry[68] were soon translated into German as the *Jahresberichte,* and this has some claim to constitute a parallel form of publication to the abstract. The two main differences were that, in the abstract journal, each publication constituted a separate item and there was a permanent claim to objectivity in reporting. In the *Jahresberichte*, on the other hand, there was a general survey of the field, when some contributors would be given more prominence than others. There was a danger that all the prejudices of the editor could come into play. In the 1820s Berzelius was very circumspect in his reports but, as his authority grew, and his theories were challenged in the 1840s his pronouncements became more subjective. This is how Gerhardt (hardly an impartial witness) characterised the difference:

> Formerly in Berzelius' account the facts observed by chemists were faithfully reported; he described them, he calmly interpreted them, checked them by his own experiments. He had no special preference for one chemist rather than for another; his report was a conscientious and impartial piece of work; he summarised the state of science in a clear and precise manner. But there is a difference if one opens the reports today. With what an angry tone, with what acrimony he speaks of everything, even the most unimportant subjects. It seems

---

[66] This service was later taken over by the *Chemische Centralblatt*.

[67] E.J. Crane, Austin M. Patterson & Eleanor B. Marr, *A Guide to the Literature of Chemistry*, New York, 1957, pp.127-8.

[68] See Section 1 of this chapter.

> that Mr Berzelius has sworn deep hatred to all those who think of crossing the threshold of a laboratory! . . .[69]

Thus the *Jahresberichte* illustrates the danger of one person passing judgement on the whole of chemistry. In the first place this became increasingly difficult as the subject grew but it was even more important that strict neutrality in matters of theory was not easily attainable. Both of these objections might be met by the establishment of a committee, which might represent several different viewpoints. It so happened that this was the next stage, although it was arrived at pragmatically simply by making use of the principle of division of labour. With Berzelius' death in 1847, a gap was left in the chemical literature. It is true that an attempt was made in Sweden to continue this tradition, but it could no longer trade on the international reputation that Berzelius had established. The attempted Swedish continuation of the series, edited by L. Svanberg, therefore collapsed after two years.

Considering that the German translation of Berzelius' reports had been the longest established, it is not surprising that it was in Germany that the need for a yearly report was felt most deeply. Liebig and Kopp thought that they should accept responsibility for a new series of *Jahresberichte*, edited from Giessen with the collaboration of university colleagues there and including not only chemistry but also some parts of physics and mineralogy. The editors said that they found it difficult to draw boundaries between these neighbouring sciences, but they admitted that, when they were summarising a review in another science, it would be the chemical aspect that would be emphasised.[70] The *Jahresberichte* presented its contents under the following headings: Physics and Physical Chemistry, Inorganic, Organic (by far the largest section), Analytical, Technical Chemistry, Mineralogy, Chemical Geology. They claimed that chemistry was in a state of transition (when is it not?) and, therefore, excused themselves from deciding between different interpretations of experiments. It was important that the *Jahresberichte* should not represent the views of one particular school. On the other hand they could not accept the whole range of different atomic/equivalent weights in use nor the different formulae used by chemists for the same substance. They, therefore, undertook to use one that would be generally understood, more or less the system of Gerhardt. This series of *Jahresberichte* continued for some time but some historians have compared it unfavourably with Berzelius' *Jahresberichte*.[71] A charitable explanation would be that by the mid-nineteenth-century it had become increasingly difficult to produce quickly an annual survey of the whole field of chemical literature.

---

[69] Gerhardt, *Comptes rendus des travaux de chimie*, Année 1845, 1846, 63.

[70] Vorrede, *Jahresberichte über die Fortschritte der ... Chemie*, 1847 & 1848 (1849), iii-vi.

[71] E. von Meyer, *A History of Chemistry*, transl. London, 1898, p.598.

This brings us to the question of the increasing specialisation of chemistry. To write about the various specialisms, into which chemistry began to develop in the late nineteenth and early twentieth centuries, would require a book in itself. Here it may be sufficient to select one or two of the more obvious divisions of pure and applied chemistry to illustrate increasing specialisation, which is an inevitable consequence of the growth of knowledge.

An early division was that between pure and applied chemistry. Of course the very earliest 'chemical arts' were based on no more than rule of thumb. It was one of the achievements of the eighteenth century to begin applying chemical theory to practice. We have mentioned earlier the application of the oxygen theory to an understanding of the manufacture of sulphuric acid. The *Annales* was able to encourage this union of pure and applied chemistry. Increasingly in the nineteenth century, however, the academic chemists and the industrial chemists formed two separate communities with only a small overlap. It was in recognition of this state of affairs that the Société chimique sponsored two parallel journals in the late 1850s: the *Répertoire de chimie pure*, edited by Wurtz, and the *Répertoire de chimie appliquée*, edited by Barreswil, the latter lasting until 1863. Both journals were then replaced by a unified *Bulletin*. Yet although this may have been desirable from the point of view of the development of the Paris *Société chimique*, there was a general recognition that there should be separate journals primarily concerned with applied chemistry. In Britain in particular manufacturers and other practical men tended to be impatient about too much theory, and we have seen how the *Chemical Gazette* and later *Chemical News* catered for this market. As examples of journals concerned with applied chemistry in Britain, Germany and France respectively, we may cite the *Journal of the Society for Chemical Industry* (1882), the *Zeitschrift für angewandete Chemie* (1888) and the more short-lived *Revue générale de chimie pure et appliquée* (1898).

One of the most important applications of chemistry to the industrial society of western Europe in the nineteenth-century was analysis. It was not simply that manufacturers needed to know about the purity of their raw materials, but ordinary citizens were increasingly concerned about the quality of their urban environment, including water, air and food. In Germany K.R. Fresenius founded the *Zeitschrift für analytische Chemie* in 1862. A major nineteenth-century problem was to legislate for minimum standards of purity of foodstuffs and, in particular, to discourage the substitution of cheaper and often unwholesome or even poisonous materials. In Britain a Society of Public Analysts was founded in 1874. From 1876 it published *The Analyst*.[72] This

[72] R.C. Chirnside and J.H. Hamence, *The 'Practising Chemists'. A history of the Society for Analytical Chemistry, 1874-1974*, London, 1974, especially pp.53-4 and chapter 25. Also 'The growing role of chemical analysis', Chap. 6 of C.A. Russell *et al.*, *Chemists by Profession*, Milton Keynes, 1977.

was a monthly journal, which was to recoup some of its expenses by taking advertisements for books, apparatus and chemicals. It was launched with a print of 1,000 copies, of which 800 were distributed among Fellows of the Chemical Society and the press. The objects of the journal were stated to be not only to present the latest analytical techniques but also

> to publish all cases of prosecution for adulteration and such parliamentary and other proceedings as may appear to touch the interests of Analysts in general.

Thus considerable emphasis was placed in the early years on the legal aspects of the work of Public Analysts. In France the journal *Chimie analytique* began publication in 1876.

The emergence of physical chemistry in the nineteenth-century is a subject on which several different points of view have been expressed. Some would claim that at the beginning of the century Berthollet and Gay-Lussac were doing physical chemistry, while others would see this rather as proto-physical chemistry.[73] Those who are guided in their judgements by the titles of journals would tend to favour the late nineteenth-century, when we have *Zeitschrift für physikalische Chemie* (1887) and the American *Journal of Physical Chemistry* (1896). In the very first volume of the *Zeitschrift* were two papers of great importance describing new theories: van't Hoff's work on dilute solutions and Arrhenius on electrolytic dissociation.[74] For the equivalent in the French language we have to wait until 1903, when the first volume of *Journal de chimie physique* was published in Geneva under the editorship of Philippe Guye. In his introduction to the first volume Guye spoke of physical chemistry as a new independent science.[75] In other words physical chemistry had existed for at least a generation but it was only recently, with increasing specialisation, that it justified a separate journal rather than being a part of general chemistry. The French Swiss and the French (who soon took over the *Journal de chimie physique*) felt strongly that, as there were specialist journals in this field in English and German, there needed to be one in the French language. Indeed Guye found further justification in French contributions to physical chemistry going back to Gay-Lussac.[76] Also relevant to physical chemistry in the French language, however, we have not only the *Annales de chimie et de physique* but also the *Journal de physique*, founded in 1872.

---

[73] For a useful survey of physical chemistry in the nineteenth-century, see chapters 5 and 6 of A. Finlay and T.I. Williams, *A hundred years of chemistry*, 3rd edition, London, 1965.

[74] Alan J. Rocke describes 1887 as an *annus mirabilis* for physical chemistry - *Chemical atomism in the nineteenth-century*, Columbus, Ohio, 1984, p.327.

[75] *Journal de chimie physique*, *1* (1903), 6.

[76] *Ibid.*, 3.

CHAPTER TEN

FRENCH CHEMISTRY IN THE NINETEENTH CENTURY

> After such an honourable life, after such a cruel death, what have we done for Lavoisier? What has France done for Lavoisier? Where can one find a monument which recalls his memory or even a simple bust? Alas! France seems to have forgotten him.
>
> (J.B. Dumas, *Leçons sur la philosophie chimique*, 1839, p.155.)

> I shall always remember with emotion the day when [Dumas] was kind enough to accept me finally as one of his students ... Apart from the public lectures given by this well-known teacher ... his very friendly and engaging conversations in the laboratory will remain deeply etched in the memories of all students who were fortunate enough to hear him. Such teaching inspired them with a feeling for scientific research.
>
> (Melsens, 'Funerailles de M. Dumas', *C.R.*, *98* (1884), 944-5.)

1. *The resurrection of Lavoisier*

In this final chapter it is time to consider to what extent nineteenth-century chemistry was influenced by the memory or the myth of Lavoisier. There were a few cases in the early 1800s when chemists seemed to be pursuing a Lavoisier research programme. In 1819 Gay-Lussac published in the *Annales* an important paper on the solubility of salts.[1] He began by paying tribute to Lavoisier and he thought it appropriate to include a page-long relevant quotation from Lavoisier's *Traité élémentaire*. Gay-Lussac owned a copy of the 1801 edition of the book and in his personal copy the relevant passage is marked. On a later occasion when a critic accused him of accepting ideas purely on the authority of Lavoisier, he replied that both he and his critic

[1] 'Premier mémoire sur la dissolubilité des sels dans l'eau', *A.c.p.*, *11* (1819) 296-315.

were small in comparison with men like Lavoisier and Berthollet.[2] In other words, despite his criticisms of Lavoisier's theory of acidity and some disagreements with Berthollet, he saw himself as carrying on the same tradition. In one sense, therefore, Gay-Lussac, as a senior editor of the second series of the *Annales,* was able to carry on a certain Lavoisier tradition up to the time of his death in the mid-century.

Yet during this time it could hardly be said that the name of Lavoisier was on everyone's lips. It was not that his contribution to chemistry was disputed - it was simply taken for granted. And chemistry had moved on through electrochemistry and the now burgeoning science of organic chemistry that had grown in a way Lavoisier would have found beyond belief.[3] One might feel that, after a generation, Lavoisier's chemistry had little further direct contribution to make. There was then an interval before the chemists rediscovered Lavoisier. He was now less a direct source of ideas than a figurehead and only a source of inspiration indirectly.

Yet a few influential chemists considered that Lavoisier was being unjustly neglected. Such a chemist was J.B. Dumas, who may have felt this all the more strongly because Lavoisier had been executed by the French government of the time. After the Terror most French people wanted to forget the violence of the Revolution and even the First Class of the Institute, the successor of the Royal Academy of Sciences, failed to deliver the customary éloge. Hence, by the 1830s, a generation had grown up, who had hardly heard of Lavoisier. It was to compensate for this state of affairs that Dumas delivered a series of lectures at the Collège de France in 1836 on the history of chemistry, in which Lavoisier was presented as the central figure. Indeed Lavoisier was presented unambiguously as a hero. Two examples will suffice of the exaggeration in which Dumas indulged. He said that some people alleged that Lavoisier's theory had been modified (as indeed it had). Dumas would have none of this:

> Lavoisier is intact, impenetrable, his armour of steel has not been pierced.[4]

To compensate for the neglect of Lavoisier, Dumas proposed to edit a complete edition of his works, a valuable contribution indeed to the history of science. But Dumas went beyond this claim:

> I will accept responsibility for publishing this edition of the works of Lavoisier; I will give the chemists their holy book (*leur évangile*).[5]

---

[2] *A.c.p., 34* (1827), 93-4.

[3] Lavoisier had tentatively suggested that there might be a few dozen organic compounds to discover.

[4] *Leçons sur la philosophie chimique professées au Collège de France en 1836*, ed. A. Bruylants, Brussels, 1972, p.156.

[5] *Ibid.*, p.157.

This heroic presentation of Lavoisier by Dumas has often been referred to.[6] It concerns us very much here not only because Dumas was to become one of the most influential figures in French chemistry but also because of his position on the editorial board of the *Annales*.

Dumas was joined in 1853 by Wurtz, first as a collaborater and then, in 1868, as a full member of the editorial board. Indeed in the 1870s Wurtz took over from Dumas as the effective senior editor of the *Annales*. Implicit in Dumas' presentation of Lavoisier had been the idea that the latter had not been the reformer of an old science but rather the founder of a new one. This sentiment became explicit in the famous quotation from Wurtz:

> Chemistry is a French science. It was founded by Lavoisier, of immortal memory.[7]

Sometimes this has been quoted as a French reaction to defeat in the Franco-Prussian war, about which Wurtz, as a former inhabitant of Alsace, felt all the more deeply.[8] It is, therefore, worth mentioning that it was published just *before* the war. Obviously in the days of bitter defeat French writers were much more likely to be fiercely nationalistic. Pasteur provides an extreme example of this.

But we must pass on to the case of Berthelot, since, having been elected as permanent secretary to the Academy of Sciences in February 1889, he decided that the ideal way for the Academy to commemorate the centenary of the French Revolution was for him to deliver an éloge of Lavoisier.[9] This task had not yet been taken on board by the Academy, even though earlier secretaries had delivered éloges of many minor Academicians. Perhaps they felt the responsibility was too great. For Berthelot as a republican, however, this was a great opportunity to celebrate the first French Republic. As a chemist, it was also an opportunity for him to lay claims to the importance of chemistry. Indeed he combined the two by calling Lavoisier's achievement '*the* chemical revolution'. His book, *La révolution chimique. Lavoisier* (1890) was aided by the recent appearance of a detailed biography of Lavoisier by Edouard Grimaux, published in 1888, and his own studies of Lavoisier's work, including his laboratory note books, from which he was able to give extracts.

---

[6] See e.g. M. Crosland, 'Lavoisier, le "mal-aimé"', *La Recherche*, *14* (1983), 784-791. For a more sceptical account of the historiography of Lavoisier, see Bernadette Bensaude-Vincent, 'A founder myth in the history of the sciences - The Lavoisier case', *Functions and Uses of Disciplinary Histories*, ed. L. Graham, W. Lepenies, P. Weingart, *Sociology of the Sciences Yearbook*, *7* (1983), 53-78.

[7] Wurtz, *Dictionnaire de chimie pure et appliquée*, vol.1, Paris, 1869, p.1.

[8] Alsace was annexed by the Prussians in 1871.

[9] Delivered at a public meeting of the Academy on 30 December 1889.

Berthelot in his éloge[10] insisted that the new chemistry had not been a collective work[11] - it was the work of a single man, Lavoisier. Berthelot reminded the Academy that no official éloge of this great scientist had been delivered. It was time to put right this injustice. He tried to present his hero as a man of the people by saying that the origins of the Lavoisier family had been humble 'and, as we say to-day, democratic'.[12] He described Lavoisier's early entry into the Academy, his many experiments and the development of his oxygen theory. Had he been spared, he might have achieved even more. But the modern historian might argue that his tragic end had helped to give rise to a legend.[13] In so far as that legend was one of Lavoisier the hero, Berthelot did as much as Dumas to cultivate it. On another public occasion he spoke of Newton and Lavoisier as 'demi-gods'.[14] This was the apotheosis of the great man of science. The choice of the most influential of chemists and the model of a French man of science invariably fell on the person of Lavoisier.

We have summarised the devotion of successive generations of French chemists to the memory of Lavoisier because Gay-Lussac, Dumas, Wurtz and Berthelot each in turn had control over the *Annales*. That is not to say that the name of Lavoisier was bandied about in the journal - on the contrary, nearly all discussions there were of *contemporary* science. But it helps in the understanding of the history of a journal if one knows something of the enthusiasms and prejudices of the editors. Each of the men listed above had a different character and a different religious affiliation. Dumas was a moderate Catholic, Wurtz a Protestant and Berthelot a secularist, yet they all shared a common reverence for Lavoisier. Perhaps it would not be too pretentious to claim that some of the spirit of Lavoisier lived on in the *Annales*. At least he seems to have provided a source of inspiration. Although all French scientists would naturally be delighted to be in a position to claim the honour for an original discovery, in the late nineteenth century French chemists were often happiest when they could link their discovery with one of the main streams of chemistry, which they saw as leading back to Lavoisier. Thus when Berthelot worked on thermochemistry, he claimed to be following in the footsteps of his illustrious predecessor.

The cult of Lavoisier provides an element of continuity reinforcing the institutional continuity of the *Annales*. After the neglect of Lavoisier in the first third of the nineteenth century, leading French chemists began to look back to discover their roots. This could have been done in a number of ways. It is in-

---

[10] 'Notice historique sur Lavoisier', *Mémoires de l'Académie des Sciences de l'Institut de France, 45,* n.d., xix-lxxii.

[11] 'Les idées qui ont triomphé ne sont pas une oeuvre collective', *ibid.*, p.xxi.

[12] *Ibid.*, p.xxii.

[13] *Ibid.*, p.lxxii.

[14] *Mémoires de l'Académie des Sciences, 47* (1904), lxiii.

teresting that it was only after Liebig's death that the journal he had edited for so long was officially named *Liebig's Annalen*. It would have been very cumbersome as well as inappropriate to speak of *Lavoisier's Annales de chimie et de physique*. It was only in the final years of his life that Lavoisier began to edit the first volumes of the journal and, when he did so, it was as the most eminent member of *an editorial board*. In other words, the history of the periodical contradicts the image of Lavoisier as a lone hero. Only in 1978 did the current editor of the *Annales de chimie*, now in its fifteenth series, add the words: 'fondées par Lavoisier' to the title.

Yet in a sense the idea of chemistry being *founded* by Lavoisier receives some support in the history of the *Annales*, which could proudly trace its publication back to 1789. The 1780s provided a new theory, a new language and the first permanent journal of chemistry. Just as the French revolutionaries could begin their calendar with the foundation of the Republic, the chemists could date their science as beginning with Lavoisier and his publications. Anything before that could be regarded as pre-history. The modern historian would not necessarily accept this view, but certainly, if any period had to be chosen as marking a dividing line between ancient and modern, the period of the French Revolution would be a very strong candidate indeed.

2. *Chemistry in the Academy and in the Société chimique*

In France the formation of the Société chimique in 1857/58 came considerably later than the foundation of the Chemical Society of London (1841) and this fits into a common pattern for French scientific societies. In France the idea was generally accepted that the Academy of Sciences represented the different branches of science. To set up any high-level scientific society independently of the Academy would suggest a spirit of rivalry or competition, and most middle-ranking scientists with an eye on the patronage of the Academy (or even eventual membership) would have felt that they could not afford to antagonise that powerful body. Thus a comparison of dates of foundation of specialist societies of the different sciences in France and in Britain shows generally the comparative lateness of the French.[15] In view of the very restricted numbers within the Academy it is, nevertheless, surprising that the need was not felt earlier for the encouragement of individual sciences at a lower level. It is important to note that, when the *Société chimique* was founded in June 1857, it was by graduate students and demonstrators who were originally concerned with self-instruction. It was, therefore, at the most junior level possible in the profession of chemistry and could not possibly be interpreted as being in competition with the senior chemists in the Academy.

[15] M. Crosland, *Science under Control*, Cambridge, 1992, p.71.

In speaking of the Academy, we return in a sense to the circle of Lavoisier. It is true that the Royal Academy of Sciences, to which Lavoisier belonged, and to which he presented his research, had been closed down in 1793, but it was replaced in 1795/96 by the First Class of the Institute which some would interpret as the Academy under another name.[16] Even the name Academy was restored in 1816 and the number of members in each of the sections[17] remained at the magic number of six. The first two members of each section were nominated by the government in 1795 and they were asked to elect their colleagues. Since in chemistry Guyton and Berthollet were official nominees and they then proceeded to elect Fourcroy, this would seem to illustrate the re-emergence after the Terror of the Lavoisier circle. Yet the mood of the time was very much geared towards utility as the justification for science and, of the remaining three members of the section to be elected two were pharmacists: Bayen and Pelletier, the third being Vauquelin. This strong representation of pharmacy provided a further link with the ancien regime. (Lavoisier had been one of three *pensionnaires* in the chemistry section of the Academy, the others being the pharmacists Cadet and Baumé.) Several Academicians elected to the chemistry section in the nineteenth century were trained as pharmacists, which is probably a reflection of the high scientific content of pharmacy education in France. Some moved from pharmacy to the rapidly growing field of organic chemistry.

The restriction on numbers in each science to six was a severe limitation to many sciences and none more than chemistry which was expanding on all fronts but especially in organic chemistry. Chemistry was, therefore, one of the most hotly contested sections for election and chemists began looking for other ways of entering the Academy. Boussingault and Payen managed to get elected to the agriculture section, the inorganic chemist Henri Sainte-Claire Deville was passed off as a mineralogist and Berthelot was accepted by the physics section. When Dumas was elected permanent secretary in 1868, this left a vacancy in the chemistry section. By then there seemed to be so many chemists in the Academy that one critic remarked that 'the Academy of Sciences was being transformed into an Academy of Chemistry'.[18] Yet at no time were there more than a dozen chemists in the Academy[19] and this left many able chemists outside. The Academy was moving towards a situation that a chemist had to be not only very able but also very senior to be elected. Thus the Academy was in danger of becoming exclusively a group of old

---

[16] This is not to deny that the ideology of the Institute was different from that of the Royal Academies. Yet *for practical purposes* there were many similarities, including a significant common membership.

[17] Except geography.

[18] J. Marcou. *De la science en France*, Paris, 1869, fasc.2, p.119.

[19] Out of a total of 63.

men. However distinguished most of them undoubtedly were, this did not help in introducing new ideas. Yet the Academy was constantly receiving reports of the latest research that was published in the Academy's *Comptes rendus*, so it would be a grave error to write off the organisation as irrelevant to the progress of chemistry, physics or any of the sciences.[20] If it is true that the prominent younger chemists Gerhardt and Laurent never became full members of the Academy, that was because they both died prematurely, Gerhardt at the age of 39 and Laurent at 46.

Before leaving the Academy, we may remind ourselves that many members of the editorial board of the *Annales* - indeed the majority - were Academicians. Of the founding editors, six out of eight were Academicians. On the resumption of publication after the Terror seven out of eleven were Academicians. In the second series both Gay-Lussac and Arago were Academicians and part of the reason for the success of the journal was that it was conducted by such prominent men of science. We have seen that when obscure scientists founded a journal, however well produced, they had great difficulty in obtaining subscriptions from the scientific community and such journals usually collapsed after a few years.

Coming now to the enlargement of the editorial board in 1840, it is notable that all the new members were Academicians, Pelouze and Boussingault having qualified in the late 1830s. When Wurtz joined in 1864, still too junior to be an Academician, he was given the status of 'collaborator' but was promoted to a full member of the board in 1868, having become an Academician the previous year. By the time Friedel and Mascart became members, they too had became Academicians. All the evidence seems to point to a policy of only appointing senior scientists as editors. Although the journal had no official connection with the Academy, the status of the Academician was being used to enhance the authority of the *Annales*.

By contrast with the Academy, originally organised by the government and intended to represent an elite, we now turn to the *Société chimique*[21] organised 'from below'.[22] It began with informal gatherings of young chemists, who used to meet weekly at a café in the Quartier Latin to discuss their work. By June 1857 they decided to formalise their meetings and establish a chemical society. The majority were foreign students with a few young Frenchmen.

---

[20] For a fuller discussion see M. Crosland, *op.cit.* (1992).

[21] In 1859 the Society became the *Société chimique de Paris*. In 1906 the Society was permitted by the government to enlarge its title and became the *Société chimique de France*.

[22] C. Pacquot, *Histoire et développement de la Société chimique depuis sa foundation*, Paris, 1950, A. Gautier, 'Le cinquantenaire de la Société chimique de France', *Revue scientifique*, 7 (1907), 641-689. *Centenaire de la Société chimique de France (1857-1957)*, Paris, 1957. There is also useful information in Ana Carneiro, *The Research School of Chemistry of Adolphe Wurtz, Paris, 1853-84*, University of Kent Ph.D. thesis, 1992.

There were originally twelve members and when they listed their names it is significant that each identified himself as the apprentice of a particular master. Three described themselves as the *élève* of Dumas, three as the *élève* of Deville, etc. Only one (Frenchman) held a junior position, that of *préparateur* at the Muséum d'Histoire Naturelle. None of the original twelve became famous but when news of their meetings became known, they were soon joined by several other young chemists of later distinction, including Butlerov, Couper and Friedel. Indeed Friedel, a student of Wurtz, was elected one of the vice-presidents. There was no question at first of professors of chemistry joining the Society but Wurtz was an exception, being comparatively young (40) and less formal in his relations with students than his professorial colleagues. He had only been appointed in 1853 as professor at the Faculty of Medicine, where he had begun to build up an informal research school, which will be described in the next section. His easy relations with his students led to his being invited in May 1858 to join the *Société chimique*. Not only did this encourage Wurtz's other students to join the Society but Wurtz invited his colleagues, men like Balard and Henri Sainte-Claire Deville and even the great *maitre*, Dumas to join. It was Wurtz more than anyone else, who transformed the Society from a group of students into what was to become a true learned society.[23]

In 1859 a new constitution was approved in line with the enlarged ambitions of the Society. Several senior French chemists were appointed to honorary positions: Dumas as president with Pasteur, Cahours, Paul Thenard and Berthelot as vice-presidents. Wurtz and Leblanc were appointed as secretaries, a position that carried responsibility for publications of the Society. The Society was beginning to provide an alternative forum for chemical discussion. Already on 23 June 1858 the Scotsman Couper had tried to explain to the Society his new ideas on affinity, which involved writing chemical formulae in a way related to what would later be called valency. He had asked Wurtz to present these ideas to the Academy earlier in the year but Wurtz, not being a member and unconvinced by the ideas, had delayed. Couper then approached Dumas, who kindly presented his paper to the Academy on 14 June, after which it was published in the *Comptes rendus*.[24] It was now 'on the record' but there was no special reason why chemists should take much notice of it. The presentation at the Société chimique had the advantage that it would be discussed. One unfortunate consequence of the delay was that Kekulé, who had some similar ideas, published them first and claimed priority. A second consequence was that Couper was dismissed by Wurtz and returned to Scotland, where he died in tragic circumstances.

---

[23] Gautier, *loc.cit.*, 646.

[24] *C.R.*, *46* (1858), 1157-60.

Just as the *Comptes rendus* helped the reputation of the Academy in the nineteenth century, so did its *Bulletin* help the Société chimique, which became effectively a national chemical society in the 1860s although it was not officially recognised as such until after 1900. Yet whereas the Academy's *Comptes rendus* remained unique in French science, the *Bulletin* had to share the chemical honours with the *Annales*. It is ironic that the same chemist, Wurtz, should be associated with both journals. He had gained some experience of journal production by being co-opted to the *Annales* in 1853, which probably helped him later in editing the short-lived *Répertoire de chimie pure* (1858) and subsequently the *Bulletin* of the *Société chimique*. When, however, he was made a full member of the editorial board of the *Annales* in 1868,[25] his primary loyalty would have been transferred to that journal since he knew that many of his former students, and notably Willm and Friedel were able to carry on his earlier work of editing the *Bulletin*. This journal has already been discussed in chapter 9.

3. *Schools of chemistry*

Scientific research schools have been the subject of several recent studies,[26] and it is interesting that nearly all the discussions relate to schools of chemistry. At first sight it might seem that Lavoisier could be credited with having founded a research school but, although oxygen provided a focus for his research, his senior colleagues had different ideas on the way chemistry should go, as has been shown in Chapter 4 and he never really had research students - only colleagues and assistants. The blossoming of higher education in the wake of the French Revolution helped to institutionalise a master/student relationship. It did this by appointing several senior scientists as professors in the Ecole Polytechnique and by providing state funds for young men to enrol as students. When these students had completed their courses they naturally looked for employment, which was sometimes available in the expanding system of higher education, which from 1808 included the first Faculties of Science. The former teachers of these young men not only provided the necessary patronage for these paid positions, but they encouraged their protégés to undertake research and to publish their findings.

---

[25] The long period of Wurtz's junior status is explained by the fact that he was invaluable in providing abstracts of foreign chemical publications. The promotion in 1868 confirms the theory that one was expected to be an Academician before becoming a member of the editorial board. Wurtz had been elected to the Academy in 1867.

[26] J.B. Morrell, 'The chemist breeders: the research schools of Liebig and Thomas Thomson', *Ambix*, *9* (1972), 1-46. G.L. Geison, 'Scientific change, emerging specialities and research schools', *History of Science*, *19* (1981), 20-40. L.J. Klosterman, 'A research school of chemistry in the nineteenth century: Jean-Baptiste Dumas and his research students', *Annals of Science*, *42* (1985), 1-40 (Part 1). The latest publication in this area is G.L. Geison and F.L. Holmes (eds.), 'Research schools. Historical reappraisals', *Osiris*, *8* (1993).

The best early example of this is the Society of Arcueil, where Berthollet and Laplace jointly presided over a parallel research programme in chemistry and physics.[27] Gay-Lussac and Arago begun their academic careers as the respective protégés of Berthollet and Laplace. Although it is true that in the later Napoleonic period Arago's independent spirit rebelled against the neo-Newtonian research programme of the authoritarian Laplace, Gay-Lussac was close to Berthollet all his life and was deeply influenced by him. There is a sense then in which the second series of the *Annales* represented a continuation of the Arcueil school. The journal was never tied to a neo-Newtonian research programme yet, when the Society of Arcueil had ceased to meet, it perpetuated the spirit of a close alliance between physics and chemistry and the surviving members of the Society of Arcueil were among its contributors.

One of the reasons why nineteenth-century French research schools have only recently been (re)discovered is that in the early years they did not usually have an official status. They did not correspond at all closely with the official institutions of higher education and they often existed outside of them. Yet a research school of chemistry has to have a laboratory and Dumas was able to build up a research school partly because he was in the happy position of having his own laboratory.[28] From 1832 to 1838 Dumas had a small private laboratory in an annex of the Ecole Polytechnique. From 1838 to 1848 he had a more spacious private laboratory in the rue Cuvier, close to his home.

The research students that Dumas gathered round him had often first come into contact with him through his lectures, for example at the Ecole Polytechnique. Most worked on organic chemistry and were often aiming for the doctorate. They included both French and foreign students. Cahours and Marignac had attended the Ecole Polytechnique. Gerhardt and Henri Sainte-Claire Deville had attended his lectures at the Faculty of Sciences. Favre and Wurtz had attended his course at the Faculty of Medicine. Dumas' many teaching positions and his enthusiasm combined to recruit students. He did not charge for the use of the laboratory but he expected a certain deference from those attending it. He was recognised as the *chef d'ecole* and his students addressed him as *maitre*. They were glad to accept his guidance in their research and his patronage in their careers. They helped Dumas to build up his substitution theory and his subsequent theory of types. Through Dumas the students had a publication outlet in the *Annales* from 1840 onwards. It was important to the impact of his research school that the students had access to the leading journal of chemistry. Dumas often appeared as the co-author in the memoirs of his students.

---

[27] M. Crosland, *The Society of Arcueil. A view of French Science at the time of Napoleon*, London, 1967.

[28] Klosterman, *loc.cit.* Dumas was probably influenced by the research school which Liebig was beginning to assemble in Giessen.

As Dumas' research students progressed in their careers, some began to establish their own research schools, as in the respective cases of Cahours, Sainte-Claire Deville and Wurtz.[29] Cahours established his research school at the Ecole Polytechnique, where he was appointed in 1851, enrolling senior students who had temporary posts as *répétiteurs* or *préparateurs*. The school was entirely unofficial, however, and had no budget. The students, who were all French, included Riche, Demarçay and Étard. A more important school was that established by Sainte-Claire Deville, sometimes described as Dumas' favourite student. Deville had two great advantages in Paris - he enjoyed the benefits of Dumas' patronage and his post at the prestigious Ecole Normale automatically attracted good students. Some like Debray, Troost and Hautefeuille were outstanding enough to be elected later in their careers to the Academy of Sciences. Deville and his school distinguished themselves particularly in inorganic chemistry and mineralogy.

To build up a reputation and a clientèle as a *chef d'école* meant much to many leading French scientists, even though such a position was entirely without official recognition. Although originally professors were paid only to teach, the activity of research attracted all ambitious chemists and they saw advanced students as a means of undertaking research which they themselves might not have the time or energy to do by themselves. The *chefs d'école* encouraged their students to undertake specific research problems under their supervision. To obtain credit for a piece of research it was necessary to publish it, and we have seen how Dumas' students had access to the *Annales*. Deville's students had no such inbuilt advantage. Deville could hardly found his own journal. An ideal solution would have been to have some special claim to publication in the *Annales de chimie*. An opportunity arose in 1862 on the death of the mineralogist Sénarmont, who had been on the editorial board since 1854. A letter has come to light revealing Deville's approach to Dumas on this occasion, proposing himself as a worthy successor. Deville wrote:

> I would try to make your journal [*sic*] a focus for work on inorganic chemistry and physical chemistry (*mécanique chimique*), which I would take from my numerous friends in French and foreign laboratories.[30]

Thus Deville was offering his own expertise and that of his closest associates to complement the existing emphasis in the editorial board on organic chemistry. It would have been a service both to the *Annales* and to his own

[29] Much of the following draws on the recent research of Ana Carneiro. Her thesis is particularly authoritative on the school of Wurtz: Ana Carneiro, *The Research School of Chemistry of Adolphe Wurtz, Paris, 1853-84*, Ph.D. thesis, University of Kent, 1992.

[30] The letter is undated but from internal evidence we can date it 1862, immediately after the death of Sénarmont. Archives, Académie des Sciences, Dumas correspondence.

research school. Yet Dumas was unwilling to bring into the editorial board the influence of another research school and Sénarmont was not replaced.

We will finally mention briefly two other major research schools which are relevant to the history of the *Annales* in so far as each *chef d'école* in turn took control of the journal. They were respectively Wurtz and Berthelot, who provide a contrast both in their approach to chemistry and in their personalities. Wurtz came from Alsace and provided an important link with German chemistry. Berthelot was much more insular. Also, as a positivist, he could not accept atoms or atomic weights, as opposed to Wurtz who became their advocate. The charismatic Wurtz had a very easy informal relationship with his students, many of them were foreign. Berthelot was much more formal and his research students were tied to him more by the temporary holding of a salaried post than by personal loyalty.

Over a hundred chemists have been identified as being members of Wurtz's research school over the period 1853-84, although Wurtz only had space for a maximum of sixteen students at a time in his laboratory at the Faculty of Medicine. Unlike many of the other schools, the majority of students were not concerned to obtain a doctorate. They were usually advanced students intending to round off their training by spending a few months or perhaps one or two years in the stimulating atmosphere of Wurtz's laboratory. His most important students included Friedel, Caventou, Grimaux and Le Bel. Among foreign students were Butlerov, Couper, Beilstein, Crafts and van't Hoff. Wurtz and his students focused on organic chemistry, working out first the heritage left by Gerhardt in his classification of compounds. On the basis of the type theory Wurtz was able to predict the existence of glycol, which he prepared. It has been shown that Wurtz's students were particularly prominent in the second stage of development of the Société chimique and subsequently. The *Bulletin* of that society provided a convenient outlet for publication of the research of the school, and thus undermined the position of the venerable *Annales*.

Berthelot was unusual in not having attended any of the *grandes écoles* but having started his career in pharmacy. His greatest coup in his early career was to secure a nomination in 1863 as professor of organic chemistry at the Collège de France. His two-volume treatise, *La chimie organique fondée sur la synthèse* (1860) had helped prepare the way by presenting himself as the great exponent of organic synthesis, complementing the method of analysis used by Lavoisier. He used the Ecole pratique des hautes études, established in 1868, to appoint a number of research assistants, whom he worked hard. Many were preparing their doctorates under his strict control. His most able student was probably Jungfleisch, with whom he published several joint articles. Although he had access to the *Annales*, it would seem that he did not

enjoy any special priviledges as a contributor until after the death of Wurtz in 1884, when he became the effective senior editor.

4. *Books and laboratories*

We have tried to place the *Annales* and science periodicals generally within a wider context. In reviewing the position of French chemistry in the nineteenth century it is, therefore, desirable to say a few words about other forms of publication and the facilities available for practical work.

Although Lavoisier did write a textbook, his colleague Fourcroy was a more consistent and influential textbook writer. His *Système des connaissances chimiques* (10 vols., 1800) was an important source of the new chemistry in the early nineteenth century. It was translated into English, German and Spanish. His one-volume *Philosophie chimique* of 1792 reached an even wider public through three editions and translations into eleven European languages.[31] The next important French textbook of chemistry was that of Thenard, which went through six editions between 1815 and 1834. Meanwhile, however, Thomas Thomson had shown that Britain too could produce textbooks and his *System of Chemistry* reached six editions in the period 1802-1820. It even received the compliment of a French translation with an introduction by Berthollet, who made rather critical remarks about its account of Dalton's atomic theory.[32]

It would be tedious to give a whole list of chemistry textbooks. It was naturally people holding teaching positions in higher education who were the main authors. In the mid-century Regnault's *Cours élémentaire de chimie* (3 vols., 1847-49) enjoyed great success as a textbook, being translated into several other languages. More ambitious was the six-volume *Traité de chimie générale* by Pelouze and Fremy, which went through several editions in the 1850s and 1860s, although Fremy is best remembered for his ten-volume chemical encyclopedia (1882-1901), prepared with the help of a number of former students of the Ecole Polytechnique and several industrialists.

In Germany many of the leading chemists wrote textbooks: there was Mitscherlich's *Lehrbuch der Chemie* (1829), Liebig's *Organische Chemie* (1841) and Wöhler's *Grundriss der Chemie* (11th edition, 1854), which gave rise to a book of the same title by Fittig (1872).[33] By the mid-century chemistry had grown to such an extent that it was difficult for any one author to cover the whole of the subject at an advanced level. Several advanced texts were therefore published under the names of two or three authors, often one for general and physical chemistry, a second for inorganic chemistry and a

---

[31] W.A. Smeaton, *Fourcroy, Chemist and Revolutionary, 1755-1809*, Cambridge, 1962.
[32] T. Thomson, *Système de chimie*, vol.1, Paris, 1809, p.21.
[33] E. von Meyer, *History of Chemistry*, trans., London, 1898, pp.594-5.

third for organic chemistry. A number of chemical dictionaries and encyclopedias began to appear. In 1837 there appeared the first volume of the *Handwörterbuch der reinen und angewandeten Chemie*, edited by Liebig, Wöhler and Poggendorff. There was also Henry Watts' *Dictionary of Chemistry* (7 vols., 1863-75). When Wurtz published his *Dictionnaire de chimie* in 3 volumes in 1869-78 he had the able assistance of his students and other collaborators. Among later treatises, which were intermediate between textbooks proper and dictionaries, special mention must be made of Beilstein's *Handbuch der organischen Chemie*, of which the first edition (1880-82) described 15,000 compounds. Unfortunately the rapid growth of the subject made new editions imperative. The Deutsche Chemische Gesellschaft took over the enormous task on a permanent basis but they were eventually forced to abandon the task in the 1960s.

Yet chemistry was never a subject that could be learned simply from books. It is a practical and experimental science, which must be based in the laboratory. But for much of the nineteenth century laboratory facilities were minimal. France, which in several ways led the world in higher scientific education around 1800, depended very much on government finance, and legislators, who were happy to establish chairs in subjects across the whole spectrum of learning, never appreciated the special claims of experimental science. Only the Ecole Polytechnique had provision for laboratories, which were provided so that students could carry out elementary practical work. There were no official research laboratories in the budget of the Ministry of Public Instruction until 1868, when the Ecole Pratique des Hautes Etudes was established. No proper historical research has yet been carried out on French science laboratories in the nineteenth century, so the following remarks will necessarily be brief.

One of the reasons for the success of the Society of Arcueil during the short period of its existence was that, in addition to the very high quality of its members, they had access to laboratory facilities in Berthollet's country house. Gay-Lussac often acknowledged what he owed to them. Most research laboratories were private laboratories. Dumas was able to afford a private laboratory because of his wealthy father-in-law. Some chemists were able to introduce extra facilities in the institution, in which they held a teaching post,but for a chemist like Gerhardt, who held no official post in Paris, this was impossible. In 1851 we find him planning a laboratory to be paid for by the fees of students, whom he would admit to a small private school of chemistry.[34] Unfortunately this sounds like a chicken and egg situation - no students would come until he had a laboratory.

---

[34] M. Tiffenau (ed.), *Correspondance de Charles Gerhardt*, vol.2, p.112. Letter of Gerhardt to Chancel, 2 February 1851.

Dumas had been able to make modest improvements in laboratory facilities at the Ecole Polytechnique in the 1830s. Later he pressed for a laboratory at the Faculty of Sciences, which was built in 1855. When Pasteur arrived at the Ecole Normale in 1857 as Director of Studies, he had to do his research in an attic. Only later was he able to convert a pavilion, built for the school architect, into a laboratory. In a famous pamphlet in 1868, *Le Budget de la science*, Pasteur complained that the French state had completely overlooked the needs of experimental scientists for laboratories, since scientists were sometimes obliged to use damp cellars. Claude Bernard had described such laboratories as the tombs of scientists. Wurtz was fortunate enough to have a chemistry laboratory at the Faculty of Medicine. He helped to draw attention to the superior laboratory facilities in some German universities and this argument was used to obtain funds for new laboratories[35] in France from the late 1860s onwards. In the higher education budget for 1868 of 7 million francs, 50,000 francs were set aside for laboratories. This was increased in later years.

It was not that successive French governments were hostile to science. On the contrary, successive republics looked to science for some legitimation. Yet educationalists tended to assume that university buildings should consist of a series of lecture theatres. If law and literature could be taught by lectures, why not science? For the legislators and higher civil servants science constituted an administrative anomaly.

5. *Some national comparisons*

France provides a classic example of an early centralised state with authority concentrated in Paris. The centralisation of the ancien regime was accentuated in the Revolutionary and Napoleonic periods, affecting the whole of the nineteenth century and much of the twentieth century also. In science the location of the Academy of Sciences and the elite teaching institutions in the capital drew the best talent there. No other city could compare with Paris and even the provincial Faculties were ruled from the capital, only becoming universities in their own right at the end of the nineteenth century. Thus there was an absence of competition with the provinces, leaving only some institutional competition within Paris itself. So the Ecole Polytechnique and the Ecole Normale became great rivals. Career advancement depended very much on patronage, and most of the great patrons were members of the Academy of Sciences. This, therefore, constituted an unchallenged centre of power and tended to exercise a conservative influence, although it has recently been ar-

[35] A. Wurtz, *Les Hautes études dans les universités allemandes*, Paris, 1870. See also: W.H. Brock, *Fontana History of Chemistry*, 1992, p.427.

gued that, contrary to a general assumption, the Academy was anything but moribund.[36]

Every country has its heroes and the hero of French chemistry was undoubtedly Lavoisier. If, as we have suggested, the cult of Lavoisier largely originated with Dumas in the 1830s, it was reinforced by Wurtz and especially Berthelot. If the French defeat in the Franco-Prussian war of 1870-71 provided an understandable reaction in the strengthening of patriotic fervour, the celebration of the centenary of the French Revolution of 1789 provided a more positive opportunity to commemorate Lavoisier. Yet such commemorations are dangerous if they persuade scientists and other intellectuals to look back complacently to a glorious past rather than to think of building a proud future. Lavoisier may well have been superior to Stahl in the eighteenth century. (He had after all the advantage of coming later, when the gaseous state had been discovered.) Yet the more important question in 1889 was how did French chemistry compare with German chemistry, and here there was much less reason for pride on the French side. French chemistry, particularly organic chemistry, had not advanced as much as German chemistry and in a centralised system Berthelot, with his refusal to acept atoms and his insistence on equivalents, exercised a powerful retarding influence.

In Germany one might select Hermann Kolbe as a parallel example of a retarding force, since he refused to accept the structural formulae on which much advance in organic chemistry in the 1870s and 1880s depended. In 1870 Kolbe was appointed editor of the *Journal für praktische Chemie* and he used his position to express his strong personal opinions on the state of chemistry. His attack in 1877 on the three-dimensional formulae of van't Hoff[37] provides one particularly famous example of the polemics which characterised his later years.

Yet Kolbe in Leipzig was only one among several senior chemists located at different university centres throughout the German state, which had come into existence in 1871. Hofmann was the professor of chemistry in the university of the new national capital, Berlin. By now Liebig had moved from Giessen to Munich in Bavaria. Liebig's great friend and collaborator, Wöhler was professor of chemistry at Göttingen from 1836 until his death in 1882. The other great German chemist of this period, Bunsen had been appointed to the University of Heidelberg in 1852, where he stayed until his retirement in 1889.

---

[36] M. Crosland, *Science under Control. The French Academy of Sciences, 1795-1914*, Cambridge, 1992.

[37] An English translation is given in M. Crosland, *The Science of Matter*. 2nd edn., Philadelphia, 1992, pp.267-8.

Each of these universities had a distinguished history, each provided laboratory facilities, which were sometimes the envy of the French.[38] In each university chemistry was taught in a slightly different way. Different professors would emphasize different aspects of the subject and, if students did not like the professor or his method of teaching, they were free to go elsewhere. There was both *Lehrfreiheit* (for the professors) and *Lernfreiheit* (for the students). It may be true that the importance of Berlin increased after 1871 when it was upgraded from being the capital of Prussia to becoming the capital of Germany. Yet Berlin never became the equal of Paris as a unique focus for talent. There was too much competition from other important German universities and every major school of chemistry felt the need for its own independent journal.

An important contribution of Germany to nineteenth-century chemistry was the use of the laboratory to train students; to understand the early development of this practice we must go back a little in time. The French had made use of laboratories to allow students at the Ecole Polytechnique in the 1790s to repeat experiments described in lectures, but this did not involve the advancement of knowledge.[39] The French higher educational system made use of lecture theatres to impart knowledge to students and this applied as much to science lectures as to the humanities. Both might give rise to great feats of oratory[40] but they did little to advance knowledge.

We have previously mentioned the good fortune of the young Liebig when he was admitted to Gay-Lussac's private laboratory.[41] He was very much the exception. When Liebig became professor of chemistry at Giessen he was determined to encourage students to work in the laboratory. In the 1830s and 1840s it was particularly important to determine the composition of organic compounds. Students would, therefore, first learn the basic analytical skills of qualitative and quantitative analysis. They could then explore the preparation of new compounds. They found themselves doing research. But the important point is that skills were learned *at the laboratory bench*, not from a lecture or a textbook. In fact many of these skills would be learned by the newcomer in a crowded laboratory from a senior student. The professor could remain in the background. The sense of participation among the students was important. They were very different from the largely passive audience in a lecture thea-

---

[38] Thus Pasteur wrote: 'Depuis trente ans, l'Allemagne s'est couverte de vastes et riches laboratoires, et chaque jour on voit naitre de nouveaux.', *Le Budget de la science*, Paris, 1868, p.4.

[39] Margaret Bradley, 'The facilities for practical instruction in science during the early years of the Ecole Polytechnique', *Annals of Science*, *33* (1976), 425-446.

[40] Robert Fox, 'Scientific enterprise and the patronage of research in France, 1800-70', *Minerva*, *11* (1973), 442-473 (453).

[41] Chapter 8, Section 6.

tre. In participating in practical chemistry they gained not only skills but enthusiasm and, when a piece of research was completed, Liebig often encouraged his students to publish it under their own names. A larger piece of research might be rewarded by the conferral of a doctorate. Foreign students were eligible for the award of a Ph.D. in German universities without the necessity for preliminary qualifying examinations insisted on by the more bureaucratic French system.

In England the two ancient universities had chairs of chemistry by 1800 but the work of their occupants was hardly distinguished. It was, therefore, an important step in the history of higher education when the monopoly of Oxford and Cambridge was broken by the foundation of University College London in 1828. Several of the early professors came from Scottish universities which had their own independent histories. Edinburgh University was particularly important in the late eighteenth century and we have had reason to mention Joseph Black, who was professor of chemistry there from 1766 until 1799. We have also mentioned Thomas Thomson, who became Regius professor of chemistry at the University of Glasgow in the early nineteenth century.

Yet universities were not the only centres for teaching and research in science. Much important work was done in London at the Royal Institution, founded in 1799. It combined a programme of popular lectures (to a middle and upper class audience including women) with superior research facilities particularly in chemistry and physics. The work of Humphry Davy was especially important and was rivalled only by the later research of his former assistant, Michael Faraday.

An important step in the cultivation of chemistry in Britain was the foundation in 1845 of the Royal College of Chemistry in London under the directorship of A.W. Hofmann, who hoped to reproduce the curriculum he had himself followed at Giessen. Among Hofmann's students was William Perkin, who discovered aniline mauve.[42] The work of Perkin and Griess in Britain on dyestuffs was soon rivalled by developments in France. Thus Verguin in 1859 manufactured fuchsine, but advance in France was handicapped by many patent disputes. Germany soon became a world leader in the production of artificial dyestuffs for several reasons, one of which was the good supply of academically trained chemists. Neither Britain nor France was able to provide the same high standard and sheer numbers of well-trained chemists.

Later in the nineteenth century several provincial centres made useful contributions to chemical education, notably Owen's College, soon to become the University of Manchester and the Yorkshire College, which became the University of Leeds. German influence continued here and often British stu-

[42] F.S. Taylor, *A History of Industrial Chemistry*, London, 1957, pp.235ff. L.F. Haber, *The Chemical Industry during the Nineteenth Century*, Oxford, 1958, 80ff.

dents were encouraged to complete their chemical education by taking a Ph.D. at a German university. If British chemists felt the need to learn a second language it, therefore, was often more likely to be German than French. Thus, although the *Annales de chimie* would continue to be taken by the leading British scientific institutions, chemists themselves might well be more likely to refer to one or more of the leading German chemical periodicals. Italian periodicals would only rarely be consulted outside Italy. The growth of nationalism in the nineteenth century meant that every country wanted scientific journals in its own language, which was bad for international communications. Of course, waiting in the wings, was the United States, which provided no language barrier to British scientists. By the end of the nineteenth century American chemical journals were beginning to make their mark as a preface to their major global role in the twentieth century.

We have mentioned the increase in intensity of national feeling in France after the Franco-Prussian war. When, four years later, Lecoq de Boisbaudran discovered a new element, it was perhaps understandable that he should name it *Francium*. This was to be matched by Nilson's discovery of a new element in 1879, which he called *Scandium* in honour of Scandinavia. Then in 1886 Winkler announced the discovery of *Germanium*. Although all her research work was carried out in France, Marie Curie preferred to call the element she discovered in 1898 *Polonium* in honour of her native Poland. A more ecumenical note was struck in 1901, when Demarçay named his new element *Europium*, which invited the later response of *Americium* (1944). Thus nationalistic feelings in the late nineteenth century led to the partial abandonment of the earlier custom of relating the names of new elements to associated minerals or to Greek words describing their properties, although the latter practice was revived for the inert gases in the 1890s. Boisbaudran himself had even revived it for his discovery of *Dysprosium* (Greek: difficult).

6. *Conclusion*

We have seen that the *Annales* contained a rich collection of memoirs on physical science with special emphasis on chemistry. It claimed not to exclude any school of thought but it is true that the French generally were slow to appreciate some developments in chemistry, such as the atomic theory and combining proportions. The *Annales* were very different from the traditional *Mémoires* of learned societies, which existed mainly for the publications of their members. The *Mémoires* of an academy, therefore, represented a kind of elite science, which other lesser mortals were permitted to read but not to contribute to or criticise. From the beginning the *Annales* represented a more democratic science although it was by no means the first in this respect; thus the *Observations sur la physique* was an open journal and so were several

others. The trouble was, of course, that this openness could expose a journal to the opposite fault - to be filled with low-level science hardly worthy of publication. Its editorial board helped the *Annales* to avoid this. On the other hand there were times in the history of the *Annales* when it was claimed that the editorial policy was too restrictive.

Although by the early nineteenth century journals had come to provide the usual medium for most scientific publication, they were by no means an exclusive medium. There were still many occasions when chemists and physicists felt that they needed to express their ideas through books. Even Berzelius, who had witnessed his long memoir on definite proportions in inorganic compounds appearing in twelve parts in successive issues of the first series of the *Annales*, felt that the French chemists should be encouraged to take combining proportions more seriously and produced his *Essai sur la théorie des proportions chimiques* (Paris, 1819) as a book to make this point. It was sad that the *Annales* simply did not have the space to publish monographs, at least not without dividing their contents into parts, which could seriously diminish their impact.[43]

A journal was, therefore, an ideal place to publish experimental results and to try out new ideas, but anyone who had taken the trouble to think out a whole new research programme could hardly be expected to compress it sufficiently to make it fit easily into one issue of the *Annales*. Thus, although Laurent made regular use of the *Annales* early in his career and also contributed frequently to the *Comptes rendus*, for a comprehensive view of his chemical philosophy one must turn to his book, *Méthode de chimie* (Paris, 1854). Similarly his friend Gerhardt produced the best synthesis of his work in the form of a textbook: *Traité de chimie organique* (4 vols., Paris, 1853-6). A good example of a research programme requiring a book is Marcellin Berthelot's *Chimie organique fondée sur la synthèse* (2 vols., Paris, 1860). Here Berthelot was laying the foundations of his later position as the prophet and high priest of French science.[44]

That it was not, however, always advantageous to publish original ideas in book form is illustrated by the case of Sadi Carnot, whose historic *Réflexions sur la puissance motrice du feu* fell stillborn from the press in June 1824.[45] At least continual surprise has been expressed that a book of such fundamental importance to the study of heat and to the later science of thermodynamics did not attract more favourable attention at the time of its publication. Indeed it is one of the claims to fame of Clapeyron that, ten years later, he drew attention

---

[43] A rare exception, which we have noted previously, is Gay-Lussac's memoir on iodine, published in a single issue of exceptional length.

[44] For a critical view of Berthelot's claim to fame which casts doubt on the originality of some of his work, see Jean Jacques, *Berthelot, autopsie d'un mythe*, Paris, 1987.

[45] James F. Challey, Art. Sadi Carnot, *D.S.B.*, *3*, 79-84. See also the work of Robert Fox.

to the importance of the work of his recently deceased fellow-countryman.[46] The son of the regicide Lazare Carnot, Sadi Carnot may well have found his very name a severe disadvantage in the Restoration. Nevertheless, he took the usual step of forwarding a copy of his book to the Academy of Sciences, where Girard gave a verbal report on it.[47] This was the most that the Academy would give to a published work. If Carnot had submitted his text in manuscript, the Academy would have appointed a commission to examine it and the memoir might have received more publicity.

Again, if Carnot had submitted his manuscript to the *Annales* and they had accepted it, it would have been read by many people and would have had a more immediate effect. Yet, although the book was a short one (118 pages), it was still too long to be incorporated into the format of the *Annales* without sub-division. All such speculation presupposes that Arago would have seen its value and have accepted it for publication, something which, considering the junior status of the author, cannot be taken for granted. On the other hand Arago had previously accepted for publication an early attempt by Petit to compare theoretically the performance of heat engines.[48] Sadi Carnot had acted independently without the support of one of the great patrons of French science, and his little book was soon submerged in the wash of other scientific publications of the time. The *Annales* was, however, able to give it the briefest mention when it published Carnot's obituary in 1833.[49] A full-length review would have made a difference but the *Annales* had now largely abandoned this feature present in the earlier series.

While on the subject of physics it may be appropriate to make the claim that there was a definite connection between the second series of the *Annales* and the Society of Arcueil. This is not a connection the author set out to demonstrate. On the contrary, he would claim it as a discovery of the 1990s when he began to reflect on the significance of the changes in 1816. As evidence for the connection, one may point in the first place to the membership of Gay-Lussac and Arago in that group. Of course they were also members of the First Class of the Institute, but the Arcueil circle was much smaller and even more select. The dual patronage of the Society of Arcueil by Berthollet and Laplace was based on a partnership between chemistry and physics. Indeed,

---

[46] Clapeyron, as a graduate of the Ecole Polytechnique, published his memoir in the house journal of that school.

[47] *Procès-verbaux du séances de l'Académie des Sciences*, (10 vols., Hendaye, 1910-22), vol.8, p.118.

[48] *A.c.p.*, *8* (1818), 287-305 (see especially pp.294-5).

[49] The issue of the *Annales* contained exceptionally a large number of short obituaries in the aftermath of the cholera epidemic of 1832, to which Carnot had succumbed. His *Réflexions* was mentioned as 're-markable for the original views', an ambiguous comment which emphasises its originality at the expense of its real worth. (*A.c.p.*, *52* (1833), 211.) Carnot's obituary of six lines may be contrasted with the five pages devoted to Chaptal in the same issue.

although we commonly refer to the society's journal as the *Mémoires de la Société d'Arcueil*, this is an abbreviated form of the actual title, which was *Mémoires de physique et de chimie* ...

We have studied the respective roles of the different editors of the first series and we saw that, although Berthollet played some part in the early years, he was hardly an active participant in the editorial board. But this was not purely negative; his energies were diverted to his new house and laboratory at Arcueil. He encouraged his protégé Gay-Lussac to publish in the Arcueil *Mémoires* and it was only when Gay-Lussac was made a member of the editorial board of the *Annales* that Berthollet's interest in that journal blossomed. Fourcroy was now dead and, with Guyton's illness in November/December 1815, Berthollet became the senior editor. The Society of Arcueil had been associated with the Napoleonic regime, which had finally come to an end. After Napoleon's defeat there would be no more regular meetings of the Society of Arcueil but much of the philosophy of that group would be perpetuated in a new series of the *Annales* through the former members of the Society, who had taken over the editorship.

The subsidiary position of physics in the *Annales* may have disappointed a few specialists in that science. It may be explained, however, as a consequence of a peculiar French tradition, which saw chemistry as *the* experimental science par excellence. After the French Revolution the educational system was geared to the selection of boys with mathematical talent to be trained as future mathematicians by specialist teachers in the senior classes of lycées. Thus some young men, who in other cultures might have become physicists, ended up as mathematicians, a profession of great prestige. If, on the other hand, they were interested in experimental science, they might well have been attracted by the powerful chemical tradition. If they were keen on practical work but not attracted to chemistry, they might become experimental physicists, like several mentioned in this book who worked on optics. Yet such specialists would seldom have any feeling of the superiority of physics. They lay uncomfortably between the twin peaks of French scientific eminence in mathematics and chemistry. If, therefore, we can speak of a partnership between physics and chemistry in the *Annales*, physics was in many ways the junior partner.

The book set out in the beginning to tell the story of a particular journal but the story has developed with several subsidiary plots, and a number of ideas and conclusions have emerged, which the author hardly suspected when he first took up his pen. It was obviously going to be a story of the rise of the *Annales*, and, once the Berthelot material had been uncovered, of its subsequent fall. But the story of the *Annales* has also thrown new light on the Lavoisier legacy, with the journal providing a cockpit for competition between rival ideologies. By emphasising the fluidity of the boundaries of chemistry in

one of its most expansionist phases we have approached an area of the history of physics which had been largely neglected. The *Annales* furnishes us with clear evidence of a historical overlap between the two subjects.

The *Annales* provides a case study of the importance of a periodical in the development of one branch of science. But we have tried to understand the *Annales* not in isolation but in the context of the history of other journals and we have tried to face squarely the question of the appropriateness of journals as opposed to books in the expansion of knowledge. We have concluded that the journal has an indispensable role in the development and communication of modern science. The *Annales* has been revealed, not simply as a French journal, but as one of international significance. Although the language of the journal - even for foreign articles - was exclusively French, this was not only for the benefit of a home readership but also because French was widely understood outside France.

In conclusion we may repeat the claim that it was largely due to Lavoisier that from the 1780s chemistry developed as a quantitative science based on the reactions of newly-identified elements and their compounds. It was an enormous jump (and a very late one) from the Aristotelian so-called 'elements' of earth, water, air and fire to an expanding list of substances, both metals and non-metals, judged to be simple entities by laboratory tests. These fundamental substances included not only solids and liquids but also a number of gases, the key role of which would have astonished earlier generations of chemists. It is true that the extraordinary importance that Lavoisier attached to oxygen was put in a broader perspective in the nineteenth century but the process of oxidation, to which he called attention, remained as a key chemical reaction.

Although physics grew in importance in the nineteenth century and new sciences like physiology and later bacteriology came to make their own claims, chemistry, the earliest laboratory science, expanded most during this period, so that in personnel and publications it became the largest of the individual sciences. One of the reasons for its success was the ever-growing importance of organic chemistry. Not only were there thousands (later hundreds of thousands) of compounds to be discovered, but their respective properties came to be understood in relation to the concept of the structure of the molecule, which guided the preparation first of synthetic dyes and subsequently of new drugs. This ready *applicability* of chemistry had been one of the selling points of the first series of the *Annales*. Yet, despite the optimism of the Enlightenment shared by Lavoisier and his colleagues, they could hardly have guessed at the entire new world which their successors would be able to create. Such advances would have been inconceivable with the former qualitative phlogistic science. The publication of the *Annales,* therefore, served both to celebrate the birth of a new and successful science and also to promote its development.

Not the least of Lavoisier's achievements was to have given publicity to the new chemistry. Of course his *Traité* helped in this respect but, as we have seen, it was nothing new to write a textbook. His contemporaries, Fourcroy and Chaptal, were also authors of successful textbooks. The main innovation of Lavoisier and his associates by way of publicity was to found a journal focused on the new chemistry. The regular monthly appearance of successive issues of the *Annales* served to hammer home the message, and the journal was to provide a beacon for chemistry for many generations to come.

APPENDIX 1

SUPPORTING DOCUMENTATION

In case there should be any doubts about the choice of extracts in this Appendix, readers may be assured that they have been chosen with considerable care. Some readers, for example, may wonder why several published extracts have been chosen at the expense of manuscript material. The answer falls into three parts. First there is the centrality of several manifestos and prospectuses, which it was important to make available. Secondly, although it is literally true that several of these extracts were in the published domain some 200 years ago, they are not to be found between the covers of any one book. Rather they are scattered - and for the uninitiated hidden - throughout different volumes of more than one series of a rare periodical. Considering its importance, the *Annales de chimie* should be widely available yet even many well-endowed large university libraries do not possess copies and certainly not of the early series.

For the third part of the answer it would be appropriate to refer to the manuscript minutes of the editorial board of the first series of the *Annales*. Although in principle the discovery of these minutes was a great prize, and it certainly provided some invaluable data, the average contents in practice are rather disappointing. The majority of what was written about the meetings was about the distribution of small payments to the different members of the editorial board, which makes rather tedious reading. It would have been all too easy for the author simply to transcribe large parts of the minutes. Yet it was thought more useful to use the minutes as a general source to study the frequency of meetings and relations with the publishers but (apart from Chapter 4) only to quote from them sparingly.

The single most valuable extract is probably a copy of the original regulations of 1789 for the administration of the *Annales*. On the other hand, we have no reason to believe that the rigid discipline originally proposed was closely adhered to in the rapidly-changing Parisian world of the early 1790s. Yet it provides an added dimension to our understanding of the *Annales* as an institution.

LIST OF DOCUMENTS

		Pages
1.	Letter from Lavoisier to Baron de Breteuil, 1 September 1787.	300
2.	The regulations of the Société des Annales de chimie, 14 January 1789.	300-2
3.	*Avertissement*, printed at beginning of Vol.1, April 1789.	302-3
4.	Letter from Berthollet to Guyton, June 1789 (extract).	303
5.	Prefatory note in re-issue of Vol.1, 1790/91.	303-4
6.	Letter from Joseph Black to Lavoisier, 1791.	305-6
7.	Prefatory note in Vol.19 on resumption of publication, 1797.	306-8
8.	Agreement between editorial board and publisher, 4 January 1798.	308-9
9.	Letter from editorial board to General Bonaparte, 11 April 1798, and reply.	309-10
10.	Decision to incorporate *Journal de Pharmacie*, 18 December 1799.	310-12
11.	Circular letter from Minister of the Interior to all Prefects, 27 December 1806.	312
12.	Prospectus of new series (bound at end of Vol. 96 (1815) of *Annales)*.	312-14
13.	Editorial note for new series, November 1816.	314-15
14.	Proprietors of all journals required to register, March 1830.	315-16
15.	Letter from Malaguti to Gerhardt, 30 September 1842, commenting on the alleged authoritarian stance of Dumas as editor of the *Annales*.	316
16.	Advertisement for complete series of back numbers of the *Annales*, 1847.	316-17

1. *Letter from Lavoisier to Baron de Breteuil*[1]

Paris, le 1er septembre 1787

Monseigneur,

J'ai communiqué à mes confrères la lettre que vous m'avés fait l'honneur de m'écrire le 15. du mois dernier relativement aux *Annales Chimiques* que M. Adet docteur en médecine se propose de publier et pour lesquelles vous avés bien voulu solliciter un privilège de Mgr le Garde des Sceaux.

Nous ne nous dissimulons pas, Monseigneur, que la condition imposée à M. Adet, de ne publier ses volumes que de trois en trois mois, nuira beaucoup au débit de son ouvrage; parce qu'il courrera les risques d'être prévenu par les autres journalistes et que ce qu'il publiera manquera souvent du mérite de la nouveauté. Nous l'avons cependant déterminé à souscrire à cette condition, mais, en même tems, nous lui avons fait espérer que vous voudrés bien presser Mgr le Garde des Sceaux pour qu'il voulut bien lui accorder les facilités suivantes.

1° La permission de proposer son ouvrage par souscription.

2° Celle de le publier sous le nom général d'*Annales Chimiques*.

3° Celle d'y inscrire par extrait les mémoires et découvertes relatives à la chymie et aux arts qui seront faittes en France ou qui lui parviendront d'Angleterre, d'Italie et d'Allemagne, quoique non inserées dans la Journal de Crell.

Si M. Adet étoit restreint à la simple traduction du journal allemand, il ne présenteroit qu'un tableau imparfait des découvertes qui se font journellement et l'objet de son travail seroit manqué pour le public et pour lui meme.

Nous esperons d'autant plus que Mgr le Garde des Sceaux ne fera aucune difficulté d'accorder ces facilités, qu'elles nous paroissent implicitement consenties par sa lettre du 13. août et que nous les rappellons ici que pour être plus assurés qu'il ne s'élevera pas de difficultés après l'obtention du privilège.

L'ouvrage de M. Adet ne devant plus être publié que de trois mois en trois mois, il sort absolument de la classe des journaux et il rentre dans celle de tous les ouvrages ordinaires.

Je suis avec un profond respect, Monseigneur, votre très humble et très obéissant serviteur.

2. *The regulations of the Société des Annales de Chimie (14 January 1789).*[2]

---

1 *Oeuvres de Lavoisier, Correspondance,* vol. 5, Paris, 1993, pp. 66-7.

2 The survival of these minutes depends on a request at a meeting of the editorial board on 6 February 1815 that the original rules of the Société des Annales de chimie should be verified. Guyton produced the relevant book and the rules were reproduced in a later minute book subsequently taken over by Gay-Lussac. ('Un des membres ayant demandé à la précédente séance la vérification d'un article du règlement, M. Guyton Morveau a mis sur le bureau le registre des délibérations de la société dans lequel il est inscrit au premier folio à la date du 14 janvier 1789.... St. Léonard, G.L.59, f.65v.).

Art.1 La direction de l'ouvrage entrepris sous le nom d'Annales de Chimie sera faite par un comité composé de tous les associés dénommés dans le traité avec M. Cuchet et dont M. Adet sera le secrétaire. Ce comité s'assemblera au moins une fois tous les quinze jours. Il sera tenu registre par le secrétaire des déliberations qui y seront prises, ainsi que du procès verbal de chaque séance et des notes détaillés des mémoires et ouvrages qui y auront été lus.

Art.2 Les assemblées se tiendront à jours reglés et à des heures fixes; elles ne pourront être de moins d'une heure et demie ni plus de deux heures et demie. Dans le cas ou le jour ou l'heure seroient changés, il en sera donné avis par un billet de convocation.

Art.3 Il sera distribué à chacun des membres du comité présent deux jetons de l'académie des sciences; mais la part des absents n'accroîtrera pas aux présens. Ceux qui arriveront un quart d'heure après l'heure convenue ou indiquée par le billet de convocation seront privés de leurs jetons. La distribution n'en sera faite qu'un quart d'heure avant la fin de chaque séance.

Art.4 Il ne sera inséré dans les Annales aucun mémoire ou extrait qui n'ait été lu au comité et approuvé. Il ne pourra être fait d'exception à cet égard que pour les traductions d'ouvrages étrangers ou pour les mémoires déjà imprimés, lesquels pourront être approuvés et insérés dans les annales sur le rapport d'un des membres qui les aura lus et examinés et qui s'en rendra garant envers le comité.

Art.5 En cas de partage d'opinion sur l'admission, la non-admission des ouvrages, sur les corrections à y faire, ou sur les préférences à accorder à l'un plutôt qu'a l'autre, l'objet de la difficulté sera mis en délibération pour y être statué à la pluralité des voix; et si deux membres du comité se réunissent pour demander qu'il soit procédé à la déliberation sur l'objet contesté par voie de scrutin, on ne pourra la leur refuser. La même règle sera observée pour tous les objets mis en déliberation. Il sera statué par un règlement particulier sur la forme qui sera observée pour le scrutin.

Art.6 Sur les 48f. par feuille convenue envers M. Cuchet, il en sera prélevé 8f. au profit de M. Adet en sa qualité de secrétaire du comité, et pour ses peines et soins pour ses frais de bureau. Ce sera en conséquence M. Adet qui sera chargé de tenir la plume dans les séances du Comité, d'enregistrer les déliberations et décisions, de faire la correspondance tant intérieure qu'extérieure, de veiller à l'impression de l'ouvrage, de revoir les épreuves et de conserver le dépôt des livres et papiers qui appartiendront à la société.

Art.7 Les mémoires, extraits ou articles redigés par les associés en nom, seront payés à raison de 32f. la feuille. A l'égard du traducteur ou du coopérateur qui ne sont point en nom, il sera traité avec eux aux meilleurs conditions qu'il sera possible; et dans le cas ou il seroit nécessaire de revoir leurs traductions ou de les corriger, il sera accordé une somme de 6f. par feuille et

même plus, s'il est nécessaire à ceux des associés qui voudront bien s'en charger.

Art.8 S'il y a quelque retranchement ou correction à faire dans des ouvrages déjà imprimés, avant de les insérer dans les annales, M. Adet en sera chargé, sans pouvoir prétendre au delà du prélèvement de 8f. par feuille ci-dessus stipulé. Dans le cas cependant d'addition considérable, il en sera fait évaluation pour être statué par le comité.

Art.9 Les billets de M. Cuchet payable à un an seront remis à M. Lavoisier qui en fera l'avance à mesure du besoin, et si d'après le compte qu'il rendra chaque année des recettes et dépenses, il se trouve un excédant de recette, il en sera disposé par le comité comme il le juge convenable. Le présent règlement a été lu, discuté et approuvé dans l'assemblée du 14 janvier pour être executé dans tout son contenu.

3. *Introduction to volume 1 (1789) of* Annales.[3]

Avertissement

Depuis l'instant où on a commencé à s'occuper de la Chimie, jamais les savans n'ont déployé plus d'activité qu'aujourd'hui pour la porter vers sa perfection; mais elle marchera d'un pas d'autant plus rapide, et procurera à la société les avantages qu'on doit en attendre, d'une manière d'autant plus certaine, que les savans des diverses contrées auront plus de facilité pour faire en quelque sorte un échange réciproque de leurs découvertes.

On sait combien l'avancement des arts se trouve étroitement lié au progrès des sciences; s'il en est une parmi elles que l'on puisse à juste titre regarder comme essentielle aux arts, c'est sans doute la Chimie, de qui la plupart de nos manufactures empruntent leurs procédés. Tous les jours on voit de nouvelles méthodes, ou la perfection des anciennes, résulter de faits nouveaux ajoutés à la masse des faits anciens.

Ces vérités, depuis long-tems, ont été senties des Chimistes, et ils ont toujours fait leurs efforts pour être instruits des découvertes dont les savans des différentes parties de l'Europe enrichissoient les diverses branches de la Chimie. Mais jusqu'à présent ils ont rencontré des difficultés qu'ils n'ont pu vaincre entièrement. Chaque savant écrit dans la langue de son pays; il faudroit en conséquence savoir les langues de différens peuples qui cultivent les sciences, pour ne rien perdre des nouvelles découvertes qui leur sont propres, mais ce travail ne peut être entrepris par des savans obligés de consacrer tout leur tems à l'étude de la nature; ils se voient donc forcés de perdre les fruits qu'ils auroient pu tirer des travaux des étrangers, s'ils avoient pu en être instruits. Il seroit utile, d'après cela, de présenter un tableau des nouvelles découvertes relatives à la Chimie et aux arts qui en dépendent dans une langue familière aux nations savantes de notre continent. La France peut, en raison

[3] *A.c.*, *1* (1789), 1-4.

de sa position, fournir des moyens de communication aux habitans éclairés des diverses parties de l'Europe et, en recueillant leurs richesses respectives, les mettre à portée d'en profiter. C'est d'après ces considérations que nous avons conçu le plan de l'Ouvrage dont nous offrons aujourd'hui le premier volume aux savans; consacré à l'utilité de la société, il renfermera toutes découvertes qui auront quelques rapports avec les arts et les sciences que la Chimie éclaire; ainsi, on y trouvera tout ce qui paroîtra de nouveau sur la métallurgie, les teintures, les procédés pharmaceutiques, etc. Appelés à cultiver la chimie, nous y présenterons un extrait de nos travaux; nous y rassemblerons, à l'aide de nos correspondances avec les Chimistes étrangers, les mémoires qui nous seront communiqués. Nous ne négligerons pas de faire connoître les ouvrages nouveaux qui seront publiés sur la Chimie, et de donner un extrait des mémoires de Chimie insérés parmi ceux des compagnies savantes de l'Europe.

Nous y insérerons les faits particuliers dont on voudra bien nous faire part, et qui jettent du jour sur certaines parties de la science, quoiqu'ils soient isolés. Enfin, ayant formé le project de répéter les expériences intéressantes qu'on aura pu faire, nous présenterons les résultats qu'elles auront eus entre nos mains. Nous espérons qu'on accueillera favorablement cet Ouvrage, dans lequel on trouvera l'ensemble des travaux de tous les chimistes sans être obligé de parcourir un grand nombre de volumes où ils sont dispersés, et souvent imparfaitement esquissés. Nous nous ferons une loi de respecter l'opinion de tout le monde, de conserver à chacun son langage, et on ne nous verra jamais, armés des traits de la censure, déprécier l'ouvrage d'un auteur parce qu'il ne sera pas d'un sentiment conformé au nôtre, persuadés qu'on doit des égards à tous ceux qui s'occupent de la recherche de la vérité.

4. *Letter from Berthollet to Guyton, June 1789 (extract).*[4]

Aulnay, 15 juin 1789

Monsieur et cher confrêre,

Je suis charmé que le premier volume des Annales ne vous ait pas deplû; Les coopérateurs qui se plaisent de vous voir à leur tête espèrent que vous trouverez que le second ne sera pas inférieur au premier: ils ne manquent pas de materiaux; mais il en faut de bons, et ils ont besoin pour cela de vos secours. Je travaille à présent à une réponse aux derniers mémoires de Mr Priestley et à l'article acide nitrique du dictionnaire de Mr Keir. Ce qui me fait de la peine, c'est qu'en rapprochant simplement leur contradictions et leurs erreurs, j'ai l'air de les traiter avec dureté, tant il y en a!

5. *Prefatory note in re-issue of volume 1 (1790/91).*[5]

Il y a deux ans que les *Annales de chimie* sont au jour, et il en paroit actuellement *sept volumes*.

---

[4] Private collection of W. A. Smeaton.

[5] *A.c.*, *1* (2nd edn.), 1-4.

L'intention des Auteurs, en publiant cet Ouvrage a été d'établir une communication et une correspondance active entre tous les Savans de l'Europe; de hâter les progrès d'une science dont l'étude dominante démontre suffisament l'importance; et de faire un rapprochement nécessaire des travaux dispersés dans un grand nombre de volumes.

Leur intention a été encore de se rendre utile à la société, en préparant par le secours de la Chimie, de nouvelles richesses aux arts et aux manufactures. Enfin, comme toutes les sciences ont entr'elles des rapports intimes, la Physique particulière, la Minéralogie, la Chimie médicale, et même les procédés applicables à l'agriculture, ont fait nécessairement partie du plan que les Auteurs avoient embrassé.

Ce plan est vaste, et déjà il a reçu son application quant à l'utilité; il sera facile d'en juger par l'extrait ci-après des matières contenues dans les six premiers volumes;* mais l'intention particulière que les Auteurs avoient: d'ouvrir une communication active entre les Savans de l'Europe n'a pas eu son entier effet, parce que le mode de distribution des *Annales* ne le permettoit pas. Cet Ouvrage paroissoit volume à volume et à des époques éloignées. Cette marche étoit nuisible aux Auteurs et au Public; aux Auteurs parce qu'il rallentissoit la publication de leurs mémoires et de leurs découvertes; aux Public parce qu'il n'étoit point instruit du tems où chaque volume parrissoit. La correspondance et l'introduction souffroient donc de ces retards.

Pour rémedier à cet inconvénient, les *Annales de chimie* paroitront à l'avenir, par cahier de sept feuilles en 8^{o}, avec des planches quand la matière l'exigera.

On continuera d'y donner des Mémoires sur la Chimie, la Physique particulière, la Minéralogie, la Chimie médicale, l'Agriculture et les Arts; et d'insérer l'analyse de tous les ouvrages nouveaux qui traiteront de ces diverses Sciences.

Comme la nouvelle que l'on adopte est infiniment plus favorable au progrès des connoissances, les Auteurs entretiendront une correspondance exacte que les Savans de l'Europe sont invités à seconder.

On délivrera douze Cahiers par an. Trois Cahiers formeront un Volume, de sorte que douze Cahiers donneront quatre Volumes dans l'année. Il paroitra un Cahier le 15 de chaque mois; ainsi le 15 janvier prochain on délivrera le premier Cahier de l'année 1791 et de suite de mois en mois sans interruption.

On souscrira par l'année entière à Paris chez Cuchet, Libraire, rue et hotel Serpente, et on payera en souscrivant 18 livres pour Paris et 21 livres pour la Province. Messieurs les Souscripteurs sont priés d'affranchir les lettres d'avis et l'argent.

Les sept premiers volumes qui ont paru se vendent ensemble ou séparément à raison de 3 liv. 12 sols le volume broché; mais les Cahiers suivans ne se séparèrent pas.

* Le septième volume vient de paraître.

6. *Copie d'une lettre de M. Joseph Black, Professeur en l'Université d'Edimbourg, Associé Etranger de l'Académie des Sciences de Paris, à M. Lavoisier.*[6]

Je vous suis très-obligé, Monsieur, de m'avoir procuré la connoissance de votre ami, M. Terray, et de son fils...

Votre lettre, Monsieur, contient des expressions si flatteuses, qu'il y a du danger qu'elles ne me rendent vain. Je ne puis pas trouver d'expression pour vous dire combien je vous suis redevable de votre bonté. Quel ne fût le mérite que vous me supposez, il a été amplement récompensé par l'approbation de votre amitié et celle de vos illustres collègues de l'Académie des sciences, qui, en m'admettant parmi eux, ont satisfait le plus grand désir de mon ambition.

Vous avez été instruit que je cherchois à faire comprendre dans mes cours à mes élèves, les principes et les explications du nouveau système que vous avez si heureusement inventé, et que je commence à leur recommander comme plus simple, plus uni, mieux soutenu par les faits que l'ancien système. Et comment aurois-je pu faire autrement? Les expériences nombreuses que vous avez faites en grand, et que vous avez si bien imaginées, ont été suivies avec un tel soin et une attention si scrupuleuse pour toutes les circonstances, que rien ne peut être plus satisfaisant que les preuves auxquelles vous êtes parvenu. Le système que vous avez fondé sur ces faits est si intimément lié avec eux, si simple et si intelligible, qu'il doit être approuvé de jour en jour davantage; et il sera adopté par un grand nombre des chimistes qui ont été longtemps habitués à l'ancien système. Il ne faut pas s'attendre à les convaincre tous: vous savez très-bien que l'habitude rend esclave l'esprit de la plupart des hommes, et leur fait croire et révérer les plus grandes absurdités. Je dois vous avouer que j'en ai moi-même éprouvé les effets; ayant été habitué trente ans à croire et à enseigner la doctrine du phlogistique, comme on l'entendoit avant la découverte de votre système, j'ai longtemps éprouvé un grand éloignement pour le nouveau système qui présentoit comme une erreur ce que j'avois regardé comme une saine doctrine: cependant, cet éloignement, qui ne provenoit que du pouvoir de l'habitude seule, a diminué graduellement, vaincu par la clarté de vos démonstrations et la solidité de votre plan. Quoiqu'il y ait toujours quelques faits particuliers dont l'explication paroit difficile, je suis convaincu que votre doctrine est infiniment mieux fondée que l'ancienne; et sous ce rapport elles ne peuvent souffrir de comparaison. Mais si le pouvoir de l'habitude empêche quelques-uns des anciens chimistes d'approuver vos idées, les jeunes ne seront pas influencés par le même pouvoir; ils se rangeront universellement de votre côté. Nous en avons l'expérience dans cette université, où les étudiants jouissent de la plus parfaite liberté dans le choix de leurs opinions scientifiques. Ils embrassent en général votre système, et commencent à faire usage de la nouvelle nomenclature. Je vous envoie pour preuves deux de leurs dissertations inaugurales pour lesquelles la chimie a été choisie. Ces dissertations

---

[6] *A.c.*, *8* (1791), 225-9.

sont entièrement écrites par les étudiants; les professeurs n'y ont aucune part. Nous les lisons avant qu'elles soient imprimées, pour voir s'il n'y a pas des fautes, et pour donner notre avis s'il s'en rencontre. Nous trouvons quelquefois des compliments exagérés pour nous-mêmes, mis nous n'avons pas la modestie ou la discretion de les effacer. Il faut pardonner aux professeurs d'Edimbourg ces ménagements pour leur renommée, puisqu'elle leur rapporte des récompenses plus importantes que des lauriers.

Recevez mille remercîmens pour les différents volumes que vous avez publiés, et dont vous m'avez honoré. Je ne puis pas vous faire un pareil envoi; mais je prendrai la liberté, dans quelque temps d'ici, de vous faire passer une courte dissertation, non encore complète, sur l'eau bouillante de quelques sources d'Islande, qui forment des petrifications siliceuses. L'espoir que vous me donnez que je pourrai quelque jour avoir le plaisir de vous voir ici en seroit un bien doux: mais de tels évènements sont trop au pouvoir de la fortune pour qu'un esprit expérimenté puisse y compter.

Je souhaite une heureuse fin à la révolution de votre pays, et suis avec la plus haute estime.... etc.

7. *Introduction to volume 19 (1797) on resumption of publication.*[7]

Avant-Propos.

Les Annales de Chimie ont été interrompues pendant trois ans, après le dix-huitième volume publié. La nécessité de s'occuper uniquement de la défense de la République, les évènemens de la révolution, enfin les occupations et les fonctions publiques des auteurs sont les causes naturelles de cette suspension. Mais ce tems n'a pas été entièrement perdu pour les sciences; la Chimie sur-tout a été cultivée avec une activité et un succès dont tous les citoyens sont les témoins; elle a créé pour la défense de la patrie des ressources et des moyens vraiement inattendus. Son utilité immédiate pour les besoins les plus pressans de la société la rend plus précieuse et plus recommandable que jamais aux yeux des amis des hommes, de tous les vrais citoyens. Aussi le nombre de ceux qui l'étudient s'accroît-il chaque jour; aussi devient-elle une des bases de l'enseignement dans toutes les écoles modernes, et sur-tout dans celles qui atteignent le plus haut degré des connoissances humaines.

Chez toutes les nations civilisées où l'on travaille sans relâche au perfectionnement de la raison, les sciences qui influent sur les productions territoriales et industrielles, et parmi lesquelles la Chimie tient aujourd'hui un des premiers rangs, obtiennent une estime générale. La culture des champs, la multiplication des animaux, l'établissment des manufactures, les échanges des créations de l'industrie contre les productions des autres peuples, voilà les vraies sources de la prospérité des nations, dans lesquelles tous les hommes sont appelés à puiser, et où ils trouveront, en servant leur patrie, leurs jouissances particulières.

---

[7] *A.c.*, *19* (1797), v-xi.

La Chimie éclaire la pratique des arts; sans elle on n'a ni produits constans à espérer, ni économie dans les procédés, ni perfectionnement dans les opérations. Faute d'en avoir connu les avantages et interrogé les résultats, les manufacturiers ont souvent commis des erreurs qui ont entraîné la perte de leurs établissemens. A peine plusieurs Chimistes habiles sont-ils devenus manufacturiers depuis quelques années, et déjà une foule de procédés ont été rectifiés; des arts nouveaux ont été créés; déjà la France a cessé d'être tributaire des autres nations pour un grand nombre de produits utiles; la préparation des acides minéraux, des différens sels, des oxides métalliques; les teintures, les verreries, si multipliées en France depuis quinze ans, sont des preuves authentiques des avantages inappréciables de la Chimie. Sans les lumières de cette science, auroit-on fait la quantité de salpêtre, de poudre et d'armes qu'on a fabriquée depuis quatre ans? Auroit-on eu le cuivre, le fer, l'acier, la potasse, la soude, les cuirs, et tant d'autres matières précieuses qui nous ont servi à vaincre nos ennemis et à soutenir notre existence? Sans la Chimie, auroit-on perfectionné, comme on a fait, l'aérostation?

Au moment où la victoire a couronné nos efforts, où une constitution sage a fixé le sort de la France, où les talens y sont honorés et appelés à servir la patrie; au moment sur-tout où de nouvelles écoles s'élèvent dans les départemens et vont répandre par-tout l'instruction et en faire sentir le besoin, les auteurs des *Annales de Chimie* ont cru qu'il étoit pressant de reprendre la suite de cet ouvrage. Leur but est de porter le flambeau de la science dans tous les ateliers; de faire connoître les procédés nouveaux; de décrire les arts encore peu connus ou même tout-à-fait inusités en France; de perfectionner les pratiques vicieuses; de rectifier les erreurs trop multipliées encore dans plusieurs manufactures; de donner les moyens d'employer à des préparations utiles une foule de substances qu'on a trop négligées jusqu'ici, et qu'on a même laissé perdre; d'écarter des ateliers les secrets souvent trompeurs, et le charlatanisme toujours perfide; d'établir les théories les plus claires des opérations les plus obscures; de diriger les pas, presque toujours inassurés et incertains, des fabricans; de détruire le mystère et de repousser la fraude; en un mot, de faire servir une des sciences les plus exactes à la multiplication de tous les objets d'industrie nationale.

Sans négliger la Chimie philosophique, ils s'appliqueront spécialement à la Chimie usuelle, à celle qui crée, qui éclaire et qui perfectionne les arts. Ils ne repousseront pas les théories brillantes et ingénieuses; mais ils en offriront sur-tout les applications utiles. C'est aux artistes, aux manufacturiers, aux ouvriers intelligens, aux commerçans éclairés et probes qu'ils destinent particulièrement cet Ouvrage. Les savans et les philosophes y trouveront en même tems tous les progrès de la physique, et la marche successive de la raison humaine. Il est beau de faire voir qu'en perfectionnant les arts, chez un grand peuple, on perfectionne aussi la raison de l'homme.

Il n'est pas nécessaire de dire qu'on a réuni tous les moyens possibles pour joindre aux découvertes des Français, celles qui se seront faites dans toutes les autres

nations où la Chimie et les arts chimiques sont cultivés avec succès, et sur-tout en Allemagne, en Espagne, en Hollande, en Italie et en Angleterre.

Les Auteurs des *Annales de Chimie*, ayant repris la suite de leur Ouvrage, se sont proposés de réunir en deux volumes, qui formeront le dix-neuvième et le vingtième de la collection, les principales découvertes et les travaux les plus remarquables en Chimie, faits en France, depuis le mois de Septembre 1793, jusqu'au mois de Janvier 1797.

8. *Agreement between editorial board and printer (4 January 1798).*[8]

Entre les soussignés Louis-Bernard Guyton, Gaspard Monge, Berthollet, Antoine-François Fourcroy, Pierre-Auguste Adet, Armand Seguin, Claude-Antoine Prieur, Jean-Henri Hassenfratz, tous demeurant à Paris et stipulant tant pour eux que pour les citoyens Chaptal et Vanmons, absents, d'une part, et Laurent-Mathieu Guillaume, libraire, demeurant à Paris, rue de l'Eperon, n^{o} 12, section du Théâtre Français, de l'autre part, est convenu ce qui suit:

ARTICLE PREMIER. - Le citoyen Guillaume promet et s'engage:

1^{o} D'imprimer en beau papier et beaux caractères, conformes aux six volumes des *Annales de chimie* qui ont paru depuis la reprise, la continuation de cet ouvrage au même nombre, douze numéros par an de sept feuilles au moins et de huit feuilles au plus, format en-octavo;

2^{o} De faire paraître chaque cahier pour le dernier jour de chaque mois de l'ère républicaine à commencer par le 30 nivôse courant;

3^{o} De faire tous les frais quelconques de cette entreprise avec deux gravures par volume sans en pouvoir rien rejeter aux auteurs;

4^{o} De n'imprimer dans les *Annales* que les seuls matériaux qui seront fournis par les auteurs et de n'y rien insérer d'étranger à leurs propres ouvrages, sans leur consentement exprès;

5^{o} De ne faire tirer aucune feuille sans qu'elle ait été corrigée et munie du bon à tirer de celui des auteurs qui en sera chargé par ses coopérateurs;

6^{o} De faire remettre à chacun des auteurs deux exemplaires de chaque numéro le jour de leur publication et de les expédier par la poste à ceux qui se trouveraient dans les départements;

7^{o} De payer aux auteurs la somme de trente-six francs pour chacune des feuilles des dites *Annales*, la somme payable immédiatement après la publication de chaque cahier, en la remise de ses billets à quatre de date, laquelle remise sera faite au citoyen Guyton qui en demeure chargé par ses coopérateurs;

---

[8] St. Léonard, G.L. 59, f.4r., 15 nivôse an 6 (4 January 1798).

8° De publier et vendre cet ouvrage par souscription au prix de quinze francs par an, non compris les frais de port;

9° D'imprimer les *Annales* au nombre de seize cents exemplaires, dont douze exemplaires seront à la disposition des auteurs, outre les deux qui leur sont alloués à chacun personnellement par l'article sixième, sans que le dit citoyen Guillaume puisse faire une nouvelle édition des dites *Annales*, à moins d'un nouvel arrangement avec les auteurs;

ARTICLE DEUXIEME. - Et de leur part les auteurs des *Annales* s'engagent:

1° De fournir au citoyen Guillaume les matériaux suffisants pour chaque numéro de cet ouvrage au plus tard le quinze de chaque mois;

2° De corriger les épreuves à mesure qu'elles arriveront au domicile des auteurs ou de celui des coopérateurs qui en sera chargé;

3° De faire à leurs frais les dessins qui y seront joints et en outre les gravures qui excèderaient le nombre de deux par volume.

Aux présentes conditions les auteurs cèdent au citoyen Guillaume la propriété de la première édition des *Annales*, depuis le tome dix-neuvième seulement, au nombre de seize cents exemplaires, ainsi que le droit de poursuivre tout contrefacteur, ou tout débitant d'édition contrefaite, permettant d'ailleurs au citoyen Guillaume, en cas où le nombre d'abonnés excèderait quinze cents, d'en augmenter le tirage, à la charge par lui d'en prévenir les auteurs et de les indemniser sous le rapport de deux francs et vingt-cinq centimes par feuille pour chaque cent, et ce aux époques et de la manière énoncée dans l'article septième.

Fait en double entre nous sousignés privés, de bonne foi,
Pour être exécuté pendant cinq ans suivant sa forme et teneur,
Paris, ce quinzième nivôse, an sixième de la République,
Signé: Vauquelin, Guyton, Guillaume, Fourcroy et Prieur.

9. *Letter from editorial board to General Bonaparte, 11 April 1798, and reply (transcribed from minutes).*[9]

Le citoyen Guyton a dit que sur l'invitation de plusieurs des membres de la Société, il avait fait prendre chez le citoyen Fuchs les dix-huit premiers volumes des *Annales*, et les sept depuis la reprise chez Guillaume, pour être envoyés au général Bonaparte, et qu'il avait accompagné cet envoi de la lettre suivante:

Paris, 22 germinal an 6e

La Société des *Annales* au Général Bonaparte.

Citoyen Général,

---

[9] *Ibid.*, f.6., 27 germinal an 6 (16 April 1798).

Il existe dans cette nation, proclamée grande par les peuples que vos victoires ont rendu libres, une Société occupée depuis dix ans à recueillir et publier ce qui peut enrichir la chimie et perfectionner les arts qui en dépendent. Pourrait-elle ne pas regarder comme une période glorieuse de ses Annales les moments que vous avez consacrés, au milieu des plus importantes occupations, à en suivre les progrès, à en sonder les profondeurs? Ce n'est donc pas seulement à un Ami des Lettres et des Sciences, qui a su jusque dans les camps fixer par l'influence de son opinion, le Rang qu'elles devaient tenir parmi les moyens de puissance et de prospérité des grands Etats; c'est encore au studieux scrutateur des lois de la nature dans cette branche des connaissances humaines que cette Société fait hommage de la collection de ses travaux.

Elle espère, Citoyen Général, que vous daignerez l'accueillir.

Salut et respect,

Signé: GUYTON

P.S. Nous demandons votre indulgence, Citoyen Général, pour la forme dans laquelle nous osons vous présenter cette collection; nous avons craint de n'avoir pas le temps de lui en donner une plus convenable.

Le citoyen Guyton a donné lecture de la réponse du Général Bonaparte conçue en ces termes:

Paris, 26 germinal an 6^{e}

J'ai reçu, Citoyens, les *Annales de Chimie* que vous avez eu l'attention de m'envoyer. Je vous en remercie; je les lirai avec fruit, grâce à la simplicité que vous avez portée dans cette partie des sciences si essentielle, et jusqu'à ces derniers temps si négligée. Vous avez trouvé encore des choses plus précieuses que la pierre philosophale; en parvenant tous les jours à arracher un de ses secrets à la Nature, vous rendrez à jamais célèbres la Nation et la Société.

Je vous salue,

Signé: BONAPARTE.

A la Société des *Annales de Chimie*.

10. *Decision of editorial board to incorporate* Journal de pharmacie *(18 December 1799).*[10]

Le Citoyen Guyton a annoncé que d'après l'invitation que lui avoit été faite à la précédente séance, il avoit eu une conférence avec le C[itoye]n Fuchs dans laquelle il lui avoit fait part du project de réunir la Société des rédacteurs des annales à celle des

[10] *Ibid.*, f.17v., 27 frimaire an 8 (18 December 1799).

rédacteurs du journal de pharmacie pour ne publier qu'un seul et même recueil, que le citoyen Fuchs avoit accédé à toutes les propositions qui venoient en exécution de cette réunion, qu'il avoit senti la necessité de fournir aux souscripteurs du journal de pharmacie le cahier courant des annales de chimie à datter de la cessation du journal de pharmacie sauf à lui à tirer le nombre nécessaire d'exemplaires conformément à la liste qui lui sera remise, au delà du nombre ordinaire pour ne point depareiller l'édition, comme aussi de donner le double exemplaire de chaque cahier à chacun des rédacteurs réunis et un éxemplaire à l'école de pharmacie, independamment des douze réservés à la société.

Le C[itoye]n Déyeux a fait un rapport de la conférence qui a eu lieu entre ses collègues rédacteurs du journal de pharmacie, dans laquelle il s'été arrêté qu'il ne seroit plus publié qu'un seul cahier pour remplir l'objet des deux journaux, au moyen de quoi la société demeure formée à l'avenir des citoyens inscrits au frontispice des annales auxquels seront adjoint comme coopérateurs les C[itoye]ns Déyeux, Parmentier et Bouillon la Grange.

Avis

Les rédacteurs des annales de chimie et du journal de pharmacie ont eû plusieurs fois l'occasion de se convaincre de la difficulté de poser une limite invariable dans le choix des matériaux qui devoient appartenir à l'une de ces deux Collections; les observations receuillies par les pharmaciens éclairés appartenant aussi essentiellement à la science chimique et à la partie de l'histoire naturelle où elle doit chercher les matières et les instruments de ses travaux, que la connoissance des principes chimiques est nécessaire au pharmacien pour perfectionner ses procédés et en apprécier les resultats, d'où il est arrivé qui les auteurs se sont souvent crus obligés de reproduire les mêmes articles dans ces deux ouvrages pour remplir l'engagement pris avec les souscripteurs de ne leur laisser ignorer aucun des faits qui pouvait les interesser.

Les considérations ont détérminé les rédacteurs de ces deux recueils à se réunir et à n'en publier à l'avenir qu'un seul pour l'avantage des souscripteurs de l'un et de l'autre. En conséquence à commencer au mois de Nivose prochain, le cahier des annales de chimie contiendra tous les articles qui devoient entrer dans le journal de pharmacie, et les souscripteurs du journal de pharmacie le recevront pour le tems qui reste à courir de leur abonnement.

Les auteurs qui étoient en correspondance avec les rédacteurs du journal de pharmacie voudront bien désormais adresser leurs mémoires et observations franc de port, au C[itoye]n Fuchs Libraire, etc.

La société a ensuite arrêtée que le titre des annales seroit changé et qu'on lui substitueroit celui ci

Annales de chimie
ou
Recueil des mémoires
concernant la chimie,
Les arts qui en dépendent
et spécialement la Pharmacie,
Par les C[itoye]ns Guyton &c.
fait et arrêté le 27 frimaire an 8

Bouillon la Grange
Guyton Hassenfratz Prieur Deyeux Vauquelin Parmentier

11. *Circular letter from Minister of the Interior to all Prefects.*[11]

Paris, 27 Décembre 1806

Le Ministre de l'intérieur,
A M. le Préfet du Départément d ___
Monsieur le Préfet, la collection qui se publie sous le titre d'*Annales de chimie*, vous est sans doute connue depuis longtemps, par la juste réputation dont elle jouit, par le nom des savans illustres qui y ont successivement coopéré, et par les découvertes dont elle renferme l'histoire. Les efforts que le Gouvernement fait depuis quelque temps pour répandre et perfectionner les lumières dans toutes les professions relatives à l'art de guérir peuvent donner encore à cet ouvrage un nouveau degré d'intérêt. La liaison intime de la chimie avec la pharmacie et avec la science médicale, rend les découvertes et la théorie de l'art chimique indispensables aux Pharmaciens et aux Officiers de santé, et l'on ne saurait trop en répandre les instructions au milieu d'eux.

C'est cette pensée que j'ai cru utile de vous rappeler l'existence des *Annales de chimie*, et de vous faire connaître que cet ouvrage continue à être publié par les hommes les plus distingués dans cette science, supposant que votre amour pour le bien public vous portera à répandre cet avis, en le communiquant aux Sous-prefets de votre département.

Recevez, Monsieur le Préfet, l'assurance de ma parfaite considération.
CHAMPAGNY.

12. *Prospectus for new series (bound at end of Vol.96 (1815) of* Annales).[12]

A l'époque de la création des Annales, la Chimie éprouvait une grande révolution; une nomenclature nouvelle venait d'être adoptée; les savans les plus célèbres, en France, en Suède, en Angleterre, en Allemagne, enrichissaient journellement la science de leurs brillantes découvertes; mais leurs Mémoires, épars dans un grand nombre d'ouvrages particuliers ou dans des collections académiques fort coûteuses,

[11] Archives Nationales, F/17/1023, dossier 13.
[12] *A.c.*, *96* (1815), bound at end of volume but with separate pagination, 1-4.

ne pouvaient être à la portée que d'un petit nombre de personnes; une feuille périodique, d'un prix peu élevé, et exclusivement destinée à la prompte publication des expériences nouvelles de Chimie, parut devoir contribuer aux progrès de cette science: tel est le but que se proposèrent les premiers fondateurs de ce Journal; tel est aussi le seul desir que puissent avoir les rédacteurs actuels, et l'unique cause des modifications importantes dont nous allons parler, et qu'ils ont cru devoir faire au plan primitif des Annales.

La Chimie et la Physique ont été pendant longtemps des sciences entièrement séparées; maintenant il serait difficile de tracer la ligne de démarcation. La multitude de substances gazeuses dont les modernes ont fait la découverte, le grand rôle qu'elles jouent dans la plupart des phénomènes de la Chimie, les réductions multipliées auxquelles elles astreignent l'observateur, soit à cause des variations de température, soit à cause de l'état du baromètre et de l'hygromètre, ont forcé le chimiste à des études qui d'abord étaient spécialement du ressort du physicien. Le parti qu'on a tiré de l'électricité pour former, comme pour détruire des combinaisons; les brillantes découvertes dont on est redevable à l'emploi des piles galvaniques, les propriétés singulières dont jouissent les rayons de différentes espèces, visibles ou obscurs, qui composent la lumière blanche, etc., etc., ont établi tant de points de contact entre la Chimie et la Physique, qu'il ne sera plus permis désormais de se livrer exclusivement à l'étude d'une seule de ces sciences. Dans cet état de choses, le plan primitif des Annales ayant paru incomplet, la Société s'est déterminée à admettre dorénavant, dans les publications de chaque mois, tout ce qui paraîtra devoir inspirer quelque intérêt non-seulement en Chimie, et dans ses applications aux arts et à la pharmacie, mais encore parmi les observations de Physique qui viendront à sa connaissance. Pour atteindre ce but sans augmenter sensiblement le prix de l'abonnement, sans rien sacrifier de l'espace qui d'abord était spécialement consacré à la Chimie, et même sans changer le format, il suffira de substituer le caractère que les imprimeurs appellent philosophie (celui de ce Prospectus) au caractère cicero, ce qui fera gagner par cahier l'équivalent de trente-six pages des anciennes Annales.

Le nouveau Journal formera donc la suite du premier; mais pour l'en distinguer, il prendra le titre *d'Annales de chimie et de physique*; il paraîtra tous les mois, comme par le passé, par cahiers de sept feuilles; quatre de ces cahiers formeront un volume.

Chaque cahier renfermera les Mémoires originaux les plus importans de Chimie ou de Physique, dont les rédacteurs auront eu connaissance, et les extraits des ouvrages nouveaux. On s'efforcera également, et autant que possible, de donner une analyse élémentaire des Mémoires physico-mathématiques des géomètres, mais en s'interdisant soigneusement les détails ou les discussions qui nécessiteraient des calculs minutieux, ou même seulement l'emploi trop fréquent des formules de l'analyse transcendante.

Tout extrait ou analyse qui présentera des observations critiques sera signé.

Les physiciens ont employé, depuis quelques années, des méthodes très-précises pour déterminer les pesanteurs spécifiques des solides, des liquides, des gaz et des vapeurs; pour évaluer les quantités dont tous ces corps se dilatent par la chaleur, leurs forces réfringentes ou dispersives, le point de solidification des liquides, celui de liquéfaction des solides, etc., etc. Les chimistes ont egalement beaucoup ajouté à l'exactitude des moyens d'analyse; en sorte que les proportions des principes constituans d'un grand nombre de corps sont connues avec une précision qu'il sera difficile de surpasser. Des tables détaillées, puisées aux meilleures sources, et qui paraîtront dans les premiers cahiers de l'année courante, offriront, dans un cadre raccourci, et, pour ainsi dire, sous une même point de vue, ces importantes données de l'expérience.

Le parti avantageux que, de nos jours, on a su tirer des observations du baromètre et du thermomètre pour déterminer les hauteurs relatives des stations, suffirait pour nous engager à publier, chaque mois, le tableau des observations météorologiques qui se font à l'Observatoire royal; mais l'exactitude de ces observations nous permettra de les comparer soit à celles des années antérieures, soit aux observations correspondantes faites dans d'autres lieux; et peut-être trouvera-t-on dans ces calculs de nouveaux motifs de se convaincre que la météorologie, considérée sous un point de vue philosophique, est très-digne de l'attention des observateurs.

Les variations de l'aiguille aimantée, diurnes ou annuelles, fourniront aussi, de temps à autre, le sujet de quelques tables, où les physiciens, les ingénieurs et les marins pourront venir puiser des nombres dont ils font un fréquent usage.

On donnera enfin, dans chaque cahier, une analyse succincte des Mémoires qui auront été présentés à la première classe de l'Institut, soit par des membres, soit par des étrangers. Ces extraits, qui paraîtront constamment peu de jours après la lecture publique des Mémoires, auront le double avantage de fixer la véritable date des découvertes, objet de tant de constestations, et de fournir aux personnes qui n'habitent pas la capitale des indications dont elles pourront souvent tirer parti.

Les nouvelles obligations que la Société contracte envers le Public l'ont déterminée à confier le soin de la rédaction des Annales à deux de ses membres, MM. Gay-Lussac et Arago. Le premier s'est chargé de tout ce qui sera relatif à la Chimie, et à ses applications aux Arts et à la Pharmacie; le second s'occupera de la partie purement physique.

On s'abbone, à Paris, chez Crochard, Libraire, rue de l'Ecole-de-Médecine, no.3.

Prix de l'abonnement pour l'année: 20 fr. pour Paris; 23 fr. pour toute la France; et 26 fr. pour l'étranger.

On ne s'abonne que pour un an.

13. *Editorial note published at end of issue for November 1816.*[13]

[13] *A.c.p.*, *3* (1816), 335.

La Société des *Annales* nous chargea, au commencement de 1816, de la rédaction de son Journal, et annonça en même temps, par un *Prospectus* particulier, l'intention où elle était d'en étendre le plan; le choix d'un plus petit caractère d'impression fit gagner sur chaque Cahier l'équivalent de trente-six pages qui ont été consacrées à la publication des travaux de physique. Nous avons pensé depuis qu'il serait utile de donner, à côté des Mémoires originaux qui nous parviendraient directement ou que nous extrairions de Journaux étrangers, une analyse plus ou moins détaillée des autres Récueils périodiques qui se publient en français; les Journaux anglais et allemands nous ont paru renfermer trop fréquemment des articles d'un intérêt purement local pour qu'il fût nécessaire de les comprendre dans cette analyse; mais du moins nous nous sommes toujours empressés d'en extraire tous les Mémoires qui, par la nouveauté des vues ou des expériences, nous ont semblé ajouter quelque chose à la masse de nos connaissances. Les Recueils périodiques italiens nous ont souvent manqué en 1816: nous avons pris des mesures pour qu'à l'avenir ces Journaux, aussi-bien que ceux qui se publient en Amérique, nous parviennent plus régulièrement; et tout nous fait espérer qu'en 1817 nous pourrons tenir nos lecteurs parfaitement au courant des progrès que feront les sciences chimiques et physiques, tant dans l'ancien que dans le nouveau continent.

Nos extraits étant quelquefois accompagnés de remarques critiques, nous nous empressons de prévenir ceux qui croiraient avoir à s'en plaindre que nous publierons leurs réponses avec plaisir; car nous sommes persuadés que la science ne peut que gagner à de telles discussions. La Société des *Annales* nous ayant cédé la propriété de ce Journal, nous prierons encore les personnes qui voudraient y insérer quelque travail particulier de le faire remettre directement à notre adresse, à l'Observatoire royal, rue d'Enfer. C'est toujours M. Crochard, libraire, rue de l'Ecole de Médecine, n° 3, qui reçoit les abonnemens: les nouvelles charges qui nous ont été imposées par les circonstances nous ont forcés d'en porter le prix à vingt-quatre francs par an.

14. *Proprietors of all journals required to register, March 1830.*[14]

En exécution du dernier paragraph de l'article 6 de la loi du 18 juillet 1828, nous soussignés Joseph Louis Gay-Lussac, membre de l'Académie des Sciences demeurant à l'Arsenal, et Dominique François Jean Arago de l'Académie des Sciences, demeurant à l'Observatoire Royal, réuissant tous deux les conditions de capacité prescrites par l'article premier de la dite loi, Déclarons publier depuis plusieurs années et vouloir continuer de publier, un écrit périodique intitulé *Annales de chimie et de physique*, qui parait une fois par mois, dont nous sommes propriétaires par portions égales, suivant l'acte d'association sous seing privé annexé à la presente et qui est imprimé chez Mme veuve Thuau, cloitre St Benoit No.4.

---

[14] Archives Nationales, F/18/315, dossier 19.

Paris le 4 mars 1830

F. ARAGO
approuvé l'écriture ci-dessus et d'autre part
GAY-LUSSAC

15. *Letter from Malaguti to Gerhardt, 30 September 1842, commenting on the alleged authoritarian stance of Dumas as editor of the* Annales.[15]

Je reconnais avec vous l'espèce de tyrannie exercée par quelques hommes sur les chimistes travailleurs, et je reconnais aussi toute la justesse de la résolution de M. Laurent de ne plus rien donner aux *Annales*. Mais je dois le dire, cette tyrannie ne m'a jamais atteint, et, au contraire, si je veux être juste, je dois déclarer que les *Annales* ont toujours eu beaucoup d'égards pour moi. Je ne saurais donc pas justifier ma défection, précisément parce que je ne suis pas dans la même position que M. Laurent. Il est vrai que je n'ai pas eu à me louer, à l'occasion de mon dernier voyage à Paris, d'un des rédacteurs des *Annales*, mais mes griefs portent plutôt sur l'homme individuel que sur ses fonctions. Cependant vous pouvez être sûr que je ne transigerai jamais avec mes convictions; et, lorsque les opinions qui ne sont pas en faveur dans les *Annales* deviendront les miennes, je les proclamerai bien haut, sans m'inquiéter de l'approbation des autres. J'ajouterai encore que, tout en reconnaissant les égards que les *Annales* m'ont prodigués, je n'en deviendrai jamais leur esclave, et je ne leur donnerai jamais mon indépendance.

16. *Advertisement for complete series of back numbers of the* Annales (1847)[16]

DIX ANS POUR PAYER
Recueil de 1789 à 1840 - 177 volumes

ANNALES DE CHIMIE
1re série, de 1789 à 1815
Par Guyton-Morveau, Lavoisier, Monge, Berthollet, etc.
95 volumes in-8 et 3 volumes de tables

ANNALES
DE CHIMIE ET DE PHYSIQUE
2e série, de 1816 à 1840
Par Gay-Lussac et Arago
75 volumes in-8 avec planches, et 3 volumes de tables

---

[15] M. Tiffeneau (ed.), *Correspondance de Charles Gerhardt*, Paris, 1918, p.205.
[16] Advertisement from back cover of A. Laurent, *Précis de cristallographie*, Paris: Victor Masson, 1847.

CONDITIONS DE VENTE

Pour faciliter à tous les amis de la science l'acquisition de ce recueil important, l'éditeur en a établi les conditions de vente comme il suit:

PREMIÈRE SÉRIE ET DEUXIÈME SÉRIE.

Les deux séries des *Annales* de 1789 à 1840, comprenant, avec les tables 177 volumes, sont expédiées *franches de port* et bien emballées aux personnes qui envoient 120 FRANCS COMPTANT ET 10 BILLETS, CHACUN DE 60 FRANCS payables d'année en année, à partir du jour de la commande.

Chacune des deux séries des *Annales* (la 1re de 1789 à 1815, 97 vol., ou la 2e de 1816 à 1840, 75 vol.) est expédiée *franche de port* et bien emballée aux personnes qui envoient 70 FRANCS COMPTANT ET 10 BILLETS, CHACUN DE 30 FR., payables d'année en année, à partir du jour de la commande.

Une remise sera faite aux personnes qui désireront payer tout le prix dans la première année.

Elles auront à envoyer, savoir:

Pour les deux séries, 200 FRANCS COMPTANT ET DEUX BILLETS, CHACUN DE 170 FRANCS, payables l'un à six mois et l'autre à un an de date;

Pour l'une ou pour l'autre série, 100 FRANCS COMPTANT ET DEUX BILLETS, CHACUN DE 90 FRANCS, payables l'un à six mois et l'autre à un an de date.

Les billets seront faits *sur timbre* et ainsi conçus:

> A tant de mois ou tant d'années de date, je payerai à l'ordre de M. VICTOR MASSON, la somme de ....à valoir sur mon exemplaire des *Annales de Chimie*, telle série
>
> le..... 184
>
> *(Écrire lisiblement ici son nom et son adresse)*
>
> *(Signer ici)*

MM les souscripteurs pourront toujours retirer leurs billets en bénéficiant d'un escompte de 5 p.100 par an.

TROISIÈME SÉRIE

La troisième série des *Annales de Chimie et de Physique,* commencée en janvier 1841, et rédigée par MM. Gay-Lussac, Arago, Chevreul, Dumas, Pelouze, Boussingault et Regnault, est publiée par cahiers mensuels qui forment à la fin de l'année, 3 vol in-8°, accompagnés de planches gravées et de figures intercalées dans le texte.

Prix de l'année pour Paris	30 fr.
les départements, par la poste	34 fr.
quelques pays étrangers, id.	38 fr.

APPENDIX 2

MEMBERS OF THE EDITORIAL BOARD, 1789 - 1913

Although most of the book discusses the *Annales* in approximately chronological order, it may be useful to present the members of the editorial board in alphabetical order for ease of reference. The only disadvantage is that this places side by side men separated by several generations.

Although a few minor figures in science are included, on the whole one is struck by the important place of many of the editors in French science. Often they had to become quite senior, having for example, been elected to the Academy of Sciences, before they were invited to join the editorial board. The galaxy of 'great names', from Lavoisier and Gay-Lussac to Dumas, Wurtz and Pasteur is concluded by the inclusion of two Nobel Prize winners: Lippmann (physics) and Moissan (chemistry).

Name	*Membership of the Editorial Board*
ADET, Pierre-Auguste (1763-c.1832) An important figure in the foundation and early years of the *Annales*, Adet was co-author with Hassenfratz of a complex system of chemical symbols intended to supplement the new chemical nomenclature. He also wrote an elementary textbook of chemistry but much of his life was lived outside of science and included the army, administration and politics.	1789-1815 (*D.S.B.*, *1*, 64-5.)
ARAGO, Dominique-François-Jean (1786-1853) A brilliant early student of the Ecole Polytechnique, Arago soon benefited from the patronage of Laplace to become Secretary of the Bureau des Longitudes. Elected to the First Class of the Institute in 1809, he was also a member of the Society of Arcueil. After	1816-1853 (*D.S.B.*. *1*, 200-3.)

1830 his political interests and his responsibilities as secretary of the Academy tended to predominate over his science. He was the inspiration of the *Comptes rendus*.

BECQUEREL, Alexandre-Edmond (1820-91) 1885-91

Son of the physicist Antoine-César Becquerel, Edmond Becquerel came from a famous scientific family (his son was to discover radioactivity). Elected to the Academy in 1863, Becquerel's main base was the Muséum d'Histoire Naturelle. His main contributions to science were in electricity, magnetism and optics. (*D.S.B.*, *1*, 555-6.)

BERTHELOT, Pierre-Eugène-Marcellin (1827-1907) 1878-1907

A graduate in both chemistry and pharmacy, Berthelot soon became a leading figure in organic chemistry. He was unsuccessful as a candidate for the Academy of Sciences until after the Franco-Prussian war of 1870-71. Under the Third Republic he briefly held several government posts and he dominated the politics of science, particularly after his election as secretary of the Academy in 1889. (*D.S.B.*, *2*, 63-72.)

BERTHOLLET, Claude-Louis (1748-1822) 1789-1815

Berthollet qualified as a doctor of medicine (University of Turin) before turning to chemistry. He was elected to the Paris Academy in 1780 and became an early convert Lavoisier's chemistry. A friend of Bonaparte, he was the founder of an informal group of scientists which met at his country house at Arcueil in the years c.1803-c.1814. (*D.S.B.*, *2*, 73-82.)

BERTIN-MOUROT, Pierre Augustin (1818-84) *(Collaborator)* 1868-1884

Bertin-Mourot succeeded Verdet as lecturer in physics at the Ecole Normale in 1867. He published several papers on optics, crystallography and meteorology. He also succeeded Verdet as the editor for foreign papers in physics in the *Annales*. He acknowledged the help of Mascart, who in turn was to succeed him.

BIOT, Jean-Baptiste (1774-1862) 1816

An early graduate of the Ecole Polytechnique and a protégé of Laplace, Biot did some collaborative research with Arago but often differed from him on grounds of personality, physical theory and politics. He was professor at the Paris Faculty of Science. His association with other journals, such as the *Journal des Savants,* helped to make him a very minor figure in the history of the *Annales*. (*D.S.B.*, *2*, 133-140.)

BOUILLON LAGRANGE, Edme-Jean-Baptiste (1764-1840) 1800-1815

A pharmacist, briefly associated with the Ecole Polytechnique as a senior technician, he became professor at the Paris Ecole de Pharmacie in 1803. Much of his research related to food, mineral waters and the preparation of medicines. He also worked on the extraction of sugar from sugar beet.

BOUSSINGAULT, Jean-Baptiste-Joseph-Dieudonné (1802-1887) 1840-1887

Predominantly an agricultural chemist, Boussingault had first gained recognition as a scientist as a result of his South American studies under the patronage of Humboldt. After working on an experimental farm in Alsace, he was appointed in 1845 to a chair at the Conservatoire des Arts et Métiers in Paris. He was elected to the Academy in 1839. (*D.S.B.*, *2*, 356-7.)

BOUTY, Edmond-Marie-Léopold (1846-1922) 1909-1913

A graduate of the Ecole Normale Supérieure, Bouty was professor of physics at the Paris Faculty of Science. He became president of the Société de Physique and was elected to the Academy in 1908.

CHAPTAL, Jean-Antoine-Claude (1756-1832) 1797-1815

A medical graduate, Chaptal soon became interested in chemistry and in 1780 became professor of chemistry at Montpellier. He was also a chemical manufacturer. He wrote books on both pure and applied chemistry. A former member of the Royal Society of Sciences of Montpellier, in 1798 he was (*D.S.B.*, *3*, 198-203.)

elected as a full member of the First Class of the Institute. From 1800-1804 he held with great success the government post of Minister of the Interior.

CHEVREUL, Michel-Eugène (1786-1889) (a) 1816
(b) 1853-1889

In 1803 Chevreul went to Paris to study chemistry under Vauquelin at the Muséum d'Histoire Naturelle, with which he was associated for the remainder of his long life. He carried out research on dyes, colour theory and the chemistry of fats. He isolated and named many members of the fatty acid series. He was elected to the Academy of Sciences in 1826. Although the senior chemist in the Academy for many years, he later had difficulty in keeping up with the rapid development of organic chemistry. (*D.S.B.*, *3*, 240-4.)

COLLET-DESCOSTILS - see DESCOTILS

D'ARCET, Jean-Pierre-Joseph (1777-1844) 1816

Son of Jean D'Arcet (1725-1801), professor of chemistry at the Collège de France and a late convert to Lavoisier's theory. The son had a position at the Paris Mint. He was elected to the Academy of Sciences in 1823.

DESCOTILS, Hyppolite-Victor-Collet (1773-1815) 1804-1815

A graduate of the Ecole des Mines, Descotils later taught there and then became director of its laboratory. He was a member of the Société Philomatique and of the Société d'Arcueil. He was a good analytical chemist. (*D.S.B.*, *3*, 346-7.)

DEYEUX, Nicolas (1745-1837) 1800-1815

A pharmacist who rose to become personal pharmacist to Napoleon. He was elected to the First Class of the Institute in 1797 to replace the pharmacist Bertrand Pelletier. He became professor at the Ecole de Pharmacie and at the Paris Faculty of Medicine. He studied beet sugar and collaborated with Parmentier on studies of milk and blood.

DIETRICH, Philippe-Frédéric, Baron de (1748-1793) 1789-1792

A nobleman from Strasbourg appointed inspector of mines, Dietrich became an associate member of the Royal Academy of Sciences in 1786. He wrote on mineralogy and translated the work of Scheele into French. Elected mayor of Strasbourg in 1790, he made enemies with the Jacobins, who were responsible for his execution in 1793.

DULONG, Pierre-Louis (1785-1838) 1816

After a year's study at the Ecole Polytechnique, Dulong withdrew on health grounds. Later he was able to make original contributions to both physics and chemistry. He held a number of teaching posts but found it difficult to combine teaching with research. He was elected to the physics section of the Academy in 1823. (*D.S.B.*, *4*, 238-42.)

DUMAS, Jean-Baptiste (1800-1884) 1840-1884

His early studies were in medicine and physiology but in 1823 he obtained a post in chemistry. He married the daughter of the wealthy and influential Alexandre Brongniart. He became professor of chemistry at the Paris Faculty of Sciences, the Ecole Polytechnique and the Faculty of Medicine, holding these posts simultaneously. He was a brilliant teacher and researcher and a good administrator. He became a powerful figure in French academic politics. (*D.S.B.*, *4*, 242-8.)

FOURCROY, Antoine-François (1755-1809) 1789-1809

The son of as apothecary but from an impoverished noble family, Fourcroy obtained a medical education with difficulty and warmly welcomed the Revolution. In the 1780s he taught chemistry and in 1785 he was elected to the Paris Royal Academy of Sciences. He collaborated with Lavoisier on the reform of nomenclature. Author of many chemical textbooks, he was also a brilliant lecturer. He was a member of the Convention and took a major part in the reform of scientific and medical institutions. (*D.S.B.*, *5*, 89-93.)

FRIEDEL, Charles (1832-1899) 1885-1899

Born in Strasbourg, Friedel entered the Paris laboratory of his fellow Alsatian Wurtz in 1854. In 1856 he had a post at the Ecole des Mines. He worked on both mineralogy and organic chemistry. The famous 'Friedel and Crafts reaction' was described in a paper published in the *Annales* in 1884. He was elected to the Academy of Sciences in 1878.

GAY-LUSSAC, Joseph-Louis (1778-1850) (a) 1810-1815 (b) 1816-1850

An early graduate of the Ecole Polytechnique, Gay-Lussac soon came under the wing of Berthollet and joined the Society of Arcueil. This helped him obtain a position at the Ecole Polytechnique and enter the Academy of Sciences. He did important work in physics and in both pure and applied chemistry. Like Arago, he was friendly with Humboldt. His great rival in chemical research was Davy. He became wealthy through his many positions especially at the Mint and at Saint Gobain. (*D.S.B.*, *5*, 317-27.)

GUYTON [DE MORVEAU], Louis-Bernard (1737-1816) 1789-1815

Originally a lawyer from Dijon, Guyton taught himself chemistry and joined the Dijon Academy. In 1782 he criticised the current chemical nomenclature but he did not accept Lavoisier's ideas until 1787. In 1791 he moved to Paris and became a deputy in the Convention. He was one of the first members of the National Institute, also professor, then director of the Ecole Polytechnique. In 1811 Napoleon made him a baron. (*D.S.B.*, *5*, 600-04.)

HALLER, Albin (1849-1925) 1907-1925

A native of the Nancy region, Haller managed in 1889 to obtain both private and public funds to establish there an important research centre, the Institut chimique. After a university post at Nancy, he succeeded Friedel as professor of organic chemistry at the Paris Faculty of Sciences. In 1900 he became a full member of the Academy of Sciences. (*A.c.p.*, [10], *4* (1925), 5-8.)

HASSENFRATZ, Jean-Henri (1755-1827) — 1789-1815

Originally a master carpenter, Hassenfratz studied mining and then worked in Lavoisier's laboratory. He collaborated with Adet on a complex system of chemical symbols intended to supplement the new nomenclature. A militant Jacobin during the Revolution, he returned to a scientific career in 1795 and taught physics at the Ecole Polytechnique and industrial mineralogy at the Ecole des Mines. (*D.S.B.*, *6*, 164-5.)

LAUGIER, André (1770-1832) — (a) 1808-1815 (b) 1816

A protégé of Fourcroy, whom he succeeded as professor of chemistry at the Muséum d'Histoire Naturelle. He discovered the regular presence of chromium in meteorites. Nearly all his publications were in the *Annales*. (*A.c.p.*, *52* (1833), 190-1.)

LAVOISIER, Antoine-Laurent (1743-1794) — 1789-1793

After a good classical education and a degree in law Lavoisier showed a marked interest in and aptitude for science. After some work on mineralogy, he turned to chemistry. His studies of combustion were to lead to the oxygen theory. Much of his time was occupied by his position as a tax collector and as a technical expert in administration. The Royal Academy of Sciences was the focus of his scientific life and he had a laboratory at the Arsenal. He was arrested during the Terror and guillotined. (*D.S.B.*, *8*, 66-91.)

LIPPMANN, Jonas-Ferdinand-Gabriel (1845-1921) — 1909-1913

At an early stage in his career Lippmann helped Bertin with the *Annales* unofficially by abstracting German papers. After research in Germany, he studied for a Paris doctorate and became professor of mathematical physics at the Facultyof Sciences. Elected to the Academy in 1886, he was awarded the Nobel prize in 1908 for his research in optics. (*D.S.B.*, *8*, 387-8.)

MASCART, Eleuthère-Elie-Nicolas (1837-1908) — 1885-1908

A graduate of the Ecole Normale Supérieure and a protégé of Verdet, he taught in secondary schools

before becoming professor of physics at the Collège de France. In 1878 he was appointed director of the Bureau Central Météorologique and in 1884 he was elected to the Academy. He worked on optics, electricity and terrestrial magnetism. He was prominent in national and international scientific organisations. (*D.S.B.*, *9*, 154-6.)

MOISSAN, Henri (1852-1907) 1896-1907

Qualifying first as a pharmacist, Moissan did most of his research in inorganic chemistry. He held a succession of posts at the Ecole Supérieure de Pharmacie, where he worked on the isolation of the intensely reactive element fluorine. With his electric furnace he claimed to have prepared artificial diamonds. Elected to the Academy in 1891, he was awarded the Nobel Prize in 1906. (*D.S.B.*, *9*, 450-2.)

MONGE, Gaspard (1746-1818) 1789-1815

A mathematician with unusually wide interests, Monge was a member of the Royal Academy from 1780 and thus a colleague of Lavoisier as well as a particular friend of Berthollet. He gave technical advice in the revolutionary war and played a prominent part in establishing the Ecole Polytechnique, where his course on descriptive geometry became famous. Like Berthollet he benefited after 1799 from the friendship and patronage of Napoleon. (*D.S.B.*, *9*, 469-78.)

MORVEAU - see GUYTON DE MORVEAU

PARMENTIER, Antoine-Augustin (1737-1813) 1800-1813

An apothecary of the old regime, most of Parmentier's work was related to food chemistry and nutrition. His campaign to popularise the cultivation and use of the potato in France as a cheap source of food has led to the immortalisation of his name in this connection. He also worked on grape sugar and agriculture. (*D.S.B.*, *10*, 325-6.)

PASTEUR, Louis (1822-1895) 1879-1895

A graduate of the Ecole Normale, Pasteur was its administrator for ten years. An indefatigable researcher, he became one of France's most famous scientists of all time. From purely chemical studies of fermentation he went on to develop the germ theory which eventually revolutionised medicine. He excelled in applying his science to the solution of practical problems, many of them agricultural or medical. Many organisations tried to benefit from the prestige of his name. (*D.S.B.*, *10*, 350-416.)

PELLETIER, Bertrand (1761-1797) 1792-1797

A pharmacist who made few original contributions to chemistry, he nevertheless did some useful practical work in checking and extending the work of others. Like his mentor D'Arcet he only accepted the oxygen theory after considerable hesitation. He was briefly a member of both the Royal Academy and its successor, the First Class of the Institute. (*D.S.B.*, *10*, 496-7.)

PELOUZE, Théophile Jules (1807-1867) 1840-1867

Trained originally in pharmacy, Pelouze was won over to chemistry by a chance meeting with Gay-Lussac. He also studied with Liebig and worked mainly on organic chemistry. He became assayer at the Paris mint and professor of chemistry at the Ecole Polytechnique and the Collège de France. In 1837 he was elected to the Academy of Sciences. (*D.S.B.*, *10*, 499.)

PRIEUR-DUVERNOIS, Claude Antoine ('de la Côte d'Or') (1763-1832) 1789-1815

Originally an army officer, Prieur became interested in chemistry through friendship with Guyton de Morveau, who came from the same region. Invalided out of the army in 1780, Prieur took up science more seriously. In the Revolution he was a member of the Committee of Public Safety and was responsible for recruiting scientists for the war effort. He also played a part in the establishment of the metric system.

REGNAULT, Henri-Victor (1810-1878) 1840-1878

A graduate of the Ecole Polytechnique and the Ecole des Mines, Regnault became assistant to Gay-Lussac at the Polytechnique and then succeeded him in 1840 as professor of chemistry. In the same year he was elected to the chemistry section of the Academy but his interests were already turning to physics. His early work was on organic chemistry. Later he studied steam engines and the thermal properties of gases. (*D.S.B.*, *11*, 352-4.)

SAVARY, Félix (1797-1841) 1840-1841

Not to be confused with the acoustics researcher Félix Savart (1791-1841), Savary was a graduate of the Ecole Polytechnique, where he became professor of astronomy. He was also a member of the Bureau des Longitudes. Elected to the astronomy section of the Academy in 1832, he served longer there than with the *Annales*.

SÉGUIN, Armand (1765-1835)* 1790-1815

A member of Lavoisier's circle from the mid-1780s, Séguin collaborated in studies of respiration. In the Revolution he profited from methods of rationalising the process of tanning. In 1796 he collaborated with Madame Lavoisier in preparing her husband's papers for publication but claimed excessive credit for himself. He was an absentee member of the editorial board of the *Annales* for much of the time. (*D.S.B.*, *12*, 286-7.)

SÉNARMONT, Henri Hureau de (1808-1862) 1854-1862

A graduate of the Ecole Polytechnique, he was professor at the Ecole des Mines and a co-editor of the *Annales des Mines* from 1849. He was elected to the mineralogy section of the Academy in 1852 and (*D.S.B.*, *12*, 303-6.)

---

* There remains some doubt about the spelling of this name since one finds the two alternatives used during his lifetime: Séguin and Seguin. This doubt is not resolved by finding the capitalised name sometimes spelled without an accent, because accents are often omitted in capitalisation in French publishing, as when giving the titles and authors of papers in a journal. Since some of these, published in the *Annales de chimie* use the form Séguin, and this is the form adopted by the authoritative *D.S.B.*, we have decided to retain this version.

did important work in crystallography. He asked that no obituaries should appear after his death.

TASSAERT, B.M. ?

A shadowy figure in the history of the *Annales*. He was co-opted in 1797 primarily to undertake translations from the German. He regularly attended meetings of the editorial board from June 1798 to August 1799, signing the register like the others. He published three original papers in the *Annales* in 1797-99, two on analysis. He left shortly after, but returned briefly later.

THENARD, Louis Jacques (1777-1857) 1810-1815

Originally a protégé of Vauquelin and Fourcroy, Thenard was attracted to the more physical approach to chemistry of Berthollet and became a member of the Society of Arcueil and a regular collaborator with Gay-Lussac, particularly in the period of great rivalry with Davy. He was elected to the Academy in 1810. His greatest discovery, hydrogen peroxide (1818), was immediately published in the *Annales*. In his later years he had many important positions and honours. (*D.S.B.*, *13*, 309-14.)

VAN MONS, Jean-Baptiste (1765-1842) 1797-1804

Born in Brussels, he first studied pharmacy. Turning to chemistry, he published his *Essai sur les principes de la chimie antiphlogistique* in 1785. After a brief political career in the revolution he returned to chemistry and published a Brussels edition of Fourcroy's *Philosophie chimique* with his own notes. He was too independently minded to remain an editor of the *Annales* for long. He was a friend of Brugnatelli. In 1817 he was given a chair at the University of Louvain.

VAUQUELIN, Nicolas (1763-1829) 1790-1815

Originally trained as a pharmacist, Vauquelin took an interest in chemistry and became Fourcroy's laboratory assistant. He held posts successively at the Ecole Polytechnique, the Ecole des Mines, the (*D.S.B.*, *13*, 596-8.)

Collège de France, the Ecole de Pharmacie and the Muséum. He was an outstanding analytical chemist and was elected to the First Class of the Institute in 1795.

VERDET, Marcel-Emile (1824-66) *(Collaborator)* 1853-1866

A graduate of the Ecole Normale Supérieure, Verdet became one of the outstanding physics teachers of mid-nineteenth-century France. He introduced the thermodynamics of Joule, Clausius, Helmholtz and William Thompson into the French scientific world. *(D.S.B., 13*, 614-15.)

WURTZ, Charles-Adolphe (1817-1884) *(Collaborator)* 1853-1868 *Editor* 1868-1884

An Alsatian with a medical doctorate from Strasbourg, Wurtz first studied chemistry with Liebig at Giessen, where he translated several of his master's papers for the *Annales*. This provided him with useful scientific contacts in Paris, where he joined Dumas in the Faculty of Medicine. He built up a research school of chemistry with many foreign students and was elected to the Academy in 1867. A staunch supporter of the atomic theory, he is also notable for his work in organic chemistry and his many associations with chemists outside France. *(D.S.B., 14*, 529-32.

BIBLIOGRAPHY

PRIMARY SOURCES

ARCHIVES

Académie des Sciences, Paris
Archives Nationales, Paris
Bayerische Staatshibliothek, Munich (Liebig correspondence)
Collège de France, Paris
Limoges, Archives départementales (material now at Ecole Polytechnique)
St Léonard de Noblat, Haute Vienne, Mairie

The fact that the eighteenth-century journal that one has chosen to study has continued publication to the present day raises hopes of finding surviving records. A preliminary enquiry from the modern publishers, however, established that they had no archives; nor were they aware of the existence of any archival records of the early years of their historic periodical. Indeed, sometimes it seems to those concerned with reporting work on the frontiers of modern science that they should not be concerned with documents of another age - as if science and history constituted two mutually exclusive activities. Yet one should not lay too much blame on the publishers of the modern *Annales*. During the first century of its existence at least the journal was always primarily the personal concern of one or more scientists and it is in their papers that documentation on the early *Annales* was most likely to be found, if indeed any such documents had survived.

It was most likely that documentation of the earliest years would not have survived the turbulence of the Revolution of 1789. Even after resumption of publication in 1797 the fact that the *Annales* was the responsibility of a large editorial board made the task of tracking records all the more difficult. The many changes of publisher magnified the difficulty. One could easily spend a lifetime looking for relevant archives. I was fortunate that, when I was working on a biography of Gay-Lussac in the 1970s, I had occasion to track down and examine his surviving laboratory notebooks (divided between several locations) and among these I found a register of minutes of meetings of the editorial board of the *Annales* covering the period 1797-1815.[1] There was a perfectly good reason why this should have been among Gay-Lussac's

[1] St. Léonard, Mairie.

papers. In 1816 he had become one of the two proprietors of the *Annales*. But he had also been a junior member of the editorial board for several years previously and he had inherited its earlier records. Although these only went back to 1797, a member of the editorial board had asked in 1815 for a transcription of the original articles of association of 1789 and this too was very fortunately included in the register.

After this, one was encouraged to take soundings of the papers of later editors. In the cases of Dumas[2] and Berthelot,[3] two of the most influential figures in nineteenth-century French science, this eventually met with some success. This means that we have some manuscript evidence of the internal working of later series of the *Annales* both in the mid-nineteenth century and around 1900. Research is sometimes rather like doing a jigsaw puzzle. Several important pieces have been found and, although it is not complete, from these pieces it is possible to build up a picture of the *Annales* over a whole century. After all, if one is interested in the final product, the published *Annales* are all to hand. What one needed to provide some confidence about really understanding the *Annales* was manuscript evidence about problems behind the scenes, circulation, and so forth and this we have been fortunate to obtain.

SECONDARY SOURCES

Among the secondary sources used in the preparation of this book three works stand out as exceptionally important, not only for the information they contain, but also as providing earlier examples of the study of scientific journals of approximately the same period. The circumstances of the preparation of each were quite different, yet all three were originally university theses for higher degrees. In two cases the theses were later published as a book. An important difference in each case is the sources available to the respective authors, which had a major influence on the kind of work produced.

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

Although this study began as a Ph.D. dissertation, the author spent a great deal of time and trouble re-working and transforming the dissertation into a book. The broad title disguises the fact that the study focuses on the chemical journals of Lorenz Crell, but its outstanding achievement is to place Crell in the full social and scientific context of chemistry in the eighteenth century in the German states. With its copious appendices containing 'biographical profiles' and 'institutional histories' the book is an invaluable source for the

---

2 Académie des Sciences, Paris, Archives.

3 Collège de France.

study of eighteenth-century German science. More relevant to the subject of this book is his Appendix III, which provides a full list of Crell's subscribers. Hufbauer was exceptionally fortunate in being able to find on the covers of Crell's journals a printed list of the subscribers, thus providing a unique insight into his readership. This fact helps to explain the title of the book, since the information obtained enabled the author to extend his studies from Crell's journals to the whole German chemical community.

Bickerton, David M., *Marc-Auguste and Charles Pictet, the Bibliothèque Britannique (1796-1815) and the Dissemination of British Literature and Science on the Continent*, Geneva, Slatkine, 1986.

This book, originally written as a Ph.D. thesis with encouragement and some guidance from the present author, provides in some ways a model of its kind. This long and almost exhaustive study illustrates what is possible for a cultural historian when the entire early archives of a journal survive and are made available to the scholar. This unusual situation depended on the fact that the journal was edited by members of an important Geneva family and the family pride of descendants has ensured that all the archives were carefully kept. The descendants of the Pictet brothers then generously made the archives freely available to David Bickerton for an unrestricted period. He responded to this opportunity, unparallelled in my experience, by a wide-ranging study, fully exploring, for example, the economics of journal production, communication and even science, although he had not begun his studies with any special expertise in any of these fields. To these studies he added his own special concern for literary production. It is unfortunate that there is hardly any commercial market for such a detailed study and, therefore, although the thesis had been published in a limited edition, it remains largely unknown. To the present writer, however, it provides a splendid example of what is possible under ideal conditions. The fact that the *Bibliothèque britannique* covers precisely the same period as the first series of the *Annales*, the fact that its editor M. A. Pictet often visited Paris in this period and was friendly with several senior members of the editorial board, the fact that when communications between France and Britain were poor the *Annales* regularly borrowed from the *Bibliothèque britannique* for news of British science, make it very relevant to this book.

Court, Susan, *The Annales de chimie, 1789-1815*, M.Phil.dissertation, University of Leeds, 1969.

A study by one of the author's first research students, based exclusively on printed sources but, nevertheless, very useful in providing a comprehensive survey of the first series of the *Annales*, including quantitative studies of the contents of the journal according to the classification 'pure', 'applied' and

'general' chemistry. It has been particularly valuable as a check to ascertain whether, in following current enthusiasms, the present author has neglected any important aspect of the early *Annales*. The dissertation was also useful in providing a detailed analysis of the *Annales*' treatment of applied chemistry and a number of other specific points.

OTHER SECONDARY SOURCES

Académie des sciences, *Procès-verbaux des séances de l'Académie des Sciences*,10 vols., Hendaye, 1910-22.

Agassi, Joseph, *Faraday as a Natural Philosopher*, Chicago, 1971.

Babbage, C., *Reflections on the Decline of Science in England*, London, 1830.

Bazerman, Charles, *Shaping Written Knowledge. The Genre and Activity of the Experimental Article in Science*, Madison, Wisconsin, 1988.

Bellanger, Claude, *et al* (eds). *Histoire générale de la presse française*, vol.1, Paris, 1969.

Bensaude-Vincent, Bernadette, 'A founder myth in the history of the sciences - The Lavoisier Case', *Functions and Uses of Disciplinary Histories*, ed. L. Graham, W. Lepenies, P. Weingart, *Sociology of the Sciences Yearbook*, *7* (1983), 53-78.

Bensaude-Vincent, B., 'A view of the chemical revolution through contemporary text-books: Lavoisier, Fourcroy and Chaptal', *B.J.H.S.*, *23* (1990), 435-460.

Bensaude-Vincent, B., *Lavoisier. Mémoires d'une Révolution*, Paris, 1993

Beretta, Marco, *The Enlightenment of Matter. The Definition of Chemistry from Agricola to Lavoisier,* Canton, MA., 1993.

Berman, Morris, *Social Change and Scientific Organisation. The Royal Institution, 1799-1844*, London, 1978.

Berthelot, M., 'Sur les publications de la Société Philomatique et sur ses origines', *Journal des savants*, 1888, 477.

Berthelot, M., *La révolution chimique. Lavoisier*, Paris, 1890.

Berthelot, M., 'Notice historique sur Lavoisier', *Mémoires de l'Académie des Sciences de l'Institut de France*, *45* n.d., xix-lxxii.

Bigourdan, G., *Le Système métrique des poids et mesures*, Paris, 1901.

Blainville, H. De, 'Notice historique sur la vie et les écrits de J.C. Delamétherie', *Journal de physique*, *85* (1817), 78-107.

Bolton, H.C., *A Select Bibliography of Chemistry, 1492-1892*, Washington, 1893.

Bouchard, Georges, *Un Organisateur de la victoire. Prieur de la Côte d'Or*, Paris, 1946.

Bouvet, Maurice, *Histoire de la pharmacie en France des origines à nos jours*, Paris, 1937.

Bradley, Margaret, 'The facilities for practical instruction in science during the early years of the Ecole Polytechnique', *Annals of Science, 33* (1976), 425-446.

Brock, W.H., *Fontana History of Chemistry*, London, 1992.

Brock, W.H. and Meadows, A.J., *The Lamp of Learning: Taylor and Francis and the Development of Science Publishing*, London and Philadelphia, n.d. [1984]

Butterfield, Herbert, *The Origins of Modern Science,* London, 1949.

Cabanis, André, *La Presse sous le consulat et l'empire (1799-1814)*, Paris, 1975.

Cannon, S.F., *Science in Culture: the Early Victorian Period*, New York, 1978.

Cardwell, Donald, *From Watt to Clausius. The Rise of Thermodynamics in the Early Industrial Age*, London, 1971.

Carneiro, Ana, *The Research School of Chemistry of Adolphe Wurtz, Paris, 1853-1884*, Ph.D. thesis, University of Kent, 1992.

Cawood, John, *The Scientific Work of D.F.J. Arago*, Ph.D. thesis, University of Leeds, 1974.

Censer, J. R. and Popkin, Jeremy D., *Press and Public in Pre-revolutionary France*, Berkeley, Cal., 1987.

[Chemical Society], *The Jubilee of the Chemical Society of London*, London, 1896.

Chirnside, R.C. and Hammence, H.J., *The 'Practising Chemists': A History of the Society for Analytical Chemistry, 1874-1974*, London, 1974.

Cohen, I. Bernard, *Revolution in Science*, Cambridge, Mass., 1985.

Cole, William A., *Chemical Literature, 1700-1860*, London, 1988.

Collins, H.M., *Changing Order. Replication and Induction in Scientific Practice*, Chicago, 1985.

Contant, J.-P., *L'Enseignement de la chimie au Jardin Royal des Plantes de Paris*, Cahors, 1952.

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

Crane, E.J., Patterson, Austin M, and Marr, Eleanor B., *A Guide to the Literature of Chemistry*, New York, 1957.

Crosland, Maurice, 'The development of the concept of the gaseous state as a third state of matter', *Proceedings of the Tenth International Congress of the History of Science*, Ithaca, N.Y., 1962, vol.2, pp.851-4.

Crosland, Maurice, *Historical Studies in the Language of Chemistry*, London, 1962. 2nd edn., New York, 1978.

Crosland, Maurice, 'The development of chemistry in the eighteenth century', *Studies on Voltaire and the Eighteenth Century*, *24* (1963), 369-441.

Crosland, Maurice, *The Society of Arcueil. A View of French Science at the Time of Napoleon I*, London, 1967.

Crosland, Maurice, *Les Héritiers de Lavoisier*, Paris: Palais de la Découverte, 1968.

Crosland, Maurice, 'The first reception of Dalton's atomic theory in France', Chap.16 of D.S.L. Cardwell (ed.), *John Dalton and the Progress of Science*, Manchester, 1968.

Crosland, Maurice, (ed.), *Science in France in the Revolutionary Era Described by Thomas Bugge*, Cambridge, Mass., 1969.

Crosland, Maurice, *The Science of Matter. Selected Readings*, Harmondsworth, Middx., 1971. 2nd edn., Philadelphia, 1992.

Crosland, Maurice, 'Lavoisier's theory of acidity', *Isis*, *64* (1973), 306-325.

Crosland, Maurice, 'Science and the Franco-Prussian War', *Social Studies of Science*, *6* (1976), 185-214.

Crosland, Maurice, *Gay-Lussac, Scientist and Bourgeois*, Cambridge, 1978.

Crosland, Maurice, 'Lavoisier, le "mal-aimé"', *La Recherche*, *14* (1983), 784-791.

Crosland, Maurice, 'The image of science as a threat: Burke versus Priestley and the "Philosophic Revolution"', *B.J.H.S.*, *20* (1987), 277-307.

Crosland, Maurice, 'Lavoisier, lone genius or "chef d'école"? The testimony of Fourcroy', in M. Goupil (ed.), *Lavoisier et la révolution chimique*, Ecole Polytechnique, Paris, 1992, pp.1-12.

Crosland, Maurice, *Science under Control. The French Academy of Sciences, 1795-1914*, Cambridge, 1992.

Crosland, Maurice and Smith, C.W., 'The transmission of physics from France to Britain, 1800-1840', *Historical Studies in the Physical Sciences*, *9* (1978), 1-61.

Darnton, Robert and Roche, Daniel (eds)., *Revolution in Print. The Press in France, 1775-1800*, Berkeley, Cal., 1989.

Daumas, Maurice, *Lavoisier, théoricien et expérimentateur*, Paris, 1955.

Dear, Peter (ed.), *The Literary Structure of Scientific Argument. Historical Studies*, Philadelphia, 1991.

Debus, Allen, *The Chemical Philosophy: Paracelsian Science and Medicine in the Sixteenth and Seventeenth Centuries*, 2 vols., New York, 1977.

Delalain, Paul, *L'Imprimerie et la librairie à Paris de 1789 à 1813*, Paris, 1900.

Deleuze, M., *Histoire et description du Muséum Royal d'Histoire Naturelle*, 2 vols., Paris, 1823.

Donovan, Arthur (ed.), 'The Chemical Revolution. Essays in Reinterpretation', *Osiris*, 2nd series, *4* (1988).

Dumas, J.B., *Leçons sur la philosophie chimique professées au Collège de France en 1836*, ed. A. Bruylants, Brussels, 1972.

Duveen, Denis I. and Klickstein, Herbert S., *A Bibliography of the Works of Antoine Laurent Lavoisier, 1743-1794*, London, 1954.

Duveen, Denis I. and Klickstein, Herbert S. 'Le Journal Polytype des Sciences et des Arts', *Papers of the Bibliographical Society of America*, *48* (1954), 402-410.

Dyson, G.M., *Searching the Chemical Literature*, Advances in Chemistry Series, *30*, Washington, D.C., 1961.

Finlay, A. and Williams, T.I., *A Hundred Years of Chemistry*, 3rd edition, London, 1965.

Fox, Robert, *The Caloric Theory of Gases from Lavoisier to Regnault*, Oxford, 1971.

Fox, Robert, 'The rise and fall of Laplacian physics', *Historical Studies in the Physical Sciences*, *4* (1974), 89-136.

Fox, Robert, 'Scientific enterprise and the patronage of research in France, 1800-70', *Minerva*, *11* (1973), 442-473.

Fresnel, A., *Oeuvres*, 3 vols., Paris, 1867.

Fullmer, June Z., *Sir Humphry Davy's Published Works*, Cambridge, Mass., 1969.

Gautier, A., 'Le cinquantenaire de la Société chimique de France', *Revue scientifique*, *7* (1907), 641-689.

Gay-Lussac, J. L., *Cours de chimie*, Paris, 1828.

Geison, G.L., 'Scientific change, emerging specialities and research schools', *History of Science*, *19* (1981), 20-40.

Geison, G.L. and Holmes, F.L. (eds.), 'Research schools. Historical reappraisals', *Osiris, 8* (1993).

Gilbert, G. Nigel, 'The transformation of research findings into scientific knowledge', *Social Studies of Science*, *6* (1976), 281-306.

Gillispie, Charles, *The Edge of Objectivity*, Princeton, N.J., 1960.

Gillispie, C. C.(ed.), *Dictionary of Scientific Biography*, 16 vols., New York, 1970-1980.

Golinski, Jan, *Science as Public Culture. Chemistry and the Enlightenment in Britain, 1760-1820*, Cambridge, 1992.

Gough, J.B., 'Lavoisier's early career in science: An examination of some new evidence', *B.J.H.S.*, *4* (1968-9), 52-7.

Grimaux, E., *Lavoisier, 1743-1794, d'après sa correspondance, ses manuscrits, ses papiers de famille et d'autres documents inédits*, Paris, 1888.

Gross, Alan G., *The Rhetoric of Science*, Cambridge, Mass., 1990.

Guerlac, Henry, *Lavoisier - The Crucial Year. The Background and Origin of his First Experiments on Combustion in 1772*, Ithaca, N.Y., 1961.

Guerlac, Henry, 'The chemical revolution: A word from Monsieur Foucroy', *Ambix*, *23* (1976), 1-4.

Guerlac, Henry, 'Chemistry as a branch of physics: Laplace's collaboration with Lavoisier', *Historical Studies in the Physical Sciences*, *7* (1976), 193-276.

Haber, L.F., *The Chemical Industry during the Nineteenth Century*, Oxford, 1958.

Hahn, Roger, *The Anatomy of a Scientific Institution. The Paris Academy of Sciences, 1666-1803*, Berkeley, Cal., 1971.

Hannaway, Owen, *The Chemists and the Word. The Didactic Origins of Chemistry*, Baltimore, 1975.

Hatin, E., *Histoire politique et littéraire de la presse en France*, 6 vols., Paris, 1859.

Hatin, E., *Bibliographie historique et critique de la presse périodique française ou catalogue ... de tous les écrits periodiques*, Paris, 1866.

Heller, Robert, 'Officiers de santé: The second-class doctors of nineteenth-century France', *Medical History*, *22* (1978), 25-43.

Hesse, Carla, *Publishing and Cultural Politics in Revolutionary Paris, 1789-1810*, Berkeley, Cal., 1991.

Holmes, Frederic Lawrence, *Lavoisier and the Chemistry of Life. An Exploration of Scientific Creativity*, Madison, Wis., 1985.

Houghton, Bernard, *Scientific Periodicals. Their Historical Development, Characteristics and Control*, London, 1975.

Hückel, Walter, '100 Jahre Geschichte der Berichte', *Chemische Berichte*, *100* (1967), i-xxxix.

Ihde, Aaron J., *The Development of Modern Chemistry*, New York, 1964.

Jacques, Jean, *Berthelot, autopsie d'un mythe*, Paris, 1987.

James, F. (ed.), *The Correspondence of Michael Faraday*, Vol.2, 1832-1840, London, 1993.

Kapoor, Satish, 'Berthollet. Proust and Proportions', *Chymia*, *10* (1965), 53-110.

Kellner, L., *Alexander von Humboldt*, London, 1963.

Klooster, H.S. von, 'The story of Liebig's *Annalen der Chemie*', *Journal of Chemical Education*, *34* (1957), 27-30.

Klosterman, Leo, *Studies in the Life and Work of J.B. Dumas (1800-84): The Period up to 1850*, Ph.D. thesis, University of Kent, 1976.

Klosterman, L.J., 'A research school of chemistry in the nineteenth century: Jean-Baptiste Dumas and his research students', Part 1, *Annals of Science*, *42* (1985), 1-40.

Knight, D.M., *Ideas in Chemistry. A History of the Science*, London, 1992.

Kronick, David A., *A History of Scientific and Technical Periodicals*, 2nd edn., Metuchen, N.J., 1976.

Kuhn, T.S., *The Structure of Scientific Revolutions*, 2nd edn., Chicago, 1962.

Kuhn, T.S., 'Mathematical v. experimental traditions in the development of physical science', Chapter 3 of: *The Essential Tension. Selected Studies in Scientific Tradition and Change*, Chicago, 1977.

Lalande, J.J., 'Notice sur la vie et les ouvrages de Lavoisier', *Magasin encyclopédique*, *5* (1795), 174-188.

Langins, J., *La République n'a pas besoin de savants*, Paris, 1987.

Laplace, P.S., *Mécanique céleste*, vol.4, Paris, 1805.

Lechevalier, H.A. and Solotorovsky, M., *Three Centuries of Microbiology*, New York, 1974.

Lilley, S., '"Nicholson's Journal" (1797-1813)', *Annals of Science*, *6* (1948), 78-102.

Lindberg, David C. and Westman, Robert S., *Reappraisals of the Scientific Revolution*, Cambridge, 1990.

Macarthur, C.W.P., 'Davy's differences with Gay-Lussac and Thenard', *Notes and Records of the Royal Society of London*, *39* (1985), 207-228.

McClellan, J.E., 'The scientific press in transition: Rozier's Journal and the scientific societies in the 1770s', *Annals of Science*, *36* (1979), 425-449.

McKie, Douglas, 'Antoine Laurent Lavoisier, F.R.S., 1743-1794', *Notes and Records of the Royal Society of London*, *7* (1949-50), 9-13.

McKie, Douglas, *Antoine Lavoisier, Scientist, Economist, Social Reformer*, London, 1952.,

Mandelbaum, Jonathan, *La Société Philomatique de Paris de 1788 à 1835*, Doctorat du 3e cycle, Ecole des Hautes Etudes en Sciences Sociales, Paris, 1980.

Marcou, J., *De la Science en France*, 2 fasc,. Paris, 1869.

Meadows, A.J., *Communication in Science*, London, 1974.

Meadows, A.J.(ed.), *The Development of Science Publishing in Europe*, London, 1980.

Melhado, Evan M., *Jacob Berzelius, The Emergence of His Chemical System*, Stockholm, 1981.

Meyer, E. von, *History of Chemistry*, trans., London, 1898.

Moore, T.S. and Philip, J.C., *The Chemical Society, 1841-1941*, London, 1947.

Morrell, J.B., 'The chemist breeders; the research schools of Liebig and Thomas Thomson', *Ambix*, *19* (1972), 1-46.

Neave, E.W.J., 'Chemistry in Rozier's Journal', *Annals of Science*, *6* (1948-50), 416-20; *7* (1951), 101-6, 144-8, 284-92, 293-99, 393-400; *8* (1952), 28-45.

Nye, Mary Jo, 'Physics and chemistry: commensurate or incommensurate sciences?' in Nye, M.J., Richards, Joan L, and Stuewer, Roger (eds.), *The Invention of Physical Science*, Essays in honor of Erwin N. Hiebert, *Boston Studies in the Philosophy of Science*, *139* (1992), 205-224.

Nye, Mary Jo, *From Chemical Philosophy to Theoretical Chemistry. Dynamics of Matter and Dynamics of Disciplines, 1800-1950,* Berkeley, Cal., 1993.

Oberg, Lars, 'De mineralsura rökningarna. En episod ur desinfektions-medlens historia', *Lychnos*, (1965-66), 159-180.

Pacquot, C., *Histoire et développement de la Société chimique depuis sa foundation*, Paris, 1950.

Partington, J.R., *History of Chemistry*, vol.3, London, 1962, vol.4, London, 1964.

Partington, J.R. and Mckie, D., 'Historical studies on the phlogiston theory', *Annals of Science*, *2* (1937), 361-404; *3*(1938), 1-58, 337-371;*4*(1939-40), 113-149.

Pasteur, Louis, *Oeuvres*, 7 vols., Paris, 1922-39.

Patterson, T.S., 'Jean Beguin and his *Tyrochinium Chymicum*', *Annals of Science*, *2* (1937), 243-98.

Pera, Marcello and Shea, William R., *Persuading Science. The Art of Scientific Rhetoric*, Canton, MA., 1991.

Perrin, Carleton E., 'The triumph of the antiphlogistians' in Harry Woolf (ed.), *The Analytic Spirit. Essays in the History of Science in Honor of Henry Guerlac*, Ithaca, N.Y., 1981, pp.40-63.

Phillips, J.P., 'Liebig and Kolbe, critical editors', *Chymia*, 11 (1966), 89-98.

Quetelet, A., 'Notice historique sur J. B. Van Mons, membre de l'Académie Royale', *L'Annuaire de l'Académie Royale des Sciences et Belles Lettres de Bruxelles*, 9e année, 1843.

Ramsay, Sir William, *The Life and Letters of Joseph Black, M.D.*, London, 1918.

Rétard, Pierre, *Les journaux de 1789. Bibliographie critique*, Paris, 1988.

Rétard, Pierre (ed.), *La révolution du journal, 1788-1794*, Paris, 1989.

Rocke, Alan J., *Chemical Atomism in the Nineteenth Century from Dalton to Cannizzaro*, Columbus, Ohio, 1984.

Sgard, Jean, *Dictionnaire des journaux, 1600-1789*, 2 vols., Paris & Oxford, 1991.

Siegfried, R., 'The discovery of potassium and sodium and the problem of the chemical elements', *Isis*, *54* (1963), 247-258.

Siegfried, R., 'Lavoisier and the phlogistic connection', *Ambix*, *36* (1989), 31-40.

Siegfried, R and Dobbs, B.J., 'Composition, a neglected aspect of the chemical revolution', *Annals of Science*, *24* (1968), 275-293.

Silliman, R.H., 'Fresnel and the emergence of physics as a discipline', *Historical Studies in the Physical Sciences*, *4* (1974), 137-162.

Simpson, A.D.C.(ed.), *Joseph Black. A Commemorative Symposium*, Edinburgh, 1982.

Singer, Charles, *The Earliest Chemical Industry. An Essay in the Historical Relations of Economics and Technology Illustrated from the Alum Trade*, London, 1948.

Skolnik, H. and Reese, K.M., *A Century of Chemistry. The Role of Chemists and the American Chemical Society*, Washington, D.C., 1976.

Smeaton, W.A., 'Guyton de Morveau: a bibliographical study', *Ambix*, *6* (1957), 18-34.

Smeaton, W.A., 'L'Avant Coureur. The journal in which some of Lavoisier's earliest research was reported'. *Annals of Science*, *13* (1957), 219-234.

Smeaton, W.A., *Fourcroy, Chemist and Revolutionary*, Cambridge, 1962.

Smith, John Graham, *The Origins and Development of the Heavy Chemical Industry in France*, Oxford, 1979.

[Société Chimique], *Centenaire de la Société Chimique de France (1857-1957)*, Paris, 1957.

Söderbaum, H.G. (ed.), *Jac. Berzelius Bref,* 6 vols. and 2 supplements, Uppsala, 1912-1941.

Szabadváry, Ferenc, *History of Analytical Chemistry*, Oxford, 1966.

Taylor, F.S., *A History of Industrial Chemistry*, London, 1957.

Théodorides, Jean, *Jean-Victor Audouin (1797-1841)*, Mémoires de la Section des Sciences, No.6. Paris, Bibliothèque nationale, 1978.

Thomson, T., *Système de chimie*, 9 vols., Paris, 1809.

Tiffeneau, M. (ed.), *Correspondance de Charles Gerhardt*, 2 vols., Paris, 1918-25.

Tucoo-Chala, Suzanne, *Charles-Joseph Panckoucke et la librairie française*, Pau, 1975.

Vouillot, Bernard, 'La Révolution et l'Empire: une nouvelle réglementation' in *Histoire de l'édition francaise*, vol.2, *Le livre triomphant, 1660-1830*, Paris, 1984, pp.526-535.

Ward, Albert, *Book Production, Fiction and the German Reading Public, 1740-1800*, Oxford, 1974.

Weeks, Mary, *Discovery of the Elements*, 7th edn., revised by Henry M. Leicester, Easton, Pa., 1968.

Wheeler, T.S. and Partington, J.R., *The Life and Work of William Higgins, Chemist (1763- 1825). Including Reprints of 'A Comparative View...'* Oxford, 1960.

Weisz, George, 'Paris Faculty of Medicine' in E. L. Newman (ed.) *Historical Dictionary of France from the 1815 Restoration to the Second Empire*, New York, 1987.

Wurtz, A., *Dictionnaire de chimie pure et appliquée*, vol.1, Paris, 1869.

Wurtz, A., *Les Hautes études dans les universités allemandes*, Paris, 1870.

NAME INDEX

Achard, F.C., 204
Adams, Edward, 205
Adet, Pierre-Auguste, 59, 71-75, 79, 93-4, 96, 98, 153, 169, 243, 301,302, 318
Ampère, André-Marie, 47, 168, 223-4
Arago, D.-F.-J.,
  and Academy, 233-4
  and *Annales*, 96, 119, 213-227, 238-9, 241, 243
  and Arcueil, 283
  career, 216, 220,318
  and meteorology, 225-6
  and physics, 219-228
Arfwedson, J.A., 229
Aristotle, 8, 23, 39
Arrhenius, Svante, 273
Audouin, Jean-Victor, 218
Avogadro, Amedeo, 150
Azaïs, P.-H., 149

Bailly, Jean-Sylvain, 27
Balard, Antoine-Jérôme, 249, 281
Baron, Théodore, 41
Barreswil, C.-L., 250-1, 272
Baumé, Pierre, 53, 121, 143
Beaumarchais, P.-A.C. de, 68
Becquerel, Alexandre-Edmond, 319
Becquerel, Antoine-César, 246
Becquerel, Henri, 243, 244
Beddoes, Thomas, 156
Beguin, Jean, 38
Beilstein, F., 287
Bérard, J.-E., 32, 149
Bergman, Torbern, 66, 138
Bernard, Claude, 288
Bernard (publisher), 105, 115, 125
Berthelot, P.-E.-M., 13, 243, 244, 251-5, 276-7, 285-6, 293,319
Berthollet, Amédée, 127
Berthollet, Claude-Louis, 31, 45, 72, 98, 99, 121, 125, 126, 286, 319
  absence from Paris, 85, 86
  and affinity, 33, 174, 188, 216
  and *Annales*, 72-4, 96, 108, 128, 168, 188, 198, 213, 243, 295, 303
  and applied chemistry, 161, 202
  and Berzelius, 100, 212
  chemistry related to physics, 213
  and definite proportions, 188
  letters, 74, 171, 212
  and oxygen theory of acidity, 75-6, 190-1
  as patron of Gay-Lussac, 108, 128, 283, 295
  and Society of Arcueil, 127-130, 283, 295
Bertin-Mourot, P.-A., 242, 319
Berzelius, J.J., 100-1, 173, 186, 187, 188-9, 200, 230, 235-6, 239, 247, 249, 270-1, 293
Bichat, M.-F.-X., 160
Biet, L., 178
Biot, Jean-Baptiste, 29, 30, 55, 128-130, 154, 215, 222, 224, 320
Black, Joseph, 14, 17, 53, 66, 79-80, 170, 305-6
Blainville, H.D. de, 138, 139
Boerhaave, Herman, 42
Boffe, Joseph de, 88-9
Bonaparte, *see* Napoleon

Bouillon Lagrange, E.-J.-B., 96, 107, 111, 174-5, 320
Boishaudran, Lecoy de, 292
Boussingault, J.-B., 241, 243, 279, 320
Bouty, E.-M.-L., 243
Bouvier, A.R., 227
Boyle, Robert, 41, 157
Breteuil, Baron de, 71-2, 300
Brewster, David, 223, 235
Brisson, Mathurin, 23, 27
Brissot, J.-P., 70
Brongniart, A.T., 125n, 218
Brugnatelli, L.V., 90, 91, 171, 266-7
Bucquet, Jean-Baptiste, 44
Buffon, G.-L.L, Comte de, 82, 146
Bunsen, R.W., 265, 289
Burdin, Claude, 227
Burke, Edmund, 7

Cadet, C.L., 113-114, 279
Cagniard de Latour, C., 246
Cahours, Auguste, 283, 284
La Caille, N.L. de, 43
Candolle, A. Pyramus de, 127n., 156
Carlisle, Anthony, 30
Carnot, Sadi, 293-4
Cattaneo, Antonio, 267
Caventou, Joseph, 229
Chandler, C.F., 268
Chaptal, Jean, 37, 48-9, 50-1, 86, 92, 95, 96, 108, 133, 155, 162, 174-5, 202-5, 243, 320
Charles, J.A.C., 27
Chenevix, R., 197
Chevreul, Michel-Eugène, 96, 168, 241, 243, 252, 321
Chladni, E.F.F., 224
Clément, Nicolas, 149-50, 169, 173, 184
Coleridge, S.T., 7
Comte, Auguste, 29
Condillac, Bonnot de, 44, 159
Condorcet, M.-J.-A.-N. C. de, 23, 60
Copernicus, N., 11, 24
Coulomb, Charles, 27, 59, 153
Couper, A.S., 281
Crell, F.L.F., 58, 64-8, 71-2, 89-90, 100, 262
Crochard, Nicolas, 105, 213, 217, 315
Croft, Henry, 261
Crookes, William, 261-2
Cruickshank, W., 136
Cuchet, G.J., 72, 83-4, 102, 142, 301
Curaudau, François, 148-9, 199
Curie, Marie, 255, 292
Cuvier, 'Georges', 138, 159

Daguerre, Louis-J.-M., 258
Dalton, John, 32, 189, 237, 256
D'Arcet, J.-P.-J., 44, 74-6, 96, 161, 169, 243, 246, 320
Daumas, Maurice, 43
Davisson, William, 39
Davy, Humphry, 7, 31, 47, 114, 132-3, 136, 144-5, 158, 180, 183-4, 198-200, 291
Davy, John, 131, 145, 180
Delambre, J.-B.-J., 33, 34, 35
De la Métherie, *see* La Métherie
Delaroche, F., 149
Delunel, 112
Demarçay, Horace, 247, 292
Descotils, H.-V.-C., 96, 126, 133, 7, 194, 212, 243, 321
Descroizilles, F.A.H., 170, 209n.
Desormes, C.B., 30, 149, 173, 184
Deyeux, Nicolas, 96, 111, 121, 204, 7, 243, 321
Diderot, Denis, 7, 8, 33, 177
Dietrich, P.-F., Baron de, 60, 72, 96, 97, 243, 322
Döbereiner, J.W., 232, 235, 246

Dugour, A.J., 84
Dulong, P.-L., 33, 96, 127n, 130, 243, 246, 322
Dumas, J.-B., 12, 231-2, 239-41, 243, 274-6, 279, 283, 287, 322
Duméril, A.-M.-C., 125n
Dupuytren, Guillaume, 156, 183

Edgeworth, Maria, 147
Ekeberg, A.G., 196
Erdmann, O.L., 263
Erlenmeyer, E., 264

Faraday, Michael, 237-8, 262
Férussac, Baron de, 246
Fischer, Emil, 266
Fittig, R., 286
Fontenelle, B. le Bovier de, 77
Foster, Henry, 226
Fourcroy, A.-F., 12, 16, 21, 35, 37, 96, 105, 106, 107, 121, 134, 155, 162, 173, 191, 286, 322
  and *Annales*, 72, 94-5, 96, 106-8, 109-13, 117, 155, 175-6, 243
  and chemical revolution, 12, 21
  and natural history tradition, 16
  and pharmacy, 108, 109-13
  textbooks, 47-8, 174, 286
  and Vauquelin, 107, 125, 172, 195-6
Fourier, Joseph, 225
Francis, William, 261
Frankland, E., 260
Fremy, Edmond, 286
Fresenius, K.R., 272
Fresnel, Augustin, 219-122
Friedel, Charles, 243, 244, 250, 269, 280, 282, 323
Fuchs, 103, 104, 125, 310-11

Galvani, Luigi, 30
Gaudin, A.M., 232
Gauthier de Claubry, H.F., 246
Gay-Lussac, Joseph-Louis, 32, 33, 55, 126, 205, 231-2, 323
  and Academy, 126, 215, 226, 280
  and *Annales de chimie*, 96, 108, 145, 150, 243
  and *Annales de chimie et de physique*, 119, 149, 213-19, 226, 228, 235-6, 238-9, 241
  and Arcueil, 28, 126, 129, 150
  and Berthollet, 106, 108, 128, 129, 283
  and Davy, 132-3, 198-201
  and Lavoisier, 274-5
  and oxygen theory of acidity, 191-2
  physical approach to chemistry, 216, 231
  and Thenard, 173, 185, 198-200
Gehlen, A.F., 67, 197, 262
Geiger, Philipp Lorenz, 263
Geoffroy, E.F., 47
Gergonne, J.D., 224
Gerhardt, Charles, 240, 247-9, 268, 270, 280, 287, 293
Germain, Sophie, 225
Gilbert, F.-H., 263
Girard, Pierre-Simon, 269
Glaser, Christofle, 39
Glauber, J.R., 39
Gmelin, C.G., 247
Graham, Thomas, 259, 264
Grégoire, Henri, 82
Gregor, William, 194-5
Gren, F.A.C., 183
Grimaux, Edouard, 12, 71, 276
Gruvel, 99
Guillaume, Laurent Mathieu, 85, 102-3, 118
Guillemain, 246
Guye, Philippe, 273
Guyton [de Morveau], L.-B., 134,323

and *Annales*, 71-4, 85, 86, 94-5, 96, 98-99, 107, 108-9, 112, 212-13, 243, 303
and disinfection, 127, 175, 206-9
and nomenclature, 18, 54
and phlogiston theory, 10, 49

Hachette, J.-N.-P., 167, 237-8
Haller, Albin, 243, 323
Hassenfratz, J.-H., 27, 71, 72, 96, 98, 105, 243, 324
Hatchett, Charles, 171, 196
Haussman, Jean Michel, 170n, 202
Haüy, R.J., 24, 74, 139, 146, 153
Henry, William, 6, 267
Herschel, John, 211, 218
Herschel, William, 32
Higgins, William, 20-1
Hisinger, Wilhelm, 194
Hodgskin, Thomas, 257
Hoff, van't, J.H., 273, 289
Hofmann, A.W., 260, 264, 265, 266, 289, 291
Humboldt, A. von, 94, 129, 130n, 172, 220

Ingen Housz, Jan, 31

Jacquin, N.J., 53
Jungfleisch, E.C., 285

Keir, James, 78, 92
Kekulé, F.A., 242, 264, 281
Kerr, Robert, 44
Kirwan, Richard, 18, 20, 78, 303
Klaproth, M.H., 67, 194-5, 196
Klostermann, J., 101, 105, 125, 212
Kolbe, Hermann, 266, 289
Kopp, E., 251
Kopp, Hermann, 264, 271
Kuhn, T.S., 10

Lalande, Lefrançois de, J.-J., 51, 111n
Lamarck, Jean-Baptiste, 21, 148
La Métherie, J.C. de, 19, 24, 53, 63, 129, 137-151, 185, 199
Lampadius, W.A., 229
Laplace, Pierre-Simon, 25, 28-9, 51, 122, 127-130, 144, 151, 183, 219, 224, 283
Lassaigne, J.L., 246
Laugier, André, 108, 134, 173, 246
Laurent, Auguste, 231, 239-40, 248-9, 258, 280, 293
Lavoisier, Antoine-Laurent,
and Academy, 9, 26, 43, 49-50, 53-4, 71, 74
and *Annales*, 59, 71-2, 80, 81-2, 96, 243, 300, 302
and caloric, 14-15, 21, 224
career, 8, 81-2, 111n., 324
and chemical revolution, 11-12, 13-14
and collaborators, 15, 19, 44, 45, 50
and composition of water, 30, 181
and conservation of matter, 17, 32
and elements, 31
and Enlightenment, 60
execution, 82
experimental details, 56-7
experimental errors, 143, 181
as hero, 274-5, 277, 289
influence of, 47, 274-5
and La Métherie, 138
and language, 44-5
and Laplace, 28, 144
letters, 48-9, 79-80
and nomenclature, 18
organic analysis, 185
originality disputed 53, 143
and oxygen theory, 14, 49-50, 181

oxygen theory of acidity, 15-16, 189-90
and phlogiston, 20, 50
physical approach, 17, 26
quantitative analysis, 185, 187
and respiration, 158, 182
revision of memoirs, 51, 53
and textbook, 41, 42-7, 55-7, 143
Lavoisier, Madame, 20
Leblanc, N., 162
Lefèvre-Gineau, L., 27
Le Fèvre, Nicase, 39
Léman, D.S., 126
Lemery, Nicolas, 40-2, 109
Libavius, Andreas, 38
Liebig, Justus von, 186, 235, 236-7, 242, 263-4, 271, 286, 290-1
Lippmann, Gabriel, 243, 324
Luc, Jean-André De, 20, 148, 154

Macquer, Pierre-Joseph, 42, 47, 69
Majocchi, G.A., 267
Malaguti, F.J.M., 240
Malesherbes, C.-G., 68-9
Malus, Etienne-Louis, 29, 128-9, 133
Maret, Huges-Bernard, 132
Marignac, J.C.G. de, 196, 283
Marivetz, 148
Marsh, James, 258
Martin, Charles, 246
Mascart, Eleuthère-Elie-Nicolas, 243, 244, 280, 324
Masson , 254, 317
Maurice, F.G., 135
Méchain, P.-F.-A., 27
Melloni, Macedonio, 225
Mersenne, Marin, 51
Millon, E., 249
Mirabeau, H.G.R., comte de, 70
Mitchill, S.L., 267
Mitscherlich, A., 230, 235, 286
Mohr, Friedrich, 264
Moissan, Henri, 243, 325
Moll, Gerrit, 145, 211
Monge, Gaspard, 45, 72, 86, 96, 98-9, 153, 154, 161, 165, 219, 243, 325
Mongez, Jean-André, 53, 137
Monnet, Antoine, 147
Morse, Samuel, 235
De Morveau, *see* Guyton de Morveau
Müller, F.J., Baron von Reichenstein, 195

Napoleon (Bonaparte), 97, 101, 130-1, 165, 211, 309-10
Newton, Isaac, 4, 56, 62, 106, 224
Nicholson, William, 30, 89, 255
Nilson, L.F., 292
Nobili, L.N., 237
Nollet, Jean-Antoine, 25, 27, 43

Oersted, Hans Christian, 149, 222-3
Oldenburg, Henry, 54, 168
Opoix, Christophe, 148

Panckoucke, C.J., 130
Paracelsus, 16, 38, 39, 157
Parmentier, Antoine-Augustin, 96, 111, 114, 203-4, 243, 325
Pasteur, Louis, 205, 234, 244, 276, 288, 326
Paterno, E., 267
Payen, Anselme, 246, 279
Pearson, George, 153, 171
Peligot, Eugène, 194
Pelletier, B., 86, 96, 97, 121, 161, 229, 243, 279, 326
Pelouze, T.J., 236, 241, 243, 286, 326
Perdonnet, 246
Perkin, William, 291
Peronneau, H.L., 105
Petit, A.-M.-T., 33, 294

Phillips, Richard, 256
Pictet, Charles, 135
Pictet, Marc-Auguste, 94-5, 135-7
Pixii, 228
Plantamour, P., 247
Poggendorff, J.C., 242, 263
Poisson, Siméon-Denis, 29, 222, 225
Poncelet, Jean-Victor, 227-8
Prévost, Pierre, 221
Priestley, Joseph, 11, 18, 20, 31, 53, 78-9, 303
Prieur-Duvernois, C.-A., 86, 96, 97, 99, 107, 155, 164, 176, 200, 243, 326
Proust, J.-L., 22, 114, 169, 174, 187-8, 176, 203
Prout, William, 186, 256

Quesneville, G.A., 247

Regnault, H.-V., 241, 243, 252, 286, 327
Reiset, J., 249
Remsen, Ira, 268
Riche, C.A., 124
Riche, J.-B.L.A., 269
Roard, J.L., 203
Robespierre, M., 81, 84
Robin, Charles, 170
Roebuck, John, 184
Romé de l'Isle, J.-B.-L., 139, 146
Rose, Heinrich, 196, 197, 235
Rouelle, G.F., 7-8, 43
Rousseau, Jean-Jacques, 9
Rozier, François, 51-3, 175
Rutherford, Daniel, 53

Sage, B.G., 146-7
Sainte-Claire Deville, H., 279, 281, 284
Savart, Félix, 224
Savary, Félix, 241, 243, 327
Scheele, C.W., 90
Scherer, A.N., 262
Scheurer-Kestner, A., 251
Schulze, J.H., 31
Schweigger, J.S.C., 263
Séguin, Armand, 47, 50, 98, 98-9, 153, 167, 182-3, 203, 243, 327
Sembenini, 267
Sénarmont, H.H. de, 243, 284
Sertuerner, F.W.A., 228
Sieyès, E.J., 69
Sigaud de la Fond, 23
Sigorgne, Pierre, 148
Silliman, Benjamin, 235, 267
Smyth, James Carmichael, 207
Stahl, G.E., 11, 20, 65, 181, 289
Stewart, Dugald, 88
Stromeyer, F., 229
Svanberg, L., 247, 271
Sylvestre, M., 124

Tassaert, B.M., 99-100, 328
Taylor, Charles, 171
Tennant, Smithson, 197
Thenard, Louis-Jacques, 32, 33, 96, 108, 112, 126, 129, 145, 167, 173, 185, 199, 203, 229, 243, 250, 286, 328
Thomson, Thomas, 256, 286, 291
Thomson, William, 242
Tigny, Madame, 178n
Trommsdorff, J.B., 67, 91, 264

Vandermonde, A., 74, 161
Van Mons, Jean-Baptiste, 86, 90-1, 96, 97, 99, 243, 328
Vauquelin, Nicolas-Louis, 94, 96, 97, 99, 107, 108, 114, 121, 134, 172n, 194-6, 203, 216, 243, 279, 328
Venel, G.F., 17
Verdet, Marcel-Emile, 242, 243, 329

Verguin, Emanuel, 291
Volhard, Jacob, 264
Volta, Alessandro, 30, 171
Voltaire, 9, 68

Warington, Robert, 259
Watt, Charles, 257-8
Watts, Henry, 260-287
Weber, J.A., 66
Westrumb, J.F., 60, 153
Winkler, C.A., 292
Wöhler, F., 228, 247, 264, 265, 286, 289
Wollaston, W.H., 32, 33, 189, 196, 197, 198, 235
Woolf, Arthur, 227, 233
Wurtz, Charles-Adolphe, 13, 242, 243, 244, 250, 253-4, 269, 276, 280-2, 285-6, 287, 288, 329

Young, Thomas, 219

Zantedesschi, 267

SUBJECT INDEX

abstracts, 268-70
Academy of Sciences
  Mémoires, 49-51
  post-revolutionary, 232-4, 278-80
  pre-revolutionary, 9, 25, 27, 72-6, 93
  (*see also* First Class of the Institute)
acoustics, 224
affinity, chemical, 45
agriculture, 158
air, composition of, 8, 15, 143, 181
alchemy, 38, 157
alkali metals, 198-9
alkaline earths, 200
alkaloids, 228-9
alum, 203
America, 77, 78, 235, 267-8
analysis
  inorganic, 187-8, 194-8, 236
  organic, 185-6, 237
Annales de chimie
  authority of, 63
  book reviews, 173-5
  break in publication, 81-6
  circulation, 117-19, 216-17, 254-5
  censorship in, 5, 145, 221, 238-40,
  controversies in, 222
  correspondence, 3, 167-72, 215
  editorial board, 92-101, 165, 241-4
  index volumes, 176-9
  international character, 76-7, 235
  influences nomenclature, 229
  obituaries, 173
  politics of, 183, 219,241
  price, 105, 217
  profits from, 217,254
  refereeing of papers, 93, 150
  reorganisation, 212-13
  resumption of publication, 84-6, 107
  style, iii, 60
  translations, 86-90
'antiphlogistic theory', 20-1
Arcueil *see* Society of Arcueil
atomic theory, Dalton's, 256, 286
atomic weights, 230
atomism, 45, 232, 252

balance, chemical, 17
balloon, hydrogen, 9, 154, 163
bankrupcy of publishers, 94, 101, 103, 105
Belgium, 90-1
bleaching, 202
boundaries between subjects, 22, 29-30, 211, 313

caloric, 14-15, 21
censorship, political, 5, 68, 69-71, 130-1
Chemical Society of London, 259-60, 265
chemistry, 7, 61, 108,
  applied, 111n., 201-6, 272-3
  British, 170-1, 255-62
  as a laboratory subject, 26, 34, 287, 290
  laws of, 32-3, 129
  lectures, 7-8, 43
  a model science, 159-60
  as natural history, 16-17
  nomenclature, 18, 34, 54, 75, 77, 142
  organic, 185-6, 231, 239
  physical, 28, 109, 188, 216,231, 273, 284
  revolution in, 10ff., 214, 276
  schools of, 282-6
  textbooks, 37-49, 286-7
  word added to title of journal, 120-1, 140-2
chlorine, 200, 202
conservation of matter, 17, 32, 46

conversion to new theory, 48-9, 79

disinfection, 206-9
Dutch chemists, 172n.
dyeing, 202-3

Ecole Polytechnique, 134, 159, 216, 218, 220, 284
Edinburgh, 79, 291
electricity, 30-1
Enlightenment, 8, 60, 207
elements
  Aristotelian, 8, 181
  naming of, 292
  of Lavoisier, 45, 142-3, 193
electrochemistry, 30-1, 230-1
electromagnetism, 222-4, 237
environmental science, 220
equations, chemical, 17, 46, 159
European perspective of *Annales*, 76, 101, 170-1, 302-4
experiments, difficult to repeat, 56-7
French language, 52, 77, 242, 296
fringe,scientific, 146-51

galvanism, 30-1
gases, 15
Geneva, 135-6
German correspondents, 171
German periodicals, 64-8, 262-6
government subsidy for publication, 114-17, 130

heat, (*see also:* caloric), 224-5, 293-4
historiograsphy, 13, 14

Institute, First Class of, 121-3, 166-7, 279
iodine, 200-1
isomerism, 228
isomorphism, 230
Italian correspondents, 171
Italian journals, 266-7

joint authorship, 172-3

laboratories, 34, 128, 283, 287-8, 290
laws, chemical, 32-3
liberty of the press, 70
light related to chemistry, 31-2

magnetism, terrestrial, 220, 226-7
mathematics, 33, 35
mechanical philosophy, 40-1
mechanics, 26
medicine, 155-6
meteorology, 214, 225-6, 314
metric system, 155, 163-4
mining, 133-4
Muséum d'Histoire Naturelle, 134

nationalism, 13, 67, 288-90
newspapers, 1-2, 68-70, 130-2

optics, 219-22
oxidation, 184
oxygen theory of acidity, 15-16, 46, 189-92
oxygen theory of combustion, 14, 180-2

paper shortage, 81
Paris, 164-6
pharmacy, 38-41, 92, 107, 109-14, 279
Philomatic Society, 123-7
phlogiston theory, 10, 50, 78, 79, 144
physics, 22-9, 34, 215, 219-27, 293-4
'pneumatic theory', 21-2, 266
poisoning, 205, 258
printing, 68ff., 82-4, 101-3, 213
professional science, 8
proportions,
  definite, 187-8, 293
  multiple, 189
publishers, 68-70, 82-6, 101-5

respiration, 15, 182-3
revolution, chemical, 10ff., 214
revolution, scientific, 10
Royal Institution, 31
Royal Society, 30, 200

saltpetre, 162

Société chimique, 280-2
Society of Arcueil, 28, 127-30, 294
soda, 162
Spanish correspondents, 171
steam engines, 227
steel, 161
substitution theory, 231
sugar, 203-4
Swedish correspondents, 171

thermodynamics, 293-4, 329
turbine, 227-8

utility of chemistry, 7, 61, 160-3

war, revolutionary, 160-3, 201, 306
water, composition of, 9, 15, 30, 78
water power, 227-8
wine, 204-5

JOURNAL INDEX

(Eighteenth and nineteenth centuries by language/country)

FRENCH

Annales de chimie, 71ff and *passim*
Annales de chimie et de physique, 211ff
Annales de mathématiques, 224
Annales du Muséum d'Histoire Naturelle, 134
Annuaire de chimie, ed. Millon and Reiset, 249
Annuaire des sciences chimiques, ed. Berzelius, 247
Bibliothèque britannique, (Geneva) ed. M.A. Pictet, 135-7
Bulletin de la Société chimique, ed. Wurtz and Leblanc, 250-52
Bulletin de la Société d'Encouragement pour l'Industrie nationale, 173
Bulletin des sciences mathématiques, astronomiques, physiques et chimiques, ed. Férussac, 246
Bulletin des sciences par la Société philomathique de Paris, 123-7
Chimie analytique, 273
Comptes rendus des travaux chimiques, ed. Laurent and Gerhardt, 273
Comptes rendus hebdomadaires des séances de l'Académie des Sciences, 245-6
Connaissance des temps, 225
Décade philosophique, 123
Journal de chimie, ed. Van Mons, 91
Journal de chimie physique (founded 1903), 273
Journal de l'Ecole Polytechnique, 134
Journal de physique (founded 1872), 273
Journal de physique, de chimie ..., ed. La Métherie, 137-151
Journal des mines, 133-4
Journal du galvanisme, 173
Journal du mineur et du naturaliste, 134
Magasin encyclopédique, 84
Mémoires de l'Académie Royale des Sciences, 49-51
Mémoires de l'Institut ... Sciences mathématiques et physiques, 121
Mémoires ... de la Société d'Arcueil, 127
Mémoires des savants étrangers (Institut/Académie des Sciences), 123
Le Moniteur, Journal officiel, 130-3, 199-200
Moniteur scientifique, ed. Quesneville, 247
Nouveau bulletin des sciences par la Société philomathique de Paris, 125-6
Observations ... sur la physique ..., ed. La Métherie, 51-4
Rapport annuel sur le progrès des sciences physiques et chimiques, ed. Berzelius, 247
Répertoire de chimie, de physique et d'application aux arts, ed. Martin, 246

Répertoire de chimie et mémorial des travaux étrangers, 247
Répertoire de chimie pure, 250
Répertoire de chimie scientifique et industrielle, 246-7
Revue général de chimie pure et appliquée, 272

BRITAIN

The Analyst, 260
Annals of Philosophy, ed. Thomson, 256
Chemical Gazette, ed. Francis and Croft, 261
Chemical News, ed. Crookes, 261-2
The Chemist, ed. Hodgskin (1824-25), 256-7
The Chemist, ed. Watt (1840), 257-8, 260
The Chemist; a Monthly Journal of Chemical and Physical Science, 260
Edinburgh Review, 255
Journal of the Chemical Society, 260
Journal of Natural Philosophy, Chemistry and the Arts, ed. Nicholson, 89, 255
Memoirs of the Chemical Society of London, 259
Nature, 245
Philosophical Magazine, ed. Tilloch, 255
Philosophical Transactions of the Royal Society, 54
Quarterly Journal of the Chemical Society, ed. Watts, 260

GERMAN

Allgemeines Journal der Chemie, ed. Scherer, 262
Almanach oder Taschenbuch für Scheidekünstler und Apotheker, 66
Annalen der Chemie und Pharmazie, ed. Liebig *et al.*, 264
Annalen der Pharmazie, 264
Annalen der Physik, ed. Gilbert, 263
Annalen der Physik und Chemie, ed. Poggendorff, 263
Annalen der Physik und physikalischer Chemie, 263
Archiv des Apothekervereins in nördlichem Deutschland, 264
Berichte der Deutschen Chemischen Gesellschaft, 265
Die Beyträge zu den chemischen Annalen, ed. Crell, 67
Chemische Annalen, ed. Crell, 66-7
Chemisches Journal, ed. Crell, 65
Jahrbuch der Chemie und Physik, 263
Jahresberichte über die Fortschritte der Chemie, 247, 270-1
Journal der praktischen Chemie, ed. Erdmann (1834), 263
Journal der praktischen Chemie, ed. Kolbe (1870), 266
Journal für die Chemie, Physik und Mineralogie, ed. Gehlen, 263
Justus Liebigs Annalen der Chemie, 264
Magazin für Pharmazie in Verbindung mit einer Experimentalkritik, ed. Geiger and Liebig, 263

Magazin für Pharmazie und die dahin einschlagenden Wissenschaften, ed. Geiger, 263
Neues allgemeines Journal der Chemie, ed. Gehlen, 262-3
Neues Jahrbuch der Chemie und Physik, 263
Neues Journal der Pharmazie für Ärzte, Apotheker und Chemiker, ed. Trommsdorff, 264
Die neuesten Entdeckungen in der Chemie, ed. Crell, 66
Physikalische-chemisches Magazin für Aerzte, Chemisten und Kunstler, ed Weber, 66
Zeitschrift für analytische Chemie, 272
Zeitschrift für angewandete Chemie, 272
Zeitschrift für anorganische Chemie, 265
Zeitschrift für physikalische Chemie, 273

ITALY

Annali di chimica, ed. Brugnatelli, 266, 267
Annali di chimica applicata alla farmacia, ed. Cattaneo, 267
Annali di fisica, chimica e matematica, ed. Majocchi, 267
Annuario delle scienzi chimiche, farmaceutiche e medicolegal, ed. Sembenini, 267
Bibliothek di farmacia, ed. Cattaneo, 267
Gazzetta chimica italiana, ed. Paterno, 267
Gazzetta eclettica di chimica farmaceutica, ed. Sembenini, 267
Gazzetta eclettica di chimica technologia, ed. Sembenini, 267
Giornale di farmacia, chimica e scienze accessorie, ed. Cattaneo, 267
Giornale di fisica, chemica e storia naturale, ed. Brugnatelli, 266
Raccolta fisico-chimica italiana, 267

U.S.A.

American Chemical Journal, ed. Remsen, 268
The American Chemist, ed. Chandler, 268
American Journal of Science, ed. Silliman, 267
Boston Journal of Chemistry, 268
Journal of the American Chemical Society, 268
Journal of Applied Chemistry, 268n.
Journal of Analytical Chemistry, 268
Journal of Physical Chemistry, 273
Medical Repository, ed. Mitchill, 267
Memoirs of the American Academy of Arts and Science, 267
Proceedings of the American Chemical Society, 268
Transactions of the American Philosophical Society of Philadelphia, 267