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Citation for published version:

Sturdy, S 2011, 'The Meanings of 'Life': Biology and Biography in the Work of J.S. Haldane (1860-1936)' Transactions of the Royal Historical Society, vol 21, pp. 171-191., 10.1017/S0080440111000089

Digital Object Identifier (DOI):

[10.1017/S0080440111000089](https://doi.org/10.1017/S0080440111000089)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Publisher final version (usually the publisher pdf)

Published In:

Transactions of the Royal Historical Society

Publisher Rights Statement:

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THE MEANINGS OF ‘LIFE’: BIOLOGY AND
BIOGRAPHY IN THE WORK
OF J. S. HALDANE (1860–1936)

By Steve Sturdy

READ 14 APRIL 2010 AT GLASGOW CALEDONIAN UNIVERSITY

ABSTRACT. In the course of his somewhat unorthodox career in science, the physiologist John Scott Haldane occasionally turned to biography to portray the aims and values that he associated with such a career. But the same concerns can also be discerned in his scientific writings which drew, in large part, on experiments he conducted on himself. For Haldane, biology, as the science of life, was inseparable from biography, as the depiction of a life in science; and he embodied both these enterprises in his own autobiographical investigations. Analysing these connections in Haldane’s work serves to illuminate the contested role of science in the growth of professional society and the emergence of the intellectual aristocracy.

British science underwent a process of professionalisation from about the mid-nineteenth century onwards, with the growth of new employment opportunities and the establishment of new career pathways. But exactly what a scientific career should look like, and particularly what status and purpose should be accorded to academic science, remained an open question until well into the twentieth century. This is evident in the career of the physiologist John Scott Haldane (1860–1936). Haldane is now chiefly remembered for his groundbreaking research into the delicate biological mechanisms underlying the regulation of breathing rate and other physiological processes, and he is often credited as one of the founders of the modern concept of homeostasis. But his scientific work ranged far more widely, to include research into health and safety in industrial workplaces and elsewhere, and Haldane would eventually withdraw from academic life to spend the rest of his career in the service of government and industry.

Haldane’s life in science was thus in itself something of an experiment: an exploration of the kinds of opportunities and activities that might be open to a professional scientist. He would occasionally reflect on the nature of such a life in short biographical writings, some of which I will examine in this paper. But I will go on to argue that his thinking

about the social role of science and scientists was not confined to his biographical writings alone. We can trace the same concerns in another, more important aspect of Haldane's work, namely his physiological research. For Haldane as for many of his contemporaries, such research involved an investigation into the nature of life. I will argue that Haldane's concern to understand life in the biological sense was continuous with his understanding of life in a biographical sense. My contention is that Haldane's research into how living organisms maintain their functional integrity in a changing physical environment also provided a way of thinking about his own career as a scientist working in a changing social environment. This convergence of biology with biography is all the more evident for the fact that Haldane performed the vast majority of his experiments on himself or on his colleagues; he was at once the subject and the object of his own research, and his life as a scientist involved a constant examination of his life as a living organism. Haldane's pursuit of a scientific career, and the choices he made about how to live life as a scientist, were thus inseparable from his embodied experience of his own biological life; in effect, autobiography was indistinguishable in Haldane's work from what we might call 'autobiology'.

Haldane's career in context

Let me start by briefly outlining Haldane's career.¹ He was born in 1860, into a minor branch of the Scottish aristocracy. At sixteen he matriculated at Edinburgh University, taking a general MA degree in 1879. He then moved on to study medicine, graduating MB, CM in 1885. Rather than practice medicine, however, he began looking for a career in scientific research and teaching. The opportunities for making a living by this kind of work were at that time very limited, with only a handful of full-time posts available in British universities and medical schools. But Haldane's ambitions were encouraged by his uncle, John Burdon Sanderson, one of the first generation of full-time academic medical scientists in England, who in 1882 had been appointed to the newly created Wayneflete Chair of Physiology at the University of Oxford.² In 1887, Haldane moved south to become Demonstrator in the Oxford School of Physiology. Once in post, he gave ample proof of his ability as a teacher and researcher. Promoted to lecturer in 1894 and reader in 1907, he would dominate the development

¹ Basic details of Haldane's life and scientific work can be found in C. G. Douglas, 'John Scott Haldane 1860–1936', *Obituary Notices of Fellows of the Royal Society*, 2 (1936), 115–39. For more extended biographical studies, see Steve Sturdy, 'A Co-ordinated Whole: The Life and Work of John Scott Haldane' (Ph.D. thesis, University of Edinburgh, 1987); Martin Goodman, *Suffer and Survive: The Extreme Life of Dr. J. S. Haldane* (2007).

² Terrie M. Romano, *Making Medicine Scientific: John Burdon Sanderson and the Culture of Victorian Science* (Baltimore, 2002).

of physiological research in Oxford from the early 1890s to the outbreak of the First World War.

Despite his evident ability, however, Haldane's career in the Department of Physiology did not proceed entirely as he had hoped. The difficulties can be traced to his understanding of the purpose of medical science, and especially of physiology, which differed significantly from that of many of his contemporaries. Many of those who championed the establishment of medical science as an occupation in its own right took the view that this could best be achieved by claiming independence from the practical expectations of doctors and others, and by insisting instead on the value of science for its own sake. 'Pure' science, untainted by the need to demonstrate immediate practical benefits, offered the best means of generating authoritative knowledge of the natural world, they argued.³ Physiology, concerned with elucidating fundamental processes occurring in living organisms, and increasingly identified by the pursuit of specialised programmes of experimental research, lent itself well to the idea of pure science; and physiologists were accordingly in the vanguard of the movement to establish independent careers in medical science.⁴ Practical benefits could still be expected to follow from the application of the knowledge they produced, but most physiologists argued that the realisation of such benefits was better delegated to subaltern 'applied' disciplines such as pathology or public health or indeed medicine itself.

Haldane shared his colleagues' desire to see the creation of full-time positions for medical research and teaching, and agreed that physiology was in the vanguard of that movement. But instead of endorsing a strategy of academic purity and abstraction, he held that physiology should demonstrate its worth by looking beyond the academic laboratory and engaging directly with the practical concerns of government and

³ Robert F. Bud and Gerrylynn K. Roberts argue that the language of 'pure' and 'applied science' acquired particular salience in the Royal Commission on Scientific Instruction and the Advancement of Science (Devonshire Commission) appointed in 1870: *Science Versus Practice: Chemistry in Victorian Britain* (Manchester, 1984), 140–51. The rhetorical use of that language in late nineteenth-century Britain is also discussed in Thomas Gieryn, 'Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists', *American Sociological Review*, 48 (1983), 781–95. On parallel developments in the USA, see Ronald Kline, 'Construing "Technology" as "Applied Science": Public Rhetoric of Scientists and Engineers in the United States, 1880–1945', *Isis*, 86 (1995), 194–221.

⁴ The literature on the growth of physiology as a scientific discipline at this time is correspondingly large. See, *inter alia*, Gerald L. Geison, *Michael Foster and the Cambridge School of Physiology: The Scientific Enterprise in Late Victorian Society* (Princeton, 1978); Stella V. F. Butler, 'Centres and Peripheries: The Development of British Physiology, 1870–1914', *Journal of the History of Biology*, 21 (1988), 473–500; Stewart Richards, 'Conan Doyle's "Challenger" Unchampioned: William Rutherford F.R.S. (1839–99), and the Origins of Practical Physiology in Britain', *Notes and Records of the Royal Society of London*, 40 (1985–86), 193–217.

industry. His own research work was consistent with this view. Throughout his career, he would spend much of his time in industrial workplaces, investigating the problems of industrial health and safety that were arousing widespread concern at that time. This did not mean that he was uninterested in advancing knowledge of fundamental biological processes; indeed, he is generally remembered for doing just that. Rather, Haldane took the view that no meaningful distinction could be drawn between pure and applied science. His own scientific work reflected this: many of his most apparently abstract physiological researches were directly stimulated by practical problems he encountered in mines and factories, and revealed a fruitful dialectic between his efforts to elucidate the fundamental processes of respiration and his concern to promote safe and healthy working conditions in industry.⁵ At the same time, his research was informed by an overtly philosophical understanding of the nature of life that was at odds with the reductionist and mechanistic perspective that most other biologists of that time adopted, either implicitly or explicitly.⁶ Haldane's heterodox understanding of the nature and aims of physiology would have adverse consequences for his academic career.

In 1895, Burdon Sanderson resigned from the Chair of Physiology to take up the post of Regius Professor of Medicine, as part of his larger strategy to build a complete medical school at Oxford. Haldane applied for the vacant Chair of Physiology, but the post went instead to Francis Gotch, a one-time assistant to Burdon Sanderson who had gone on to become the first full-time professor of physiology at University College, Liverpool. Meanwhile, Burdon Sanderson tried to steer Haldane towards research and teaching in hygiene and public health – a more clearly 'applied' field of science for which he evidently felt his nephew's talents were more suited.⁷ In the event, Haldane remained within the Department of Physiology, where his abilities as a researcher and teacher effectively eclipsed Gotch's largely undistinguished efforts.⁸ On Gotch's death in 1913, Haldane again applied for the Chair of Physiology, and was again passed over, this time in favour of the neurophysiologist C. S. Sherrington.⁹ Sherrington was undoubtedly brilliant, and would go on

⁵ Douglas, 'John Scott Haldane', 135; Sturdy, 'A Co-ordinated Whole', *passim*.

⁶ Steve Sturdy, 'Biology as Social Theory: John Scott Haldane and Physiological Regulation', *British Journal for the History of Science*, 21 (1988), 315–40.

⁷ Sturdy, 'A Co-ordinated Whole', 251–6.

⁸ See for instance, Anon., 'The Oxford Medical School', *British Medical Journal*, 1 (1906), 1479–91, which characterises Gotch as 'an original investigator . . . an inspiring teacher', but considers Haldane to be 'universally recognised as one of the first of living physiologists' (1486). It is telling that although Gotch was a Fellow of the Royal Society, no obituary of him was ever published in the Society's *Proceedings*.

⁹ Sturdy, 'A Co-ordinated Whole', 271–3.

to win the Nobel Prize for his work on the physiology of nervous reflexes. But as we shall see, his selection over Haldane owed as much to the latter's views on the nature and purpose of physiology as to Sherrington's own achievements as a researcher.

On being rejected for the second time, Haldane resigned his position in the Oxford University Department of Physiology. He retained a Research Fellowship at New College, Oxford, and he continued to collaborate with university colleagues in the laboratory he had built at his home. But other than this, he would pursue the remainder of his career largely outside academia, promoting the value of scientific expertise in the solution of problems of industrial regulation and management: as a Gas Referee, employed by the Board of Trade to regulate the production of town gas; as director of a coal industry laboratory charged with promoting safety measures in mines; as president of the Institution of Mining Engineers; and as an expert member of various Royal Commissions and other official investigations.¹⁰

These basic events of Haldane's career locate him at a point in British history when the proper nature and social role of professional science was still subject to negotiation and contestation. But the emergence of the professional scientist at that time was part of a much wider process of social transformation. This was the period when the new professional middle class consolidated their position as key figures in the maintenance and management of an increasingly differentiated and organised industrial society.¹¹ The world was shifting from one dominated by an old elite of inherited wealth and aristocratic status, to one increasingly mediated by technical, managerial and other forms of expertise. Such expertise was commonly certified by academic training. Consequently, as part of this process, the British university system was itself professionalised and expanded in the decades from the mid-nineteenth century onwards. Salaried university professorships, along with an insistence on peer evaluation as the main criterion for career advancement, served to secure

¹⁰ Apart from the work he undertook during the first world war, which is described in detail in Sturdy, 'A Co-ordinated Whole', 276–355, and in Goodman, *Suffer and Survive*, 268–328, Haldane's career after resigning his Oxford University readership has received only incidental scholarly attention. His contribution to the development of diving suits and high-altitude pressure suits is discussed at length in Alexander von Lünen, 'Under the Waves, Above the Clouds: A History of the Pressure Suit' (Ph.D. dissertation, Technische Universität Darmstadt, abridged version, 2010), and his role in debates over miners' lung diseases in Arthur McIvor and Ronald Johnston, *Miners' Lung: A History of Dust Disease in British Coal Mining* (Aldershot, 2007), 69–73.

¹¹ Harold Perkin, *The Rise of Professional Society: England since 1880* (1989).

the autonomy of the emerging profession, leaving academics free to foster new kinds of scholarship, including a greater emphasis on the pursuit of research as one of the main aims of academic life.¹² Haldane's own discipline of physiology was at the forefront of the professionalisation process. Not only was it one of the leading disciplines in the struggle for salaried academic posts and the promotion of research; it was also central to the establishment of academic training as a necessary basis for admission to the medical profession.¹³

Haldane was thus a transitional figure in a broad and far-reaching social transformation. Indeed, as a member of an old landed family who chose to cultivate a professional career, he was at once actor and exemplar in the shift from an aristocratic towards a more professional social order. The Haldanes were prominent within that small group of families – mostly descended from the lesser aristocracy – identified by Noel Annan as playing a disproportionately influential role in the intellectual and professional life of twentieth-century Britain.¹⁴ As is clear from the success of this 'intellectual aristocracy' in founding its own dynasties, the new professional society did not represent a complete break with the culture of an earlier ruling class; at least in part, it involved a transformation within the ruling class and its means of ruling.¹⁵ As Haldane's troubled trajectory makes clear, however, there was no single view on what the new social order should look like, let alone on the role that scientists should occupy in that order. Haldane, like all those who endeavoured at that time to build professional careers, was engaged in a project to create a new polity in which their own special skills and abilities would enjoy particular authority. For the time being, the outcome of that project remained unclear. Professional science, in particular, did not develop along pre-determined lines. How scientific expertise should be constituted, what kind of authority it should assert and how scientists might best contribute to the organisation and governance of modern society, were all still being worked out.

¹² R. D. Anderson, *Universities and Elites in Britain since 1800* (1992); A. J. Engel, *From Clergyman to Don: The Rise of the Academic Profession in Nineteenth-Century Oxford* (Oxford, 1983); Sheldon Rothblatt, *The Revolution of the Dons: Cambridge and Society in Victorian England* (1968). The role of science in that transformation is examined in T. W. Heyck, *The Transformation of Intellectual Life in Victorian England* (1982).

¹³ Thomas Neville Bonner, *Becoming a Physician: Medical Education in Britain, France, Germany, and the United States, 1750–1945* (New York and Oxford, 1995), 236–79.

¹⁴ Noel G. Annan, 'The Intellectual Aristocracy', in *Studies in Social History*, ed. J. H. Plumb (1955), 241–87.

¹⁵ Perry Anderson, 'Components of the National Culture', *New Left Review*, 50 (1968), 3–57, at 15–16; William Whyte, 'The Intellectual Aristocracy Revisited', *Journal of Victorian Culture*, 10 (2005), 15–45.

Recasting auto/biography

The growth of the professional middle class was reflected in the changing conventions of the literary genre of biography. Writing in the 11th edition of the *Encyclopaedia Britannica*, Edmund Gosse – a personal friend, incidentally, of the Haldane family – meditated on recent developments in the genre. Where earlier forms of biography had treated the life of the individual primarily as a personification of ‘certain definite moral qualities’, Gosse argued, modern writings tended to reflect ‘the true conception of biography as the faithful portrait of a soul in its adventures through life’.¹⁶ More recent scholars have elaborated on this insight. Early nineteenth-century biography was characterised by a predominantly biblical hermeneutic, concerned with charting the career of individual souls in their journey from sin to salvation. By the time Gosse came to write his own autobiography in *Father and Son*, this pietism had given way to a more relativistic view of individual development as an open-ended process of personal self-realisation.¹⁷ This implied a shift in the social message that readers should find in a biography. By showing how personal salvation was to be sought by living a life of virtue within the constraints of birth and station, earlier pietistic biography had taught primarily how one should accept one’s place within a preordained religious and social order. By contrast, the more open-ended narratives favoured by Gosse were concerned with the problems of finding a place and a role within a changing social order. As such, they conveyed a more functional understanding of social virtue.

Gosse was himself aware of this shift in the exemplary aim of biography: ‘The only remnant of the old rhetorical purpose of “lives” which clearer modern purpose can afford to retain is the relative light thrown on military or intellectual or social genius by the achievement of the selected subject.’¹⁸ Gosse’s use of the word ‘genius’ is significant. In his 1869 study of *Hereditary Genius*, Francis Galton – himself a member of the intellectual aristocracy – had attributed it to those individuals who achieved the highest social distinction for their ‘originality of conception, for enterprise, for activity and energy, for administrative skill, for various acquirements, for power of literary expression, for oratory, and much besides of general values, as well as for more specially professional merits’.¹⁹ In effect, Galton relativised genius by recasting it, not simply as intellectual brilliance, but

¹⁶ Edmund Gosse, ‘Biography’, *Encyclopaedia Britannica*, 11th edn (Cambridge, 1910), III, 952–4, at 952.

¹⁷ Linda H. Peterson, *Victorian Autobiography* (New Haven, 1986), 156–91.

¹⁸ Gosse, ‘Biography’, 953.

¹⁹ Francis Galton, *Hereditary Genius: An Inquiry into its Laws and Consequences* (1869), 7.

as the ability to play an animating role in society.²⁰ Gosse took this a step further, locating genius in precisely those spheres of activity – military, intellectual, social – where the new professionals were most actively seeking to assert their influence. As conceived by Galton and Gosse, the notion of ‘genius’ served the purposes of the new professional middle class in ways that the notion of a life redeemed by Christ’s blood did not. It reflected the idea that lives should be valued, not for their exemplification of transcendental moral values, but for their influence on the development of society and culture. Biography, as a chronicle of a soul’s ‘adventures through life’, provided a way of illuminating and exemplifying the role that the new professional class was coming to play in society.²¹ That is not to say that biography did not continue to present a vision of a moral life. But late nineteenth- and early twentieth-century biography reworked earlier moral tropes in ways that were more appropriate to a professionalising society. Hard work, self-sacrifice and the importance of ‘character’ all continued to be idealised as moral virtues, but now inflected by a new stress on the importance of independent thought, self-determination and social leadership.²² As Robbie Gray observed in his analysis of Victorian autobiography, ‘Middle-class men were concerned to present themselves as makers of the world they inhabited.’²³ Special virtue was often accorded to those whose personal convictions led them to sacrifice their own advancement to the advancement of some greater social good: a life well lived was a life devoted to a particular social aim or mission.

Complementing this concern with social mission was an almost ethnographic interest in the particular fields or domains of activity in which such a mission might be pursued. This was particularly evident in the burgeoning sub-genre of collective biography, itself a notably successful division of the Victorian biographical enterprise.²⁴ Tellingly, the *Dictionary of National Biography* – the most monumental achievement of that sub-genre – listed its subjects’ occupations before detailing their parentage, in a move which epitomised the ascendancy of profession

²⁰ Cf. Simon Schaffer, ‘Genius in Romantic Natural Philosophy’, in *Romanticism and the Sciences*, ed. Andrew Cunningham and Nicholas Jardine (Cambridge, 1990), 82–98.

²¹ David Amigoni looks at how a new generation of professional academic historians sought to wrest biography from the hands of gentlemanly ‘men of letters’, and thereby to assert their own authority over the training of young minds for public service: *Victorian Biography: Intellectuals and the Ordering of Discourse* (Hemel Hempstead, 1993).

²² Ira Bruce Nadel, *Biography: Fiction, Fact and Form* (1984), 13–38. See also Stefan Collini, *Public Moralists: Political Thought and Intellectual Life in Britain, 1850–1930* (Oxford, 1991).

²³ Robbie Gray, ‘Self-made Men, Self-narrated Lives: Male Autobiographical Writing and the Victorian Middle Class’, *Journal of Victorian Culture*, 6 (2001), 288–312, at 307. See also Donna Loftus, ‘The Self in Society: Middle-class Men and Autobiography’, in *Life-Writing and Victorian Culture*, ed. David Amigoni (Aldershot, 2006), 67–86.

²⁴ Nadel, *Biography*, 13–66.

over birth.²⁵ But the convergence of biography with occupational differentiation found its most intense expression in another sub-genre of biography, namely the professional obituary. As distinct professional groups began to establish themselves as the guardians of particular social functions, so the publication of obituaries in professional journals came to serve the purpose of representing these new occupations to their members and to the public at large. Scientific obituaries were a case in point. The practice of publishing obituary notices of eminent scientists dated back to later eighteenth-century France.²⁶ British scientists were initially slow to follow suit, reflecting the relatively unprofessionalised state of British science at that time.²⁷ Towards the end of the nineteenth century, however, the number of obituaries published in the *Proceedings of the Royal Society*, and the number of words devoted to each obituary, began to increase rapidly. By the 1930s the Society judged this undertaking sufficiently important to warrant the publication of separate volumes of obituary notices. The same period also saw an enormous growth in professional journals devoted to specific scientific disciplines, many of which also carried obituary notices. Such obituaries were principally concerned with exemplifying the activities and values that defined a particular science; the information they provided was overwhelmingly about the contributions the subject had made to the advancement of their discipline, while those aspects of the subject's life that did not relate directly to professional concerns were clearly relegated to second place. The writing of scientific lives – both in obituaries but also in a growing number of longer biographies of particularly important scientists – thus epitomises the way that the exemplary function of biography came, by the early twentieth century, to subservise the project of professional consolidation and advancement.²⁸

²⁵ David Amigoni, 'Life Histories and the Cultural Politics of Historical Knowing: The *Dictionary of National Biography* and the Late Nineteenth-century Political Field', in *Life and Work History Analyses: Qualitative and Quantitative Developments*, ed. Shirley Dex, Sociological Review Monograph 37 (1991), 144–66.

²⁶ Charles B. Paul, *Science and Immortality: The Éloges of the Paris Academy of Sciences (1699–1791)* (Berkeley, Los Angeles and London, 1981).

²⁷ Biographies of individual scientists did become increasingly common during the early nineteenth century, but these were usually iconic founder-figures rather than more ordinary practitioners. See e.g. Richard Yeo, 'Genius, Method, and Morality: Images of Newton in Britain, 1760–1860', *Science in Context*, 2 (1988), 257–84; L. S. Jacyna, 'Images of John Hunter in the Nineteenth Century', *Medical History*, 21 (1983), 85–108.

²⁸ Given the interest that historians of science have taken both in the professionalisation of science and the function of scientific biography, it is surprising to find that they have scarcely considered the relationship between the two. See, for instance, Michael Shortland and Richard Yeo, eds., *Telling Lives in Science: Essays on Scientific Biography* (Cambridge, 1996); Thomas Söderqvist, ed., *The History and Poetics of Scientific Biography* (Aldershot, 2007).

Haldane's biographical reflections

Even as science gained in professional solidarity and social influence, there remained room for disagreement over just what form that influence should take. Scientific biography was one site where individuals could exemplify their different visions of what science should be. Haldane was among those who availed themselves of the opportunity to do so, making several contributions to the biographical literature of his chosen profession. While these writings celebrated such general scientific values as dedication to the pursuit of new knowledge, they also served to illustrate and endorse the particular approach to science that Haldane himself favoured.

A case in point is the obituary he wrote of the German pathologist and early advocate of the germ theory, Max von Pettenkofer.²⁹ Haldane published this piece in the first volume of the *Journal of Hygiene*, of which he was himself one of the founding editors. The new journal reflected Haldane's views on the practical value of science. Rather than championing a particular line of disciplinary research, it provided a common outlet for scientists from different disciplines who were keen to advance the practice of public health. 'With a view to increasing the general usefulness of the *Journal of Hygiene*', the editors declared, 'we propose not to limit the contributions entirely to reports of original observations and experiments, but to accept and encourage discussions of administrative and practical questions, the importance of which is apt to be overlooked in scientific journals.'³⁰ The *Journal* was an attempt to establish a programme of inquiry defined more by the sphere of social action to which it was addressed than by any narrowly disciplinary concerns with scientific purity. In his memoir, Haldane portrayed Pettenkofer as a tragic hero of this kind of practically oriented science.

Trained as a chemist, from the 1850s Pettenkofer turned his scientific skills to public health work. Despite his chemical background, he was alert to the biological aspects of disease causation, favouring a form of germ theory over the miasmatic views that had dominated German public health measures in the first half of the century. However, his particular conception of germ theory and of its implications for sanitary practice was challenged by Robert Koch in the 1880s. Pettenkofer held that the virulence of disease germs depended on the natural and human environment in which they found themselves; consequently, he favoured an approach to public health that focused on understanding

²⁹ J. S. Haldane, 'The Work of Max von Pettenkofer', *Journal of Hygiene*, 1 (1901), 289–94.

³⁰ George H. F. Nuttall, John Haldane and Arthur Newsholme, 'Introduction', *Journal of Hygiene*, 1 (1901), 1–2.

and improving that environment. Koch, by contrast, sought first to elucidate the behaviour of germs isolated in the laboratory, and only secondarily to apply that knowledge to matters of public health; control the germ, through measures such as quarantine and the development of vaccines, and you controlled the disease. Pettenkofer fared badly in the ensuing controversies, as Koch's theories and ideas of practice won favour among public health administrators. Pettenkofer became an increasingly marginal figure in German medical science, and committed suicide in 1901.³¹ Haldane's commemoration of Pettenkofer in the *Journal of Hygiene* signalled the new journal's commitment to a more holistic, environmentally oriented conception of public health than the laboratory-centred bacteriological reductionism favoured by Koch and his followers. It also celebrated Pettenkofer's exemplary devotion to his scientific mission. In 1892, Pettenkofer had publicly drunk a culture of cholera microbes sent to him by Koch, in order to prove that germs alone did not cause disease. Recalling this event, Haldane reproduced Pettenkofer's statement that he was prepared to 'die in the service of Science as a soldier on the field of battle . . . The man who wills to stand higher than an animal must be ready to sacrifice even life and health for a higher ideal good.'³² Pettenkofer had survived that particular battle, but lost the war for recognition in his own lifetime. Haldane's obituary vindicated Pettenkofer, and announced his determination to carry forward the programme of practically engaged science that his life exemplified.

Biography thus provided Haldane with a way to reflect on his own position as a scientist. It offered consolation for the difficulties of his own career;³³ it vindicated his commitment to views that were unpopular among his peers; and it served to exemplify and validate the particular professional project that he pursued. It also offered an outlet for Haldane's reflections on the role of professional service more generally. In 1929, one of his cousins published a family history which traced the Haldane line back to its first appearance in the thirteenth century, and included brief biographies of the more noteworthy members of the family. In many respects, this volume can be read as a straightforward example of the older genre of genealogy, which identified social status with the patrilineal inheritance of titles and property. But in a short essay that he contributed

³¹ The most comprehensive account of Pettenkofer's rise and fall can be found in Richard J. Evans, *Death in Hamburg: Society and Politics in the Cholera Years 1830-1910* (Oxford, 1987), 237-75, 490-507.

³² Haldane, 'Max von Pettenkofer', 294.

³³ This consolatory function is even more apparent in the biography he published of J. J. Waterston, a Scottish scientist who, far more than Pettenkofer, was marginalised in his lifetime and only recognised some years after his death: J. S. Haldane, 'Memoir of J. J. Waterston', in *The Collected Scientific Papers of John James Waterston*, ed. J. S. Haldane (Edinburgh, 1928), xiii-lxviii.

to this work, Haldane recast these earlier notions of inheritance in a more modern and functionalised form.³⁴

Haldane's essay was informed by the ideas of the economist Henry George, whose work he had read and approved as a young man. In the 1880s, George had mounted a well-publicised challenge to prevailing legal notions of landed property. For George, land belonged not to those individuals or families who had historically laid claim to it, but to the communities who lived on it. Land in private hands should be regarded, not as private property, but as a loan from the community, to be paid for in rent or taxes rendered back to the community. That rent could be generated by putting the land to productive use, or it might be raised from elsewhere, for instance in the pursuit of a remunerative career. Possession of land was not a right to be inherited but a privilege to be earned. In effect, George functionalised the notion of ownership by linking it to the fulfilment of a productive or otherwise valued role in the life of the community.³⁵ In his essay on the heredity of the Haldanes, Haldane reiterated his own support for George's idea of land tax:

Since the value of all property is dependent on the community within which it is held, that community seems perfectly justified in gradually taking back an equivalent of the interest on this value, with the result that, unless the holder of property can himself earn the equivalent of that interest, the value of the property returns ultimately to the community.³⁶

He went on to argue that those views actually served to ratify the Haldane family's ownership of estates in Scotland.

'Family "influence" and unpaid public service are powerless against [taxation and death duties]', Haldane told his readers, 'so that those who have inherited must, if they are to maintain the old position, adopt some sufficiently lucrative profession or employment.'³⁷ That was precisely what the Haldanes had done. Pointing to his family's long history of public service, initially to patrons from the higher ranks of the aristocracy and latterly in the professions, he observed that it was not just property alone that had passed from father to son. There was also transferred a 'conscious and growing tradition, developing with the civilisation in contact with it'.³⁸ It was the inheritance of this tradition – of work, of professional service and of social and cultural leadership – rather than any mere legal fiction of heredity that had enabled one Haldane after another

³⁴ J. S. Haldane, 'The Heredity of the Gleneagles Family', in J. Aylmer L. Haldane, *The Haldanes of Gleneagles* (Edinburgh, 1929), 269–72.

³⁵ Warren J. Samuels, Kirk D. Johnson and Marianne F. Johnson, 'The Duke of Argyll and Henry George: Land Ownership and Governance', in *Henry George's Legacy in Economic Thought*, ed. John Laurent (Cheltenham, 2005), 99–147.

³⁶ Haldane, 'Heredity of the Gleneagles Family', 270.

³⁷ *Ibid.*

³⁸ *Ibid.*, 269.

to earn the rent on their land.³⁹ Haldane found vivid proof of this claim in his own family history. Patrick Haldane, an eighteenth-century lawyer, had earned a reputation for harsh and unpopular judgements. As a result, his business had suffered, and his estates would have passed out of the family had it not been for the intervention of a more prudent brother, whose own success in the service of the East India Company enabled him to redeem the lands. Haldane interpreted this story as evidence that the continuity of family inheritance could only be sustained by continuously adapting to new forms of public service: 'Where there is failure in this development', he concluded, 'the direct family line suffers disaster, and is replaced by other family lines.'⁴⁰

Haldane thus recast the older genre of genealogy in ways that were consistent with new professional ideals of social achievement as the proper basis of social standing. In so doing, he mirrored at the level of family history the same shift as Gosse had observed at the level of individual biography. For Haldane, what mattered was not the inheritance of fixed qualities of property or status but rather a developing and adaptable tradition of work and service that had enabled his family to sustain its identity and integrity on its journey through changing historical circumstances. At the level of the family as of the individual, functional adaptation and achievement were the guarantors of personal virtue and social success. Continuing eminence in social life was a matter of constant self-making, in productive interaction with the world they inhabited and helped to shape. As a member of the family whose cultural heredity he described, Haldane plainly saw his own scientific activities as contributing to this project of professional self-realisation.

Haldane's science of life

Haldane's reflections on professional life, and on his own life and role as a professional scientist, were not confined to his biographical writings. They are also evident in the work for which he is better known, namely his research into life in the biological sense. Haldane's interest in the nature of life had initially developed during his undergraduate studies at the University of Edinburgh, when he had become immersed in the

³⁹ Haldane's emphasis on the inheritance of tradition, rather than biological traits, effectively set him apart from the efforts of Frances Galton, among others, to naturalise inheritance as a biological phenomenon.

⁴⁰ Haldane, 'Heredity of the Gleneagles Family', 269. Haldane was not alone in arguing thus. Mrs Humphry Ward, herself a member of the intellectual aristocracy through her family connection to Matthew and Thomas Arnold, worked similar arguments into her best-selling novel *Marcella*. Her literary success had recently enabled her to acquire an estate in Hertfordshire. John Sutherland, *Mrs Humphry Ward, Eminent Victorian, Pre-eminent Edwardian* (Oxford, 1991), 141–2.

philosophical idealism that dominated British philosophy at that time.⁴¹ His decision to study medicine was inspired by that philosophy: 'I had become interested in questions, the answer to which can only be obtained from the study of the processes of life', he later explained.⁴² His reflections on those questions would be published in the explicitly philosophical articles and books that he published throughout his life. But they also informed his pioneering research into the processes of physiological regulation, and his explanation of how such processes enable living organisms to maintain their integrity in the face of constantly changing circumstances.

Haldane was not alone in seeking to understand the phenomena of physiological regulation and integration. For instance C. S. Sherrington, who secured the Oxford Chair of Physiology to which Haldane had aspired, devoted much his career to addressing the same questions.⁴³ But Haldane and Sherrington differed markedly in the kinds of answers they offered. Sherrington, like most other physiologists of the time, held that regulatory phenomena were ultimately reducible to physical and chemical processes that could be understood in purely mechanistic terms; and he saw his own research into the nervous coordination of muscular action as validating this view of the living body as an exquisite machine.⁴⁴ Sherrington acknowledged that his research was guided in part by ideas of function and purpose which 'trench on a kind of teleology . . . We cannot but feel that we do not obtain due profit from the study of any particular type-reflex unless we can discuss its immediate purpose as an adapted act.'⁴⁵ But he held that his own elucidation of reflex processes effectively eliminated teleology by showing how everything that occurred in the nervous system could be understood purely in terms of cause and effect. 'You thought Nature intelligent, even wise', he concluded. 'You now know her devoid of reason . . . How can she have reason or purpose being pure mechanism?'⁴⁶

⁴¹ Sturdy, 'A Co-ordinated Whole', 12–75.

⁴² Anon. [J. S. Haldane], *Letter to the Edinburgh Professors by a Medical Student – Edited, with Preface, by a Graduate of Eminence* (1890), 1.

⁴³ Garland Allen includes both Sherrington and Haldane among those who effected a shift from the 'mechanistic materialism' of mid-nineteenth-century physiology to a position that he calls 'holistic materialism': Garland E. Allen, *Life Science in the Twentieth Century* (Cambridge, 1978), 74, 88–94, 97. See also Donna Jeanne Haraway, *Crystals, Fabrics and Fields: Metaphors of Organization in Twentieth-Century Developmental Biology* (New Haven, 1976).

⁴⁴ The most detailed historical study of Sherrington's scientific work is still Judith P. Swazey, *Reflexes and Motor Integration: Sherrington's Concept of Integrative Action* (Cambridge, MA, 1969).

⁴⁵ C. S. Sherrington, *The Integrative Action of the Nervous System*, 2nd edn (New Haven, 1947), 236, 238.

⁴⁶ C. S. Sherrington, *Man on his Nature: The Gifford Lectures, Edinburgh 1937–8*, 2nd edn (Cambridge, 1951), 290.

Haldane rejected this mechanistic understanding of vital phenomena. Teleology was not simply a convenient fiction to guide physiological investigation, he argued; rather, it was an irreducible aspect of biological reality itself. Those who, like Sherrington, dismissed the idea of purpose and adaptation as nothing more than a trick of the mind betrayed their own metaphysical prejudices. From the viewpoint of idealist philosophy, by contrast, it was evident that living processes really did involve a kind of purposiveness. '[T]he distinguishing feature of vital activity is self-preservation, or the conservation of the organism in a state of functional activity', Haldane declared in the first paper he ever published.⁴⁷ Biology, he later insisted, necessitated a view of living organisms as 'expressing and preserving their own identity'.⁴⁸ Far from explaining away the appearance of teleology, detailed physiological investigation simply showed that biological processes were functional through-and-through. 'The more delicate and definite the physiological regulations which the advance of experimental physiology is constantly discovering', he declared, 'the stronger the case for vitalism'.⁴⁹ Haldane saw his own research into the regulation of breathing as a case in point: 'The idea which gives unity and coherence to the whole of the physiology of respiration is that of the organic determination of the phenomena', he argued.⁵⁰ And not just his own research: he saw Sherrington's work on reflex phenomena as proving the same point. According to Haldane, the latest research into reflex action showed that 'It is the end obtained, and not the physical response, which is simple and definite . . . A mechanism which attains ends in this way is inconceivable . . . even in the case of the complex activities of the nervous system the teleological conception is the only one which is ultimately capable of rendering the phenomena intelligible'.⁵¹ For all that he might protest to the contrary, Haldane argued, Sherrington's research

⁴⁷ R. B. Haldane and J. S. Haldane, 'The Relation of Philosophy to Science', in *Essays in Philosophical Criticism*, ed. Andrew Seth and R. B. Haldane (1883), 41–66, at 54.

⁴⁸ J. S. Haldane, 'Life and Mechanism', *Guy's Hospital Reports*, 60 (1906), 89–123, at 104.

⁴⁹ J. S. Haldane, *Organism and Environment as Illustrated by the Physiology of Breathing* (New Haven, 1917), 16–17. By 'vitalism', Haldane did not mean the kind of dualistic vitalism that supposed that some kind of immaterial vital principal was super-added to a mechanical body. Such a view involved 'a breach, or rather innumerable breaches, in the intelligibility of the universe', he argued: J. S. Haldane, *Religion and the Growth of Knowledge* (1924), 14. His own view was determinedly monistic, and late in life he would complain that 'It has always been difficult for me to prevent confusion between the ideas which I had adopted and the old fashioned Vitalism': J. S. Haldane, 'Autobiographical Notes' (n.d.), National Library of Scotland, MS 20235, fo. 181.

⁵⁰ J. S. Haldane, *Mechanism, Life and Personality: An Examination of the Mechanistic Theory of Life and Mind* (1913), 88.

⁵¹ Haldane, 'Life and Mechanism', 118, 121.

served to demonstrate that 'here, as elsewhere in recent physiology, the fact of co-ordination has been the keynote of recent work'.⁵²

Haldane's teleological understanding of regulatory processes also had implications for where in the living body those processes should be seen to reside. Sherrington's view of nervous integration and coordination was hierarchical and centralised, locating ultimate control over the organs of the body in the central nervous system.⁵³ For Haldane, by contrast, organic regulation was radically decentralised; it was an essential property of all the parts equally. Each part was exquisitely adapted to fulfil its function within the organism as a whole, and tended naturally to act in such a way as to maintain the functional integrity of that whole. While the nervous system had an important role to play in mediating communication and coordination between the various parts, it was still only one organ among many, each of which contributed in its own way to the maintenance of the whole. It was not even the dominant organ of internal communication. For Haldane, delicate shifts in the constitution of the blood conveyed far subtler messages about the changing state of the body, which served to regulate even the actions of the nervous system.⁵⁴ Where Sherrington saw a centralised hierarchy of nervous control mechanisms, Haldane saw a collaborative effort by the community of organs to maintain their collective identity and function.

This disagreement between Haldane and Sherrington over the nature of biological regulation had implications beyond the sphere of physiology itself. It also reflected the way they tended to envisage the processes of social regulation. The use of physiological metaphors to think about society, and of social metaphors to think about biology, was commonplace at that time. Indeed, as Roger Smith has argued, it involved more than just explicitly metaphorical or analogical reasoning: talk about biological processes often slipped seamlessly into talk about society, in ways that elided any clear distinction between biological and social discourse.⁵⁵ Ideas about the integrative action of the nervous system, in particular, were commonly mobilised in discussions of social coordination and integration. Just as the nervous system served to coordinate bodily action

⁵² J. S. Haldane, *The Sciences and Philosophy: The Gifford Lectures, University of Glasgow, 1927 and 1928* (1929), 50.

⁵³ Roger Smith, *Inhibition: History and Meaning in the Sciences of Mind and Brain* (1992), 179–90.

⁵⁴ See for instance his *chef d'œuvre*, *Respiration* (Oxford, 1922), which emphasised the mediating role of the blood in regulating a host of organic functions, and which ended with a chapter of 'General Conclusions' arguing that the facts of respiration made clear the impossibility of a mechanistic account of life.

⁵⁵ Roger Smith, 'Biology and Values in Interwar Britain: C. S. Sherrington, Julian Huxley and the Vision of Progress', *Past and Present*, 178 (2003), 210–42. See also Gregg Mitman, 'Defining the Organism in the Welfare State: The Politics of Individuality in American Culture, 1890–1950', in *Biology as Society, Society as Biology: Metaphors*, ed. Sabine Maasen, Everett Mendelsohn and Peter Weingart (Dordrecht, 1995), 249–78.

by synthesising and communicating information about the state of the body and its environment, so social action was seen to be coordinated through the synthesis and communication of appropriate knowledge of society and the world. Sherrington's hierarchical, centralised model of reflex integration and coordination mirrored widely held views about government as a hierarchically organised, centralised 'sensorium' gathering social intelligence and using it to enact and administer appropriate legislative and bureaucratic controls.⁵⁶ It was a vision that appealed to many scientists, who were inclined to see themselves as part of that central sensorium, working in their laboratories to produce pure, disinterested knowledge of the world and how best to act on it.⁵⁷

Haldane dissented from this view of government, and of scientists' role in relation to it. Like many others who criticised 'mechanical' accounts of social progress, he was suspicious of claims that social order could be imposed through central legislation.⁵⁸ Top-down compulsion was ultimately incapable of imposing order where the members of society were unable or unwilling to do what was demanded of them. Effective government must proceed organically, in keeping with the disparate abilities and expectations of the various members of the social organism. Just like physiological regulation, Haldane took the view that social regulation should be understood in radically decentralised terms – a teleologically arranged, adaptive process of self-adjustment that took place throughout society, and that thereby conduced to the maintenance of the social organism as a whole. This was no mere metaphor. From the perspective of philosophical idealism, Haldane saw the teleological processes of self-regulation that made possible the continuing integrity of a living organism as identical with those involved in the day-to-day coordination of social life.⁵⁹

⁵⁶ See J. A. Hobson, 'The Re-statement of Democracy', *Contemporary Review*, 81 (1902), 262–72, for an instance of such reasoning by neurological metaphor.

⁵⁷ For an earlier view of scientists, and intellectuals more generally, as belonging to the social sensorium, see Elizabeth Green Musselman, *Nervous Conditions: Science and the Body Politic in Early Industrial Britain* (Albany, 2006); Christopher J. Lawrence, 'The Nervous System and Society in the Scottish Enlightenment', in *Natural Order: Historical Studies of Scientific Culture*, ed. Barry Barnes and Steve Shapin (1979), 19–40.

⁵⁸ Those whose political ideas were informed by philosophical idealism, in particular, were inclined to denounce both the 'mechanical' economics of laissez-faire liberalism and the 'mechanical' socialism of the Fabians and others further to the left, and to urge instead what Andrew Vincent and Raymond Plant call a 'moralised capitalism' that located the impetus to social betterment in the shared sentiments of citizens: *Philosophy, Politics and Citizenship: The life and Thought of the British Idealists* (Oxford, 1984), 31–3, 83–7.

⁵⁹ Sturdy, 'Biology as Social Theory'. Haldane's elevation of humoral over nervous regulation, and the preference for decentralised rather than centralised government that he associated with it, has interesting parallels with the view of Arthur Keith and Morley Roberts, discussed in Rodhri Hayward, 'The Biopolitics of Arthur Keith and Morley Roberts', in

This had implications for how he envisaged the role of scientists, in particular. Rather than withdrawing into laboratories remote from the rest of the world, they should involve themselves directly in society in all its parts. His own work on the health conditions of workplaces showed why and how. Physiological phenomena elicited in the laboratory were not necessarily the same as those that occurred under the ordinary circumstances of life. Consequently, if physiologists were to address the problems occurring in the workplace, it was no use handing down recommendations based solely on knowledge won in the laboratory, since these would rarely prove applicable to local circumstances. Rather, scientists should work directly with those affected to develop a proper appreciation of problems they faced and to help them devise viable and appropriate means of alleviating their problems. Rather than seek to influence society through the agency of central government alone, scientists should involve themselves in the local processes of social self-regulation. It was just such a role that Haldane sought to fulfil through his own engagement with the problems of industry.⁶⁰

Conclusion: self-experimentation, autobiology and autobiography

Haldane's research into the nature of physiological regulation thus reflected – indeed, served in effect to naturalise – the ideas about the social function of the professional classes, and in particular the role of professional scientists, in his occasional biographical writings. This was precisely the kind of scientific life that he himself sought to live. In this regard, it is striking to note that his biological view of life was in large part based on experiments that he conducted on himself. Throughout the course of his career in physiology and industrial health, Haldane performed his physiological research almost exclusively on himself or on other human subjects; whether investigating the minute regulation of breathing or the effects of poisonous gases on miners, he was always his own favourite guinea-pig. In effect, he used his own biological life to demonstrate the principles of physiological regulation that he saw as informing his chosen biographical life.⁶¹

Regenerating England: Science, Medicine and Culture in Inter-war Britain, ed. Christopher Lawrence and Anna-K. Mayer (Amsterdam, 2000), 251–74.

⁶⁰ Haldane's views on how to effect reforms in industrial practice, and the limits of legislation to do so, are discussed in Sturdy, 'A Co-ordinated Whole', 160–3, 174–83.

⁶¹ On the relationship of science, authority and identity in the practice of self-experiment during the late eighteenth and early nineteenth centuries, see Simon Schaffer, 'Self-Evidence', in *Questions of Evidence: Proof, Practice, and Persuasion across the Disciplines*, ed. James Chandler, Arnold I. Davidson and Harry Harootunian (Chicago, 1994), 56–91; Noel B.

In part, Haldane's preference for self-experimentation had a methodological basis. He took the view that vivisectional experiments on animals, of the kind favoured by Sherrington and most other experimental physiologists, inevitably abstracted from and often distorted the normal processes of regulation. If the physiologist's aim was to understand normal biology, it would be better to investigate a whole, conscious human being than an anaesthetised and vivisectioned animal. Moreover, self-experimentation added an extra dimension to his physiological observations by enabling him to take note, not just of objective phenomena, but also of subjective experiences that might alert him to subtle biological responses that were not registered by the particular methods of observation and measurement that he happened to be employing at the time.⁶² Physiology, for Haldane, was the science of life, and all aspects of life, including the subjective, were grist to the physiological mill.

More than this, however, physiology was an intimate part of the way Haldane experienced himself as a biographical individual. His scientific researches did not just elucidate biological life in the abstract; they illuminated life as he himself lived it. Indeed, physiology – and especially the teleological aspect of physiology that he himself stressed – had direct practical consequences for how he chose to live. In his thirties, he developed an irregular heart beat. The dominant cardiological wisdom of the day dictated that anyone suffering from such a condition should live as a semi-invalid, lest any sudden exertion precipitate a complete cardiac collapse. But Haldane chose to consult J. S. Mackenzie, a general practitioner from Burnley who had undertaken physiological research into the action of the heart, and who was just beginning to make a name for himself as a consultant cardiologist. Mackenzie's understanding of physiology was similar in important respects to Haldane's, with its emphasis on adaptation and the self-maintenance of vital function. Mackenzie took the view that in many cases of heart disease, the heart was able to adjust its action to compensate for whatever damage or disruption it had suffered. In such cases, patients need not retire from active life, but could continue to function as normal. Haldane heeded Mackenzie's advice, and went on to enjoy thirty more years of vigorous scientific and professional activity.⁶³ His functional understanding of physiological life

Jackson, 'Critical Conditions: Coleridge, "Common Sense", and the Literature of Self-Experiment', *ELH*, 70 (2003), 117–49.

⁶² Haldane's experimental style is discussed further in Sturdy, 'A Co-ordinated Whole', 201–41.

⁶³ J. B. S. Haldane, 'The Scientific Work of J. S. Haldane', in *Penguin Science Survey 1961*, ed. S. A. Barnett and Anne MacLaren (Harmondsworth, 1961), Part 2, 11–33, at 19. McKenzie's contribution to the physiological redefinition of heart disease is described in Christopher J.

was thus instrumental in enabling him to pursue his social function as a scientist and a citizen.

Haldane's life can thus be seen as a protracted biological experiment – a study of the processes by which a living body responds, over days and years, to the circumstances in which it finds itself. His physiological researches served both to deepen his understanding of those processes and to inform the life he lived: self-experimentation was not just a means of scientific observation, but a way of experiencing life itself. Haldane literally embodied his own knowledge of physiology,⁶⁴ while his elucidation of physiological processes can be seen, in a very real sense, as a form of autobiography.⁶⁵ At the same time, Haldane's career was also an experiment in the kind of life that might be lived by a professional biologist, and his self-experiments served to dramatise the virtues that he associated with such a life. In the course of his researches in mines and factories, he repeatedly put himself in physical danger, and even the experiments he conducted in the relative safety of his own laboratory often involved a considerable degree of discomfort and sometimes risk. Haldane's approval of Pettenkofer's willingness to 'die in the service of Science as a soldier on the field of battle' found a peculiar resonance his own life, particularly during the First World War when he undertook research into poison gases for the War Office. In the course of this work, he repeatedly risked exposure to dangerous concentrations of gas. His health was impaired as a result, leaving him bent and often breathless. For the rest of his life he would bear the stigmata of his devotion to science and to the social purpose that he saw science as serving.⁶⁶

For Haldane, physiology was thus a way of experiencing and expressing some of the most intimate aspects of his very self; in effect, life as autobiography was inseparable from life as autobiography. Physiological investigation of his own body provided a means of addressing and answering a multiplicity of questions about how he should live his life. It helped him to understand his own health and his own capabilities; it provided him with tools for investigating and managing industrial life; it exemplified the principles of physiological and social regulation that he believed should inform the role of science in the modern world; and it

Lawrence, 'Moderns and Ancients: The "New Cardiology" in Britain 1880–1930', *Medical History*, Supplement No. 5 (1985), 1–33.

⁶⁴ Christopher Lawrence and Steven Shapin, eds., *Science Incarnate: Historical Embodiments of Natural Knowledge* (Chicago and London, 1998).

⁶⁵ Cf. Thomas Söderqvist, *Science as Autobiography: The Troubled Life of Niels Jerne*, trans. David Mel Paul (New Haven, 2003), for a more psychologicistic approach to science as self-realisation.

⁶⁶ The risks Haldane ran in the course of his work are well described in Goodman, *Suffer and Survive*, *passim*.

provided an opportunity to enact the values that he saw as central to his own professional identity.

As we have seen, this physiological understanding was at odds, on practically every count, with the way that most leading physiologists of his generation envisaged their own professional identity.⁶⁷ Small wonder, then, that he lost out to Sherrington in his bid to lead the Oxford Department of Physiology. This was undoubtedly a blow to his professional ambitions – but perhaps less so than it would have been for many of his colleagues. Haldane was nothing if not adaptable, as his self-experiments made abundantly clear, and the university laboratory was only one of a number of environments in which he saw himself pursuing a scientific life. His decision to withdraw from academia was far from the end of his career, and he continued to pursue an active life in science and industry. His resignation removed him from the mainstream of professional science, however, and thereby from the purview of scientific biography; his later career was largely glossed over in the obituaries written on his death, and has received little attention from historians of science. Haldane continued to live life on his own terms, but in the end, those terms meant little to those who determined what an exemplary life in science should look like.

⁶⁷ Cf. Roger Smith, 'The Embodiment of Value: C. S. Sherrington and the Cultivation of Science', *British Journal for the History of Science*, 33 (2000), 283–311.