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0521828732 - The 1702 Chair of Chemistry at Cambridge: Transformation and Change

Edited by Mary D. Archer and Christopher D. Haley

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## **The 1702 Chair of Chemistry at Cambridge**

### **Transformation and Change**

The University of Cambridge's 1702 Chair of Chemistry is the oldest continuously occupied chair of chemistry in Britain. The lives and work of the 1702 chairholders over the past three hundred years, described here, paint a vivid picture of chemistry as it slowly transformed from the handmaiden of alchemists and adjunct of medical men into a major academic discipline in its own right. The book has twelve chapters, covering all fifteen chairholders, from Giovanni Francesco Vigani, a contemporary and friend of Isaac Newton, through Smithson Tennant, discoverer of osmium and iridium, and Alexander Robertus Todd, Nobel Laureate and elucidator of the structure of key components of the double helix, to the current chairholder, master molecule maker Steven Victor Ley. Containing personal memoirs and historical essays by acknowledged experts, this book will engage all who are interested in the pivotal role chemistry has played in the making of the modern world.

MARY ARCHER is a former fellow and lecturer in chemistry at Newnham College, Cambridge. She currently sits on the Chemistry Advisory Board and chaired the Tercentenary Steering Group in the Department of Chemistry at the University of Cambridge.

CHRISTOPHER HALEY was formerly Archivist and Historian of the Department of Chemistry at the University of Cambridge.

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# The 1702 Chair of Chemistry at Cambridge

## Transformation and Change

*edited by*

MARY D. ARCHER

CHRISTOPHER D. HALEY

*Department of Chemistry, University of Cambridge*



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## Contributors

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**James Baddiley** James Baddiley read chemistry at Manchester University, where he did his Ph.D. with Alex Todd on nucleotide structure and synthesis. In 1944, he moved with Todd to Cambridge, obtaining an ICI Fellowship at Pembroke College to work on nucleotide and nucleoside synthesis, and achieving the first structurally definitive chemical synthesis of ATP. He then worked independently in Stockholm, London and Harvard before taking up the Chair of Organic Chemistry, and subsequently the Chair of Chemical Microbiology, at the University of Newcastle-upon-Tyne. He established the structures of several nucleotide co-enzymes, notably co-enzyme A, and discovered the teichoic acids, which are major polymers in many bacterial walls and membranes. In 1980, he returned to Cambridge to continue research in the Department of Biochemistry. He is an Emeritus Fellow of Pembroke College. He has received many awards, including Fellowship of the Royal Society of Edinburgh and of the Royal Society (Leeuwenhoek Lecturer, Davy Medal). He was knighted in 1977.

**Alan Battersby** Alan Battersby began his chemical research at the Universities of Manchester and St Andrews (Ph.D. 1949). He gained a Commonwealth Fund Fellowship (1950–52) for study in the United States at the Rockefeller Institute with Lyman Craig on peptides and at the University of Illinois with Herbert Carter on pyruvate oxidation factor. In 1954, he joined the staff at the University of Bristol and initiated his research on biosynthesis. He was invited to a chair at the University of Liverpool in 1962 and was elected FRS in 1966. In 1969 he joined Alex Todd as the holder of a second chair of chemistry at Cambridge before being elected to the 1702 Chair in succession to Todd in 1988. He is an Honorary Fellow of St Catharine's College. He became Emeritus Professor in 1992 and continued both experimental research and his writing. He has received numerous national and international awards including the Davy,

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Royal and Copley Medals of the Royal Society, the Roger Adams Medal, the Antonio Feltrinelli International Prize, the Wolf Prize and the Alonso Welch Award. He was knighted in 1992 for services to science.

**Mary Ellen Bowden** Mary Ellen Bowden studied history and chemistry at Smith College, Massachusetts. She undertook graduate studies at Yale University, first as a master's student in history and education in preparation for a brief stint as a high school teacher in the Maryland suburbs of Washington, DC. She returned to Yale as a doctoral candidate in history of science and medicine, studying with Larry Holmes and Derek Price among others and writing her dissertation with Price on seventeenth-century astrology. After a decade of administration and teaching at Goucher College and Manhattanville College, she came to the Chemical Heritage Foundation, Philadelphia, where she has researched and written exhibits and publications on subjects ranging from alchemy to solid-state chemistry. At CHF she is Senior Research Historian and Curator of the Roy G. Neville Historical Chemical Library.

**William Brock** William Brock read chemistry at University College, London before taking his doctorate in history of science at the University of Leicester. He taught History of Science and Victorian Studies at Leicester from 1959 to 1998, and is now Emeritus. He has published extensively on the history of chemistry, scientific periodicals and the development of scientific education. His books include *From Protyle to Proton* (1985), *The Fontana History of Chemistry* (1992), *Science for All* (1996) and *Justus von Liebig* (1997), and he is currently writing a biography of Sir William Crookes. He was President of the British Society for History of Science, 1978–80, and edited *Ambix*, 1968–83. He has been Chairman of the Society for the History of Alchemy and Chemistry since 1993.

**Dan Brown** Dan Brown was educated at the Glasgow Academy and the University of Glasgow and began his chemical research at the Chester Beatty Research Institute in London on anti-tumour agents. He joined the research group of Basil Lythgoe and Alexander Todd in Cambridge in 1948, later becoming an Assistant Director of Research and then Reader in Organic Chemistry in the Department of Chemistry. His early research was directed towards understanding the chemistry of nucleotide derivatives that led to general structures of DNA and RNA. This was followed by extended studies of chemical mutagenesis and antiviral agents, subsequently carried out as an attached scientist at the MRC Laboratory of Molecular Biology in Cambridge. He is a Fellow (and sometime Vice-Provost) of King's College, Cambridge and has also been a Visiting

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Professor at the University of California at Los Angeles and at Brandeis University. He was elected to the Royal Society in 1982, and together with Professor Sir Hans Kornberg FRS he wrote the biographical memoir of Alex Todd for the Royal Society.

**Christopher Haley** Christopher Haley read Natural Sciences at St. John's College, Cambridge. This was followed by postgraduate studies in the Department of History and Philosophy of Science at Cambridge, where he completed his doctorate on nineteenth century models of the æther under the supervision of Simon Schaffer. As the historian and archivist of the Department of Chemistry at the University of Cambridge throughout 2002, he was one of the organisers of Chem@300, the conference that celebrated the tercentenary of the 1702 Chair and led to the commissioning of this volume.

**Kevin C. Knox** Kevin C. Knox completed his doctoral dissertation on culture and scientific change in Georgian Cambridge and London at Cambridge University before returning to North America in 1996 as a visiting professor at the University of California, Los Angeles. In 1997, he became the Ahmanson Postdoctoral Instructor in the Humanities at the California Institute of Technology, where he currently works as the historian of the Institute Archives. He has been involved in a number of multimedia projects related to the history of science and has published numerous works on late-Georgian natural philosophy and mathematics. With Richard Noakes, he co-edited *From Newton to Hawking: A History of Cambridge University's Lucasian Professors of Mathematics*, published by Cambridge University Press in 2003.

**Steven Ley** Steve Ley is the current BP 1702 Professor of Organic Chemistry at the University of Cambridge, and a Fellow of Trinity College. He studied for his Ph.D. at Loughborough University with Harry Heaney and then did his post-doctoral work with Leo Paquette at Ohio State University. He returned to the UK in 1974 to continue post-doctoral studies with Sir Derek Barton at Imperial College, London. He was appointed to the staff of Imperial College in 1975, became a Professor in 1983 and served as Head of the Department of Chemistry from 1989. He was elected to the Royal Society in 1990 and moved to Cambridge to take up the BP 1702 Chair of Organic Chemistry in 1992. His work involves the discovery and development of new synthetic methods and their application to biologically active systems. So far his group has synthesised over 90 major natural products. His published work has been recognised by 17 major international awards, and he was appointed CBE in 2002. He holds honorary degrees from three universities. He is currently chairman of the Novartis



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Foundation Executive Committee, and he stepped down as President of the Royal Society of Chemistry in July 2002.

**Bill Nolan** Bill Nolan is the Bristol-Myers Squibb Teaching Fellow in the Department of Chemistry at the University of Cambridge. He was an undergraduate at Imperial College, London, 1982–85, during which time his organic chemistry tutor and final year project supervisor was Steve Ley, the current 1702 Professor. He moved to Cambridge to work for his Ph.D. with Ralph Raphael – he was Ralph's last research student and his Ph.D. work was directed towards the synthesis of indolocarbazole natural products. He spent a year as a post-doctoral fellow at Parke-Davis Neuroscience Research Centre in Cambridge and then returned to Lensfield Road as a post-doctoral worker with Andrew Holmes. He was appointed to his current post in 1995. He is a Fellow of Robinson College where, amongst other things, he is Director of Studies in Natural Science.

**Robert Ramage** Robert Ramage completed his B.Sc. and Ph.D. under the supervision of Ralph Raphael at Glasgow University. He then undertook post-doctoral work with Bob Woodward at Harvard University, 1961–63, on the synthesis of vitamin B<sub>12</sub>, and at the Woodward Research Institute, Basel, 1963–64, on the synthesis of cephalosporin C. In 1964, he was appointed Lecturer in Organic Chemistry at the University of Liverpool and there followed a five-year period of research on the synthesis and biosynthesis of alkaloids with Alan Battersby, 1964–69, and later with George Kenner on protein synthesis. In 1977, he was appointed Professor of Organic Chemistry at UMIST, becoming Head of Department in 1979. He went to Edinburgh University in 1984 as Forbes Professor of Organic Chemistry, serving two spells as Head of the Department of Chemistry before his retirement in 2001, when he became Scientific Director of Albachem Ltd. He is a past-president of the Perkin Division of the Royal Society of Chemistry and a Fellow of the Royal Societies of both Edinburgh and London.

**Colin Russell** Colin Russell started his career as an organic chemist working in polytechnic education and researching heterocyclic chemistry. He joined the Open University in 1970 to take up a post in the history of science, which he had recently entered via the history of chemistry (his doctoral thesis was on the rise and development of valency theory). He has since written a number of books, from an elementary text on bakery science to a major biography of Edward Frankland and (as co-author) a new history of the British chemical industry. He became Professor of History of Science and Technology at the Open University in 1981, and is now Emeritus Professor. He was until 2002 a member of Council of the Royal Society of Chemistry and he is also a former

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chairman of its Historical Group. In 1986–88, he was President of the British Society for the History of Science. Having been a Visiting Fellow at Wolfson College, Cambridge, he is now a senior member, and also an honorary visiting scholar in the Department of History and Philosophy of Science at the University of Cambridge.

**Simon Schaffer** Simon Schaffer is Reader in History and Philosophy of Science at the University of Cambridge. He read natural sciences at Cambridge, then history of science at Harvard. His Cambridge Ph.D. on Isaac Newton's cosmology was awarded in 1980. He has taught at Imperial College, London and since 1984 at the Department of History and Philosophy of Science. He co-wrote *Leviathan and the Air Pump* with Steven Shapin (Princeton University Press, 1985), and has since produced work on the history of experiment and the physical sciences. Most recently, he has co-edited *The Sciences in Enlightened Europe* for Chicago University Press.

**John Shorter** John Shorter read chemistry at Exeter College, Oxford and did his D.Phil. on organic solution kinetics with Sir Cyril Hinshelwood. He was a staff member of what is now the University of Hull from 1950 to 1982, and is now Emeritus Reader in Chemistry. He has been Secretary of the International Group for Correlation Analysis in Chemistry (formerly Organic Chemistry) since 1982, and was a member of the IUPAC Commission on Physical Organic Chemistry, 1990–97. He has authored or co-authored many papers on physical organic chemistry, particularly on linear free-energy relations, and he is the author or co-editor of several books in this field. He was formerly Secretary and then Chairman of the Royal Society of Chemistry's Historical Group, and in 'retirement' he writes on the history of physical organic chemistry.

**Larry Stewart** Larry Stewart was educated in the UK, France and Canada, and received his Ph.D. in the history and philosophy of science from the University of Toronto. He is Professor of History and former Head of the Department of History at the University of Saskatchewan and currently visiting scholar at the Max-Planck-Institut für Wissenschaftsgeschichte in Berlin. He is the author of *The Rise of Public Science. Rhetoric, Technology and Natural Philosophy in Newtonian Britain, 1660–1750* (Cambridge University Press, 1992) and (with Margaret C. Jacob) *Practical Matter. The Impact of Newton's Science, 1687–1851* (Harvard University Press, forthcoming). He is currently writing a study of chemistry, medicine and social reform in the late eighteenth century.

**Arnold Thackray** Arnold Thackray read chemistry at Bristol University and worked in industry before taking a Ph.D. in the history of science at Cambridge, where he was the pupil of Professor Mary Hesse as well as being the first student

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of Churchill College to be elected to its fellowship. He has made his career in the USA for the past 35 years. He has variously served as editor of *Isis and Osiris*, President of the Society for Social Studies of Science, Chairman of the Department and Joseph Priestley Professor of the History and Sociology of Science at the University of Pennsylvania, and Founding President of the Chemical Heritage Foundation.

**Melvyn Usselman** Mel Usselman read chemistry at the University of Western Ontario, Canada, and did his Ph.D. there with Paul de Mayo in organic photochemistry. As a post-doctoral fellow, he collaborated with de Mayo in the construction of a history of chemistry course and simultaneously obtained an MA in History at UWO under the supervision of Larry Holmes. He joined the Chemistry Department at UWO as an assistant professor in 1975, became an associate professor in 1981, and served as associate Chair, 1992–95. He teaches courses in general, organic and historical chemistry and has received teaching awards at UWO, as well as an Ontario Confederation of University Faculty Associations teaching award. In recent years, he has reconstructed the critical experimental works purporting to establish the law of multiple combining proportions, and also Liebig's 1831 combustion apparatus and his early analyses of alkaloids. In 2001, he completed a project to modernise all the chemistry articles and biographies of *Encyclopaedia Britannica*. He has published several papers on the life and science of William Hyde Wollaston as preliminary work towards a full scientific biography.

**Dudley Williams** Dudley Williams received his bachelor and Ph.D. degrees, in chemistry and organic chemistry, respectively, from the University of Leeds in 1958 and 1961. He subsequently studied as a post-doctoral Fellow at Stanford University, 1961–64. Since 1964, he has worked at the University of Cambridge, where he is a Fellow of Churchill College and Professor of Biological Chemistry. He was elected a Fellow of the Royal Society in 1983. He knew Ralph Raphael for much of his career, but particularly well during Ralph's years in Cambridge.

**Peter Wothers** Peter Wothers read chemistry at Cambridge, graduating in 1991 before doing his Ph.D. on stereoelectronic effects and conformational analysis with Professor Tony Kirby. In 1996, he was appointed to the newly established post of Teaching Fellow in the Department of Chemistry at Cambridge. He lectures to undergraduates and also runs the physical chemistry practical courses. Beyond that, he is involved in teaching chemistry to all age groups, giving demonstration lectures to the general public and school children, running courses for schoolteachers and supporting the International Chemistry Olympiad. He has co-authored two textbooks, *Organic Chemistry* and

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*Why Chemical Reactions Happen*, both published by Oxford University Press. Throughout his time at Cambridge, he has remained at St Catharine's College, where he is the Director of Studies in Chemistry. In 2002, he was awarded one of the University's Pilkington Teaching Prizes. He has a keen interest in the history of chemistry and has amassed a fine collection of chemistry books from the seventeenth and eighteenth centuries.

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## Preface

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It was a summer's day in 2001. We were among a group of Cambridge chemists making an excursion to the Whipple Museum of the History of Science to view the recently reconstructed post-war photochemistry laboratory in Free School Lane, only yards from where the young George Porter had built the first flash photolysis apparatus some fifty years ago. It was there that we realised that another anniversary in the long history of chemistry at Cambridge was upon us: the University's 1702 Chair of Chemistry would turn 300 years old the following year.

We all felt that we could not ignore such a landmark, and in December 2002 the Department of Chemistry held a two-day symposium, entitled *Chem@300*, to mark the tercentenary. The papers given at that meeting, with one or two later additions, form the basis of this book. *The 1702 Chair of Chemistry at Cambridge: Transformation and Change* pays tribute not only to the chemist's core skill of transforming one set of molecules into another, but also to the subject of chemistry itself, and how it has changed over the centuries from the handmaiden of alchemists and adjunct of medical men into a major academic discipline in its own right. The book is a history of the 1702 Chair, rather than a general history of chemistry in the University, so many important developments in Cambridge chemistry (and biochemistry) have fallen outside its remit.

The 1702 Chair of Chemistry at Cambridge is (save for an interregnum in World War II) the oldest continuously occupied chair of chemistry in Great Britain, although it is not the oldest chair of chemistry in the country: that honour goes to Oxford, where Robert Plot was appointed first curator of the Ashmolean Museum and Professor of Chemistry in 1683, but the chair lapsed for some time after his death: evidently Oxford thought the subject had no future.

This book presents a series of essays on the 1702 chairholders, each described by an expert or – in the case of Alan Battersby and Steven Ley – by the

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chairholder himself. The sweep is wide, from Giovanni Francesco Vigani, a contemporary and friend of Isaac Newton, through Richard Watson who sat in the House of Lords as Bishop of Llandaff, Smithson Tennant the discoverer of osmium and iridium, to George Downing Liveing, during whose long tenure of the chair the Natural Sciences Tripos was created and the college chemical laboratories waxed and waned. We enter modern times with Alexander Robertus Todd, Nobel Laureate and elucidator of the structure of key components of the double helix, the elegant synthetic and biosynthetic work of Ralph Raphael and Alan Battersby and end with the current chairholder, master molecule maker Steven Ley.

For simplicity, we use the title '1702 Chair of Chemistry' throughout, but this has never been the precise title of the chair, nor according to modern reckoning was it founded in 1702. True, the Grace of Senate that brought Vigani's chair into being was dated *10<sup>mo</sup> Feb. 1702*, but the University, like most official bodies in England, was still using the old Julian calendar at the time. Under our present Gregorian calendar, the date of the chair's foundation was 21 February 1703. As to the name of the chair, Vigani held the simple title 'Professor of Chemistry', as did subsequent chairholders up to and including William Jackson Pope, even though four new chairs (Physical, Colloid Science, Metallurgy and Theoretical Chemistry) had been created in the Department by the time Pope died in 1939. Pope's death created a vacancy in the field of organic chemistry, so his post was renamed 'Professor of Organic Chemistry' by Grace of 26 February 1943 (*Reporter*, 2 February 1943, p. 358), and this was the title conferred on Pope's successor, Alexander Todd. In 1969, the University created a second Chair of Organic Chemistry *ad hominem* for Alan Battersby, and in the following year the date of 1702 was first attached to the earlier chair to distinguish the two. Thus Todd occupied the 1702 Chair of Organic Chemistry, as did his successor Ralph Raphael.

In 1990, the British Petroleum Company announced a generous benefaction of £1.5 million to re-endow the 1702 Chair, as one of a series of four endowments or re-endowments of British university chairs organised by Robert Horton, then chairman and chief executive of BP, and David Simon, then BP's Managing Director. In recognition of the benefaction to Cambridge, the General Board proposed that the chair be renamed the BP Professorship of Organic Chemistry (1702), and this was approved by Grace of 1 May 1991 (*Reporter*, 6 March 1991, p. 472). The structure of this formal title follows the University's 'subject, name (date)' convention for all dated chairs, but in normal usage the date is placed first. Thus it was when the current chairholder Steven Ley took up his appointment in 1992, he became the fifteenth holder of the '1702 Chair of Chemistry', but the first to take the title '1702 BP Professor of Organic Chemistry'.

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We are indebted to Dr and Mrs Alfred Bader and to the Amberstone Trust for sustained financial support that enabled the Department to engage CH as archivist and historian for an eighteen-month period, and to Trinity College, Cambridge for their kind contribution towards the costs of publication of this book. We warmly thank our contributing authors for the dedication they have brought to their subjects and the patience with which they have dealt with our editorial queries. We also thank Jayne Aldhouse, Michelle Carey, Tim Fishlock, Andy Flower and Emily Yossarian of Cambridge University Press, and Liz Alan, Nick Bampos, Alan Battersby, David Buckingham, Brian Crysell, Peter Grice, Andrew Holmes, Jeremy Sanders, Jane Snaith, Brian Thrush, David Watson, Peter Wothers and Dudley Williams of the Department of Chemistry, Jacky Cox and Elisabeth Leedham-Green of the University Archives, Liba Taub of the Whipple Museum, Brian Callingham and John Eatwell of Queens' College, Richard Glauert and Denis Marrian of Trinity College, Nick Champion, Alison McFarquar and Mark Mniszko of the University Press and Publications Office, Deborah Easlick and Jane Crawford of the Development Office, Brian Emsley, David Giachardi and Cath O'Driscoll of the Royal Society of Chemistry, James Bamberg and Bernie Bulkin of BP, Peter Morris of the Science Museum, John Hudson of the Society for the History of Alchemy and Chemistry, Helen Brown, Hilary Todd and Sandy Todd, and Grant Buchanan, John Emsley, Roy MacLeod, Barbara Mann and Colin Russell. All these have commented on parts of the manuscript (as well as in some cases writing a chapter) or helped in other ways to redeem the sometimes fragile and dispersed history of the 1702 chairholders, thus making it possible to assemble the continuing story of chemistry in Cambridge.

*Mary Archer*  
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## Holders of the 1702 Chair of Chemistry at Cambridge

	Date elected (n.s.)	Date vacated (n.s.)	
Vigani, John Francis (c. 1650–1713)	1703	1713	Died in office
Waller, John (c. 1673–1718)	1713	1718	Died in office
Mickleburgh, John (c. 1692–1756)	1718	1756	Died in office
Hadley, John (1731–1764)	1756	1764	Died in office
Watson, Richard (1737–1816)	1764	1771	Resigned
Pennington, Isaac (1745–1817)	1773	1793	Resigned
Farish, William (1759–1837)	1794	1813	Resigned
Tennant, Smithson (1761–1815)	1813	1815	Died in office
Cumming, James (1777–1861)	1815	1861	Died in office
Liveing, George Downing (1827–1924)	1861	1908	Resigned
Pope, William Jackson (1870–1939)	1908	1939	Died in office
Todd, Alexander Robertus (1907–1999)	1944	1971	Resigned
Raphael, Ralph Alexander (1921–1998)	1972	1988	Resigned
Battersby, Alan Rushton (1925–)	1988	1992	Resigned
Ley, Steven Victor (1945–)	1992	–	–



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## Illustration acknowledgements

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Front cover: ‘*The Alchemist’s Experiment Takes Fire*’ by Hendrick Heerschop, by courtesy of the Fisher Collection, Chemical Heritage Foundation, Philadelphia.

Back cover: Vigani’s arms on stained glass by Henry Gyles © Christopher Haley, with thanks to the Norwich Union.

Figure 1.1: Reproduced from Denis Dodart’s *Mémoires pour servir à l’histoire des plantes*, Figure 1.4: Interior of the ‘Publick Elaboratory’ from William Combe’s *History of the University of Cambridge*, and Figure 1.7: The Botanic Garden from William Combe’s *History of the University of Cambridge*, by courtesy of the Institute Archives, Caltech.

Figure 1.2: Vigani’s advertising flyer, by courtesy of the Bodleian Library, University of Oxford (John Johnson Collection, Patent Medicines 14).

Figure 1.3: Plan of the ‘Publick Elaboratory’ from Cambridge University Library (UL), Views.x.2[79a], Figure 1.5: Inventory of the ‘Publick Elaboratory’ from UL CUR 39.11.2(2), Figure 4.3: The Schools in the Botanic Garden from Cambridge University Library Views.x.2(73), Figure 5.2: Double distillation apparatus, from *Phil. Trans. Roy. Soc.* (1814), Figure 5.3: Ledger of Wollaston & Tennant’s sales of platinum, from UL Wollaston Mss., Add MSS 7736, notebook I, Figure 5.5: Wollaston/Tennant financial agreement from UL Wollaston Mss., Add MSS 7736, notebook L1, Figure 5.7: Tennant’s apparatus for potassium production, from *Phil. Trans. Roy. Soc.* (1814), Figure 6.3: Sketch of Cumming’s laboratory from UL DAR.204.4 (14/11/1822), Figure 6.4: Development of the New Museums site from UL Archives UA.P.VIII.3, Figure 6.6: Cumming’s electromagnetic instruments, from *Trans. Camb. Phil. Soc.* (1822), and Figure 8.5: Plan of Pembroke Street Laboratory from UL Archives, UA.P.VIII.10, by permission of the Syndics of Cambridge University Library.

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Figure 1.6: Portrait of John Hadley © The British Museum.

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