RUPERT HALL AND MARIE BOAS HALL AT THEIR RETIREMENT IN 1980

# Alfred Rupert Hall
1920–2009

# Marie Boas Hall
1919–2009

This memoir, perhaps unusually for the British Academy, is essentially a love story. It is set against the war of 1939–45, the Cold War and the threat of nuclear annihilation, the decline of British imperial power, the cultural arguments that consequently arose, and the post-1945 growth of academia including the establishment of the new discipline of the history of science which would contribute significantly to our understanding of the nature of scientific knowledge and its various relations with society and culture.

Unlike many love affairs that are conducted across continents and between individuals from radically different backgrounds, this one had a happy conclusion for the two principal figures involved, albeit with a period of considerable pain and unhappiness. In September 1957 Marie Boas, who came from a New England academic family, and Rupert Hall, who belonged to a family of shoemakers in the English Midlands but, by then a Fellow of Christ's College, Cambridge, fell in love with an intensity that came as a shock to them both.

This memoir will first trace their separate and rather different lives for the nearly forty years before that event and then move on to their lives and work thereafter which became so inextricably linked that it would be pointless, indeed repetitious, even to attempt to disentangle them. Indeed without their intimate relationship the landscape of the history of science

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during the past half century would have been very different in a number of respects, including publications and the training of the next generations of historians of science.[1]

## Rupert Hall

### Background, early life and education

On Hall's mother's side, her grandfather, Thomas Ritchie (*c*.1833–1917), a draper born in Ayrshire, had moved to Stoke-on-Trent by 1856 when he married Margaret McLellan (*c*.1830–98), born in Dumfriesshire. One of their sons, Andrew (*c*.1859–1931), continued in the drapery trade and at the time of his marriage in 1883 to Janet Ferguson (1856–1943) was a travelling draper. Their eldest daughter, Margaret (1885–1961), married into the Hall family of shoemakers who had lived in Staffordshire since the early nineteenth century. William Cade Hall (*c*.1852–1919) worked and lived in Stafford and in 1874 married Eliza Dawson. They had six children most of whom also worked in the shoe trade. Their third child, Alfred Dawson Hall (1879–1961), married Margaret Ritchie in June 1911 in the Wesleyan Chapel in Basford located between Stoke-on-Trent and Newcastle-under-Lyme, close to the Wedgwood pottery works at Etruria. By then he had risen to the position of foreman in a Norwich shoe factory and later moved into shoe sales. The peripatetic nature of this role presumably explains why his children were born in different towns—Doreen Janet (1913–72), later a musician, in Norwich, and Enid Catherine (1915–64), later a nurse, in Leicester. He served in the army during the Great War and it seems possible that his wife returned to her family for the duration, which

[1] The papers of Hall and Boas Hall are in the archives of Imperial College. As they have yet to be sorted or catalogued, they are simply cited here as IC MS Hall. Both wrote a number of autobiographical reminiscences, some of which were published. Their unpublished accounts, mostly it appears written in the 1990s, exist in typescript in the archives of Imperial College and the British Academy. For Hall they are (1) 'Biographical Notes', (2) 'How I became an Historian of Science and the Author of Books A Sidelight on the Twentieth Century' and (3) 'An account of Alfred Rupert Hall Litt.D. F.B.A.'. For Boas Hall they are (1) 'Marie Boas Hall A Brief Autobiography' and (2) 'How the partnership of Hall & Hall came into existence The Junior partner's tale'. These are cited as Hall or Boas Hall, followed by the number. Also in 1993 Scott Mandelbrote interviewed the Halls on two occasions which formed the basis for his 'A. Rupert Hall', *Metascience*, 1994, issue 5, pp. 64–84 which on pp. 77–84 contains a significantly shortened and edited version of the interviews. However, a transcript of the entire interviews is in All Souls College MS LX.2.6 [Box 1] 0 and is cited as Mandelbrote interview.

would explain why Alfred Rupert (though he never used Alfred) was born at 8 Victoria Street, Basford, on 26 July 1920.[2]

Hall first attended May Bank Infants' School in Newcastle until 1928 when the family moved to Leicester, which also had a large shoemaking industry. It is not known which primary school he attended in Leicester, but he passed the scholarship examination and in 1931 entered Alderman Newton's School, 'not the most fashionable grammar school in Leicester',[3] but it did have strong connections with Christ's College, Cambridge. Hall's mathematics teacher, Tom Pickering (1907–2000), and his physics teacher, H. S. Hoff (1910–2002, better known as the novelist William Cooper), had both been taught at Christ's by the ex-Newtonian Charles Snow (1905–80) who was originally a chemist before becoming a novelist, civil servant and pundit. Indeed Snow's brother was in the sixth form when Hall entered the school.[4] Such connections had improved the quality of the school compared to when Snow had been a pupil and laboratory assistant there (between 1916 and 1925) and were to prove decisive for Hall. Hoff became a significant figure in Hall's schooling since he interested him in the theory and practice of wireless, a very popular hobby in the 1930s. In his early teens Hall made his own wireless sets, bought books such as *The Admiralty Handbook of Wireless Telegraphy* (first published in 1925) and subscribed to *Amateur Wireless*.[5] Nevertheless, Hall later thought that had the teaching of science been better, he might well have become a scientist.[6]

But perhaps the most influential teacher on Hall was the head of history, Herbert 'Bert' Howard (1900–63). Clearly a quite remarkable and inspirational teacher, Snow modelled the character George Passant on him in his *Strangers and Brothers* novel sequence.[7] Howard would ask his pupils to answer absurd questions such as 'Which was the bigger fish: the Habsburg or the herring?'[8] Each year Howard selected the six brightest pupils when they entered the school at the age of eleven and then guided them through their time there. By this mentoring during his forty years at the school his pupils obtained thirty-nine awards from Cambridge alone.[9]

[2] Sources for this paragraph are Hall (1), p. 1, the General Register Office records of births, marriages and deaths and the ten yearly census from 1841 to 1911 in The National Archives.
[3] Hall (1), p. 1.
[4] Hall (3), p. 2.
[5] Hall (3), p. 12 and (2), pp. 6–7.
[6] Mandelbrote interview, p. 3.
[7] C. P. S[now], 'Mr. H. E. Howard', *The Times*, 15 Nov. 1963, p. 21, col. b.
[8] Hall (3), p. 8.
[9] Neil McKendrick, conversation with FJ, 21 Oct. 2011.

These included at least three other distinguished historians besides Hall ('conscious all my life of a real indebtedness to Bert'[10]): Jack Plumb (1911–2001, FBA 1968), Neil McKendrick, and Peter Bowler (FBA 2004). Although Hall and Plumb, whose social backgrounds were remarkably similar,[11] had lived only 200 yards apart, and indeed their mothers knew each other as Tory activists, they first met only in 1935 in Howard's house;[12] thereafter they socialised quite frequently when they were in Leicester.[13]

Howard played a crucial role in ensuring that Hall won an Open Minor Scholarship to read history at Christ's College. The competition, held in December 1937, Hall described as 'gladiatorial'.[14] Neither Sidney Grose (1886–1980, who would be his tutor[15]) nor Anthony B. Steel (1900–73, who would be his supervisor) liked the seventeen-year-old Hall much, but Howard's 'prestige saved him', and so he came second from the bottom in the £60 class.[16] He entered Christ's College a few days after the Munich crisis at the end of September 1938. In such circumstances it should not be found surprising that Hall joined the Cambridge University Socialist Club, though he resisted suggestions to join the Communist Party. However, by the end of his first term he had given up on the Socialist Club, writing later that 'the undergraduate futility and its public-school cum working-class solidarity was too apparent'.[17] His social life centred on Snow's Sunday evenings at Christ's, where he formed lifelong friendships, for example with the chemist Philip George (1920–2008).[18]

The lecturer whom Hall found most inspiring was the economic historian Michael Postan (1899–1981, FBA 1959) and much later Hall considered doing his Ph.D. in that area.[19] Following the departure of many faculty for various parts of the war effort, Plumb took over supervising Hall for his second year, 1939–40,[20] but failed to prevent him taking an Upper Second in the Part I examination, which bitterly disappointed Hall, just as the British Expeditionary Force retreated to Dunkirk in May 1940.

[10] Hall (2), p. 2.
[11] David Cannadine, 'John Harold Plumb 1911–2001', *Proceedings of the British Academy*, 124, *Biographical Memoirs of Fellows*, V (2004), 271.
[12] Hall (3), p. 4.
[13] Hall (2), pp. 3–4.
[14] Hall (3), p. 3.
[15] Hall (3), p. 2.
[16] Snow to Howard, 17 Dec. 1937 and 18 Dec. 1937, Snow file, ULC MS Plumb papers.
[17] Hall (3), p. 7.
[18] Hall (3), pp. 10 and 9.
[19] Mandelbrote interview, p. 1.
[20] Hall (3), p. 10–11.

**The army**

As a result of both these events, Hall left Cambridge and, after spending a couple of months in the Home Guard,[21] in September 1940 volunteered as a Signalman in the Royal Corps of Signals, his first choice of regiment,[22] doubtless accounted for by his long-standing interest in wireless. Recommended very quickly for officer training, he was sent to Catterick training camp in Yorkshire. After a year there, his colonel commented that Hall 'Possesses certain qualities of leadership and should develop. Has unusual technical ability and had done very well indeed;'[23] he was immediately commissioned as second lieutenant.

With the prospect of service overseas he married in December 1941 Anne Hughes (1913–80) seven years his senior. The daughter of a pottery manager and a friend of one his sisters, Hall had known her since they were children. She spent the war in the Land Army[24] and in April 1942 he was posted to Egypt, arriving towards the end of June (the ship went via Cape Town[25]). From there he joined the 10th Army in Persia and Iraq. Promoted to lieutenant whilst there, he established a direct wireless link between Baghdad and London which he later regarded as one of his better pieces of work.[26] His section then returned to North Africa where they participated in the operations of the 8th Army following the battle of El Alamein. After the end of the war in Africa, Hall participated in the invasions of Sicily (July 1943) and the Italian mainland and in the subsequent slow 'zigzag advance northwards to the Alps'[27] until March 1945 when he flew (in a Lancaster bomber) back to England to attend a special wireless course at Catterick. A brief sojourn in occupied Vienna followed before demobilisation in time to resume his studies in Cambridge, though not formally discharged until the start of November 1945.

Hall, as a signals officer, spent virtually the entire war in rear areas. Indeed the only action that involved him directly was when an enemy bomb destroyed the telephone exchange and signals office whilst he was stationed at Cesena (10 December 1944).[28] Hall's later recollections of the

[21] Hall (3), p. 12.
[22] Cadet Record Sheet.
[23] Cadet Record Sheet.
[24] Hall (2), p. 15.
[25] Hall (3), p. 17.
[26] Hall (2), p. 8.
[27] Hall (3), p. 21. On a single sheet of paper in IC MS Hall, Hall listed the places, with precise dates, where his unit was located in Italy.
[28] Hall (1), p. 2.

war were of 'intense tedium & drunkenness, with playing poker somewhere in between'.[29] Nevertheless, his less than five years in the army clearly made a strong impression and it dominates disproportionately his various unpublished autobiographical writings. He attended El Alamein reunions[30] and with Paul Randall (1912–2007), who later became a colonel and was one of the few fellow officers with whom Hall formed a lifelong friendship, he edited a selection of songs from the 8th Army signal corps.[31]

## Cambridge

Hall's tutor, Grose, had applied for his early release from the army,[32] and so in the middle of October 1945 Hall found himself back in Cambridge to read for Part II of the history tripos, for which he successfully obtained the first class degree that had eluded him six years earlier. As a consequence of this degree Christ's awarded him a Bachelor Research Fellowship and he put aside his original intention to work as a teacher (he had been offered a position at Queen Elizabeth's Grammar School, Blackburn).[33] Together with some supervision and marking,[34] the Fellowship gave Hall the financial security to start a family; indeed he and Anne only really began their married life on his return to Cambridge where their first daughter, Alison, was born in November 1947.

As to the subject of his research, the Regius Professor of Modern History, George Clark (1890–1979, FBA 1936), suggested that Hall should research some aspect of the history of science, specifically ballistics. This choice of history of science intersected with the interests of both Charles Raven (1885–1964, FBA 1948), the Master of Christ's between 1939 and 1950 who had worked on the history of early English naturalists, and also Hall's friend Philip George.[35] To some extent Hall embracing the specific topic of ballistics in seventeenth-century England was not as surprising as it might seem. Interested in science at school in his teens, he had been fascinated by books such as Albert Neuburger's *The Technical Arts and*

[29] Hall to Boas, 18, 19 Oct. 1957, IC MS Hall.
[30] Programmes etc. in IC MS Hall.
[31] A. R. Hall and P. Randall, *1941–1945 Songs of the Eighth Army Signal 1647 Fifty Years On* (no place, *c*.1992).
[32] Hall (1), p. 2.
[33] Hall (2), p. 15.
[34] Hall (2), p. 15.
[35] Hall (1), p. 2 and (3), p. 16.

*Sciences of the Ancients* (1930) and had read related works such as Johann Beckmann's *A History of Inventions and Discoveries* (many nineteenth-century editions) and one of the chemistry books by Eric Holmyard (1891–1959), which contained much historical material, that his sister Enid had acquired.[36] Furthermore, Philip George, who had remained in Cambridge during the war, had begun collecting historic chemistry books which Hall read through.[37]

During his research Hall became connected with those few at Cambridge who took an interest in the history of science. These included Raven as well as Herbert Butterfield (1900–79, FBA 1965), whom he first met at the end of 1947.[38] Hall had a distant relationship with Raven,[39] but he did arrange an informal seminar in the Master's Lodge at Christ's. There Hall met, among others, Alistair Crombie (1915–96, FBA 1990) and Samuel Lilley (1914–87).[40] Although Crombie taught at University College London from 1946 until 1953 (when he went to Oxford), he retained strong connections with Cambridge. A close friend of Hall, Crombie, a zoologist by background and a Roman Catholic, argued strongly for a continuity of natural knowledge from the medieval period to the seventeenth century.[41] Lilley, a mathematician by background taking a Marxist view of science, with which Hall fundamentally disagreed, held a fellowship in the history of science at St John's College between 1946 and 1949, before going to Birmingham in 1950.[42]

Hall became close to Butterfield who acted as a lifelong patron and supporter, both within and outwith Cambridge. Plumb, who had been elected a Fellow of Christ's College in 1946, was Hall's other major patron, but he seems to have concentrated most of his efforts in the college. The details are opaque, but Hall was elected a Research Fellow in 1949 (renewed in 1952), and an official Fellow in 1955, the same year in which he was appointed College Steward. As a number of commentators have pointed out,[43] Hall belonged to a quintet of historians teaching at the

[36] Hall (2), p. 1.
[37] A. R. Hall, 'Beginnings in Cambridge', *ISIS*, 75 (1984), 22.
[38] Hall (2), p. 18.
[39] Hall (2), p. 17.
[40] Hall, 'Beginnings', p. 23.
[41] John North, 'Alistair Cameron Crombie, 1915–1996', *Proceedings of the British Academy*, 97 (1998), 257–70.
[42] Vidar Enebakk, 'Lilley revisited: or science and society in the twentieth century', *The British Journal for the History of Science*, 42 (2009), 563–93.
[43] Neil McKendrick, Obituary of Kenyon, *Independent*, 10 Jan. 1996. David Cannadine, 'The era of Todd, Plumb and Snow', in David Reynolds (ed.), *Christ's: a Cambridge College over Five Centuries* (London, 2005), p. 188. See also Cannadine, 'Plumb', p. 278.

college in the 1950s, the other three being Frank Spooner (1924–2007), John Kenyon (1927–96, FBA 1981) and Barry Supple (FBA 1987), all of whom Plumb appears to have selected.

Butterfield, who had published his famously iconoclastic *The Whig Interpretation of History* in 1931 (possibly a source for Hall's distrust of the notion of progress), had been appointed Professor of Modern History in 1944. He was thus in a position to play a key role in reviving the study of the history of science in Cambridge which had begun in 1936 with the establishment of the History of Science Committee by the Marxist biochemist Joseph Needham (1900–95, FRS 1941, FBA 1971) and the pathologist Walter Pagel (1898–1983, FBA 1976). That committee was chaired by Needham and dominated by scientists. However, in 1942 Needham went to China on a British Council mission and the chair was taken over by Butterfield. Needham did not return to Cambridge until 1948 by which time the committee was dominated by historians.[44] This was one of the reasons why there was continual friction between Butterfield, Needham and Raven.[45]

Butterfield was determined that the history of science should be taught and practiced by trained historians. To illustrate this view he delivered for the committee in the Lent and Easter terms of 1948 a course of lectures in the Arts Building[46] to an audience of about fifty to sixty (including Hall[47]) on 'The Origins of Modern Science', published the following year.[48] In this he concentrated on the 'scientific revolution' which he asserted, in an oft-quoted passage, 'outshines everything since the rise of Christianity and reduces the Renaissance and Reformation to the rank of mere episodes, mere internal replacements, within the system of medieval Christendom'.[49] The scientific revolution was thus an extraordinary significant event in human history which needed to be studied primarily by historians, with all their available tools, and not by scientists. This view was shared by Raven who told Needham that there was a real danger that history of science would become a refuge for second rate scientists which, he hinted, was the case with Herbert Dingle (1890–1978) who had recently been

[44] Anna-K. Mayer, 'Setting up a discipline: conflicting agendas of the Cambridge History of Science Committee, 1936–1950', *Studies in the History and Philosophy of Science*, 31 (2000), 665–89.
[45] Mandelbrote interview, p. 7.
[46] David Dewhirst, conversation with FJ, 4 Aug. 2011.
[47] Mandelbrote interview, p. 7.
[48] Herbert Butterfield, *The Origins of Modern Science 1300–1800* (London, 1949).
[49] Ibid., p. viii.

appointed Professor of the History and Philosophy of Science at University College London.[50]

Butterfield wanted to expand the subject in Cambridge and to this end, despite being unanimously urged by the committee to repeat his lectures during the 1948–9 year,[51] he declined and instead suggested the creation of a lectureship and specifically mentioned Hall in this regard, and also the possibility that he might in addition be appointed curator of the Whipple collection of scientific instruments.[52] In 1944 Robert Whipple (1871–1953), chairman of the Cambridge Scientific Instrument Company, had donated his collection of old scientific instruments and books to the university, together with some money. Because of the war it took some time to decide what to do with the collection and by 1948 Butterfield clearly saw an opportunity to use the collection to promote both the history of science and Hall's career.

At a meeting of the committee on 3 June 1948 it was decided that an application should be made to establish a lectureship in the history of science (which was not accepted).[53] In the meantime, while this was going through the Cambridge administrative process, the committee decided to appoint a temporary part-time curator (for an honorarium of £100) and invite someone to deliver a course of lectures similar to Butterfield's. Three candidates were discussed: Crombie, Hall and Lilley. Needham's notes of the meeting refer to Crombie as 'R' (right wing) and Lilley as 'L' (left wing) with the clear implication that the committee viewed their political positions as *ipso facto* ruling them out of consideration.[54] So Hall was appointed to the Whipple and invited to deliver eight lectures on sixteenth- and seventeenth-century science (for £25).[55]

The issues at stake are clearly seen in correspondence. A few years later Butterfield praised Hall for being neither Roman Catholic nor Marxist.[56] Needham, from his Marxist perspective, agreed with this analysis, but not with the practical consequences: 'The general criticism of Lilley is that he is too Marxist, and of Crombie that he is too Thomist.

[50] Raven to Needham, 6 May 1948, ULC MS NEEDHAM B309.
[51] History of Science Committee minutes, 12 March 1948, ULC MS NEEDHAM B309.
[52] Butterfield to Needham, 27 May 1948, ULC MS NEEDHAM B309.
[53] History of Science Committee minutes, 10 March 1949, ULC MS NEEDHAM B310.
[54] Needham's notes of History of Science Committee meeting, 3 June 1948, ULC MS NEEDHAM B309. For further details and also the background to the decision see Anna-K. Mayer, 'Setting up a discipline, II: British history of science and "the end of ideology", 1931–1948', *Studies in the History and Philosophy of Science*, 35 (2004), 55–6.
[55] History of Science Committee minutes, 3 June 1948, ULC MS NEEDHAM B309.
[56] Butterfield to Downs, 8 Jan. 1955, ULC MS BUTT/531/H6.

Hall here in Cambridge has never much impressed me; he is wafted on by the Butterfield circle, to which I do not adhere.'[57] But beyond the issue of individual ideological beliefs existed the question of who was qualified to do the history of science. A few days after the appointment meeting Needham wrote a long letter to Charles Singer (1876–1960), perhaps the leading historian of science in the country at that time, in which he complained about the assumption that only trained historians could do history of science, and about the committee's decisions, saying that they clearly wanted Hall appointed and asking if Singer knew anything about Hall.[58] To the latter point Singer responded 'I don't know H. [*sic*] R. Hall at all, but to suppose that you can make an historian of science from a man untrained in science seems to me silly.'[59]

Hall took up his new positions, whilst still completing his Ph.D. thesis. For the Whipple collection, he had the assistance of David Dewhirst (to whom he had been introduced by Snow[60]), then a research student in metallurgy, who helped Hall gain some basic knowledge of scientific instruments.[61] Hall began unpacking the objects and he added to the collections items from various colleges and also persuaded the Director of the Cavendish Laboratory, Lawrence Bragg (1890–1971, FRS 1921), to donate some early apparatus from the laboratory.[62] Whipple was delighted that something, at last, was happening with his collection[63] and on 5 May 1951 the first Whipple Museum opened on a site in Corn Exchange Street.[64]

Since plans were well advanced to include a paper in the history and philosophy of science in the Natural Sciences Tripos, the disappointing decision not to create an assistant lectureship in 1949 was reversed the following year with the establishment of the position from October 1950.[65] John Ratcliffe (1902–87, FRS 1951), head of the radio group at the

[57] Needham to Taylor, 2 Oct. 1950, quoted in Enebakk, 'Lilley Revisited', p. 575.
[58] Needham to Singer, 7 June 1948, ULC MS NEEDHAM B309.
[59] Singer to Needham, 20 June 1948, ULC MS NEEDHAM B309.
[60] David W. Dewhirst, 'The opening of a new gallery at the Whipple Musuem', in Liba Taub and Frances Willmoth (eds.), *The Whipple Museum of the History of Science: Instruments and Interpretations to Celebrate the Sixtieth Anniversary of R. S. Whipple's Gift to the University of Cambridge* (Cambridge, 2006), pp. 75–6.
[61] A. R. Hall, 'The first decade of the Whipple Museum', in Taub and Willmoth, pp. 58–9.
[62] A. R. Hall, 'Whipple Museum of the History of Science, Cambridge', *Nature*, 167 (1951), 878–9.
[63] Whipple to Hall, 2 March 1949, quoted in Frances Willmoth, 'Documents from the founding and early history of the Whipple Museum', in Taub and Willmoth, *The Whipple Museum*, pp. 7–8.
[64] Hall, 'The first decade', p. 61.
[65] History of Science Committee minutes, 16 Feb. 1950, ULC MS NEEDHAM B310.

Cavendish, was very keen to include a non-scientific component in the Tripos and saw the history of science as an effective way of achieving this.[66] Hall, as the incumbent, became the assistant lecturer which in 1953 was converted into a full lectureship with Hall appointed for three years.[67] Hall's lectureship entailed an increase in his workload and, following the opening of the Whipple Museum, he wrote a memorandum asking for the appointment of a part-time curator under his general direction. He suggested his research student, Derek Price (1922–83), for the position, which was agreed.[68] The inclusion of philosophy of science in the Tripos meant that a lecturer had to be appointed to cover this and in 1952 Norwood Russell Hanson (1924–67) took up the position. American-born, Hanson had studied philosophy at both Oxford and Cambridge, and took history very seriously indeed, which is probably why he and Hall got on very well indeed, spending much time in discussion and reading each other's work.[69]

While during 1948 and 1949 Hall's positions in Cambridge were being established, he continued work on his Ph.D. thesis, which he submitted in April 1949. His examination, held in the Athenaeum Club, was conducted by Clark (by now Provost of Oriel College, Oxford) and Singer.[70] On Singer's recommendation to Cambridge University Press, the thesis was published three years later and contained many of the themes that would recur throughout Hall's scholarly career.[71] His fundamental conclusion, that the 'practice of artillery contributed nothing to seventeenth-century science',[72] reflected his firm view that science had its own logic which had little to do with technology, at least before the nineteenth century, if then: 'At the time of their composition Newton's propositions were as irrelevant to the technical practice of the age as Maxwell's electromagnetic waves; and the practical applications of the one and the other were equally unforeseen.'[73]

[66] Mandelbrote interview, p. 9.
[67] Sartain (Cambridge University) to Hall, 12 Aug. 1953, IC MS Hall.
[68] A. R. Hall, 'Memorandum on the Staffing of the Whipple Museum', 26 Aug. 1951 and Minutes of the History of Science Committee, 14 Nov. 1951, both in ULC MS NEEDHAM B314.
[69] Mandelbrote interview, p. 22. N. R. Hanson, *Patterns of Discovery: an Inquiry into the Conceptual Foundations of Science* (Cambridge, 1958), p. 196.
[70] A. R. Hall, 'Review and reminiscences', in Richard L. Dalitz and Michael Nauenburg (eds.), *The Foundations of Newtonian Scholarship* (Singapore, 2000), pp. 197–207, on 204.
[71] A. R. Hall, 'Ballistics in the Seventeenth Century' (University of Cambridge Ph.D. thesis, 1949) and *Ballistics in the Seventeenth Century: a Study in the Relations of Science and War with Reference Principally to England* (Cambridge, 1952).
[72] Hall, *Ballistics* (1952), p. 161.
[73] Ibid., p. 164.

One is tempted to speculate whether Hall's wartime experiences of using a science-based technology influenced him in developing these views. He would have known, first hand, of the serious problems that almost inevitably arise when using scientific knowledge for practical purposes. Furthermore, Hall appears to have been deeply concerned with the way science had been used during the war, especially in the development of atomic weapons. He was always equivocal in his attitude towards the idea of progress and this may have influenced him into arguing for a history in which science, contrary to the Marxist interpretation and indeed modern practice, was unrelated to technology.

He read widely in the subject and was heavily influenced by the work of Alexandre Koyré (1892–1964), especially his three volume *Etudes galiléennes*, published in 1939, which Hall read at some point in the late 1940s.[74] Koyré stressed the importance of the change in theoretical outlook brought about by science rather than the establishment of facts—a non-positivist view of science. He was particularly critical of the experiments made by Galileo Galilei (1564–1642), some of which he doubted had happened, and emphasised the philosophical method of the *exposition des textes* in historical writing. Inspirational for Hall, Koyré's approach showed him that the subject need not be a dull one of simply establishing facts and order of events as Hall found in journals such as *ISIS* or *Annals of Science*.[75]

Thus in his thesis Hall traced the development of the theoretical understanding of projectile motion through the work of figures to whom he would continue to devote much time to studying: Galileo, Christiaan Huygens (1629–95, FRS 1663) and above all Isaac Newton (1642–1727, FRS 1672). Hall's first paper, published in the *Cambridge Historical Journal*, discussed the significance of one of Newton's notebooks that he kept while an undergraduate at Cambridge in the first half of the 1660s. Hall read this in the University Library whilst undertaking his thesis research.[76] What is striking about this paper was the way Hall helped understand a historical problem (in this case the origin of Newton's *annus mirabilis*) by the use of manuscript material. At the time it was almost unheard of to use manuscripts in the history of science in this way, but, as

[74] Hall (2), p. 19–20.
[75] Hall (2), p. 20.
[76] A. R. Hall, 'Sir Isaac Newton's note-book, 1661–1665', *Cambridge Historical Journal*, 9 (1948), 239–50.

Hall pointed out, knowing anything about what Newton was doing before 1665 was 'precious'.[77]

Although not published in a history of science journal, Hall's article was noticed by Henry Guerlac (1910–85), Professor of the History of Science at Cornell University, who wrote asking Hall for two offprints.[78] Hall at this time was expanding his horizons—for example, he attended the sixth International Congress of the History of Science held in Amsterdam in 1950, where he met Koyré.[79] He also came to the attention of Thomas Kuhn (1922–96) who taught history of science at Harvard University from 1948 to 1956 and met Hall in 1950 when he was sent by the President of Harvard, James Conant (1893–1978), to find out about history of science in England.[80] When, the following year, Kuhn heard that Guerlac's former student Marie Boas, then teaching at the University of Massachusetts, was going to England to study the papers of Robert Boyle (1627–91, FRS 1663) at the Royal Society, he suggested that as they were interested 'in the same kind of subjects',[81] she should 'look up' Hall.[82]

## Marie Boas

### Background, early life and education

Boas's ancestors mostly originated in the Jewish communities of the German speaking countries. Both her grandfather, Herman Boas (1854–98), a tailor, and his wife Sarah Eisenberg (b.1857) had emigrated as children from Germany to the United States. They eventually settled in Providence, Rhode Island, where they had six children including Boas's father, Ralph Boas (1887–1945), and George Boas (1891–1980) the historian of ideas. Both brothers attended Brown University in Providence, where Ralph Boas read English, graduating AB in 1908 and AM in 1910. Boas's other grandfather Rudolph Schutz (b.1858), a jeweller, emigrated from Austria as a child and married the Vermont-born (but half-Austrian) Esther Beckman (b.1860). They too settled in Providence where their daughter,

[77] Hall, 'Newton's note-book', p. 241.
[78] M. B. Hall, 'Recollections of a history of science guinea pig', *ISIS*, 90 (1999), S76.
[79] Mandelbrote interview, p. 21.
[80] Steve Fuller, *Thomas Kuhn: a Philosophical History of Our Times* (Chicago, 2000), p. 173.
[81] Boas Hall (1), p. 10.
[82] Boas Hall (2), p. 22.

and Boas's mother, Louise Schutz (1885–1973) was born. She too studied English at Brown, graduating AB in 1907 and AM in 1910.[83]

Not only did Ralph Boas and Louise Schutz (who married in September 1911) both teach English, they also collaborated on a study of New England puritan minister and scholar Cotton Mather (1663–1728, FRS 1713) and on a self-help book for new Americans.[84] Ralph Boas was a prolific writer of textbooks,[85] which was financially rewarding,[86] whilst Louise Boas published studies of Walter Scott (1771–1832) and Elizabeth Barrett Browning (1806–61), as well as an account of the development of women's colleges in the United States.[87]

Ralph Boas had a fairly peripatetic teaching career, beginning in Whitman College, Walla Walla in Washington State. There their son, also called Ralph (1912–92), later a distinguished mathematician who wrote the classic paper on the 'mathematical theory of big game hunting',[88] was born. However, they returned to New England in 1917 where Ralph senior taught in Massachusetts at the Central High School in Springfield, Mount Holyoke College, and finally, from 1928, Wheaton College in Norton, a rundown agricultural town about thirty miles south of Boston.[89] The latter two institutions were women's liberal arts colleges and in 1929 Louise Boas was also appointed Associate Professor of English at Wheaton; in 1950 she became full professor, a position that she held until 1952.

It was at Springfield, 'a manufacturing town noted only for its arsenal',[90] that Marie Boas was born on 18 October 1919. When she was aged about four the family moved to South Hadley which she recollected, with fondness, as 'an attractive village in lovely rolling countryside where I learned to enjoy walking, recognising wild flowers, and when I recovered

[83] Information for this paragraph is taken from the births, marriages, deaths and census records of both Rhode Island and the United States, and the graduate files of both R. P. Boas and L. S. Boas held in Brown University archives. These latter also inform the following two paragraphs.
[84] Ralph and Louise Boas, *Leading Facts for New Americans* (New York, 1923); *Cotton Mather, Keeper of the Puritan Conscience* (New York, 1928).
[85] These include Ralph Boas, *The Study and Appreciation of Literature* (New York, 1931); (with Barbara Hahn) *Social Backgrounds of English Literature* (Boston, 1923); (with Katherine Burton), *Social Backgrounds of American Literature* (Boston, 1933).
[86] Boas Hall (2), p. 1.
[87] Louise Boas, *Woman's Education Begins; the Rise of the Women's Colleges* (Nonton, IL, 1935); *Elizabeth Barrett Browning* (New York, 1930); *A Great Rich Man; the Romance of Sir Walter Scott* (New York, 1929).
[88] H. Pétard (pseud.), 'A contribution to the mathematical theory of big game hunting', *American Mathematical Monthly*, 45 (1938), 446–7.
[89] Boas Hall (2), p. 2.
[90] Boas Hall (1), p. 1.

from a series of illnesses, starting school'.[91] Being the daughter of English teachers meant that she was surrounded with books and 'imbued from an early age with the idea that one's parents wrote books'.[92] At the age of twelve she was helping them proof read and a few years later her mother acknowledged her contributions to the compilation of a bibliography.[93]

Boas attended a private boarding school in Norton and then spent the year 1935–6 studying English and chemistry at Wheaton College. Her work there included an essay on the printing innovations introduced by William Morris (1834–96) which she regarded as her real introduction to scholarship and recollected that 'factual writing and the use of secondary sources came to me easily'.[94] But it was chemistry that captured her imagination and when she entered the women-only Radcliffe College, 'then a curious subsidiary'[95] of Harvard University, in 1936, despite her family background she chose that subject to study. She progressed steadily until February 1939 when her parents were granted sabbatical leave and decided to visit Europe, where her brother, who had studied mathematics at Harvard, was spending a year in Cambridge. After short periods in France, Switzerland and Italy, Boas and her parents settled in London. In the reading room of the British Museum, Boas helped her mother with her researches on Harriet Westbrook (1795–1816), the first wife of Percy Shelley (1792–1822), not completed until the early 1960s.[96] They took a brief holiday in Devon and visited Poland, before returning to Massachusetts in August 1939, landing the day Britain declared war on Germany.[97]

## Wartime

Although the United States was not yet fighting, the outbreak of war had a direct effect on the remainder of Boas's education. Due to a change in Harvard's admission policies, she became one of the first two women to attend lectures alongside male students there and following the completion of her degree in 1940 was then among the first women to be allowed to work as a postgraduate in the Harvard chemistry laboratories, obtaining her Masters degree in 1942.

[91] Boas Hall (1), p. 1.
[92] Boas Hall (2), p. 1.
[93] Louise Boas, *Woman's Education*, p. xi.
[94] Boas Hall (2), p. 1.
[95] Boas Hall (2), p. 4.
[96] L. S. Boas, *Harriet Shelley. Five Long Years* (London, 1962).
[97] For a vivid account of the tour see R. P. Boas, 'Mr. Boas says …', *Wheaton Alumnae Quarterly* (1939), 12–15. There is a copy of this in the graduate file of Boas in Brown University archives.

After the United States declared war against the Axis powers in December 1941, Boas, not wishing to work on either poison gas or explosives to which Harvard chemistry had switched, volunteered in the summer of 1942 to work as a civilian for the Army Signals Corps at Fort Monmouth, New Jersey. She learned how to wire radios and write instructions for their use. Having done this in a variety of mid-west towns, she began to doubt the usefulness of her work and, despite her job classification as 'essential', was able to leave the Corps in the middle of 1944. She then moved to the secret (she had not previously heard of it) Radiation Laboratory at the Massachusetts Institute of Technology, which developed new types of radar including those stemming from the cavity magnetron invented at the University of Birmingham in 1940.[98] She was placed in the technical manual section and, as with her previous work for the Signals Corps, this involved understanding how to work various new forms of radar and write the instructions for their use, but in this case she found the work far more congenial.[99] In total, however, she 'hated the war years … & felt I was missing out on life'.[100] Despite this, one might plausibly suggest that the clarity that she later displayed in both her writing and her lectures stemmed from this period when she had to explain the use of unfamiliar and complex pieces of equipment to those lacking the necessary technical skills and knowledge.

## Cornell

After the end of the war Boas, with two others from the technical manual section, joined the Historian's Office in the laboratory. This had been founded in 1943 and was headed by Henry Guerlac. Though for her the project lasted only eight months, it proved to be decisive in Boas's move to the history of science, all the more so because Guerlac was one of the very few practitioners of the subject in America. In the early 1930s he had studied chemistry and biochemistry at Cornell University, before moving to Harvard where his interest turned to the history of science. His Ph.D. thesis was entitled 'Science and war in the old regime. The development of science in an armed society' (1941) and following its completion he moved to the new history of science department at the University of Wisconsin, Madison. However, two years later he was granted leave of absence to

[98] M. B. Hall, 'Guinea pig', pp. S68–9.
[99] Boas Hall (1), p. 6.
[100] Boas to Hall, 16 April 1958, IC MS Hall.

lead the team of about half-a-dozen to work on the official history of the United States radar programme.[101]

Guerlac and Boas shared an office,[102] and she later recounted that 'The whole operation was conducted in a joyous spirit of historical adventure, with each member of the highly diverse staff being given jobs suitable to his or her talents.'[103] The results of the project were not properly published until 1987, after Guerlac's death,[104] though he and Boas in 1950 wrote a joint paper on naval radar.[105] At the end of the project he agreed to take her on as a Ph.D. student when he returned to academia in 1946 as professor in the history department at Cornell. There she was the first research student in the history of science and course assistant on Guerlac's historical course for chemical engineers, although he quickly expanded both the number of students and course assistants. It was, however, this work that gave her the funds to pursue her research.

As someone who, aside from her work at the Radiation Laboratory, had done no historical research, Boas followed courses on medieval history and astronomy as a science.[106] She originally proposed the history of atomism for her thesis, not then realising how large a subject it was. Guerlac suggested the history of pneumatics and eventually, after further prompting, she wrote her thesis on Boyle and the corpuscular philosophy as a study of theories of matter in the seventeenth century; evidently her research was conducted in the same spirit as at the Radiation Laboratory. During her final year (1948–9) she was awarded Cornell's George Boldt Fellowship in history, which was a 'reluctant admission'[107] of her status as an historian and allowed her to complete writing her thesis free of teaching duties.

It was at Cornell that Boas began to develop her own style as an historian. Even though she had respect for the Belgian-born positivist George Sarton (1884–1956), one of the earliest practitioners of the subject in the United States, founder of the journals *ISIS* and *Osiris* as well as the History of Science Society, she rejected what she saw as his biographical

[101] Material on Guerlac is taken from M. B. Hall, 'Henry Guerlac, 10 June 1910–29 May 1985', *ISIS*, 77 (1986), 504–6. For his brief time at Wisconsin see Victor L. Hilts, 'History of Science at the University of Wisconsin', *ISIS*, 75 (1984), 71–2.
[102] M. B. Hall, 'Guinea pig', p. S69.
[103] M. B. Hall, 'Guerlac', p. 505.
[104] Henry E. Guerlac, *Radar in World War II*, 2 vols. (Los Angeles and New York, 1987).
[105] Henry E. Guerlac and Marie Boas, 'The radar war against the U-boat', *Military Affairs*, 44 (1950), 99–111.
[106] M. B. Hall, 'Guinea pig', p. S70.
[107] Ibid., p. S72.

and bibliographical approach, although he was helpful to her in publishing her early work. Nor was she enamoured of the work of sociologists such as Robert Merton (1910–2003) which linked the development of science in the seventeenth century to the Puritan ethic. Her (then) radical historiographical edge came, like Hall's, from her study of Koyré's *Etudes galiléennes*. As she recollected: 'Koyré's call for the study of texts and concentration on ideas rather than on social and economic influences greatly appealed to me and justified my approach to my thesis topic.'[108]

Her thesis covered not only Boyle but also the influence in the Renaissance and seventeenth century of the views expressed by Hero of Alexandra (*c*. AD 10–70) in his *Pneumatica*,[109] and concluded with a chapter on the theory of attraction in the work of Newton. Here she attributed the source of his ideas to his chemical experimentation (a view she quickly retracted) and expressed some puzzlement as to why Newton's biographers had found his alchemy discreditable. Altogether it was an impressive achievement; especially as it was based entirely on the printed sources she had available at Cornell and at Harvard during the summers. The bulk of her thesis was published as a 138-page paper in *Osiris*, entitled 'The establishment of the mechanical philosophy'.[110] The change of title was significant in that it embraced her view that the key to seventeenth-century natural philosophy was understanding particles in motion, rather than the nature of matter; presumably the title of her thesis had to be approved at Cornell before it was written. Her thesis introduced many of the themes that were to occupy her professional career; for example, a concentration on the Renaissance and seventeenth century (though not exclusively so) and the primacy for historical study of the relations of ideas and texts. In many ways Boas was fortunate to choose a period and a topic that would be central to the interests of historians of science in the ensuing decades, as she seems to have recognised in her foreword to the 1981 reprint of the paper.[111]

In her time at Cornell she had also shown hard work and great strength of character in her achievements, learning much in areas where she had not previously been trained. It was these qualities that put her in a good position when the need to find a job arose. She was quickly appointed an

[108] M. B. Hall, 'Guinea pig', p. S72.
[109] M. Boas, 'Hero's *Pneumatica*: a study of its transmission and influence', *ISIS*, 40 (1949), 38–48.
[110] M. Boas, 'The establishment of the mechanical philosophy', *Osiris*, 10 (1952), 412–541.
[111] M. B. Hall, *The Mechanical Philosophy* (New York, 1981).

assistant professor in the history department at the University of Massachusetts, Amherst, very near her childhood home at South Hadley. The appointment was made on condition that she taught nineteenth-century history and so she spent the summer of 1949 reading up on the topic. Though she had little opportunity to teach her own subject, she found that routine teaching needed little preparation[112] and so was able to write and publish a few articles, but overall found her time there 'rather dismal'.[113]

Guerlac had given her one of the offprints that Hall had sent him of his paper on Newton's early notebook, which, as she later wrote, she found 'an eye-opener for manuscript scholarship was in its infancy as regards 17th century history of science'.[114] At that time virtually all historians of science wrote from published sources and indeed some, such as I. Bernard Cohen (1914–2003) at Harvard, thought, even as late as 1956, that this was a virtue.[115] Hall's paper prompted her to wish to look at one of Newton's notebooks on chemistry. The microfilm that she ordered took two years to arrive from Cambridge University Library; as Hall later told her, they had mislaid it.[116] As with Hall and Newton's unpublished work, she turned, also influenced by Koyré, to thinking about Boyle's unpublished papers which, so far as she could see, had not been studied seriously since the eighteenth century.[117] In the summer of 1951, using her own savings and accompanied by her mother, she visited London to work on them in the library of the Royal Society, then located in Burlington House. Following Kuhn's introduction Boas and Hall met for the first time during her visit.[118] But aside from her later recollection that they 'did indeed find that our interests were similar and friendly',[119] no other trace of this encounter has been found and they appear to have had no further contact for a couple of years.

[112] Boas Hall (1), p. 8.
[113] Boas to Hall, 16 April 1958, IC MS Hall.
[114] Boas Hall (2), pp. 19–20.
[115] Boas Hall (2), p. 20.
[116] Boas Hall (2), p. 20.
[117] M. B. Hall, 'Guinea pig', p. S76.
[118] Ibid.
[119] Boas Hall (2), p. 22.

## Hall and Boas

### 1951 to 1957, friendship

Boas returned to Massachusetts for the 1951–2 year, towards the end of which she was told that her contract, along with that of two of her colleagues, appointed at the same time, would not be renewed since otherwise they would automatically receive tenure. She recollected that 'rather bitterly I noticed that only the man without a PhD was not fired'.[120] Through an 'old friend'[121] she secured an interview for a position in the history department at Brandeis University which had been recently founded, amidst some controversy. She was appointed there but, as at Massachusetts, the position was not related to the history of science and she had to teach introductory history, which at Brandeis was dominated by Frank Manuel (1910–2003). The great advantage for Boas of Brandeis was that she easily became part of the network of historians of science centred on Harvard. Because of the disruption occasioned by the move to Brandeis, Boas was not able to visit England during 1952.

But she did so the following year and renewed contact with Hall, meeting him for lunch at Millbank which she enjoyed so much she invited herself to see him in Cambridge in mid-July 1953 and he met her off the train.[122] The reason why they lunched in Millbank was that Hall had become one of the editors to publish *A History of Technology* in five substantial volumes. This project was funded by ICI and despite holding three jobs in Cambridge Hall seems to have felt short of money.[123] The initial editors were Singer and Holmyard; Hall joined them at the end of 1951,[124] with the fourth and final editor, Trevor Williams (1921–96), joining in time for the publication of volume one in 1954, the year in which Hall's second daughter, Clarissa, was born. *A History of Technology* involved Hall in making weekly journeys to London to the project office housed in ICI's Millbank headquarters. He was largely responsible for volume three,[125] published in 1957, which covered the period roughly from 1500 to 1750. He contributed the chapter on 'Military Technology' (as he had done for volume two) and concluded the volume with a chapter on the rise

[120] Boas Hall (2), p. 21.
[121] M. B. Hall, 'Guinea pig', p. S77.
[122] Boas to Hall, 13 July 1953 and 16 July 1953, IC MS Hall.
[123] Hall (2), p. 20.
[124] Worboys (ICI) to Hall, 27 Nov. 1951, IC MS Hall.
[125] Hall (2), p. 23.

of the West which he ascribed to increasing technological sophistication. In this Hall softened his earlier stance on the relations of science and technology and commented that by about 1700 there was already some justification for a linkage between them. But he ended on a pessimistic note: '[Men] saw science as the inspiration of technology, and technology as the key to a life of richness and prosperity: what they could not see, however, was the infinite and tortuous complexity of man himself'.[126]

The project was valuable to Hall not only in providing him with additional income but also in giving him a fair acquaintance with the development of Western technology. Despite the tensions that inevitably arise in this kind of collaborative project,[127] it did lead Hall to a close association with Singer who invited him on occasion to stay at his home on the Cornish coast, Kilmarth, just outside Par.[128] Nevertheless, Singer never changed his mind that only those trained in science could do history of science; perhaps history of technology was different in his mind.

At the same time as running the Whipple Museum, undertaking his college and teaching duties and working on *A History of Technology*, Hall published his book on seventeenth-century ballistics in 1952. At the start of that year, following Plumb's suggestion and recommendation, Hall signed a contract with Longmans to write a book entitled *The Scientific Revolution 1500–1800*, the manuscript to be delivered in the autumn of 1953;[129] possibly the timing was related to his need for money. This learned and highly readable book, based on Hall's lectures to undergraduate students, popularised the term scientific revolution which thereafter for a few years became the metaphor of choice for historians and writers on science—for example Kuhn's *The Copernican Revolution* (1957), whilst the full title of Snow's 1959 Rede lecture at Cambridge University was *The Two Cultures and the Scientific Revolution* and finally in 1962 Kuhn's *The Structure of Scientific Revolutions*.

Furthermore, the subtitle of Hall's book, *The Formation of the Modern Scientific Attitude*, confirmed his belief that modern science originated in this period: 'Much more has been learnt about Nature, from the structure of matter to the physiology of man, in the last century and a half than in

[126] A. R. Hall, 'The rise of the west', in C. Singer, E. J. Holmyard, T. I. Williams and A. R. Hall (eds.), *A History of Technology. Volume 3 From the Renaissance to the Industrial Revolution c.1500–c.1750* (Oxford, 1957), p. 721.
[127] See, for example, Hall to Singer, 8 Nov. 1955; Singer to Hall, 14 Nov. 1955; Williams to Hall, 14 Nov. 1955; Hall to Singer, 15 Nov. 1955; Williams to Hall, 18 Nov. 1955. IC MS Hall.
[128] Hall (2), p. 23.
[129] Mandelbrote interview, p. 9. Blagden to Hall, 24 Jan. 1952, IC MS Hall.

all preceding time. Of this there can be no doubt. But the scientific revolution ends when this vastly detailed exploration began, for it was that which made such investigation possible.'[130] Furthermore, Hall related none of this to practical issues; the words 'engineering' and 'technology' are notably absent from the index. This is peculiar both because Hall was working on *A History of Technology* at the same time and also his view, echoing Butterfield, that science 'is the one product of the West that has had decisive, probably permanent, impact upon other contemporary civilizations. Compared with modern science, capitalism, the nation-state, art and literature, Christianity and democracy, seem regional idiosyncrasies, whose past is full of vicissitudes and whose future is full of dark uncertainty.'[131] Why, it might be asked, should science be regarded as so generally important other than as a driver for technological change? Furthermore, once again Hall's pessimism comes through as does his view that the original creation of modern science was largely unrelated to practical concerns.

Following the completion of *The Scientific Revolution*, Hall began to contemplate a series on the history of science to be published by Cambridge University Press. It is not clear precisely what he had in mind, as Boas pointed out in replying to his invitation to contribute to the series—the same letter in which she suggested, as a 'brash American', that they should be on first name terms henceforth.[132] Boas had been kept busy with her duties at Brandeis as well as Secretary of the History of Science Society, a position she held from 1953 until 1957 apart from 1956 when Kuhn took on that role. She found her early meetings of the Council dull, but became involved in a 'junior revolution' which, together with a financial crisis, improved things.[133] Nevertheless, she had time to do some writing on Boyle and help establish a discussion group of younger historians of science in the Boston and Cambridge area, including Kuhn.[134]

Boas had not expected to visit England during 1954, but at the end of June she and her mother were touring the Forest of Dean from where she wrote to Hall saying that she would be in Cambridge in a couple of weeks and hoped 'to have a good history-of-science talk' with him and to hear the latest news about his book.[135] On 19 July she arrived in Cambridge and

[130] A. R. Hall, *The Scientific Revolution 1500–1800: the Formation of the Modern Scientific Attitude* (London, 1954), p. 364.
[131] Ibid.
[132] Boas to Hall, 6 March 1954, IC MS Hall.
[133] Boas to Hall, 18 Nov. 1955, IC MS Hall.
[134] Boas to Hall, 6 March 1954, IC MS Hall.
[135] Boas to Hall, 4 July 1954, IC MS Hall.

invited Hall and Anne (whom she had met during her 1953 visit)[136] to dinner the following day.[137] Boas returned to Massachusetts in time for the October hurricane season which she described experiencing, both in Cambridge and at her mother's home in Orleans on Cape Cod. In the same letter she asked Hall for support in her application for a Guggenheim Fellowship to allow her a year off from teaching and to study in England, hoping that she was not presuming on their friendship.[138] That month *The Scientific Revolution* was published and Hall sent her a copy;[139] she also reviewed it enthusiastically for *ISIS*.[140]

By this time, Hall's reputation was rising. With Butterfield's (and presumably Plumb's) support, he was elected to an official fellowship at Christ's in early 1955[141] and at the beginning of the following year his lectureship was made permanent.[142] At the same time Gerald Holton wrote inviting him to move to Harvard, an offer which though Hall found tempting he declined, citing, among other things, family reasons.[143] Nevertheless, doubtless to remind Cambridge of his existence, he showed the correspondence to Butterfield, who found it sufficiently alarming for him to tell Hall that he would have his support should Cambridge decide to establish a chair in the history of science.[144]

Boas was successful in obtaining a Guggenheim Fellowship and in July 1955 she moved to London for a year and lived at 12 Buckland Crescent, in Belsize Park. She mostly worked on Boyle and completed the text of what would become her first book: *Robert Boyle and Seventeenth-Century Chemistry* (Cambridge, 1958) won the first Pfizer Prize to be awarded by the History of Science Society.[145] She also became acquainted with the historians of science at University College London, including Douglas McKie (1896–1967), none of whom she found stimulating.[146] She stayed with Hall and his wife during the first week of November[147] and he

[136] Boas to Hall, 6 March 1954, IC MS Hall.
[137] Boas to Hall, 19 July 1954, IC MS Hall.
[138] Boas to Hall, 12 Oct.1954, IC MS Hall.
[139] Boas to Hall, 13 Nov. 1954, IC MS Hall.
[140] *ISIS*, 46 (1955), 304–5.
[141] Downs to Hall, 3 March 1955, IC MS Hall. Butterfield to Downs (draft), 8 Jan. 1955, ULC MS BUTT/531/H6.
[142] Taylor to Hall, 3 Feb. 1956, IC MS Hall.
[143] Hall to Holton, 2 Feb. 1956, IC MS Hall.
[144] Butterfield to Hall, 6 Feb. 1956, ULC MS BUTT/531/H7.
[145] *ISIS*, 51 (1960), 85.
[146] Boas to Hall, 16 Nov. 1955, IC MS Hall.
[147] Boas to Hall, 21 Oct. 1955, IC MS Hall.

invited her to the Ladies night at Christ's.[148] In line with inviting other scholars, such as the civil engineer at Imperial College, Alec Skempton (1914–2001, FRS 1961),[149] to deliver lectures on their specialist topics to his students, Hall asked Boas to lecture twice during the Easter term of 1956.[150] In September they both attended the eighth International Congress of History of Science held in Florence and Milan, between the 3rd and the 9th. Boas later wondered whether it was that trip that began to move their relationship beyond friendship as she remembered their being cross with each other and was surprised;[151] thereafter she began keeping Hall's letters to her.

After her year in England Boas returned to Brandeis for the start of the new teaching year and began corresponding with Hall almost monthly, though mostly on professional matters. Thus she asked if he would be 'angelic enough' to find out what had become of the manuscript of the Boyle book that she had given to a typing agency in London. But she also discussed her car, an MG, and the political situation, being staunchly opposed to the idea of the Republican Dwight Eisenhower (1890–1969) serving a second term as President.[152] In reply Hall asked if she would care to change her E for Britain's E (the Prime Minister, Anthony Eden, 1897–1977) and said that he had rung Cambridge University Press and found that the typescript of her book had arrived.[153] This was at the time of the Suez debacle and he felt moved to write Boas a letter entirely devoted to the crisis: 'There has been nothing like this since Munich. It is worse than Munich.'[154]

At this time, Hall was contemplating a sabbatical for the entirety of 1958. Most of this he told Boas would be spent in England because of school commitments, but he thought he could manage three months in America and asked her advice as to how practicable this was.[155] She made some helpful suggestions about lecture fees, travel etc. to confirm her view of its feasibility, adding, in pen, against that passage '& very nice too'.[156] What threw these plans off track was that Marshall Clagett (1916–2005)

[148] Boas to Hall, 20 Dec. 1955, IC MS Hall.
[149] Hall to Boas, 9 Nov. 1957, IC MS Hall.
[150] History of Science Committee minutes, 12 June 1956, ULC MS NEEDHAM B324.
[151] Boas to Hall, 14, 15, 16 April 1958, IC MS Hall.
[152] Boas to Hall, 25 Oct. 1956, IC MS Hall.
[153] Hall to Boas, 30 Oct. 1956, IC MS Hall.
[154] Hall to Boas, 3 Nov. 1956, IC MS Hall.
[155] Hall to Boas, 30 Oct. 1956, IC MS Hall.
[156] Boas to Hall, 3 Nov. 1956, IC MS Hall.

at the University of Wisconsin invited Hall to contribute a paper on the scholar and craftsman idea (something which Hall later said he did not know much about,[157] but in which he continued to separate science and technology)[158] to a major conference to be held in Madison during September 1957 on 'Critical Problems in the History of Science'.[159]

**1957–1959, a transatlantic love affair**

Early in 1957 Boas decided to leave Brandeis following their decision not to promote her. She was aware of three available positions; two at the University of California (Los Angeles and Berkeley) and one at the University of Leeds. She wrote asking for Hall's advice, especially about Leeds.[160] Hall commented that there were not any strong candidates in England, so if she did apply for Leeds he would withdraw his support from a name he had put forward.[161] She corresponded with Stephen Toulmin (1922–2009) at Leeds and appears, with Hall's help, to have been offered the position there.[162] However, she quickly decided to accept the appointment to the Department of History at UCLA to teach history of science entirely, for the first time.[163] She was anxious about Hall's reaction,[164] but he said he would have done the same thing in her position.[165] Between June and August, Boas was back in Buckland Crescent and met Hall a number of times and they both attended a conference at Royaumont near Paris.[166]

According to Hall, his marriage, at least on his side, was already in trouble by 1947[167] as the tone of his letters to Boas at this time reflects, Hall writing on one occasion a letter which began 'My dear Marie' and ended 'Please don't think it doesn't give me great pleasure to hear from you';[168] their frequent meetings suggests that if they had not, unknowingly

[157] Mandelbrote interview, p. 12.
[158] This was later published as A. R. Hall, 'The scholar and the craftsman in the scientific revolution', in M. Clagett (ed.), *Critical Problems in the History of Science* (Madison, WI, 1959), pp. 3–23.
[159] Hall to Boas, 22 Dec. 1956, IC MS Hall.
[160] Boas to Hall, 5 Feb. 1957, IC MS Hall.
[161] Hall to Boas, 11 Feb. 1957, IC MS Hall.
[162] Boas to Hall, 23 March 1957, IC MS Hall.
[163] Boas to Hall, 11 March 1957, IC MS Hall.
[164] Boas to Hall, 23 March 1957, IC MS Hall.
[165] Hall to Boas, 26 March 1957, IC MS Hall.
[166] Boas to Hall, 22 May 1957, IC MS Hall.
[167] Hall to Boas, 11 to 14 Sept. 1957 and 8, 9 Oct. 1957, IC MS Hall.
[168] Hall to Boas, 10 May 1957, IC MS Hall.

as yet, already fallen in love, then the conditions were right for it to happen. As indeed it did at the Madison meeting held from 1 to 11 September 1957 which was Hall's first visit to America. The day before the conference ended Hall spoke to Boas about his feelings for her, exchanging two kisses;[169] after that there was, could be, no going back: 'I could almost be angry with you' she wrote two days later 'because I would not have known how much you meant to me if you had not spoken—but after that I knew what would happen.'[170]

The immediate problem was that both flew out of Madison on the 11th—Boas to UCLA to start her new job and Hall, first to the University of Indiana at Bloomington, then to Pennsylvania to meet his old friend Philip George and to Massachusetts to meet the historians of science there, before returning to Cambridge. Although both suggested that they would soon return to normality, or rationality set in, as Boas put it,[171] these declarations were half-hearted, as they must have known, especially as they began writing daily to each other. These were very long letters usually on five sheets (the maximum permitted by postage) of air letter paper written over a period of two or three days in moments snatched from their very busy schedules. At the best it took four days, but usually five, for letters to go between Cambridge and Los Angeles, so replies tended to be to letters sent ten days to a fortnight earlier.

The development of their relationship and their deep, passionate and enduring love went through four very well defined periods. The first, from September 1957 until February 1958, was conducted entirely by letter. In these they explored, sometimes with painful honesty, their feelings and quickly consolidated their love. Very early on they decided that Hall should return to America, originally in the summer of 1958, but their impatience to meet again eventually brought this forward to February. Both had attacks of guilt, especially in regard to Anne's position, and the unwritten long-term future implications of their relationship. They were clearly living in their own world and Boas commented that they were 'both behaving in a particularly young & foolish way';[172] Hall referred to living a double life[173] and they told no one.

The second phase of their relationship lasted from February 1958 until the first week of April. Hall returned to America and by delivering lec-

[169] Hall to Boas, 1, 2 Oct. 1957, IC MS Hall.
[170] Boas to Hall, 12, 13 Sept. 1957, IC MS Hall.
[171] Boas to Hall, 12, 13 Sept. 1957, IC MS Hall.
[172] Boas to Hall, 28, 29 Sept. 1957, IC MS Hall.
[173] Hall to Boas, 3, 4, 5 Oct. 1957, IC MS Hall.

tures in Bloomington, Seattle, Berkeley and Los Angeles he was able to pay for his visit. They spent time together there and later during his visit an idyllic period at Cape Cod: 'We did manage an amazing range of life, in our time together—work & play & social life, & holiday idling & domestic contretemps—& it was all equally & deeply satisfactory.'[174] If there had been any doubts about the rightness of their relationship when he arrived, there were none when he left, but again they did not talk about their long-term future. Writing on the plane taking her back to Los Angeles, Boas told Hall that 'perfect bliss' had come to an end but not permanently.[175] Hall, likewise writing on his plane back to England, wrote to her 'Dearest heart, we do belong, we are wonderful together and for each other.'[176]

His return to England signalled the start of the third and infinitely most painful phase of their relationship, conducted mostly by letter but with fairly frequent transatlantic telephone conversations. Instead of going directly to Cambridge, Hall went to Buckland Crescent where Boas's mother, Louise, was living. She 'made me [Hall] face what I mean to do. She wouldn't have if I'd refused to face it, but I knew myself I have to. We can't go on like this.'[177] Hall went to Cambridge where he told Anne about the affair and asked for a divorce, but, of course, she had suspected that he was having an affair and with whom.[178] Thus began a very emotional and hellish time for everyone involved, and especially for Hall who had serious scruples about what he was proposing to do (especially in regard to his daughters, who were still very small), scruples for which Boas said she loved him all the more for holding.[179]

At first Anne refused to divorce him and Hall agreed to try for a year to see if their marriage could be saved,[180] but would be with Boas in August and during 1959 as they had agreed—indeed almost the first thing that Boas did when she got back to Los Angeles was to make a reservation on a flight to London for early August.[181] Such desperate solutions were simply untenable even in the short term, and Boas, clearly very unhappy, uncertain and depressed in Los Angeles, explained to Hall that he must consider himself as well as others and that he needed to make a decision

[174] Boas to Hall, 7 April 1958, IC MS Hall.
[175] Boas to Hall, 6 April 1958, IC MS Hall.
[176] Hall to Boas, 6 April 1958, IC MS Hall.
[177] Hall to Boas, 8 April 1958, IC MS Hall.
[178] Hall to Boas, 9 April 1958, IC MS Hall.
[179] Boas to Hall, 10, 11 April 1958, IC MS Hall.
[180] Boas to Hall, 21, 22 April 1958, IC MS Hall.
[181] Boas to Hall, 8, 9 April 1958, IC MS Hall.

one way or the other within eighteen months, or else all their lives would be shattered.[182] After much further anguish, many letters (including an exchange between Boas and Anne), phone calls, and a meeting between Anne and Louise Boas,[183] it became clear that there was no point in even trying to keep the marriage going and Anne agreed to divorce him. Louise Boas dealt with the last remaining practical problem so far as the relationship was concerned by, at the end of May, paying Hall's air fare to fly on 3 June to Los Angeles and Boas.[184] Thus began the final phase of their relationship which lasted for more than fifty years, for thereafter Hall and Boas would never be separated again for any significant period of time.

They spent the summer in Los Angeles and in the autumn returned to London to live at 24 Montague Square, though it is not clear on what basis Boas was able to leave UCLA to come to London. Derek Price saw them at the beginning of October, shortly after their return, and reported to Singer that 'They seemed to be quite happy together.'[185] Hall worked in Cambridge teaching twenty-one hours weekly ('a great strain'[186]) and lived in Christ's whilst Boas stayed in London. They usually spent the weekends in London and when he was in Cambridge continued to write to each other daily, although somewhat shorter letters than when the Atlantic was between them. Occasionally she would visit Cambridge and Leicester, where Hall introduced her to Bert Howard who found her 'company very stimulating!'[187] It was during this period that Hall spent much of his research time exploring the Newton manuscripts in the University Library. Towards the end of November he commented to Boas that 'we may have to bring out a book of unpublished remains',[188] a suggestion to which she responded enthusiastically: 'a joint book would be wonderful'.[189] It was in this context of these Newton studies that Hall got to know D. T. 'Tom' Whiteside (1932–2008, FBA 1975),[190] then completing his doctorate on late seventeenth-century mathematics and shortly to embark on his eight volume *Mathematical Papers of Isaac Newton*, published between 1967 and 1981, a project so massive that aside from papers and lectures he published nothing else.

[182] Boas to Hall, 14, 15, 16 April 1958, IC MS Hall.
[183] Hall to Louise Boas, 11 May 1958, IC MS Hall.
[184] Hall to Singer, 2 June 1958, Wellcome Collections PP/CJS/A.42.
[185] Price to Singer, 8 Oct. 1958, Wellcome Collections PP/CJS/A.47.
[186] Hall to Butterfield, 23 Feb. 1959, ULC MS BUTT/531/H9.
[187] Hall to Boas, 12 Jan. 1959, IC MS Hall.
[188] Hall to Boas, 25 Nov. 1958, IC MS Hall.
[189] Boas to Hall, 26 Nov. 1958, IC MS Hall.
[190] Hall to Boas, 18 March 1959 and 19 March 1959, IC MS Hall.

Hall and Boas's major concern during the period was, however, finalising the divorce which proved protracted, with Hall seeking speed and Anne showing no sign of haste. This prompted Boas to accuse her of making everyone unhappy, 'a futile thing since it can't be constructive, & only hurts herself & the children as well as you'.[191] Although Anne slowly dealt with the paperwork, it would seem that she was still harbouring hopes of Hall returning to her, though her methods of persuasion were such as to ensure that he 'couldn't go back to <u>that</u> kind of life'[192] as he put it following a particularly harrowing exchange of letters. The petition was not served until the end of January 1959.[193] Following its completion, Hall and Boas married in Marylebone Register Office on 10 June 1959, the witnesses being her mother and Hall's sister Doreen.

**1959–1963, America**

Just before he asked Anne for a divorce, Hall had written to Boas 'I shall get a job in America as soon as possible'[194] and a few days later: 'We can only live together in America, now.'[195] There was no pressing institutional necessity for him to leave his Cambridge jobs as his return to work there in October 1958 illustrates. Butterfield (who had had his own passionate affair in the 1930s though it did not lead to divorce and remarriage[196]) and the Master of Christ's, Brian Downs (1893–1984, who was himself divorced), both wanted Hall to stay,[197] whilst Plumb despaired at being left behind in a 'dreary college'.[198] Indeed the only criticism from his colleagues that Hall seems to have encountered came from a mathematics fellow at Christ's, Stourton Steen (1897–1979).[199] But Hall also sensed that he was stuck in Cambridge, which was unlikely to create a senior post in the near future. It is clear from his correspondence that he did not enjoy undergraduate teaching, had no opportunity for teaching advanced students and indeed had been 'fed up with Cambridge' since at least the middle of

[191] Boas to Hall, 22 Oct. 1958, IC MS Hall.
[192] Hall to Boas, 11 Nov. 1958, IC MS Hall.
[193] Hall to Boas, 29 Jan. 1959, IC MS Hall.
[194] Hall to Boas, 8 April 1958, IC MS Hall.
[195] Hall to Boas, 12, 13 April 1958.
[196] Michael Bentley, *The Life and Thought of Herbert Butterfield: History, Science and God* (Cambridge, 2011), pp. 78–94.
[197] Hall to Singer, 2 June 1958, Wellcome Collections PP/CJS/A.42.
[198] Hall to Boas, 13, 14 May 1958, IC MS Hall.
[199] Hall to Boas, 2 Oct. 1958, IC MS Hall.

1956.[200] Furthermore, Anne wanted him to leave Cambridge: 'I think I owe her that much.'[201] The divorce settlement meant that Hall had to pay half his salary to her in alimony[202] and so Boas Hall had to remain employed so they could support themselves. Since there were no positions available in England, unless they lived apart for significant periods of time on opposite sides of the Atlantic, it really meant finding a job for Hall in America.

Hall had strong possibilities of positions at Michigan, Wisconsin and Indiana; Boas had done a good job of spreading the word that he was looking for a job in America, although not the reason. In the end the key figure was Horace W. Magoun (1907–91), a distinguished neuroscientist, who in 1950 had moved to UCLA where he founded the Brain Research Institute. He had also established in 1953 UCLA's programme in the history of medicine with funding from the National Institute of Health and was 'quite well acquainted' with Boas Hall.[203] He created 'an unexpected niche'[204] for Hall as Associate Research Medical Historian, based in the Medical Center. Hall had met Magoun when he had lectured at UCLA in early 1958 and from Hall and Boas's correspondence it is clear that she had done some gentle lobbying to secure this position for him. Thus on 23 February 1959 Hall resigned his posts at Cambridge with effect from 30 September. He told Butterfield that he was sorry to leave Cambridge, and asked to be considered if there was a chance for him in the future.[205] Downs, as Master of Christ's, wrote a fulsome letter of thanks and praise for all of Hall's time at Cambridge and wished him well for the future.[206]

At UCLA Boas Hall returned to her teaching and research whilst Hall concentrated on his research. He worked with the historian of Renaissance medicine Charles O'Malley (1907–70) who in 1959, much to Hall's annoyance since it meant that there would be no possibility of a permanent job for him at UCLA, had been appointed Professor of Medical History there.[207] Nevertheless, O'Malley and Hall organised a seminar series on scientific literature in England during the sixteenth and seventeenth cen-

[200] Boas to Hall, 13 July 1956, IC MS Hall.
[201] Hall to Singer, 2 June 1958, Wellcome Collections PP/CJS/A.42.
[202] Hall to Linstead, 28 Jan. 1962, IC MS KH/2/2.
[203] Mandelbrote interview, p. 36.
[204] A. R. Hall, 'Introduction' to *Science and Society: Historical Essays on the Relations of Science, Technology and Medicine* (Aldershot, 1994), p. viii.
[205] Hall to Butterfield, 23 Feb. 1959, ULC MS BUTT/531/H9.
[206] Downs to Hall, 26 Feb. 1959, IC MS Hall.
[207] Hall to Boas, 28 April 1959, IC MS Hall.

turies;[208] Hall put the museum experience he had gained at the Whipple to use when he acted as consultant for an exhibition of microscopes held in 1961;[209] and he wrote a paper on the understanding of the cardiovascular system by the second-century AD physician Galen.[210] Hall later recollected that they had enjoyed their time at UCLA, but apart from Boas Hall there was no one else there to talk to about the history of science.[211]

Hall probably did enough to justify his place at UCLA as an historian of medicine. But it is clear that most of his and Boas Hall's research efforts were concentrated on Newton and related topics. They published a number of articles and in 1962 Cambridge University Press issued their edited selection of previously *Unpublished Scientific Papers of Isaac Newton*, which mainly dealt with the development of Newton's ideas on the nature of matter. This was the end of the project that they had started in late 1958 during Hall's last year at Cambridge. Most significantly, perhaps, they began their joint work on the correspondence of Henry Oldenburg (*c*.1619–77, FRS 1663), who had been the first Secretary of the Royal Society between 1663 and his death in 1677.[212] Hall had first come across Oldenburg's correspondence when he had been researching his Ph.D. thesis in the late 1940s. In the Royal Society he had found letters from Oldenburg to the poet John Milton (1608–74), a Christ's man, and this had sparked Hall's initial interest. He began transcribing and came to realise that Oldenburg's correspondence represented a vast clearing house of scientific exchange in the early history of the Royal Society at a time when science in England was beginning to flourish as never before.[213] As early as 1953 it was known that he was working on an edition of Oldenburg's letters,[214] but with all his other commitments during this time progress would undoubtedly have been slow.

Aside from combining their formidable knowledge and skills in editing Oldenburg's correspondence, quite how they saw their future at that point is not certain, but judging from his output Hall clearly did not see himself as an historian of medicine and presumably as a consequence his

[208] A. R. Hall and C. O'Malley, *Scientific Literature in Sixteenth & Seventeenth Century England* (Los Angeles, 1961).
[209] Papers and text of captions in IC MS Hall.
[210] A. R. Hall, 'Studies on the history of the cardiovascular system', *Bulletin for the History of Medicine*, 34 (1960), 391–413.
[211] Mandelbrote interview, p. 36.
[212] Boas Hall (1), p. 12.
[213] Mandelbrote interview, p. 27.
[214] Sister M. Marion to Hall, 30 July 1953, IC MS Hall.

time in this role at UCLA could only be limited. The late 1950s was a time when new departments devoted solely to the history of science and medicine were established in the United States due, in part, to the establishment by the National Science Foundation in the late 1950s of its programme in the history and philosophy of science.[215] During 1960 alone three new departments were founded at Princeton, Yale and Indiana. Both Hall and Boas Hall were on the advisory committee of the new Department of History and Logic of Science at Indiana, then chaired by Russell Hanson, who had left Cambridge for Bloomington in 1957 and was very keen to have the Halls move there.[216] His idea was to create a department that would cover the scientific revolution in its entirety with Edward Grant on late medieval science, Boas Hall on the Renaissance and Hall on the seventeenth and eighteenth centuries, together with three philosophers of science. The Halls did not make the move from Los Angeles to Bloomington until the autumn of 1961 because of the need to address the rules of Indiana University about the employment of a husband and wife in the same department.[217] They enjoyed Bloomington and later recollected 'we never found such an exciting and creative intellectual environment again as we had there'.[218]

There they completed writing Boas Hall's *The Scientific Renaissance, 1450–1630* (London, 1962) and Hall's *From Galileo to Newton, 1630–1720* (London, 1963), which he regarded as a better book than *The Scientific Revolution*.[219] These two books, both published by Collins, became very influential and at least one was awarded as a prize at Alderman Newton's school.[220] These books were intended to be the second and third volumes in a series conceived by Hall in the late 1950s entitled 'The Rise of Modern Science' covering, in eight volumes, the history of science from the ancient world to the twentieth century.[221] Although no further volumes were published, the Halls did however cover this large topic in their joint *A Brief History of Science* (New York, 1964, with the preface dated Indiana,

[215] Margaret W. Rossiter, 'The History and Philosophy of Science Program at the National Science Foundation', *ISIS*, 75 (1984), 95–104. Boas served on the grants committee for a number of years, Boas Hall (1), p. 9.
[216] Boas Hall (1), p. 11.
[217] Kevin T. Grau, 'Force and nature: the Department of History and Philosophy of Science at Indiana University, 1960–1998', *ISIS*, 90 (1999), S304.
[218] Mandelbrote interview, p. 39.
[219] Norman Cantor, 'The Scientific Revolution: A. R. Hall', in *Perspectives on the European Past: Conversations with Historians*, 2 vols. (New York, 1971), Vol. 1, p. 346.
[220] Recollection by Peter Bowler.
[221] Hall to Bragg, 18 Sept. 1958, RI MS WLB 51B/200.

15 December 1962) which, despite selling 40,000 copies, was not deemed a success by the publishers (New American Library) who pulped the remainder.[222]

Furthermore, the Halls took on research students including David Lindberg (1935– ) and Victor Thoren (1935–1991), who had originally worked with them at UCLA on Tycho Brahe (1546–1601) but who followed them when they moved to Indiana. They continued work on Oldenburg's correspondence, for which they received a $12,000 grant from the National Science Foundation,[223] and completed the first two volumes,[224] though not immediately published. They spent the summers in England working on the project and attending meetings such as the 1961 conference on scientific change organised by Crombie and held in Rhodes House in the University of Oxford.

At this meeting Kuhn presented what was essentially the first third of his *The Structure of Scientific Revolutions*, which would be published the following year. Hall, who later said he could not see any connection between Kuhn's *The Copernican Revolution* and *The Structure*,[225] concluded his commentary on Kuhn's paper at the Oxford meeting by saying that he seemed 'to be concerned rather with the minor tactics than with the grand strategy of scientific change'[226] and suggested that Kuhn's paradigms were monolithic. Hall continued his attack on Kuhn's views a couple of years later in November 1963 at one of the famous fortnightly seminars organised by Karl Popper (1902–94, FBA 1958, FRS 1976) at the London School of Economics, much to Popper's approval.[227] Despite the criticism of Hall and others, Kuhn's work became and remains massively influential in the academic world and beyond, mostly in the area of science studies and philosophy of science. Historians of science, right from the beginning as indicated by Hall's comments, found, and still find, the framework of scientific change proposed in Kuhn's *Structure* to be unhelpful and very few historians have analysed science in those terms.

[222] Boas Hall (1), p. 12.
[223] Grau, 'Force and nature', p. S306.
[224] Mandelbrote interview, p. 39.
[225] Mandelbrote interview, p. 23.
[226] A. R. Hall, 'Commentary on T. S. Kuhn, "The function of dogma in scientific research"', in A. C. Crombie (ed.), *Scientific Change: Historical Studies in the Intellectual, Social and Technical Conditions for Scientific Discovery and Technical Invention from Antiquity to the Present* (London, 1963), p. 375.
[227] Private communication, 2 Sept. 2011, from Jagdish Hattiangadi to FJ. See also Jagdish Hattiangadi, 'Kuhn debunked', *Social Epistemology*, 17 (2003), 175–82, especially p. 177.

Hall continued his critique of what was beginning to be labelled the externalist view—as opposed to his internalist view—of the factors that were claimed by historical sociologists, such as Merton, to have caused the scientific revolution. He outlined his views in a paper entitled 'Merton revisited' published in 1963,[228] which was strongly criticised by Robert Young (1935– ) in a Festschrift for Needham that, amongst other issues, discussed the development of the history of science in Britain.[229] Young described Hall's views, as seen ten years later, as apparently 'bizarre', as coming to the reverse conclusion to Marxists in regard to the relationship between science and society, and stressing the 'severe limitations' to his approach and that of others.[230]

Looking back at the debate between externalism and internalism, as exemplified by the writings of Hall and of Young, it is striking how it was conducted in the realm of ideas, rather than in terms of historical and biographical contexts. While this was entirely in line with Hall's views and practice, it is a bit surprising that Young followed suit. Familiar with history of science in post-Hall Cambridge—he arrived there in 1960 to do his Ph.D.—Young was clearly unacquainted with the battles that had been fought out in the 1940s and 1950s. It would seem, also, that he was unfamiliar with the impact that wartime service had on the previous generation. Both these factors contributed significantly to the formation of Hall's historiographic views. Leaving aside the various ideological commitments, the internal–external debate emerged from the argument as to who was qualified to do history of science—scientists or historians—and this did not necessarily conform easily with other ideological considerations. Marxists and scientists such as Needham and Lilley at Cambridge and those who belonged to the 'Visible College'[231] elsewhere, were mostly very high-level scientific practitioners, who analysed science in terms of social and economic structures and modes of production. Non-Marxist scientists tended to view modern science as contributing crucially to material prosperity and a general improvement in living standards. Either

[228] A. R. Hall, 'Merton revisited or science and society in the seventeenth century', *History of Science*, 1 (1963), 1–16.

[229] Robert Young, 'The historiographic and ideological contexts of the nineteenth-century debate on man's place in nature', in Mikuláš Teich and Robert Young (eds.), *Changing Perspectives in the History of Science: Essays in Honour of Joseph Needham* (London, 1973), pp. 344–438.

[230] Ibid., pp. 346 and 356.

[231] Gary Werskey, *The Visible College: a Collective Biography of British Scientists and Socialists of the 1930s* (London, 1978).

way, science was a critically important activity and thus its creation needed to be understood. Historians, such as Butterfield and Hall, who accepted the rhetoric, sought to do this.

At one level the criticisms made by Needham or Singer of Butterfield and Hall, that only a training in science qualified someone to work in the history of science, referred to the specialised knowledge of the various sciences. But there was another feature of this argument which affected Hall's historiography. Although he had considerable experience of the difficulties of applying science in practice, he had never undertaken any scientific research and this seems to have contributed to a mild positivism and idealism stemming from his concentration on the history of theory through reading Koyré and a consequent tendency to downplay the significance of experiment. Thus, for example, Hall accepted Koyré's view of the impossibility of the experiment where Galileo described the motion of water and wine without mixing, until the present author demonstrated it to him. Boas Hall, on the other hand, had undertaken some scientific research and consequently knew the problems inherent in experimental work. Partly as a consequence of this experience, and partly as a reaction to Sarton, she tended to be rather less positivist in outlook, despite the influence of Koyré, but, like Hall, she followed Koyré in concentrating on the history of ideas approach to the history of science.

All this fitted in very well with their colleagues at Bloomington where the experience of working with philosophers strengthened Hall's analytical interests.[232] And this goes a long way to explaining the explicit historiographical turn that Hall's work took in the early 1960s. Yet despite the intellectual excitement at Indiana, the Halls' freedom to do research, to visit Europe in the summers, and the financial benefits of being there, all was not happy and there were tensions within the new small department. The Halls turned down an invitation from Pennsylvania, but Hanson formally accepted an offer from Yale in early 1963.[233] Before that, indeed within months of taking up their positions at Indiana, Hall wrote a letter of enquiry when a new chair in the history of science and technology was announced at Imperial College late in 1961.

[232] Mandelbrote interview, p. 37.
[233] Grau, 'Force and nature', pp. S306–7.

## Imperial College, 1963–1980

### Appointment

The origins of what became the Department of the History of Science and Technology at Imperial College can be traced to some correspondence in the autumn of 1958 between the Rector, Patrick Linstead (1902–66, FRS 1940), the head of physics, Patrick Blackett (1897–1974, FRS 1933), and Charles Singer. The immediate cause of the correspondence was the emigration of Derek Price to the United States after failing to find a job in England, despite having an enormously powerful patron in Lawrence Bragg, first as Director of the Cavendish Laboratory until 1953 and then as Director of the Davy–Faraday Research Laboratory at the Royal Institution.[234] Singer bemoaned the loss of Price to Britain and suggested to Blackett approaching ICI to found a chair for him at Imperial dealing with the humanistic relationships of science.[235] Blackett copied this correspondence to Linstead who turned this proposal into developing history of science which he was very keen to do, but for which there was no funding provision.[236] Nevertheless, a college committee was formed and on 22 May 1959 it convened a dinner for outside experts to discuss the matter. Those who attended included Hall, Singer and McKie, whilst those from the college, in addition to Linstead and Blackett, included a number with strong historical interests such as Skempton and the theoretician, philosopher and historian of mathematics, Gerald Whitrow (1912–2000). Singer continued to insist that for the historian of science 'scientific training was more important than historical'[237] and later suggested that Price should be appointed[238]—this was shortly after Price had failed, much to his disgust, to be appointed as Hall's successor at Cambridge.

What was not in contention at the dinner was the idea that the humanistic relations of science should be interpreted as meaning the history of science. Coming less than two weeks after Snow had delivered his diatribe against the supposed separation of scientific and literary cultures in his 'Two Cultures' lecture, the timing of the dinner could hardly have been more apposite. How many of those at the dinner knew of the lecture is not

[234] See the Price file in Bragg's papers, RI MS WLB 55F.
[235] Singer to Blackett, 10 Sept. 1958 and 12 Sept. 1958, IC MS KH/2/1.
[236] Blackett to Linstead, 23 Sept. 1958, IC MS KH/2/1.
[237] Notes of a dinner meeting held on 22 May 1959 at 178 Queensgate, IC MS KH/2/1.
[238] Singer to Linstead, 24 July 1959, IC MS KH/2/1.

known—it would be a little while before Frank Leavis (1895–1978) supplied his incendiary rejoinder that would make Snow's lecture far more significant than it deserved.[239] At this time Hall and Boas were working on radio talks for the BBC Third Programme to be part of a series on the history of science. These were published in *The Listener*[240] and collected together in a book to which Hall provided the foreword dated 1 January 1960. He began: 'If it is true, as Sir Charles Snow has argued, that our present educational system produces two cultures, the history and philosophy of science occupies a central position between them,'[241] and then proceeded to make a strong case for the expansion of the subject to provide a solution to the cultural problems of science that Snow had focused on. The idea that history of science (combining, as Hall pointed out, elements from both science and history) would help solve the two cultures problems seems to have been one attractive to the higher reaches of university administrations on both sides of the Atlantic. In the ensuing years many new departments devoted to the subject would open as well as individual appointments made across a wide range of academic departments.

So far as Imperial College was concerned, throughout the remainder of 1959 discussions continued about possible figures to fill a chair in the history of science, should it be established, as well as how it should be funded. In early 1960 ICI agreed to contribute £1,500 annually for seven years towards the chair[242] and by the middle of 1961 it had been included in the University Grants Committee quinquennial funding settlement for the college to start in October 1962.[243] The position was announced in December 1961 and was framed explicitly in the rhetoric of the two cultures: 'the first holder of the chair will have the opportunity to bridge one of the gaps between the humanities and the sciences'.[244] In early January 1962 Hall wrote to Linstead asking for details, mentioning Boas Hall and adding that he was not sure that he wanted to leave the United States.[245] Linstead replied that he had not regretted his own moves to and fro across

[239] Guy Ortolano, *The Two Cultures Controversy: Science, Literature and Cultural Politics in Postwar Britain* (Cambridge, 2009).
[240] M. Boas, 'The machinery of nature', *The Listener*, 61 (1959), 1106–8; A. R. Hall, 'The experimental way', *The Listener*, 62 (1959), 131–3.
[241] A. R. Hall, 'Foreword', in A, R. Hall (ed.), *The Making of Modern Science Six Essays* (Leicester, 1960), p. 3.
[242] ICI to Linstead, 2 Feb. 1960, IC MS KH/2/2.
[243] Linstead to Blackett, 17 May 1961, IC MS KH/2/2.
[244] 'History of Science and Technology at the Imperial College', *Nature*, 192 (1961), 1131.
[245] Hall to Linstead, 4 Jan.1962, IC MS KH/2/2.

the Atlantic and referred to Boas Hall as a 'special opportunity',[246] a phrase that would recur in correspondence as 1962 progressed. Hall, after a slight hesitation, responded by saying that he would not apply for the position, that Boas Hall was 'In many ways … far more able than [he]', adding that they could not afford to live on a single salary because of the alimony. He concluded by expressing the hope that the college would employ a professional historian—surely a riposte to the views of the now dead Singer.[247]

Sixteen people applied for the chair including the historians Samuel Lilley (1914–87), Frank Greenaway (1917– ) and Donald Cardwell (1919–98), but also the science communicators Magnus Pyke (1908–92) and Anthony Michaelis (1916–2007).[248] The appointment board of the University of London, whose membership included Butterfield, Blackett and Linstead, met on 15 February 1962 and decided that none of the applicants was appropriate for the position. Instead they decided that Linstead would approach, in order of preference, Joseph Needham and then Hall and if both declined the Board would reconvene. Needham declined, and since his rejection does not seem to have been followed up this suggests that it had been couched in a non-negotiable way.

At the beginning of March 1962 Linstead was considering how best to approach Hall. At this point Butterfield intervened to say that Hall must be brought back and suggested, as an inducement, that Boas Hall should be offered a position, although he had never met her.[249] Linstead told Butterfield that he did not rule out this option, again referred to it as a 'special opportunity' and added that he had invited Hall to London in May to discuss the matter.[250] Hall took some time to respond[251] and eventually suggested that as they were coming to England at the end of June they should meet then, to which Linstead agreed.[252]

They met at the start of July and with Blackett's approval Linstead offered them both jobs, with Boas Hall to be appointed at Senior Lecturer level (which Imperial could offer) with it being understood that she would be promoted to Reader the following year, this being an appointment

[246] Linstead to Hall, 12 Jan. 1962, IC MS KH/2/2.
[247] Hall to Linstead, 28 Jan. 1962, IC MS KH/2/2.
[248] File relating to board of advisors meeting on 15 Feb. 1962, IC MS KH/2/3.
[249] Butterfield to Henderson, *c.*7 March 1962, IC MS KH/2/2.
[250] Linstead to Butterfield, 16 March 1962, IC MS KH/2/2. Linstead to Hall, 9 March 1962, IC MS KH/2/2.
[251] Hall to Linstead, 22 March 1962, IC MS KH/2/2.
[252] Linstead to Hall, 4 April 1962, IC MS KH/2/2.

which only the University of London could make and thus could not be done immediately.[253] Hall then hesitated for two months about whether to accept or reject the offer, a delay that clearly irritated Linstead. But during this period some of the details were worked out, such as where they would have their offices and departmental library—180 Queensgate. Furthermore they were offered a flat (on very reasonable terms) next door at 179 while they found somewhere to live permanently. Against the move was their enjoyment of working in Indiana, although Hanson's imminent departure lessened that attraction, and they would take a significant cut in salary. On the other hand there was the near impossibility of continuing work on Oldenburg while based in Indiana, and, but probably significantly, the personal reason to be nearer Hall's daughters.[254] Eventually on 3 September Hall accepted on both their behalves agreeing to start at the beginning of October 1963.[255]

On 19 November 1963 Hall delivered his inaugural lecture entitled 'Historical relations of science and technology'.[256] In this he surveyed both disciplines, noting the institutional weakness of the history of technology compared to that of science, criticised the undue optimism of nineteenth-century historians and spent a significant proportion of his time talking about Newton. On such an occasion Hall could not ignore the cultural context which had brought the department and his chair into existence. He commented that he preferred to leave bridge building to civil engineers (one imagines Skempton's chuckle in the audience), but repeated the position he had taken four years earlier that he believed the subjects had 'a large role waiting for them in the more liberal scheme of British education that I hope will come'.[257] *Nature* published Hall's lecture in its entirety over nearly five pages which is an indication of the importance attached to his appointment and the subjects, both by the college and also more broadly by the scientific and engineering communities.

## Teaching

The new Department of the History of Science and Technology, of which Hall and Boas Hall were the only members for the first few years, was

[253] Note by Linstead, 3 July 1962, IC MS KH/2/2.
[254] Mandelbrote interview, p. 39. Boas Hall (1), pp. 12–13.
[255] Hall to Linstead, 3 Sept. 1962, IC MS KH/2/2.
[256] A. R. Hall, 'Historical relations of science and technology', *Nature*, 200 (1963), 1141–5.
[257] Ibid., p. 1145.

always intended to be a research department; Blackett had used the comparison of the Department of Meteorology.[258] Hence undergraduate courses were only very slowly built up. In part this was due to the reluctance of individual departments to permit their students to take courses outside their control, although Chemical Engineering allowed Boas Hall to deliver a popular course on the history of technology to their students.[259]

To make an immediate impact on the consciousness of the college following their arrival, the Halls put on a course of lectures (some of which were delivered by others), entitled '400 Years of Mechanism: Theory and Practice 1500–1900', which was open to the entire college. The following year Hall delivered a series of six lectures on the early history of the microscope and in 1965 they provided a series on the history of chemical theory.[260] Thereafter, following the establishment of a postgraduate programme, these series were discontinued, but the Halls retained their college-wide presence by contributing to the lunch time lectures organised by Associated Studies.

The development of the postgraduate programme was delayed by Imperial College's then status as a school of the University of London, the degree-awarding authority. This meant that to establish masters courses in the history of science and technology necessarily required going through the committee structures of both college and university and this took time. However, the college on its own could establish one-year postgraduate diploma courses, awarded on the basis of a short research project, which is what the Halls did initially. Their first student, Richard Hills, wrote his 60,000 word dissertation on the drainage of the fens for which he gained his Diploma of Imperial College in 1964.[261]

By the middle of 1966 the Halls had received the necessary authorisations to establish masters courses in the history of science and in the history of technology which first ran in 1967–8. Each year thereafter around half-a-dozen students took the history of technology course and slightly more did the history of science. Both courses could be done full time in a year or part time over two or more years. Because neither history of science nor technology were studied at undergraduate level, the Halls insisted that before anyone pursued doctoral research they should first do one or

[258] Notes of a dinner meeting held on 22 May 1959 at 178 Queensgate, IC MS KH/2/1.
[259] Boas Hall (1), p. 13.
[260] Lecture course announcements in IC MS KH/1/2 and Hall to Linstead, 27 Aug. 1963, IC MS KH/2/4.
[261] Richard Hills, conversation with FJ, 6 July 2009.

other of the masters courses, or at the very least attend the lectures. Most students for both masters and research possessed first degrees in a science or engineering subject or, occasionally, history or design. Thus the Halls viewed the master degrees as conversion courses before going on to undertake research.

However, both masters and research students were, they found, slow in coming because of the funding arrangements, or rather lack thereof, an issue that particularly frustrated the Halls. The history of science groups at Oxford and Cambridge Universities were given quotas from the Department of Scientific and Industrial Research (from 1965 the Science Research Council) or from the Department of Education and Science from which they could directly allocate grants to students. History of science at Imperial College was not part of this quota system which the Halls found discouraged a number of students from studying with them.[262] Students could apply directly to these sources for support, but in practice very few were successful.

But in the end they produced many students who subsequently went on to pursue distinguished careers in the history of science. Among research students, of whom more than twenty completed their theses, can be counted Andy Wear (who worked on Renaissance anatomy), Albert van Helden (Saturn's rings in the seventeenth century), Janet Browne (mid-nineteenth-century biogeography), J. V. Field (Kepler's geometrical cosmology), Nick Russell (early modern animal breeding), Frank James (the beginnings of spectroscopy) and Steve Pumfrey (William Gilbert, but he completed at the Warburg Institute).

It is apparent, both from the work of these individuals and from the others, that the Halls were more than happy to supervise students on almost any topic or scientific speciality, although it is noticeable that there was only one thesis on the twentieth century and none on any pre-sixteenth-century subjects. Nearly half of the theses dealt with the nineteenth century which reflected a growing trend in the subject and the beginnings of doubting the view of the Halls and others that the origins of modern science lay in the sixteenth and seventeenth centuries alone. There was little in the way of research training and methodological teaching (possibly because the Halls believed that what was necessary had been covered in the masters courses), although research students were strongly encouraged to read and discuss the various works of Robin Collingwood

[262] Hall to the Secretary of the Science Research Council, 27 July 1967, IC MS KH/2/4. This was a very strongly worded letter and it is not clear whether it was sent.

(1889–1943, FBA 1934), especially the *Autobiography*.[263] The Halls ran a closed seminar for their students in order to keep them 'free of the sometimes vicious personal attacks that formed part of the intellectual argument in the history of science community in the 1970s'.[264] Whilst the overwhelming preponderance of the theses submitted at Imperial were internalist in outlook, the lack of explicit methodological training meant that students were not indoctrinated with this view. Indeed most of those who pursued careers in the history of science moved into more socially oriented historical studies of science, but with a clear respect for the value of the content of scientific knowledge. All in all 'As teachers the Halls were inspiring, painstaking, approachable and kind.'[265]

Amongst their diploma and masters students who went elsewhere for their doctorates can be counted Richard Hills, Nick Fisher, Andy Cunningham and Anne Sant (later Secord). Furthermore the Halls hosted research students from overseas (mostly American) universities, such as Bob Westman, Patri Pugliese, David Roos and Jim Secord, for a year. Amongst senior scholars who visited the department for extended periods were Emory Kemp, L. J. Jones, Jim Taub, Rod Home and Martin Rudwick (FBA 2008). All in all, the Halls built up, from scratch, a scholarly department which became, for a while, one of the major centres for the history of science both nationally and internationally.

To mark Hall's seventieth birthday in 1990 a group of their former students organised, on behalf of the British Society for the History of Science, a conference, 'Renaissance and Revolution', held at Keble College, Oxford. It is a testimony to the esteem in which they were held that the meeting was very well attended by historians of science at all stages of their careers including those who held somewhat different views from them.[266] A smaller meeting was held at the Royal Institution in 2000 to mark their eightieth birthdays.

[263] For Hall on Collingwood see A. R. Hall, 'Presidential Address: can the history of science be history?', *British Journal for the History of Science*, 4 (1969), 217–18.

[264] Andrew Wear, 'Obituary Rupert Hall (1920–2009) Marie Boas Hall (1919–2009), *Medical History*, 53 (2009), 588.

[265] J. V. Field, 'Obituary. Alfred Rupert Hall (26 July 1920–5 February 2009) and Marie Boas Hall (18 October 1919–23 February 2009)', *British Journal for the History of Science*, 43 (2010), 103.

[266] A selection of some of the papers presented at the meeting was published as J. V. Field and Frank A. J. L. James (eds.), *Renaissance and Revolution: Humanists, Scholars, Craftsmen and Natural Philosophers in Early Modern Europe* (Cambridge, 1993).

**Research and projects**

The Halls were also expected to pursue their own research. At Imperial the first volume of Oldenburg's correspondence was published in 1965 by the University of Wisconsin Press. This contained a foreword by Linstead as Foreign Secretary of the Royal Society, but the Halls dated their preface Indiana September 1962. In the following twelve years they published a further ten volumes, the last two published by Mansell in London—that is one every year until 1971 and then a volume every other year. They then encountered problems with finding a publisher who was willing to complete the project by publishing the final two volumes, but eventually in 1986 (after they left Imperial) volumes twelve and thirteen were produced by Taylor and Francis. Their preface, dated February 1980, commented that 'We have at last, after twenty years work, come to the end of a task we undertook light-heartedly.'[267] But they were satisfied that all the effort had been worthwhile and that Hall's original vision of the scope of the project had been borne out. If much of the Halls' work has suffered the usual fate of historical writing to be superseded by later work and interpretations, their edition of Oldenburg's correspondence will surely remain invaluable to historians for many years to come—a permanent monument to their relationship, quite possibly something that might never have come into existence but for that. Furthermore, Hall firmly believed that it was the duty of historians to make documentary contributions to the subject.[268]

The reputation of the Halls, and the department as they built it up, ensured that they and it would attract funding for key projects. Although Hall had extensive expertise in the history of technology and Boas Hall some, clearly the subject was not as well covered by them as the history of science. To rectify this, in 1966 Linstead successfully applied to the Leverhulme Trust for a five-year research fellowship in the history of technology.[269] This application was probably stimulated by the presence in the department during 1965–6 of Norman Smith (1938–2009), who had returned from a three-year stint teaching civil engineering in New Zealand. He had a very strong interest in the history of water engineering and had obtained a Science Research Council research fellowship which he used to spend the year in the department. Smith was mentioned specifically in the application to the Leverhulme and his help in the second half of the 1960s

[267] A. R. Hall and M. B. Hall, *The Correspondence of Henry Oldenburg*, 13 vols. (Madison, WI, and London, 1965–86), Vol. 13: p. xv.
[268] Mandelbrote interview, p. 15.
[269] Linstead to Murray, 4 March 1966; Murray to Linstead, 30 June 1966, IC MS KH/2/4.

was invaluable to the Halls in ensuring the success of the diploma and masters course in the history of technology.

Following the demolition of most of the Imperial Institute in the late 1950s, the Doric Portico at Euston Station in 1962, the closure of the Transport Museum in Clapham and the proposed closure of St Pancras Station, the 1960s saw the emergence of an influential and effective group opposed to further destruction of Britain's Victorian industrial heritage led by figures such as the poet John Betjeman (1906–84), his friend the film-maker Arthur Elton (1906–73) and the writer L. T. C. 'Tom' Rolt (1910–74). In 1968 the Duke of Edinburgh (FRS 1951) chaired a committee to consider a proposal by Betjeman to move the Transport Museum to St Pancras which would become a museum of industrial technology.[270]

Before anything could be done the magnitude of what would be involved had to be established. To this end the Director of the Leverhulme Trust, Lord Murray of Newhaven (1903–93), asked the department to undertake a pilot survey to identify what survived and the Trust provided the necessary funding for the project. Smith was appointed Principal Investigator for the project, the report of which was published a couple of years later.[271] Following Smith's work, another meeting was held at Buckingham Palace, the outcome being the establishment by the Standing Commission on Museums and Galleries of a working party to consider the issues. Chaired by the Earl of Halsbury (1908–2000, FRS 1969), its membership included Elton, Rolt, and Hall, who was a key figure in making the recommendations.[272] In a plethora of activities directed towards the preservation of industrial heritage, the working party and Smith's report were two strands that were both praised by the arts minister, Viscount Eccles (1904–99), in the ensuing debate in the House of Lords. But he enfolded most of them into a more general review of museum provision in Britain.[273] However, one recommendation of the working party that was implemented was the establishment of a fund to support the purchase and conservation of items of scientific, industrial and technological significance. Called the PRISM fund and chaired initially by Paul (later

[270] Standing Commission on Museums and Galleries, *The Preservation of Technological Material: Report and Recommendations* (London, 1971), p. 2.
[271] Norman A. F. Smith, *Victorian Technology and its Preservation in Modern Britain* (Leicester, 1970).
[272] Standing Commission on Museums and Galleries, *Eighth Report 1965–1969* (London, 1970), p. 24.
[273] House of Lords debate, 15 May 1972, *Hansard*, v.330, cc.1255–71.

Lord) Wilson (1908–80), Hall was one of its 'livelier' members for the ten years he served on it.[274]

Another key project that came to the department shortly afterwards was the completion of a printed edition of Isaac Newton's correspondence. The Royal Society had been considering such a project since the start of the twentieth century, but it was not until 1939 that they appointed the astronomer Henry Plummer (1875–1946, FRS 1920) to the position of editor.[275] Because of the war not much progress was made and in 1947, following Plummer's death, the metal physicist Edward Andrade (1887–1971, FRS 1935) was appointed chair of the Royal Society's Newton Letters Committee. The mathematician Herbert Turnbull (1885–1961, FRS 1932) became editor, but the project ran into difficulties,[276] as might be expected from anything that involved Andrade,[277] together with an unwieldy and editorially active committee. Nevertheless, Turnbull produced the first volume in 1959, with volumes two and three appearing in succeeding years, though the latter volume was published posthumously. His assistant Joseph Scott (1892–1971) took over and published the fourth volume in 1967.[278]

Andrade died in 1971 and the Royal Society invited the mathematician James Lighthill (1924–1998, FRS 1953) to take over as chair of the Newton Letters Committee. After reading through the papers Lighthill wrote at the end of July 1971 'Quite honestly the invitation seems comparable to that given to Hercules to clean the Augean stables!', and went on to outline the conditions on which he would accept the chairmanship. These included retiring Scott, reforming the structure and functions of the committee and above all appointing a leading Newton scholar as editor, mentioning Hall by name.[279] Matters were made easier when Scott died less than three weeks later[280] and it would appear that Lighthill's other demands were agreed to. He acted quickly and invited Hall to undertake the task, which he accepted on a number of conditions including the appointment of a research assistant on the project.[281] For this position Hall had Laura

[274] John Robinson, conversation with FJ, 9 Jan. 2012.
[275] Minutes of Newton Letters Committee, 23 May 1939, RS MS CMB120A.
[276] Boas to Hall, 18 July 1955, IC MS Hall.
[277] Frank A. J. L. James and Viviane Quirke, 'L'affaire Andrade or how not to modernise a traditional institution', in Frank A. J. L. James (ed.), *'The Common Purposes of Life': Science and Society at the Royal Institution of Great Britain* (Aldershot, 2002), pp. 273–304.
[278] For further details see the editors' preface to R. H. Dalitz and M. Nauenburg (eds.) *The Foundations of Newtonian Scholarship* (Singapore and London, 2000), pp. xi–xii.
[279] Lighthill to Maunsell, 29 July 1971, RS MS RMA 663 NL/3 (third file).
[280] Martin to Lighthill, 27 Aug. 1971, RS MS RMA 663 NL/3 (third file).
[281] Hall to Lighthill, 20 Sept. 1971, IC MS KH/2/5.

Tilling in mind; she was then a research student of his working on a thesis on eighteenth-century observational error that she completed in 1973. By the first week of October negotiations had been completed[282] and at the start of February 1972, at what proved to be the final meeting of the Newton Letters Committee, Hall's appointment was formally agreed and he was awarded a grant of £3,000 (later increased to £4,000) annually to cover his honorarium, expenses and research assistant.[283]

The final three volumes of Newton's correspondence went from 1709 until his death in 1727, covering much of his time at the Royal Mint. Furthermore, undated letters, those that should have been published in earlier volumes as well as corrections, were included. Because of the chaotic state in which the papers were given to Hall and Tilling, they effectively started locating, editing and researching from scratch.[284] However, by the middle of 1976 their work had been completed.[285] Volume five appeared at the start of the previous year and the remaining volumes in 1976 and 1977.

Another major project was editing and publishing the *ISIS Cumulative Bibliography*, which appeared in six volumes between 1971 and 1984. The proposal to do this arose at the time of the fiftieth anniversary of *ISIS* in 1963. The original idea was simply to index the volumes, but this was complicated by the inclusion of a critical bibliography in *ISIS* (one of Sarton's ideas) which comprehensively listed all the publications in the history of science. Eventually it was decided that the *Cumulative Bibliography* would include all the entries in the critical bibliography—in effect it would be a large comprehensive bibliography of publications in the history of science and allied subjects between 1913 and 1965. A professional librarian (and wife of Gerald Whitrow), Magda Whitrow (1914–2010), was appointed editor and Hall gave her office space at Imperial to house the project and the tens of thousands of index cards on which the bibliography was based. In 1968 the office was moved to the Science Museum but returned to Imperial in 1976. It was perhaps the last major bibliography to be produced before the advent of computers (the entries were typed onto new camera-ready index cards using IBM golfball typewriters), but it provided

[282] Lighthill to Martin, 7 Oct. 1971, RS MS RMA 663 NL/3 (third file).
[283] Minutes of Newton Letters Committee, 2 Feb. 1972, RS MS CMB120B. This decision was ratified by the Royal Society Council the following week.
[284] A. R. Hall and Laura Tilling, *The Correspondence of Isaac Newton Volume V 1709–1713* (Cambridge, 1975), p. xiv.
[285] Hall to Robinson, 18 Dec. 1975 and Hall to Le Grand, 6 June 1976, RS RMA 1194 File A.63.

gainful employment for some of the Halls' research students lacking financial support.

## Expansion and Closure

While the Halls and their colleagues had done exactly what they had been invited to do when they moved to Imperial in the early 1960s, by the end of the decade and into the 1970s this was not what the college wanted; history of science was no longer seen as the, or even a, solution to the cultural problems of science. The Halls lost their major backer in the college when Linstead died suddenly on 22 September 1966, to be eventually replaced as Rector by the atomic scientist Lord Penney (1909–91, FRS 1946) in 1967. Blackett, one of the Halls' other supporters, had left the college in 1965 to become President of the Royal Society, but they continued to enjoy the support of Whitrow and Skempton who, as head of Civil Engineering, was particularly helpful with the issues surrounding Norman Smith.

Penney was concerned with the poor state of the college's finances, and on one occasion raided the department's reserves which, though small in absolute terms, he regarded as disproportionately large for its size.[286] He was basically as unsympathetic to the humanities and social sciences as Linstead had been supportive.[287] The problems this created for the Halls were played out in their struggle to obtain a permanent appointment for Smith, once his Leverhulme Fellowship ended in the middle of 1970. Smith had been appointed a temporary lecturer in August 1969, but as the next quinquennium did not begin until 1972–3 (the earliest point at which any funding resulting from a successful college bid would become available) there was a two-year gap. The departmental reserves would cover the first year and if they did not Hall wrote that he would be willing to make up the difference from his own salary and made a strong case for Smith's appointment beyond July 1971.[288] Key to making Smith's appointment permanent, as Penney pointed out, was how many students there would be in the department during the coming quinquennium, an issue that Hall had already addressed.[289] Hall was successful as in April 1971 the college

[286] Penney to Hall, 11 Feb. 1970, IC MS KH/2/5.
[287] Hannah Gay, *The History of Imperial College London 1907–2007: Higher Education and Research in Science, Technology and Medicine* (London, 2007), p. 571.
[288] Hall to Penney, 9 July 1970, IC MS KH/2/5.
[289] Penney to Hall, 8 Sept. 1970 and Hall to Jackson, 26 Nov. 1969, IC MS KH/2/5.

increased the department's budget by £2,500 for 1971–2[290] which allowed Smith to be made a permanent member of the department, thus increasing its size by 50 per cent. He continued to take most of the responsibility for the history of technology masters course and supervising most of the research students in that area. In 1976 he and Hall edited the first of an annual volume of essays entitled *History of Technology*, a series which continues to be published.

However, securing Smith's appointment would be the Halls' last success so far as the college was concerned. In 1973 another atomic scientist, Lord Flowers (1924–2010, FRS 1961), became Rector. As the 1970s unfolded with the oil crisis, industrial unrest and high levels of inflation, amongst much else, university budgets started to come under pressure. The appointment of Shirley Williams in September 1976 as Secretary of State for Education and Science marked the beginning of retrenchment, a process that continued with vigour following the election in May 1979 of the Conservative government, led by Margaret Thatcher (FRS 1983).[291] Flowers was not necessarily opposed to government higher education policy, indicated by his being the first peer to join the short-lived Social Democratic Party which Williams and others founded in 1981.

At the start of 1976, the Halls sought to expand the department again by the addition of a junior lecturer, specifically to undertake the undergraduate teaching that was slowly increasing. They also pointed out that since they would both reach the age of sixty (the earliest possible retirement age, although they could have both continued for a further seven years) during the 1979–80 academic year, they intended to retire then and therefore there was a need to plan for their succession.[292] The reference to their retirement was a serious tactical error and Flowers pounced, saying that he could not promise a new lectureship, but that the prospect of their retirement changed things;[293] all he had to do was to wait for three years and the future of the subject at Imperial would no longer be in the Halls' hands.

The Halls confirmed in the spring of 1979 that they would be leaving in the summer of 1980, thus permitting, as they thought, ample time to find successors. When there was no movement, Hall wrote to Flowers, shortly after the general election that brought Thatcher to power, asking

[290] Penney to Hall, 2 April 1971, IC MS KH/2/5.
[291] Gay, *Imperial College*, pp. 466–7.
[292] Hall to Flowers, 11 Feb. 1976, IC MS KH/2/5.
[293] Flowers to Hall, 12 Feb. 1976, IC MS KH/2/5.

for assurances that his chair would be continued. Flowers declined to provide this and added that he hoped that Hall would not write round the country about the matter.[294] Matters came to a head in June when Boas Hall sought permission to accept part-time students on the M.Sc. course and experienced 'considerable distress' when this was refused on the grounds that students who would go beyond 1980 could not be accepted.[295] The implication was clear: it had been decided to close the department, although Flowers did ask the Professor of History of Science at Oxford University, Margaret Gowing (1921–1998, FBA 1975, FRS 1988), who seems to have been a personal friend, for her views, but she only told him who was not suitable.[296] The Halls were distressed when it was decided that after they retired what was left of the department (i.e. Norman Smith) would be merged with Associated Studies to form a new Department of Humanities with only a single lecturer as their replacement.[297] Hall's last contribution to the college was to write a short history for its seventy-fifth anniversary in 1982. It was published in October that year, but contained no Rectorial foreword or preface.[298] One does wonder whether Hall had adopted the view implied in the letter that he had written to Flowers asking for reassurance about the future of the department: 'When I came to Imperial College sixteen years ago I believed it to be an institution seriously devoted to education, learning and research and I have not yet abandoned that position.'[299]

## Rewards

With such a distinguished record, especially in research, it should not be found surprising that the Halls were widely recognised for their work. However, it was mostly Hall who received the rewards and this was probably what they wanted, as suggested by the subtitle of one of Boas Hall's autobiographical pieces: 'The junior partner's tale'. With this she did herself somewhat less than justice, since, according to Butterfield, she was

[294] Hall to Flowers, 17 May 1979, IC MS KH/2/6 and Flowers to Hall, 18 May 1979, IC Hall.
[295] Hayman to Flowers, 20 June 1979, IC MS KH/2/6.
[296] Gowing to Flowers, 6 July 1979 and 6 Nov. 1979, IC MS KH/2/6.
[297] Flowers to Hall, 5 Dec. 1979, IC MS KH/2/6.
[298] A. R. Hall, *Science for Industry: a Short History of The Imperial College of Science and Technology and its Antecedents* (London, 1982).
[299] Hall to Flowers, 17 May 1979, IC MS KH/2/6.

sometimes considered the better of the two,[300] which was also Hall's opinion[301]—doubtless such mutual admiration and respect of one another goes a long way to accounting for the success of their relationship.

They of course took part in running the British Society for the History of Science. Boas Hall served on its Council between 1970 and 1973 whilst Hall served from 1964 to 1969 (during which he was President, as a 'benevolent dictator',[302] between 1966 and 1968) and again 1973 to 1979. Hall served on the British National Committee for the History of Science (which was based at the Royal Society) and was also President of the International Academy of the History of Science from 1977 until 1981. Both these roles meant that he was a key figure when in 1978 Britain hosted the fifteenth International Congress for the History of Science held in Edinburgh. Hall's connections with the Royal Society meant that he was invited to deliver two of their named lectures, Wilkins (1973) and Leeuwenhoek (1988)—the only occasion on which a non-scientist has thus far delivered that lecture. In 1994 he was President of the History of Science section at the annual meeting of the British Association in Loughborough and it thus fell to him to chair the famous discussion between Harry Collins (1941– ) and Lewis Wolpert (1929– , FRS 1980) on the sociology of science, a spat that provided the *Times Higher Education Supplement* with copy for some weeks afterwards.

Hall's status as an historian, even of science, meant that he was not eligible for election to the Royal Society, although Snow thought he was one of the few people who should be both FRS and FBA.[303] Hall's connections were mostly with the scientific community, especially at Imperial College and the Royal Society, and this meant that he was somewhat isolated from the humanities community and its reward systems. In 1975 Hall applied for the Litt.D. degree from the University of Cambridge. Butterfield wrote a supportive, if somewhat equivocal ('Hall is not a genius') report[304] and the degree was conferred on him. The same year Hall was considered for Fellowship of the British Academy, but the proposal found little favour at that time. However, Whiteside was elected then and

[300] Butterfield to Williams, *c.*13 Jan. 1977, ULC MS BUTT/531/H12.
[301] Hall to Linstead, 28 Jan. 1962, IC MS KH/2/2.
[302] David Knight, Obituary of Hall, *Guardian*, 27 May 2009.
[303] Neil McKendrick, conversation with FJ, 21 Oct. 2011.
[304] H. Butterfield, 'Report on the work submitted by Dr. A. R. Hall for the Litt.D. degree', 1975, ULC MS BUTT/531/H12. Presumably due to the close similarity in content with Butterfield to Williams, *c.*13 Jan. 1977, the cataloguer assumed they were versions of the same document and thus allocated them the same manuscript number.

two years later he proposed Hall.[305] Butterfield was asked for his opinion, and, as with the D.Litt., was supportive, writing that Hall had the authenticity and originality to qualify as a Fellow. Yet there was the same caveat: 'at no point does he [Hall] emerge as having the sort of "genius" which makes Whiteside unique'.[306] Presumably independently, later in the year Flowers, realising Hall's position and possibly out of a slight sense of guilt, wrote to Gowing (another of the 1975 intake) asking for her to support Hall for the fellowship[307] to which he was elected the following year. As Plumb wrote in his letter of congratulation: 'It has been a long haul since Leicester.'[308]

Hall in his reply to Flowers's congratulatory letter commented that 'I certainly hope I shall not long remain a unique FBA at IC.'[309] But for reasons that are not clear Boas Hall had to wait sixteen years before she was elected to the British Academy, this despite being jointly awarded with Hall the highest award of the History of Science Society, the Sarton Medal, in 1981.[310] Nevertheless, she was elected to the Academy in 1994, her principal sponsor being Whiteside.[311]

## After Imperial

With their departure from Imperial and the completion of Oldenburg's correspondence coinciding, the Halls now had the freedom to pursue other interests. Furthermore, having first lived in Chiswick and then in a flat in Bayswater on the other side of Hyde Park from the college, they were tired of living in London. In 1968 they had purchased a country cottage in Tackley, a village to the north of Oxford with the immense convenience of a railway station. They enlarged the cottage to take their books,[312] owned a cat (Isaac Newton Felis), they had a garden and an allotment, they walked in the countryside, entertained their friends and former students, ran the bookstall at the church fete, attended evensong[313] (though

[305] Williams to Butterfield, 11 Jan. 1977, ULC MS BUTT/531/H11.
[306] Butterfield to Williams, *c.*13 Jan. 1977, ULC MS BUTT/531/H12.
[307] Flowers to Gowing, 27 June 1977, IC MS KH/2/5.
[308] Plumb to Hall, 18 May 1978, IC MS Hall.
[309] Hall to Flowers, 3 July 1978, IC MS KH/2/5.
[310] F. L. Holmes, 'Award of the Sarton Medal for 1981', *ISIS*, 73 (1982), 266–8.
[311] Information from Peter Brown.
[312] Boas Hall (1), p. 14.
[313] Stephen M'Caw, Funeral sermon, 4 March 2009.

by no means believers) and were prominent in the Tackley Local History Group. Their involvement here included a paper by Hall on Tackley's water supply and collaboration in publishing wills relating to the village.[314]

However, they did not entirely abandon London in the early 1980s. In 1974 Hall had been appointed chairman of the Wellcome Trust's Advisory Panel on the History of Medicine and had become a close friend of the Director of the Trust, Peter Williams; indeed his wife Billie (1925–2007) had taken the history of science masters course and had then undertaken her doctoral research at University College, submitting her thesis in 1976 on the work of Luigi Galvani (1737–98).[315] During Hall's chairmanship, the academic role in the history of medicine undertaken by the Wellcome Trust expanded. This included the establishment of the close links with University College London and medical history units elsewhere in the country. However, when the Director of the Wellcome Institute for the History of Medicine retired in 1979, Hall as chairman tried to provide direction through the committee, but this was not a success. Despite their friendship, Williams was not blind to Hall's difficulty with administration and thought he was not 'stern' enough with the committee.[316] The result was that in 1981 Williams added the duties of Director of the Institute to his tasks (which he did for two years) and Hall took on the role, for four years, of coordinator of the history of medicine programme at the Trust, for which he was paid £10,000 annually and had the use of a flat in Euston Road.[317] In the course of working for the Wellcome Trust, Hall wrote, with B. A. Bembridge (a Deputy Director of the Trust), its history from its founding in 1936 until 1986 and included a foreword by the then chair of Trustees, David Steel (1916–2004).[318]

Despite their commitments, of which the Wellcome Trust was by far the most significant, during the 1980s and 1990s the Halls mostly researched and wrote, which is what they had intended to do following Imperial. It is noticeable that during their time at Imperial, aside from the volumes of the Oldenburg and Newton correspondences, and a steady

[314] A. R. Hall, 'Tackley streams and water', in *Watery Tackley: Publication Number 4 of the Tackley Local History Group* (Tackley, 2000), pp. 1–12. *Tackley Wills 1463–1707: Publication Number 6 of the Tackley Local History Group* (Tackley, 2004).

[315] Published, with a foreword by Hall, as B. I. Williams, *The Matter of Motion and Galvani's Frogs* (Bletchingdon, 2000).

[316] Peter Williams, *The Story of the Wellcome Trust: Unlocking Sir Henry's Legacy to Medical Research* (Hindrigham, 2010), p. 68.

[317] Barren to Hall, 23 Dec. 1981, IC MS Hall.

[318] A. R. Hall and B. A. Bembridge, *Physic and Philanthropy: a History of the Wellcome Trust 1936–1986* (Cambridge, 1986).

stream of papers and reviews, they had not produced a book during those seventeen years. In 1980, however, Hall published *Philosophers at War; the Quarrel between Newton and Leibniz* (Cambridge, 1980) on which he had been working during the 1970s. In this he analysed the quarrel between Newton and Gottfried Leibniz (1646–1716, FRS 1673) over the invention of calculus.

Hall's first post-Imperial book, published in 1983, was listed as the third edition of *The Scientific Revolution*, but was substantially an almost entirely new book. Entitled *The Revolution in Science 1500–1750* (Harlow, 1983) and with no subtitle, it drew upon much of the research that had been undertaken by the Halls and others in the preceding thirty years. Nevertheless, and despite giving a significant role to technology and an entire chapter to experimentation, Hall stated that he would 'unashamedly follow a positivist or even a whiggish line'.[319] This was a carefully thought out position which he defended in detail in a paper published the same year.[320] In terms of *The Revolution in Science*, he meant that he was writing a history of science which culminated in the work of Newton, not one that necessarily led to today's science beginning in 1800 as he had suggested in 1954; hence the lack of a subtitle and taking the end-point back by fifty years. This striking change in approach showed how the history of science was now part of a contextual history, rather than something studied just by scientists usually with some modern aim in view, and was thus worth studying in its own right.

As one of the leading experts on Newton, Hall was the obvious choice to write his biography when Blackwell's began their series of science biographies under the editorship of David Knight, a former student of Crombie's. Hall agreed to this commission on the condition that he could also write a biography of the Platonist Henry More (1614–87, FRS 1664), a Christ's man, who would not have been an obvious choice for the series. Hall delivered this book first and was not sympathetic to More;[321] as Knight wrote, it was 'inimical, detailing the metaphysics and psychical research with fascinated distaste'.[322] There were, however, no such feelings in his Newton biography, published two years later. Hall began by saying: 'I have endeavoured here to write an account of the greatest mind in British history'[323] and concentrated on the scientific work for which Newton

[319] A. R. Hall, *The Revolution in Science 1500–1750* (London, 1983), p. 2.
[320] A. R. Hall, 'On whiggism', *History of Science*, 21 (1983), 45–59.
[321] A. R. Hall, *Henry More and the Scientific Revolution* (Oxford, 1990).
[322] David Knight, Obituary of Hall, *Guardian*, 27 May 2009.
[323] A. R. Hall, *Isaac Newton: Adventurer in Thought* (Oxford, 1992), p. xiii.

remains famous. In addition to a couple of volumes in which he collected some of his papers,[324] Hall was to publish two more books, both on Newton. The first was devoted to Newton's *Opticks* (1704),[325] which doubtless contained material that could not be included in his biography, whilst in the second he published a collection of eighteenth-century biographies written in English, French and Italian.[326] Hall's last publication, appropriately, took him back to the start of his career with an account of his work at the Whipple Museum in the 1950s published in a collection of essays to mark the sixtieth anniversary of Whipple's gift.[327]

While Hall in the 1980s and 1990s concentrated on Newton, Boas Hall worked on the history of the Royal Society. Immediately after leaving Imperial she began working on a history of the Society during the nineteenth century. The then President Andrew Huxley (1917–2012, FRS 1955) took a strong personal interest in the project due to the impending celebrations to mark the centenary of the Presidency, between 1883 and 1885, of his grandfather, Thomas Henry Huxley (1825–95, FRS 1851); indeed the Society paid her travelling expenses.[328] The book, with a foreword by Huxley, was published as *All Scientists Now: the Royal Society in the Nineteenth Century* (Cambridge, 1984), and is a useful case study showing how the scientific community in the nineteenth century deliberately sought to give itself an exclusive professional identity, thereby moving science away from other areas of culture, thus sowing the seeds of the cultural problems of science during the mid twentieth century. This work, together with her service on the Royal Society's Library Committee, led to her being invited to write the history of the library, which was published in 1992.[329]

But in the latter part of the 1980s and into the 1990s she returned to studying the early Royal Society, which provided the subject for her last two books. In the first, *Promoting Experimental Learning* (Cambridge, 1991, and dedicated to her former students), she explored what actually happened at meetings of the Society between its founding in 1660 and Newton's death in 1727. The second, a biography of *Henry Oldenburg*,

[324] A. R. Hall, *Newton, his Friends and his Foes* (Aldershot, 1993), and *Science and Society*.
[325] A. R. Hall, *All Was Light: an Introduction to Newton's Opticks* (Oxford, 1993).
[326] A. R. Hall, *Isaac Newton: Eighteenth-Century Perspectives* (Oxford, 1999).
[327] Hall, 'The first decade'.
[328] Boas Hall (1), p. 15.
[329] M. B. Hall, *The Library and Archives of the Royal Society, 1660–1990* (London, 1992).

had for its subtitle *Shaping the Royal Society* (Oxford, 2002). This was really an extended introduction to his correspondence and was her last published work.

By now into their eighties, the Halls began to suffer the usual infirmities associated with being in one's ninth decade. They were visited weekly by Peter Williams who lived in a nearby village and, despite advice from friends and colleagues, they refused to move from their cottage which was not really suitable as they began to markedly deteriorate first physically and then mentally. This was painful both for themselves and for those who had known them in their prime. The end came quickly in the early part of 2009 when Hall died in the John Radcliffe Hopital on 5 February. Boas Hall lasted less than three weeks longer, dying in the Horton General Hospital in Banbury on the 23rd. There was a joint funeral service in St Nicholas's Church, Tackley, on 4 March, a sunny but fresh spring day with the daffodils already out. Well attended by former students, colleagues and their friends, Peter Williams delivered the address on their lives, and they were laid to rest side by side in the churchyard.

As so often happens with successful pioneers, the very success obscures the magnitude of the achievement. Some of the things that we now take for granted simply did not exist when they started their careers. For the Halls, perhaps the two most significant changes they contributed to bringing about were making history of science a proper branch of history and emphasising, both by their historical writings and by their practice, the value of studying and publishing manuscripts. Both these are now so taken for granted that it requires considerable historical imagination to understand that in the 1940s and indeed into the 1950s such views would have been generally regarded as perverse and that the Halls were both historiographically radical in their day.

Both Hall and Boas would have undoubtedly enjoyed successful careers individually. But by bravely defying the prevailing social conventions, by having confidence in their joint future during the very difficult and emotional closing years of the 1950s, Hall and Boas created the formidable partnership in the history of science that has been outlined in this memoir. Their passionate love, respect and admiration for each other surely produced historical work of a quality and influence much greater than anything they might have done separately.

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