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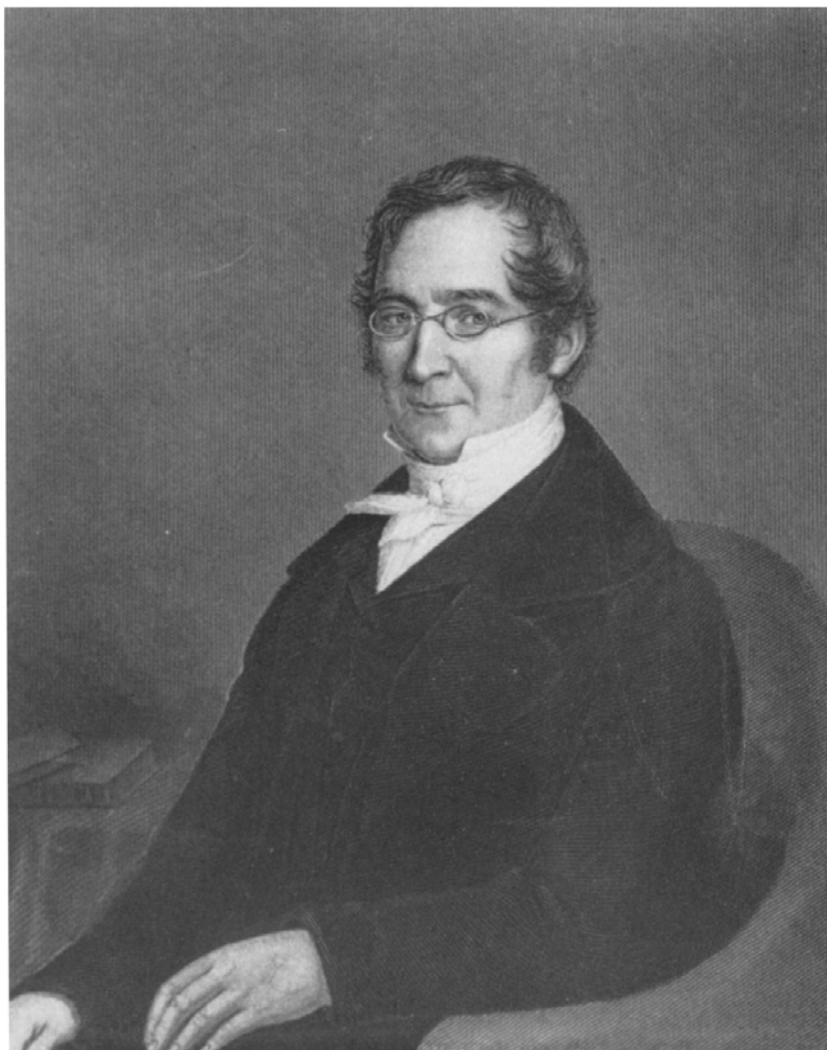
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A stylized, cursive signature of Gay-Lussac enclosed in an oval. The signature is written in a fluid, handwritten style with a large initial 'G' and 'L'.

Gay-Lussac in later life.

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Gay-Lussac

Scientist and bourgeois

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Contents

| | | |
|---|--|-----|
| | <i>Preface</i> | ix |
| | <i>Chronological table</i> | xiv |
| | <i>List of abbreviations</i> | xvi |
| 1 | A young provincial in Paris | 1 |
| | Introduction | 1 |
| | Early education | 4 |
| | The Ecole Polytechnique | 9 |
| | The Ecole des Ponts et Chaussées | 17 |
| 2 | The apprentice of Arcueil | 21 |
| | Assistant to Berthollet | 21 |
| | The thermal expansion of gases as studied by Gay-Lussac and Dalton | 25 |
| | Balloon ascents | 28 |
| | Election to the Institute | 31 |
| | The Arcueil group | 32 |
| | On the staff of the Ecole Polytechnique and a European tour | 34 |
| | Marriage | 40 |
| 3 | Personal influences and the search for laws | 43 |
| | Lavoisier's influence | 44 |
| | Berthollet's influence | 47 |
| | Laplace's programme and influence | 49 |
| | The influence of the Arcueil circle on the formulation of the law of combining volumes of gases | 59 |
| | The search for laws | 54 |
| | The law of combining volumes of gases | 59 |
| | Scientific laws | 62 |
| | Tables and graphs | 63 |

CONTENTS

| | | |
|---|--|-----|
| | Analogical argument and classification | 67 |
| | Scientific method | 68 |
| 4 | Collaboration and rivalry | 71 |
| | Rivalry with Davy | 73 |
| | The 'discovery' of iodine | 80 |
| | Differences of style and character | 87 |
| 5 | The volumetric approach | 92 |
| | Reacting volumes and chemical composition | 100 |
| | Vapour densities | 104 |
| | Organic chemistry and the practical determination of vapour densities | 107 |
| | The influence of the volumetric approach | 109 |
| 6 | Scientific research | 115 |
| | Scientific productivity | 115 |
| | Work in physics | 117 |
| | The physical chemist | 128 |
| | Prussic acid and cyanogen | 129 |
| | The problem of acidity | 131 |
| | Isomerism | 134 |
| | Atomic weights and equivalents | 136 |
| | Fermentation | 140 |
| 7 | Professor, Academician and editor | 143 |
| | The Faculty of Science | 144 |
| | The Ecole Polytechnique | 151 |
| | The Muséum d'Histoire Naturelle | 156 |
| | The Academician | 159 |
| | The <i>Annales de chimie et de physique</i> | 166 |
| | Gay-Lussac under attack | 175 |
| 8 | A scientist in the service of government and industry | 178 |
| | The Gunpowder Service | 181 |
| | The Mint | 188 |
| | Alcoholometry | 190 |
| | Stearic candles | 193 |
| | The Saint-Gobain Company | 195 |
| | The Gay-Lussac tower | 199 |

CONTENTS

| | | |
|----|--|-----|
| 9 | A new technique and the dissemination of technical information | 205 |
| | Volumetric analysis | 205 |
| | Apparatus | 211 |
| | <i>Instructions</i> | 214 |
| | Estimation of saltpetre | 216 |
| | Estimation of bleaching powder | 218 |
| | Estimation of silver | 219 |
| | Lightning conductors | 222 |
| 10 | Scientist and bourgeois in the political arena | 226 |
| | Salaries and sympathies | 228 |
| | The political arena | 234 |
| | The Chamber of Deputies | 236 |
| | Protectionism | 239 |
| | Applied science and industry | 242 |
| 11 | The legacy | 248 |
| | Students and research associates | 249 |
| | The family | 253 |
| | Conclusion | 255 |
| | <i>Appendix: select correspondence</i> | 263 |
| | <i>Notes</i> | 280 |
| | <i>Select bibliography</i> | 312 |
| | <i>Name index</i> | 325 |
| | <i>Subject index</i> | 330 |

Preface

‘I should place him [Gay-Lussac] at the head of the living chemists of France’

Humphry Davy¹

‘one of the first [natural] philosophers of the age’

J. F. Daniell²

The name of Gay-Lussac is remembered in many ways. His work on the density of alcohol–water mixtures is perpetuated in the ‘degrees Gay-Lussac’, which in France have come to replace the medieval ‘degrees proof’ as a means of describing the strength of alcoholic drinks. The ‘Gay-Lussac tower’ was the name given to a vital part of the manufacture of sulphuric acid in recognition of Gay-Lussac’s contribution to this industry. The scientist’s name is associated with a type of barometer and a burette. He is also commemorated in the mineral ‘Gay-Lussite’³ and in *Gaylussacia*, the botanical name for the huckleberry. Perhaps Gay-Lussac himself would have derived most satisfaction from being remembered above all as the man who formulated two fundamental laws of nature. If his own scrupulous acknowledgment of unpublished antecedents has meant that his law of the thermal expansion of gases is now more generally known as ‘Charles’ law’, at least his discovery of the regularity in the ratio of the volumes of combining volumes of gases is still appropriately known, and learned by every elementary student of chemistry as ‘Gay-Lussac’s law’. Yet he is so little known as a man that he is listed in the British Library catalogue – a source of international repute – as Gay-Lussac, *Nicholas François*, although his Christian names were indisputably *Joseph Louis*. In his own day the label ‘Gaylussacite’ (*gaylussacien*) was used by his enemies to denote a member of the scientific establishment, but such usage becomes redundant after a man’s death.

This biography will help give flesh and bones to one of the names found in science text-books but, in so doing, it may also make a small contribution to a fuller understanding of the development of science. The study of individual cases can do something to correct the picture of

PREFACE

science and scientists given by those who wish to make generalisations about the subject but have no time or inclination to go back to the sources.

The dearth of biographies of important French scientists compared to the relative abundance of biographies of British scientists was commented on at the beginning of this century.⁴ Recently the same phenomenon has been commented on again and a historian has remarked that there are not yet enough examples available of detailed lives of scientists. He continues:

French scientists have suffered particularly from this neglect. Biography is not a genre that the French excel in. This is due partly to a preference for more grandiose philosophical themes than mere individuals can provide, and partly to a powerful tradition of *éloges*, raised to a high level by the Academies, which has encouraged subtle essay-writing more than detailed research.⁵

Gay-Lussac certainly obtained his *éloges* and he has also been fêted by French local historians. It is high time that a more serious biography was written of a man who made major contributions to physics and chemistry and who has a claim to be considered as one of the first professional scientists.

But a biography is not a hagiography. Gay-Lussac was a scientist and a man and not a saint. I have tried to place the man in his intellectual, social and national context and have indicated this by the title of the book. The term 'bourgeois' should be understood descriptively rather than pejoratively. It is intended to signify that Gay-Lussac was born into a middle-class French family and always stayed within a middle-class context. This was not so important at the beginning of his career in Napoleonic France, but in the 1830s and 1840s under Louis Philippe Gay-Lussac can be taken as an example of a French citizen in the professional classes or the upper bourgeoisie. His habits of hard work and his sense of duty and responsibility were qualified by the common desire to build up a small fortune. The desire to provide for his family was one of several factors which led Gay-Lussac away from pure science to applied science. Thus in order for us to understand why he chose to do one piece of research rather than another it is not sufficient to look within science. Scientific problems must be seen against the background of Gay-Lussac's employment, his place in the Academy of Sciences, his colleagues, friends and family.

The Academy⁶ made a distinction in 1803 between the mathematical sciences and the natural sciences. As Gay-Lussac's work was in physics and chemistry, his research lay at the interface of these two divisions,

PREFACE

making some use of mathematics but also having sympathy with more descriptive sciences. Thus his work was more central and perhaps more typical of 'French science' than, say, the work of a mathematician or a botanist. The distinction between mathematical science and natural science was recognised in the Faculty of Science and students for the first degree were required to attend lectures in one branch only. The course on basic physical science, taught by Gay-Lussac, was the only one common to the two programmes.

In describing the work of a scientist it is understandable that one should emphasise his successes, but one should also say something about failures, which can be equally instructive in arriving at an understanding of one's subject and the problems of his time. Any biographer is tempted to pursue relentlessly the details of his subject's life and work. I have exercised some restraint here. Although I have tried to get inside my subject to understand how his mind worked, I have also considered him against the background of his contemporaries. I feel that it is important not only to know what Gay-Lussac did but also how this differed from the work of other scientists of the time.

I have gone out of my way to suggest where Gay-Lussac obtained his ideas and to stress the influence of his mentors. But to do this is not to suggest that his work was mostly derivative. We may wish to know if some of Gay-Lussac's inspiration is found in his predecessors, but we are even more interested in how he took further their ideas and modified them.

I used to think of the biography of a scientist as falling naturally into two parts – life and work. In such an account one would deal first with personal details before examining fairly exhaustively and in chronological order all the scientific work of one's subject. This method of working is clearly easier since the writer is not forced to ask himself continually whether there is any relation between the scientist's life and his work. Indeed it is a convenient format for any author who may not think there is much connection between the two and perhaps merely recounts some biographical information by way of introduction. My approach has been to relate as far as possible the life and the work, believing as I do that every man is a child of his age; his life and his work can best be understood against the backcloth of the culture in which he grew up. Science is the product of scientists, both as individuals and in organised groups and this is the justification for writing the biography of any scientist. I have been selective rather than exhaustive and I have not shirked the responsibility of interpretation and evaluation.

A chronological table has been introduced which fulfils the double

PREFACE

purpose of showing what Gay-Lussac did year by year and of providing a reminder of the general historical background. This has left me free to take a thematic rather than a strictly chronological approach to the life and work of the French savant and thus to relate him to his contemporaries and to more general problems. This discussion in one place of particular themes, e.g. scientific rivalry, educational institutions, the search for laws of nature, has certain advantages for the reader with broad interests in the social or philosophical aspects of science and for whom this study of Gay-Lussac might provide fresh data. Such a reader can be selective in his reading of the book and, I hope, easily find material on some aspect of nineteenth-century science which is illustrated in the life and work of Gay-Lussac. A historian with little interest in the details of scientific research might pass over chapters 5 and 6 and still get something from the remainder of the book.

A collection of previously unpublished letters is included in a collection of primary source materials in the Appendix. A few extracts in translation have been given in the text but an appendix allows them to appear in their proper context. The letters have been chosen both because they are representative of different aspects of Gay-Lussac's life and for the information they contain. They provide a series of windows on the world of the scientist, usually seen with his own eyes but sometimes with those of his contemporaries. They cover the period from his arrival in Paris at the age of 17 to after his death. Reasons of space do not allow a larger collection of letters but they have not led to any vital omission.

The idea of writing a biography of Gay-Lussac and some preliminary work towards its realisation was started some time ago. Enquiries which began with descendants of Gay-Lussac took me to France and from Paris to the provinces. Research spread to sources in Britain, Germany, Sweden and the U.S.A. and manuscript materials were examined in many different circumstances ranging from an air-conditioned American library to a converted French chapel, from the office of a *notaire* to the chateau which once belonged to Madame de Pompadour. One of the benefits arising from the curiosity of foreign scholars is a greater appreciation by the owners of the historical value of the material in their keeping and I am glad that Gay-Lussac's library, exposed at the beginning of my research to rain and to rats, has been rescued and saved from further deterioration. The present dispersal and temporary housing of Gay-Lussac's archives precludes complete systematic description. It is to be hoped that the bicentenary celebrations in 1978 will focus attention on the desirability of bringing some of these sources together and cataloguing them.

PREFACE

If I had been looking for an easy piece of research with documents neatly assembled under one roof, I would have considered myself singularly unfortunate in my choice of subject. The task would certainly have been easier if Gay-Lussac's research had been confined to one field or to one institution but also it would have been less worthwhile. A study of a man who contributed to several areas of science, both pure and applied, who was associated with many institutions and who was a public figure, is more likely to reveal the vicissitudes of a career in science than a study of a less versatile figure.

For access to manuscript sources I am indebted to Madame Roger Gay-Lussac, Monsieur Pechdo, Monsieur Decanter, Monsieur Larre, Monseieur Laissus, and to archivists and librarians at the Académie des Sciences, the Archives Nationales, the Ecole Polytechnique, the Service Historique of the French army, the archives of the French artillery, the Royal Institution, the Royal Society and the Wellcome Historical Medical Library. I have used printed books and periodicals at the Bibliothèque Nationale, the British Library, the Institute of Historical Research, London University, the Science Museum Library, the University of Kent and the University of Leeds. Part of chapter 7 was drafted when, as a visiting professor at the University of Pennsylvania, I had access to the Edgar Fahs Smith collection of books on the history of chemistry. My appointment at the University of Kent in 1974 enabled me to go from a few draft sketches to a full-length book. I must thank the Nuffield Foundation for payment of my salary over several years and the standing committee for the Unit for the History of Science under the chairmanship of Professor Graham Martin for encouragement in my research.

I should like to thank various friends and colleagues for private criticism of a first draft of this book. Alec Dolby read and criticised chapter 3, Crosbie Smith looked critically at chapter 6, Graham Smith gave me the benefit of his specialised knowledge in connection with chapter 8, and William Fortescue made some improvements in chapter 10. Raymond Coulon kindly checked the French text in the Appendix. Bill Smeaton read the complete draft and made a large number of detailed criticisms and corrections to the typescript. I should also like to thank Richard Ziemacki and the staff of the Cambridge University Press for all their help. For the typing I owe much to the efficiency and accuracy of Veronica Ansley and Yvonne Procter. Christoph Meinel kindly helped with corrections at the proof stage. Various other acknowledgements are given in endnotes. The author must take responsibility for the contents of the book and the translations provided.

Chronological table

Life and work of Gay-Lussac

| | | |
|--------------|--|--|
| 1778 | Born at St Léonard (Limousin) | |
| 1795 1797 | Goes to Paris Enters Ecole Polytechnique | |
| 1800 | Graduates from Ecole Polytechnique. Enters Ecole des Ponts et Chaussées | |
| 1801 | Joins Berthollet at Arcueil | |
| 1802 | Memoir on thermal expansion of gases ('Charles' law') | |
| 1804 | Balloon ascent (7000 m). <i>Répétiteur</i> at Ecole Polytechnique | |
| 1805 | European tour with Humboldt | |
| 1806 | Return to Paris. Elected to First Class of Institute. Research on specific heats of gases and capillarity | |
| 1807 | Vol. 1 of <i>Mémoires</i> of Society of Arcueil | |
| 1808 | Preparation of potassium by chemical method (with Thenard). Preparation of boron (with Thenard). Law of combining volumes of gases | |
| 1809 | Suspects elementary nature of 'oxymuriatic acid' (chlorine). Professor at Paris Faculty of Science. Marriage | |
| 1810 | Professor at Ecole Polytechnique. Analysis of organic compounds (with Thenard) | |
| 1811 | Publication in book form of collection of memoirs (with Thenard): <i>Recherches physico-chimiques</i> | |
| 1813-14 | Research on iodine and hydracids | |

French history

| | | |
|-----------|---|--|
| 1789 | Meeting of Estates General. Fall of Bastille. Abolition of feudal privileges | |
| 1790 | Civil constitution of the clergy | |
| 1792 | France at war. Meeting of Convention. Declaration of a Republic | |
| 1793 | Execution of Louis XVI. Mass mobilisation. Académie des Sciences closed | |
| 1794 | Fall of Robespierre | |
| 1795 | Ecole Polytechnique. Foundation of National Institute to replace former Academies | |
| 1795-9 | France ruled by Directory | |
| 1799 | Napoleon Bonaparte seizes power | |
| 1799-1804 | Consulate | |
| 1802 | Peace of Amiens | |
| 1804 | Bonaparte declares himself Emperor | |
| 1808 | Establishment of University of France including Faculties of Science | |
| 1810 | Madame de Staël, <i>De l'Allemagne</i> | |
| 1812 | Occupation of Moscow by French troops. Retreat | |
| 1814 | Abdication of Napoleon. Constitutional Charter of Louis XVIII | |

| | | | |
|------|--|--------|---|
| 1815 | Research on cyanogen radical | 1815 | Return of Napoleon ('Hundred Days'). Final defeat at |
| 1816 | Editorship of <i>Annales de chimie et de physique</i> . Visit to England with Arago | | Waterloo. Return of Louis XVIII |
| 1818 | Memoirs on cold and absolute zero. Estimation of potash. Member of consultative committee to artillery | | |
| 1819 | Memoir on solubility of salts | | |
| 1820 | Memoir on estimation of soda (with Welter) | | |
| 1821 | Memoir on rendering textiles fireproof | | |
| 1822 | Study of relationship between density and alcohol content of alcoholic liquors | | |
| 1824 | Instruction on estimating chlorine in bleaching powder. Analysis of fulminating silver (with Liebig). <i>Instruction</i> on lightning conductors | 1824 | Death of Louis XVIII. Accession of Charles X |
| 1825 | Patent for stearic candles (with Chevreul) | | |
| 1828 | Estimation of potash. Publication (unauthorised) of his physics and chemistry lectures at Faculty of Science | | |
| 1829 | Assay master at Bureau de Garantie at Paris Mint | | |
| 1831 | Elected to Chamber of Deputies | 1830 | July Revolution. Louis Philippe on throne |
| 1832 | <i>Instruction</i> on the estimation of silver. Professor of Chemistry at Museum of Natural History. First association with Saint-Gobain Company | 1831–2 | Cholera epidemic |
| 1835 | Second <i>Instruction</i> on estimating chlorine in bleaching powder | 1834 | Balzac, <i>Le Père Goriot</i> |
| 1839 | Nominated to Chamber of Peers. Memoir on chemical forces | | |
| 1840 | Resigns chair at Ecole Polytechnique | 1840 | Proudhon, <i>Qui est-ce que la propriété?</i> |
| 1842 | Patent for recycling oxides of nitrogen in manufacture of sulphuric acid ('Gay-Lussac tower') | 1842 | Comte, <i>Cours de philosophie positive</i> completed |
| 1844 | Memoir on respiration | 1842–6 | Railway mania |
| 1848 | Last published scientific memoir (on aqua regia) | 1848 | Abdication of Louis Philippe. Provisional government. Universal suffrage. Constituent Assembly elected. Second Republic |
| 1850 | Death | 1852 | Napoleon III Second Empire |

Abbreviations

| | |
|---------------------|--|
| <i>A.c.</i> | <i>Annales de chimie</i> |
| <i>A.c.p.</i> | <i>Annales de chimie et de physique</i> |
| <i>A.C.R.</i> | Alembic Club Reprints |
| <i>Ch.D.</i> | Chambre des Députés |
| <i>Ch.P.</i> | Chambre des Pairs |
| <i>C.R.</i> | <i>Comptes Rendus hebdomadaires des séances de l'Académie des Sciences</i> |
| <i>G.L.</i> | Gay-Lussac archives, Limoges |
| <i>J. de phys.</i> | <i>Journal de physique</i> |
| Liebigiana | Archive series Liebigiana, Bayerische Staatsbibliothek, Munich |
| <i>M.S.A.</i> | <i>Mémoires de physique et de chimie de la Société d'Arcueil</i> |
| <i>Phil. Trans.</i> | <i>Philosophical Transactions of the Royal Society of London</i> |
| <i>P.V. Inst.</i> | <i>Procès-verbaux des séances de l'Académie des Sciences</i> |