Performing Scientific Naturalism: The Popular Scientific Lecture and Victorian Culture, *c.*1860-1890

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Contents

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Illustrations

Abstract

This thesis situates popular science lectures within broader Victorian cultures of public speech. In so doing, it argues that scientific naturalists such as Thomas Henry Huxley, John Tyndall and Robert Stawell Ball, adopted the lecture form as a specific tool with which to persuade the public of the validity of empirical scientific methods. It establishes a literary theoretical, and historical framework through which the textual versions of their performances should be read, highlighting the ways in which the scientists' claims to objectivity were enhanced, or obfuscated, through translation into print.

Chapter one considers how Tyndall and Ball shaped their public performances in order to demonstrate their authority to speak for science. Technologies such as the lantern slide and demonstration apparatus, so integral to these scientists' performances, were represented in print in ways which complicated performers' presentations of scientific objectivity. Chapter two turns to Huxley, and examines the ways in which the scientist's self-presentation as an authoritative and morally upright figure drew on both early nineteenth-century science lecturing conventions, and pulpit oratory. It also shows that Victorian print cultures, including satires, and reporting of speech in newspapers, generated multiple versions of the same performance.

The first two chapters illustrate how the male performer's body was integral to their presentation of scientific authority. Chapter three provides a counter-voice to this by examining the public lectures of four women: Catherine Buckton, Arabella Buckley, Eleanor Ormerod and Lydia Becker. Their occupation of the lecture platform challenged the perception that women lacked the physical and intellectual strength to do science. Chapter four looks at scientific themes in the public lectures of two non-scientists, Charles Kingsley and John Ruskin, and the ways in which these men adopted the rhetoric of scientific naturalists to both agree with, and challenge, their claims to scientific authority. Finally, chapter five moves to the provinces, with an in-depth case study of lecture circuits in Manchester. It looks at the way in which public scientific speech

moulded class relations in the city, and how scientific naturalists capitalized on the consolidation of civic identities.

Introduction

The Nineteenth-Century Scientific Lecture in Context

When the biologist Thomas Henry Huxley published an after-dinner speech he had given to the Liverpool Philomathic Society in April 1869, he insisted that the text was 'a speech which really did get itself spoken'.[1] Implied in his statement was the suggestion that not all printed "speeches" really were that, as well as the sense that the direct experience of a speech validated the authenticity of its content. Such an insistence on direct experience was also a constituent of the empirical methods that Huxley and other scientific naturalists were campaigning for. In that same speech Huxley asserted that:

> If the great benefits of scientific training are sought, it is essential that such training should be real; that is to say that the mind of the scholar should be brought into direct relation with fact, that he should not merely be told a thing, but made to see by the use of his own intellect and ability that the thing is so and no otherwise.
>
> (p. 182)

Popular lectures could offer that direct experience in the form of live demonstrations. The very form of the lecture – as a performance that was witnessed by audiences of more than one person, and that caused the wonders of nature literally to appear before that audience – made it a vehicle through which empirical scientific method was presented to the public.

This thesis offers a reading of the popular scientific lecture in Britain in the second half of the nineteenth century, as a tool that was consciously used to persuade an audience of the veracity of scientific naturalism. As Joseph Meisel points out, public speech was not just a part of,

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[1] Thomas Henry Huxley, 'Scientific Education: Notes of an After-Dinner Speech', *Macmillan's Magazine*, 20 (June 1869), 177-184 (p. 177). All first references to primary texts given in footnotes, subsequent references given in main body of thesis. Lecture texts and reports of performances are treated as primary texts.

but 'helped to condition' nineteenth-century public life.[2] From Parliament to the courts, political platforms and public lectures, to penny readings and theatre, this period was saturated by public speech. The scientific lectures with which this thesis is concerned developed from multiple and complex traditions of public speech which, importantly, developed in parallel with print. Scientific naturalists exploited the existing cultural associations of the platform to posit their own scientific authority.

Scientific naturalism, as defined by Frank Turner in his foundational *Between Religion and Science* (1974), refers to the practices of a select group of Victorian men, amongst them Huxley, John Tyndall, Herbert Spencer, and G. H. Lewes, who were active in the second half of the century.[3] Specifically, as Turner sees it, scientific naturalism grew from, and was used to support, three major aspects of science: Dalton's atomic theory, the law of the conservation of energy, and evolutionary theory.[4] Its advocates stressed a 'repudiation of supernaturalism', replacing it with 'new interpretations of man, nature, and society from theories, methods, and categories of empirical science'.[5] In so doing, scientific naturalists sought to replace the spokesmen for traditional views on nature – for example clergymen-practitioners of science – as the authority voice for (new, empirical) science on a national level. They aimed to make science into a profession, and the salaried scientist an essential advisor to government.

Turner's definition of scientific naturalism (that it was centred on three scientific ideas and their communication by a specific group of men) is important to this thesis. It provides historical specificity to the argument that the convergence of a new scientific outlook, developments in print media, and a peculiarly Victorian vogue for public speech, moulded the popular science lectures of the period. However, the argument of *Between Science and Religion* –

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[2] Joseph Meisel, *Public Speech and the Culture of Public Life in the Age of Gladstone* (New York: Columbia University Press, 2001), p. 276.
[3] Frank Miller Turner, *Between Science and Religion: The Reaction to Scientific Naturalism in Late Victorian England* (New Haven: Yale University Press, 1974), pp. 9-10.
[4] Ibid., p. 24.
[5] Ibid., p. 12.

that there were figures in Victorian culture who opposed scientific naturalism on the grounds that there were limitations to the empirical method – in many ways shows that Turner's narrow definition can and should be disaggregated. In pointing out the problems with scientific naturalists' apparent public intolerance for other ideas, figures such as Henry Sidgwick in fact demonstrated a pragmatic view of intellectual authority.[6] The fact that some delivered a "softer" scientific naturalism using the same channels as Huxley and others, suggests that we need to view the term more broadly, and that reading the performances of individuals who did not conform to this group (such as Charles Kingsley), will show that it was possible to agree with some, but not all, aspects of scientific naturalism.

By including figures such as Arabella Buckley, whose commitment to spiritualism was not shared by core scientific naturalists, it is possible to consider how their emphasis on education through observation could be woven into earlier teaching traditions. Including the behaviour of individuals such as Lydia Becker at scientific meetings, allows for a consideration of how the scientific ideas underpinning scientific naturalism were communicated by those who were excluded from its professionalizing aspects.

No study exists which is devoted to the role that the popular lecture form played in establishing the authority of scientific naturalism in Britain during the second half of the nineteenth century. The current thesis seeks to remedy this, examining the scientific lecture by means of both historical and literary theoretical methods. This introductory chapter lays the contextual foundations for the study as a whole, outlining the status of public speech more broadly in the Victorian period.

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[6] Ibid., p. 60.

Public Speech: The Tradition

Lectures were a familiar form in Victorian public life and all topics, from literature to science, history to music, were ripe subjects for discussion.[7] But the form which was longest established, and which had the furthest public reach, was the sermon. Its influence will be discussed in greater detail in chapters two and three. Thorough critical work has been carried out on the Victorian sermon by scholars such as Keith Francis, Ciaran Toal and Diarmid Finnegan, who each consider the impact that developments in science had on the content and style of sermons.[8] Robert Ellison has looked to the movement of the sermon itself from pulpit to page, carrying out detailed rhetorical analysis on the printed works of Charles Haddon Spurgeon, John Henry Newman, and George Macdonald.[9] Ellison points out that texts of sermons performed different functions: they were published in religious magazines and periodicals for general readers, and provided texts which other preachers could read out loud.[10] Such critical works highlight the complex social functions of religious speech in the nineteenth century: the immediacy of delivery and the authority of the preacher to give that message, versus the potential of wide print distribution. The concern that something could be lost in translation was not, however, confined to religious speech, but was felt in politics too.

Alfred Kinnear remarked in his 1899 article, 'The Trade in Great Men's Speeches', that '[t]he days, indeed, of five and six column speeches are gone, and there exists, seemingly, neither

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[7] On lectures by literary figures see Matthew Bevis, 'Lecturing Ruskin', in *Pulpit, Platform, Rhetoric*, ed. by Martin Hewitt (Leeds: Leeds Centre for Victorian Studies, 2000), pp. 122-136.

[8] Keith Francis, 'Nineteenth-Century British Sermons on Evolution and *The Origin of Species*: The Dog That Didn't Bark?', in *A New History of the Sermon: The Nineteenth Century*, ed. by Robert H. Ellison (Leiden: Brill, 2010), pp. 269-308; Ciaran Toal, 'Preaching at the British Association for the Advancement of Science: Sermons, Secularization and the Rhetoric of Conflict in the 1870s', *British Journal for the History of Science*, 45 (March 2012), 75-95; Diarmid A. Finnegan, 'Exeter-Hall Science and Evangelical Rhetoric in Mid-Victorian Britain', *Journal of Victorian Culture*, 16 (2011), 46-64.

[9] Robert H. Ellison, *The Victorian Pulpit: Spoken and Written Sermons in Nineteenth-Century Britain* (London: Associated University Presses, 1998).

[10] Ibid. pp. 46, 49.

the taste nor the capacity to revive them'.[11] Kinnear's remark represents the trajectory of published parliamentary speech across the nineteenth century. Until the 1770s, the publication of parliamentary debates was forbidden; MPs apparently feared that they would not be able to debate openly if their words were subject to public scrutiny.[12] When restrictions were lifted however, there began a century-long obsession with parliamentary oratory. William Cobbett's *Parliamentary Debates* (1802-), which in 1812 became *Hansard's*, was 'the first elaborate and connected record of parliamentary discussion published in England'.[13] The public had access not just to the decisions of Parliament, but also to how MPs made those decisions. Written reports also meant that particular interest grew in the relationship between printed speech and its original delivery: the permanency of script versus the transience of the spoken word, the slowness and deliberation of writing against the improvisatory and instantaneous nature of speech. William Hazlitt considered this issue in 'On the Difference Between Writing and Speaking' (1820), and concluded that a politician who was good at one was usually not good at the other.[14] For Thomas Carlyle, parliamentary speech was synonymous with buffoonery, its proliferation in newspapers scattering scraps of rubbish ever further beyond the House. Carlyle likened empty political speech to forged paper currency,[15] a 'glistering phosphorescence' (p. 34), its outward appearance deceiving listeners (and readers), making them unable to distinguish between it and the real article. In becoming print, speech was commodified; a value was placed upon it which enabled a judgement to be made on substance – veracity, sincerity and content.

Now with greater access to parliamentary speeches, journalists debated the most effective forms of oratory, and what constituted eloquence itself. 'Pitt observed that eloquence is

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[11] Alfred Kinnear, 'The Trade in Great Men's Speeches', *Contemporary Review*, 75 (March 1899), 439-444 (p. 440).
[12] Christopher Reid, 'Whose Parliament? Political Oratory and Print Culture in the Later 18th Century', *Language and Literature*, 9 (2000), 122-132 (p. 124).
[13] Matthew Bevis, *The Art of Eloquence: Byron, Dickens, Tennyson, Joyce* (Oxford: Oxford University Press, 2007), p. 18.
[14] Hazlitt writes that '[t]he most flaming orator I ever head, is the flattest writer I ever read', 'On the Difference Between Writing and Speaking', *London Magazine*, 2 (July 1820), 22-33 (p. 23).
[15] Thomas Carlyle, 'Stump-Orator' (May 1850), *Latter-Day Pamphlets* (London: Chapman and Hall, 1850), p. 10.

not in the speaker, but in the audience',[16] one writer noted, arguing that the success of a parliamentary speech was down to the amount of 'party spirit' it roused in the House (p. 587). Another wrote that, while the content of a speech is more easily understood when read, if one 'wants to know whether a Minister is a coward or a brave man, there is nothing like hearing him speak'.[17] The latter quotation suggests that the way in which a public figure spoke gave clues about his character, something which will be discussed in chapter two. The former gives the audience a degree of responsibility for the speech's success. But the fact that this writer chose to discuss Pitt suggests that they were looking back to a golden age of parliamentary oratory. Indeed, as Meisel points out, there was a perceived general decline in public speech-making throughout the century.[18] This may or may not have been justified, but later nineteenth-century writers felt that there was a marked difference from that golden age.

Matthew Bevis observes that '1850 sees the first recorded instance of the verb "voice" applied to "writings", while 1855 witnessed the word "audience" being used to refer to "readers of a book"'.[19] This mid-century linguistic shift is indicative of the close relationship between speech and print, in which both readers, and writers and speakers, became aware of an expansion in potential witnesses to a particular performance. Words could be textually carried beyond their original point of delivery. Nikki Hessell discusses the tacit understanding between 'editors, journalists and readers alike' of parliamentary reports, that 'reporters were engaging in a mixture of factual transcription and fictional representation'.[20] There was an acknowledgement that, due to the multiple agents involved in the transmission of a speech, some embellishment was to be expected. Indeed, the extent to which this was a recognized part of speech reporting is

[16] 'Oratory', *Cornhill Magazine*, 2 (November 1860), 580-590 (p. 585).
[17] 'The Power of Oratory', *Saturday Review*, 21 (17 February 1866), 195-196 (p. 196).
[18] Meisel, p. 282. An excellent study of the evolution of parliamentary speech during this period is Josephine Hoegaerts, 'Speaking Like Intelligent Men: Vocal Articulations of Authority and Identity in the House of Commons in the Nineteenth Century', *Radical History Review*, 121 (January 2015), 123-144.
[19] Bevis, *The Art of Eloquence*, p. 22.
[20] Nikki Hessell, *Literary Authors, Parliamentary Reporters: Johnson, Coleridge, Hazlitt, Dickens* (Cambridge: Cambridge University Press, 2013), p. 141.

demonstrated by the fact that it was picked up in the fiction of some of the best known novelists of the period.

The scene of the Eatanswill election in Dickens's *The Pickwick Papers* (1836-7) is inhabited by characters who are either paralysed by nerves and cannot speak, or who have a lot to say but cannot be heard. The Mayor's speech is 'rendered [...] inaudible' by a bell ringing, 'with the exception of the concluding sentence, in which he thanked the meeting for the patient attention with which they heard him throughout'.[21] Later one speaker 'delivered a written speech of half an hour's length, and wouldn't be stopped, because he had sent it all to the Eatanswill Gazette, and the Eatanswill Gazette had printed it, every word' (p. 157). This comic inversion in which published text comes before speech, asks whether political speech is dull because it must imitate text, or whether it was dull to begin with.

The body of the political speaker, too, became the subject of fiction. At the hustings in Eliot's *Middlemarch* (1871-2) Mr Brooke's voice is parroted back to him by his own effigy, 'a parrot-like, Punch-voiced echo of his words', making a pantomime out of democracy.[22] Brooke, as a stuffed puppet, lacks the corporeal integrity of the full-blooded politician; he has no substance, and neither do his words. Shortly before his ascent to the platform Brooke 'take[s] another glass of sherry' (p. 502), an action which was 'a surprise to his system which tended to scatter his energies instead of collecting them' (p. 503). Melmotte's drunken attempts at parliamentary speech making in Anthony Trollope's *The Way We Live Now* (1875) are similarly marked by ill-preparedness and the mistaken belief that alcohol will steady his nerves – he 'had not dreamed of putting two words together',[23] and 'knew nothing of the forms of the House:- was more ignorant of them than an ordinary schoolboy' (II, p. 179). He fares no better in his second attempt:

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[21] Charles Dickens, *The Pickwick Papers*, ed. by James Kinsley (Oxford: Oxford University Press, 2008), p. 156.
[22] George Eliot, *Middlemarch*, ed. by David Carroll (Oxford: Oxford University Press, 1998), p. 474.
[23] Anthony Trollope, *The Way We Live Now*, ed. by John Sutherland (Oxford: Oxford University Press, 2008), vol 2, p. 180.

> He was drunk [...] he had forgotten in his audacity that words are needed for the making of a speech, and now he had not a word at his command. He stumbled forward, recovered himself, then looked once more round the House with a glance of anger, and after that toppled headlong over the shoulders of Mr Beauchamp Beauclerk, who was sitting in front of him.
>
> (II, p. 318)

Melmotte's foreign status, which had been couched in ambiguity throughout the novel, is here brought to the fore; these disastrous, ultimately aborted speeches show that, as an outsider in a society which sets such stock by public speech, he misunderstands the propriety of the situation (not to mention that his drunken oral impotence brings home the physiological outcome of combined speech-making and alcohol).

Scientific Performance: The Tradition

Scientific lectures in nineteenth-century Britain were part of these traditional and widespread oratorical cultures, cultures which had serious messages, be they religious or political.[24] They also need to be read in parallel with, but as distinct from, the North American lecture circuit.[25] In North America, lecturers toured an already established lyceum lecture circuit, something which was absent from the British scene. But it is true to say that, on both sides of the Atlantic, scientific lectures originated in traditions of showmanship and spectacle, which ultimately had commercial value.[26] Late eighteenth-century itinerant lecturers, such as the self-styled "Dr" Gustavus

[24] On the evolution of the meaning of the word 'lecture' in relation to the sermon, and science, see David Knight, 'Scientific Lectures: A History of Performance', *Interdisciplinary Science Reviews*, 27 (2002), 217-224. On the changing meaning of 'performance' see Michael Wintroub, 'Taking a Bow in the Theatre of Things', *Isis*, 101 (December 2010), 779-793.

[25] The American lecture circuit was more organized and more institutionalized than in Britain, and the celebrity of the speaker was 'beginning to be consumed as a commodity'. See Amanda Adams, *Performing Authorship in the Nineteenth-Century Transatlantic Lecture Tour* (Surrey: Ashgate, 2014), p. 11. See also Tom Wright, 'Britain on the American Popular Lecture Circuit 1844-1865', (PhD Thesis, University of Cambridge, 2010). Wright's assertion that printed lectures were 'modified and transformed by editorial imperatives' (p. 10), has influenced the treatment of journalistic texts in the present thesis. For science lectures in North America see P. Lucier, 'The Professional and the Scientist in Nineteenth-Century America', *Isis*, 100 (December 2009), 699-732.

[26] Richard Altick, *The Shows of London* (Cambridge, Massachusetts: Belknap Press of Harvard University, 1978), p. 363.

Katterfelto (d. 1799), combined natural philosophy with visually captivating chemical demonstrations and "magic" tricks. Katterfelto stressed the spectacle of his performances and his use of such optical instruments as the solar microscope, in verse advertisements – testifying to their playful, frequently fictional, nature.[27] As Jonathan Crary notes, during the nineteenth century, optical instruments were 'points of intersection where philosophical, scientific, and aesthetic discourses overlap[ped] with mechanical techniques, institutional requirements, and socioeconomic forces'.[28] From the mid-1820s onwards, devices originally designed for scientific research on optics were converted into popular entertainments.[29] The creation of "Phantasmagoria" using the magic lantern began at the beginning of the century,[30] while dissolving views originated in the 1830s.[31] During the late eighteenth and into the nineteenth century, the value of the scientific lecture was judged to be manifold. Itinerant lecturers operated in a marketplace in which each competed for entrance fees, fame, and the authority to speak for natural philosophy.[32] It was also during the eighteenth century that lectures began, with illustrations, to make their way into print.[33]

The heyday of the itinerant lecturer was over by the second half of the nineteenth century. Ian Inkster notes that their demise was already under way by the beginning of the century, in part due to the rise of scientific institutions, both amateur and professional. 'The rise of scientific instruction in the local schools and institutions, and in the universities, and the progress of cheap publishing', Inkster writes, 'at once created a scientific public and ensured that

[27] See for example a handbill, 'Wonderful Wonders, Wonders and Wonders', c. 1785, University of Oxford, Bodleian Library, John Johnson Collection: Magic and Mystery 3 (42).

[28] Jonathan Crary, *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century* (Cambridge, MA: MIT Press, 1990), p. 8.

[29] Ibid., p. 104.

[30] Steve Humphries, *Victorian Britain through the Magic Lantern* (London: Sidgwick and Jackson, 1989), p. 15.

[31] Ibid., p. 18.

[32] As Simon Schaffer notes in his assessment of the late eighteenth-century lecture marketplace, '[l]ecturers competed with each other for audience and status [...] systems of value were brought forward for scrutiny, and tacit assumptions about the private vices and public benefit of natural philosophy were rendered explicit'. 'The Consuming Flame: Electrical Showmen and Tory Mystics in the World of Goods', in *Consumption and the World of Goods*, ed. by John Brewer and Roy Porter (London: Routledge, 1994), pp. 489-526 (p. 490). See also Schaffer, 'Natural Philosophy and Public Spectacle in the Eighteenth Century', *History of Science*, 21 (1 March 1983), 1-43.

[33] A. D. Morrison-Low, *Making Scientific Instruments in the Industrial Revolution* (Hampshire: Ashgate and National Museums Scotland, 2007), p. 268.

such a public was less dependent on transitory provision'.[34] However, during a time in which science was indeed becoming increasingly organized, itinerant lecturing remained an important way for scientists and amateur institutions to survive, well into the latter half of the nineteenth century. Further, scientific sites such as the Royal Polytechnic Institution (1838) and the Adelaide Gallery (1832) in London (and the Royal Victoria Gallery of Practical Science in Manchester (1840), modelled on the Adelaide), 'provided a site for mechanics and London's instrument makers to present spectacular shows and to appear before the public as men of science'.[35] In performing science in this way – in showing and demonstrating – such men of practical science put the case for mechanical science to a wider scientific and amateur public. Such institutions updated the established association between natural philosophy and spectacle, to include more recent mechanical and technological developments.

John Henry Pepper (1821-1900) presided over the Polytechnic from 1854, and it is his 'Ghost' that best illustrates the Institution's spectacular agenda.[36] 'Pepper's Ghost' was an optical illusion which was first presented to the Polytechnic's audience in 1862, and which was used to accompany readings, including Dickens's 'The Haunted Man'. 'The object of our said Invention', reads the instrument's patent, 'is by a peculiar arrangement of apparatus to associate on the same stage, a phantom or phantoms with a living actor or actors, so that the two may act in concert, but which is only an optical illusion as respects the one or more phantoms so introduced'.[37] 'A large glass screen is placed on the ordinary stage, as well as in front of a hidden second stage beneath'. When actors on the hidden stage were illuminated, a reflected image became visible on the glass to the audience. Importantly, '[t]he glass is adjustable and it is readily adjusted to the

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[34] Ian Inkster, 'Culture, Institutions and Urbanity: The Itinerant Science Lecturer in Sheffield 1790-1850' (1976), *Scientific Culture and Urbanisation in Industrialising Britain* (Hampshire: Ashgate Variorum, 1997), pp. 218-232 (p. 228).

[35] Bernard Lightman, *Victorian Popularizers of Science: Designing Nature for New Audiences* (Chicago: University of Chicago Press, 2007), p. 198.

[36] Ibid., pp. 196-216 for details of the Polytechnic and Pepper's premiership.

[37] Patent for 'Improvements in Apparatus to be Used in the Exhibition of Dramatic and Other Like Performances', Pepper and Henry Dircks, 5 February 1853, in Professor Pepper, *The True History of Pepper's Ghost; and All About Metempsychosis* (London: Cassell and Company, 1890), p. 5.

proper inclination, by having a person in the pit and another in the gallery to inform the party who is adjusting the glass when they see the image correctly'. This not only shows the importance of the role of assistants; reference to different parts of the auditorium suggests a democratic approach to showmanship in which Pepper wanted all seats to have clear visibility. The adjustable apparatus meant that the 'Ghost' could be exhibited in different places, and Pepper even took it on tour to America in the mid-1870s.

Alongside such demonstrations of mechanical ingenuity, sciences which would now be (and at the time by many people were) considered pseudo-sciences, made their way into public performances. Itinerant lecturers carried out the controversial practices of phrenology, and later mesmerism and phreno-mesmerism.[38] Phrenology, the study of the external features of the skull to determine a person's character, had secured its place in the public's consciousness by the 1820s, thanks to the British lecture tour of one of its founders, Johann Gaspar Spurzheim, between 1814 and 1815, and further lectures by his follower, George Combe.[39] As Terry Parssinen suggests, phrenology's appeal lay partly in the fact that it appeared to be an empirical 'science of the mind', and partly because an audience could feel fully part of the demonstration.[40] A diagnosis of sorts could be given to the subject of a phrenological examination, offering them a more concrete, less abstract message than they might take away from a lecture on natural science. Parssinen also notes that the 'phrenological societies that sprang up in Britain during the 1820s and 1830s were, in structure and intent, identical to contemporary organizations like the Linnean or the Literary and Philosophical Societies'.[41] It may be a little strong to suggest that these societies were 'identical', but they certainly strove to imitate existing scientific organizations, and in doing so hoped to imbibe some of their scientific credibility. Phrenological

[38] Fred Kaplan explains the increasingly close relationship between mesmerism and phrenology, *Dickens and Mesmerism: The Hidden Springs of Fiction* (Princeton, NJ: Princeton University Press, 1975), pp. 13-14.
[39] Roger Cooter, *The Cultural Meaning of Popular Science: Phrenology and the Organization of Consent in Nineteenth-Century Britain* (Cambridge: Cambridge University Press, 1984), pp. 3-7.
[40] Terry M. Parssinen, 'Popular Science and Society: The Phrenology Movement in Early Victorian Britain', *Journal of Social History*, 8 (Autumn 1974), 1-20 (p. 3).
[41] Ibid., p. 8.

societies staged lectures, provided libraries and museums, and published papers in such journals as the *Phrenological Journal and Miscellany* (1823-1847). Through these vehicles phrenology was able to gain and maintain some scientific integrity. It must also be noted that the view of brain functions as connected to character that was developed by one of phrenology's founders, Franz Joseph Gall, can be seen as an ancestor to cerebral localization.[42]

In mesmeric performances, a mesmerist (usually male) placed his subject (usually female) under a trance by moving his hands over their body (but not touching them), thereby communicating the force of "animal magnetism". Once in this trance, the subject might be gifted with a number of powers: a loss of sensation to the extent that they could endure extreme pain; the ability to "see" inside a person's body and diagnose hidden medical conditions; and transformations of personality. John Elliotson, professor of practical medicine at the newly founded University College, London, believed that mesmerism could be used to treat nervous conditions. In the summer of 1838, in the University College Hospital Theatre, Elliotson appeared to place patients in a mesmeric trance. These performances, given in a scientific space to a professional audience, were intended to bolster mesmerism's integrity as a science. However, the practice always had its sceptics, not least those who wrote for the *Lancet*;[43] following a "trial" by the editor Thomas Wakely, in which he challenged Elliotson to identify a "magnetized" piece of metal, the latter resigned his post at UCL.

Despite these attempts from the medical community to discredit mesmerism, its popularity with the public did not immediately decline. 'The early 1840s was a promising time for travelling lecturers presenting themselves as vigorous, independent-minded individuals

[42] See first chapter of Robert M. Young, *Mind, Brain and Adaptation in the Nineteenth Century: Cerebral Localization and its Biological Context from Gall to Ferrier* (Oxford: Oxford University Press, 1990), pp. 9-53.

[43] For example, Charles Radclyffe Hall writing in the *Lancet* wryly noted that '[s]o delicate [...] is the mesmeric agent, that the mere presence of a sceptical person will generally prevent an experiment from perfectly succeeding, and has often been assigned as the cause of failure'. 'On the Rise, Progress, and Mysteries of Mesmerism in All Ages and Countries', *Lancet*, 45 (1 February 1845), 112-118 (p. 112).

unfettered by the stale assumption of an outmoded orthodoxy', writes Alison Winter.[44] Mesmerists covered a wide geographical and social area, performing at mechanics' institutions, middle-class societies, and upper-class soirées.[45] Its appeal was universal because, like phrenology, it offered its audiences an interactive model of science, and promised practical diagnosis over abstract knowledge. Itinerants such as one W. J. Vernon emphasized the spectacle of mesmerism, but at the same time tried to give it the air of medical authority. From 1845, Vernon even took a Dr Owens on tour with him; Owens would lecture on the history of mesmerism beforehand, leaving Vernon only the task of conducting the trance.[46] A handbill for one of Vernon's lectures at the Royal Adelaide Gallery (fig. 1), requests that, in particular 'Professional Gentlemen' attend, and notes that his aim is to ascertain the 'truth or fallacy' of mesmerism 'by the most rigid Experiments'. The sexual connotations of the male mesmerist having control over the female subject's body, meant that often its more salacious aspects featured in British culture.[47] However, the fact that Elliotson was a respected scientist (until his involvement in mesmerism) and a committed empiricist, shows that it was not easy to define exactly what the professional scientist should be practising.[48] It is clear that Elliotson firmly believed that mesmerism worked. Further, the emphasis in Vernon's handbill on truth and experiment shows just how important these terms were to those attempting to earn for their field the name of science.

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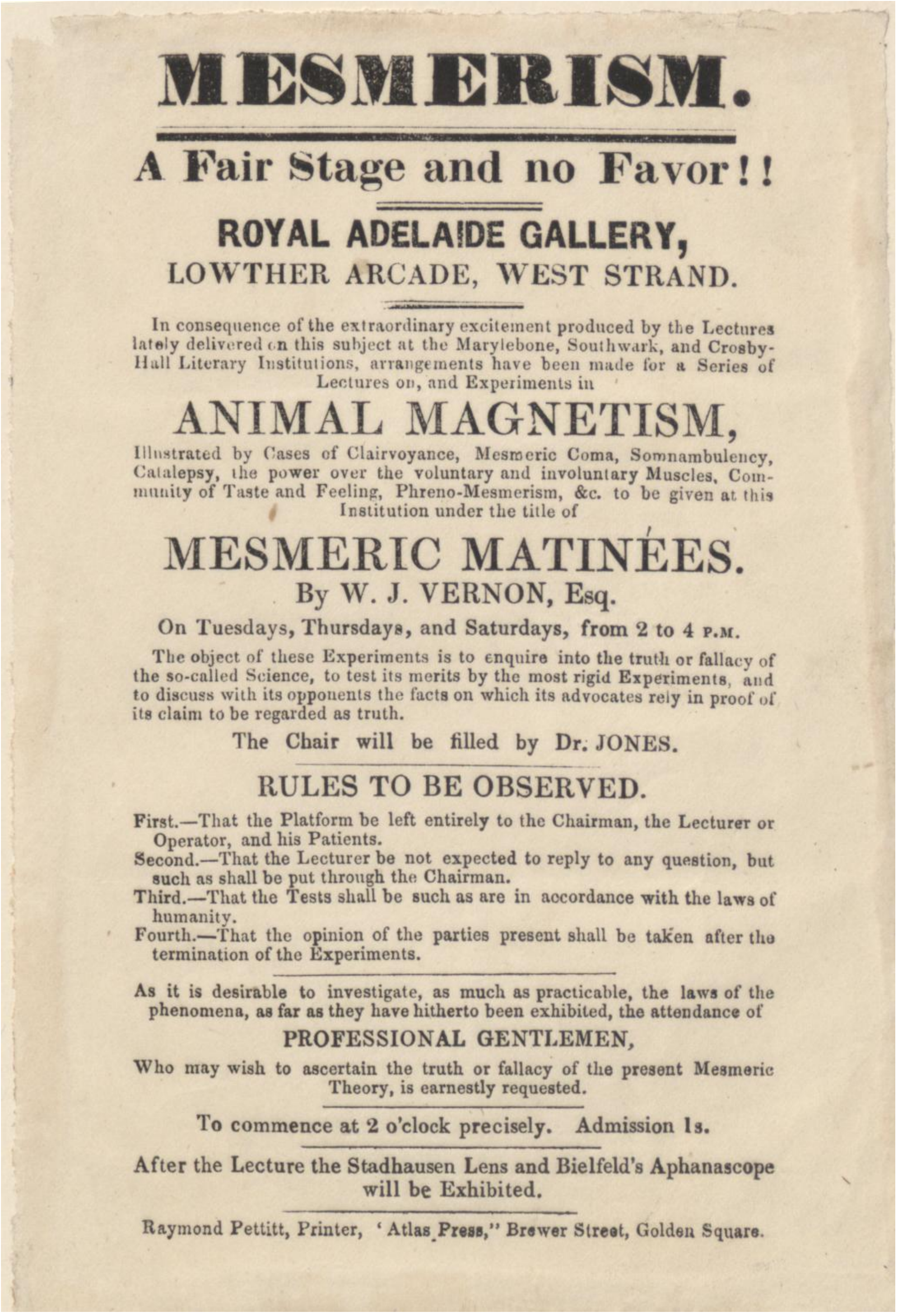
[44] Alison Winter, *Mesmerized: Powers of Mind in Victorian Britain* (Chicago: University of Chicago Press, 1998), p. 110. On the development of mesmeric performance in the middle decades of the century, from Elliotson's healing science, to more overt entertainment in the hands of itinerant popular lecturers, see Terry M. Parssinen, 'Mesmeric Performers', *Victorian Studies*, 21 (1977), 87-104.
[45] Winter, pp. 110-114.
[46] Parssinen 'Mesmeric Performers', p. 94.
[47] We might look to the roles that mesmerism played in literature, for example Charles Warren Adams's *The Nottinghill Mystery* (1862-3), and at the end of the century George du Maurier's *Trilby* (1894). Mesmerism's voyeurism clearly carried creative potential.
[48] Kaplan writes that Elliotson 'represents the serious scientific approach to the phenomena: the attempt to categorize its various manifestations, to apply scientific standards of evidence and verifiability', p. 21.



MESMERISM.

A Fair Stage and no Favor!!

ROYAL ADELAIDE GALLERY,
LOWTHER ARCADE, WEST STRAND.

In consequence of the extraordinary excitement produced by the Lectures lately delivered on this subject at the Marylebone, Southwark, and Crosby-Hall Literary Institutions, arrangements have been made for a Series of Lectures on, and Experiments in

ANIMAL MAGNETISM,

Illustrated by Cases of Clairvoyance, Mesmeric Coma, Somnambulency, Catalepsy, the power over the voluntary and involuntary Muscles, Community of Taste and Feeling, Phreno-Mesmerism, &c. to be given at this Institution under the title of

MESMERIC MATINÉES.

By W. J. VERNON, Esq.

On Tuesdays, Thursdays, and Saturdays, from 2 to 4 P.M.

The object of these Experiments is to enquire into the truth or fallacy of the so-called Science, to test its merits by the most rigid Experiments, and to discuss with its opponents the facts on which its advocates rely in proof of its claim to be regarded as truth.

The Chair will be filled by Dr. JONES.

RULES TO BE OBSERVED.

First.—That the Platform be left entirely to the Chairman, the Lecturer or Operator, and his Patients.
Second.—That the Lecturer be not expected to reply to any question, but such as shall be put through the Chairman.
Third.—That the Tests shall be such as are in accordance with the laws of humanity.
Fourth.—That the opinion of the parties present shall be taken after the termination of the Experiments.

As it is desirable to investigate, as much as practicable, the laws of the phenomena, as far as they have hitherto been exhibited, the attendance of

PROFESSIONAL GENTLEMEN,

Who may wish to ascertain the truth or fallacy of the present Mesmeric Theory, is earnestly requested.

To commence at 2 o'clock precisely. Admission 1s.

After the Lecture the Stadhausen Lens and Bielfeld's Aphanascope will be Exhibited.

Raymond Pettitt, Printer, 'Atlas Press," Brewer Street, Golden Square.

Fig. 1.[49]

[49] Handbill to lecture on mesmerism by W. J. Vernon at the Royal Adelaide Gallery, c. 1840-1850. University of Oxford, Bodleian Library, John Johnson Collection: Magic and Mystery 3 (49) <http://gateway.proquest.com/openurl?url_ver=Z39.88-2004&res_dat=xri:jjohnson:&rft_dat=xri:jjohnson:image:20090401101430mf:1> [accessed 21 September 2016].

Scientific Performance in Transition: The Lecture as Educational Tool

As I have demonstrated, the public often experienced science during the nineteenth century through entertainments. But society experienced significant changes during this period which resulted in the increased importance of science to economic and social life; with this came a rising demand that people not just be entertained by the wonders of science, but that they also know something of its workings and application to technology. The period experienced technological developments including the expansion of the railway network, the display of new technology in the 1851 and 1862 Great Exhibitions, and inventions such as the telegraph, telephone and phonograph.[50] In printing, stereotyping and steam-powered technology and the lifting of "taxes on knowledge" made scientific knowledge attainable for more people.[51]

Inkster argues that by the end of the 1810s, in the lecture courses put on by itinerant lecturers, '*instruction* began to predominate as an overtly declared aim',[52] and that that instruction was largely centralized in educational institutions.[53] The first mechanics' institution was founded in Glasgow in 1820,[54] and the movement is said to have originated in working-class lectures staged in Glasgow's Andersonian Institute, around 1800, by George Birkbeck.[55] The movement

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[50] The telegraph will be discussed in detail in chapter five. For developments in audio technology see Jonathan Sterne, *The Audible Past: Cultural Origins of Sound Reproduction* (Durham: Duke University Press, 2003); John M. Picker, 'Aural Anxieties and the Advent of Modernity', in *The Victorian World*, ed. by Martin Hewitt (London: Routledge, 2012), online edition, unpaginated [accessed 29 July 2016]; Steve Connor, 'The Modern Auditory I', in *Rewriting the Self: Histories from the Renaissance to the Present*, ed. by Roy Porter (London: Routledge, 2002), pp. 203-223.

[51] Aileen Fyfe, *Steam-Powered Knowledge: William Chambers and the Business of Publishing, 1820-1860* (Chicago: University of Chicago Press, 2012), pp. 20-68 for the Chambers's use of these technologies from the 1830s. *Chambers's Journal*, when founded in 1832, competed in an already existing market of cheap, instructive texts alongside religious tracts, and pamphlets from the Society for the Diffusion of Useful Knowledge, p. 22. Paper tax was repealed in 1861; the tax on newspaper adverts ended in 1853, p. 16. On developments in mechanical education see Gordon W. Roderick and Michael D. Stephens, *Scientific and Technical Education in Nineteenth-Century England* (Newton Abbot: David & Charles, 1972).

[52] Ian Inkster, 'The Public Lecture as an Instrument of Science Education for Adults – the Case of Great Britain, c. 1750-1850' (1980), in Inkster, *Scientific Culture and Urbanisation* pp. 80-107 (p. 87).

[53] Ibid., p. 80.

[54] Mabel Tylecote, *The Mechanics' Institutes of Lancashire and Yorkshire before 1851* (Manchester: Manchester University Press, 1957), p. 19.

[55] The *Mechanics' Magazine* appears to be one of the earliest publications to attribute the movement to Birkbeck (as opposed to other voluntary libraries established at the time such as the Glasgow Gas Workmen's Library (est. 1821),

was to contribute considerably to the 700 adult education institutions existing in Britain by the 1850s,[56] and have its own journal, the *Mechanics' Magazine* (f. 1823). Mechanics' Institutions often had a reading room, library, a lecture hall, and even a museum. Henry Brougham, who was closely involved in the foundation of the London Mechanics' Institution in 1824, stressed the movement's commitment to practical scientific instruction when he wrote that scientific discoveries 'immediately connected with experiment and observation, are most likely to be made by men, whose lives being spent in the midst of mechanical operations, are at the same time instructed in the general principles upon which these depend, and trained betimes to habits of speculation'.[57] Calls for the foundation of the London Mechanics' Institution stated that:

> The principal object of it will be, to make [working men] acquainted with those facts of chemistry, mechanical philosophy, and of the science of the creation and distribution of wealth, which, at this period of society, it is essential for them to know; and the means of accomplishing this will be, to bring numbers of them together in large rooms, where they may hear these facts stated, and have them explained to them, by men who have made it the business of their lives to learn and discover them.[58]

Arguments in favour of the lecture here reveal anxieties surrounding class divisions; the lecture theatre is envisioned as an upscale classroom for adults where they may be fed 'facts' by experts. Such a reading jars with Brougham's optimistic belief in the clarity of the lecture compared to reading: 'things are explained to them which no books sufficiently illustrate [...] a word may often get rid of some obstacle which would have impeded the unassisted student's progress for days'.[59] The mechanics' institution lecture was to become culturally synonymous with dry scientific instruction, representing the almost paradoxical notion that detailed, pure and abstract scientific knowledge was essential for the successful performance of mechanical labour. This

see Tylecote (1957), pp. 10-12). At the Andersonian Institute Birkbeck issued a notice alongside his usual lecture list: 'I shall deliver a series of lectures upon the *mechanical properties of solid and fluid bodies*, abounding with experiments, and conducted with the greatest simplicity of expression and familiarity of illustration, solely for persons engaged in the practical exercise of the mechanic arts [...]', 'London Mechanics' Institute', *Mechanics' Magazine*, 1 (18 October 1823), 114-119 (p. 116).

[56] J. W. Hudson, *The History of Adult Education* (London: Longman, Brown, Green, and Longmans, 1851), p. vi.

[57] Henry Brougham, *Practical Observations Upon the Education of the People, Addressed to the Working Classes and Their Employers* (London: Richard Taylor, 1825), p. 10.

[58] 'Institutions for Instruction of Mechanics: Proposals for a London Mechanics' Institute', *Mechanics' Magazine*, 1 (11 October 1823), 99-102 (p. 102).

[59] Brougham, p. 11.

reputation may have contributed to the decline in lectures on science and mechanics (sharper than that recorded in the arts), to be replaced by lighter entertainments.[60] The decline was also part of a more general trend from mid-century: the decrease of lectures staged by amateur societies.[61] It is possible that people could obtain instruction more effectively elsewhere – from periodicals and books, and schools and universities beginning to take a greater interest in the sciences.

Of course lectures accompanied by classes and exams were then, as now, a fundamental aspect of university education, and university chairs were held by such figures as the North British physicists, P. G. Tait (1831-1901), who was Professor of Mathematics at Queen's College Belfast (1854-1860), and William Thomson (1824-1907), who was a professor at Glasgow University from 1846.[62] The majority of professional scientists who lectured in the later decades of the century were university educated. But the early lecture experiences of men who went on to make significant scientific contributions, were varied. Famously Faraday's appointment as laboratory assistant at the Royal Institution in 1813 is said to have come about through his presentation of meticulous lecture notes to Humphry Davy. The chemist and natural philosopher John Dalton (1766-1844) lived on lecture fees for most of his life and was based at the Manchester Lit and Phil.[63] The physicist James Joule (1818-1889) witnessed Dalton's lectures and himself went on to deliver papers there.[64]

For the members of the X Club, an exclusive group of nine scientists, with Huxley at its centre, their early experiences of lectures were important. Tyndall, prior to receiving a German

[60] Hudson notes that over a fourteen year period from 1835, the number of lectures at the Manchester Mechanics' Institution almost halved, from 395 in 1835-39, to 199 in 1845-49. Physical and Mental Sciences fell from 243 to 90; Literature, Education, Fine Arts and Drama declined less markedly, from 152 to 139. Hudson, p. 132.

[61] Henry A. Ormerod notes that in 1839 lecturing was abandoned by the committee of the Liverpool Institution, *The Liverpool Institution: A Record and a Retrospect* (Liverpool: Liverpool University Press, 1953), p. 20. Lecture attendance at the Royal Manchester Institution fell after 1856, R. D. Bud, 'The Royal Manchester Institution', in *Artisan to Graduate: Essays to Commemorate the Foundation in 1824 of the Manchester Mechanics' Institution* [...], ed. by D. S. L. Cardwell (Manchester: Manchester University Press, 1974), pp. 119-133 (p. 127).

[62] Crosbie Smith, 'Tait, P. G. (1831-1901)' and 'Thomson, William, Baron Kelvin (1824-1907), in *Oxford Dictionary of National Biography* (Oxford: Oxford University Press, 2004), *Online Edition* <www.oxforddnb.com> [accessed 19 December 2013]. All subsequent references are to this edition and are referred to as *ODNB*.

[63] Frank Greenaway, 'Dalton, John (1766-1844)', *ODNB* [accessed 19 December 2013].

[64] Crosbie Smith, 'Joule, James (1818-1889)', *ODNB* [accessed 19 December 2013].

education when he was tutored by Bunsen at the University of Marburg, frequently attended mechanics' institution lectures. The mathematician Thomas Archer Hirst (1830-1892) joined the Halifax Mechanics' Institution and, like Tyndall, later studied at Marburg.[65] The chemist Edward Frankland (1825-1899) who was born in Garstang, Lancashire, borrowed books from his local mechanics' institution library, and he too studied at Marburg.[66] Joseph Dalton Hooker (1817-1911) attended lectures at Glasgow University as a child, where his father William Jackson Hooker was Regius Professor of Botany, while William Spottiswoode (1825-1883) gave lectures at the school for employees of his family printing firm, before going on to lecture at the more illustrious Royal Institution and the British Association for the Advancement of Science (BAAS).[67]

When considered as a whole, the cultural weight attached to public speech in the nineteenth century meant that the form itself carried great potential to influence the reception and acceptance of modes of scientific truth. Discourses surrounding public speech suggested that the success of an oration was contingent upon whether an audience could be held and ultimately convinced. The powers and responsibilities that came with the role of, for example, a preacher, were not to be taken lightly, but the potential that the platform held for establishing authority of any kind was overwhelming.[68] The space which it opened up was therefore one in which different modes of scientific authority could be tested.

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65 Robin J. Wilson, 'Hirst, Thomas Archer (1830-1892)', *ODNB* [accessed 17 December 2013].

66 Colin A. Russell, 'Frankland, Edward (1825-1899)', *ODNB* [accessed 17 December 2013].

67 Jim Endersby, 'Hooker, Joseph Dalton (1817-1911)' and A. J. Crilly, 'Spottiswoode, William (1825-1883)', *ODNB* [accessed 17 December 2013].

68 [H. Wace], 'Scientific Lectures – Their Uses and Abuses', *Quarterly Review*, 145 (January 1878), 35-61; [D. Mulock], 'Sermons', *Cornhill Magazine*, 9 (January 1864), 33-40.

Imagined Audiences: Theories and Methodology

I am interested in those nineteenth-century popular science lectures which sought first and foremost to instruct. These were not, unlike the oft-parodied instructional lectures discussed above, simply improving discourses which left their audience with a medicinal aftertaste. Rather, these lectures were performed by scientists who administered a dose of education with a sweeter mouthful of entertainment, using particular moments of activity to hold the audience's attention via all of their senses. In such lectures, isolated moments of impressive visual displays were linked together through speech to form a coherent narrative. While they had to be captivating displays in their own right, these individual pockets of entertainment could be rearranged to make complex scientific arguments. By actually showing the unfolding of natural processes to a live audience during a scientific lecture, scientific naturalists presented a partial solution to their communicative dilemma. Peter Garratt succinctly notes this particular philosophical problem faced by empiricists: 'how to move knowledge-claims reliably outward from the essentially private realm of the senses, perception, and intellect, without contradicting its grounding principle that all knowledge must be constituted by and within the mediating structures of experience'.[69] Scientific naturalists sought to convince non-scientific communities of the importance of observation. But language is an imperfect representation of an individual's experience of nature. Lecture demonstrations allowed audience members to see for themselves, and not merely read about phenomena in books.

My thinking on this subject has been influenced by Steven Shapin and Simon Schaffer's *Leviathan and the Air-Pump* (1985), a work which focuses not on nineteenth-century professionalizing scientists, but on Robert Boyle's air-pump experiments during the third quarter of the seventeenth century. It argues that the type of experiment, who witnessed it, and how its

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[69] Peter Garratt, *Victorian Empiricism: Self, Knowledge, and Reality in Ruskin, Bain, Lewes, Spencer and George Eliot* (Madison; Teaneck: Fairleigh Dickinson University Press, 2010), p. 29.

results were communicated, were fundamental to the truth claims made by Boyle (that he had successfully created a vacuum), and that these same arguments were used by Thomas Hobbes to counter the validity of such claims. Shapin and Schaffer set out their thesis with the following questions:

> How is a successful experiment identified, and how is success distinguished from experimental failure? [...] Why does one do experiments in order to arrive at scientific truth? Is experiment a privileged means of arriving at consensually agreed knowledge of nature, or are other means possible? What recommends the experimental way in science over alternatives to it?[70]

They go on to ask:

> How, and to what extent, are experiments actually replicated, and what is it that enables replication to take place? How is the experimental boundary between fact and theory actually managed? Are there crucial experiments and, if so, on what grounds are they accounted crucial?
>
> (p. 14)

For Boyle, 'matters of fact' were absolutes, created in and by nature without the interference of man. Shapin and Schaffer distinguish three 'technologies' that Boyle used in order to establish certain scientific matters of fact. The experimental apparatus itself constituted the material technology. The literary technology of the texts which described the investigations allowed readers, absent from the scene, to 'virtually witness' the experiments taking place.[71] Finally, social technologies designated how experimental philosophers ought to conduct themselves and the language they should use when talking to each other, ensuring that everyone who witnessed an experiment, actually or virtually, understood the claims that were being made.[72] Boyle's texts thus used '[e]laborate sentences with circumstantial details encompassed within the confines of one grammatical entity, [which] might mimic the immediacy and simultaneity of experience

[70] Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, NJ: Princeton University Press, 1985), p. 3.
[71] Ibid., p. 77.
[72] Ibid., p. 25.

afforded by pictorial representations'.[73] The more readers who might be brought into an artificial circle of witnesses to the experiments, through linguistic markers which recreated the temporal and spatial experience of actually attending them, the greater the authority of Boyle's science.

Much of this aspect of *Leviathan*'s argument is applicable to the world in which the scientific naturalists operated. One reviewer of the first edition of John Tyndall's *On the Scientific Use of the Imagination*, a discourse delivered before the British Association for the Advancement of Science (BAAS) in 1870, referred to the scientist's 'hearers, or [...] that wider circle to whom he speaks in his published speech or pamphlet'.[74] The potential of the popular press to expand audiences for science was a useful literary technology for Victorian scientists, offering a far wider reach than did early modern publication networks. However, Shapin and Schaffer's argument needs to be significantly modified if it is to be usefully applied to a reading of Victorian popular science. While the audience was no longer a gentlemanly coterie from the Royal Society, whose witnessing had value because of their recognized high moral (i.e. social) standing, the audience of a popular science lecture in the nineteenth century was still relied upon for a kind of validation. Scientific naturalists were competing for government jobs which would give them ultimate responsibility for science in industry and education on a national scale. By actually doing live experiments, scientific naturalists *performed* their belief that doing and experiencing with the senses was preferable to reading. However, the popular audience did not make truth judgements on the science itself; they were there to be persuaded of the validity of empirical methods. We therefore need to exercise caution in drawing directly from *Leviathan* because the act of *showing* phenomena to an audience had different epistemological implications for scientific naturalists, than it did for Boyle. The scientific *truth* of whether Boyle had created a vacuum in his air-pump experiments depended on whether the experiment succeeded when it was being witnessed by others. Demonstrations which took place in the nineteenth-century lecture hall, if they failed, did

[73] Ibid., p. 64.
[74] 'Professor Tyndall on Imagination in Science', unsigned review, *Saturday Review*, 30 (24 September 1870), 399-400 (p. 400).

not constitute a rejection of that particular scientific theory. As Jeremiah Rankin and Ruth Barton point out, 'Tyndall generally addressed his audience as recipients rather than creators of scientific knowledge [...] Although he made occasional suggestions for repeating his field observations or conducting simplified versions of his demonstrations, such experiments bore little resemblance to those he conducted in the course of his own research'.[75] The *demonstrations* Tyndall was using to *persuade* a popular audience of the validity of a particular theory, were not the same experiments as those he had undertaken in order to establish that theory.

Nineteenth-century scientists referred to "experiments" and "demonstrations" interchangeably in both their laboratory work and their popularizations, but for the present purposes it is helpful to use these terms to distinguish between two different practices. "Experiment" will be used to define an act which sets out to determine scientific validity, and "demonstration" will denote the re-presentation of natural phenomena, the understanding of which has already been established through experiments prior to the lecture. Thomas Hankins and Robert Silverman have pinpointed the second half of the eighteenth century as the period when, historically, "demonstration" evolved to refer almost exclusively to the act of showing already tested natural phenomena to an audience outside of the laboratory.[76] Tyndall, coming after this linguistic shift, was famous for rehearsing his demonstrations until they were absolutely perfect; he did not present work to his popular audience so that they might critique it, but rather so that they might be convinced that his method was sound. Furthermore, Tyndall could construct an apparently equal intellectual relationship with his audience for rhetorical effect, asking them for example, to 'correct me if I go astray, and to censure me if you find me dealing

[75] Jeremiah Rankin and Ruth Barton, 'Tyndall, Lewes and Popular Representations of Scientific Authority in Victorian Britain', in *The Age of Scientific Naturalism*, ed. by Bernard Lightman and Michael S. Reidy (London: Pickering and Chatto, 2014), pp. 51-70 (p. 66).

[76] Thomas L. Hankins and Robert J. Silverman, *Instruments and the Imagination* (Princeton, NJ: Princeton University Press, 1995). See especially chapter three, 'The Magic Lantern and the Art of Demonstration', pp. 37-71 (p. 58).

unfairly with my subject'.[77] Tyndall was clearly aware that he was using a rhetorical strategy – it was certainly not an admission that the majority of his audience could actually correct him. Through this he could give his audience a false sense of agency, convincing them that they were his potential equals in science, and thus making them more likely to accept his argument.

A problem also arises when we try to reintegrate what is clearly a performance, an act of persuasion, back into our historical conceptions of nineteenth-century scientific naturalism. By lecturing, scientists presented themselves on a public stage, directly associating their presence with the physical manifestations of their work. They controlled demonstrations, and thereby gained an air of mastery over nature. In one sense, this emphasis on the presence of the scientist was calculated, captivating the audience as in any other public entertainment. If the performance worked well, viewers were charmed by the scientist's personality, and their liking for him transferred to an acceptance of his science too. As Martin Hewitt argues, '[l]ecturers were expected to embody and so reinforce the message of their words. Their bodies were more than just an illustration of the subject, but the personification of the message in the person of a visible actor'.[78] The body and the voice of the scientist were scrutinized by the press for clues as to his moral standing and therefore his trustworthiness. A preoccupation with masculine traits as authoritative, powerful, and active, pervaded the self-presentation of such scientific naturalists as Tyndall and Huxley. But the centrality of the person and their upright, moral conduct, could at odds with another fundamental aspect of late nineteenth-century scientific objectivity: the removal of personality. Lorraine Daston and Peter Galison have outlined this view, that 'the all-too-human scientist must, as a matter of duty, restrain themselves from imposing their hopes,

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[77] John Tyndall, first lecture on *Heat Considered as a Mode of Motion: Being a Course of Twelve Lectures Delivered at the Royal Institution of Great Britain in the Season of 1862* (London: Longman, Green, Longman, Roberts, & Green, 1863), p. 1.

[78] Martin Hewitt, 'Beyond Scientific Spectacle: Image and Word in Nineteenth-Century Popular Lecturing', in *Popular Exhibitions, Science and Showmanship, 1840-1910*, ed. by Joe Kember, John Plunkett and Jill A. Sullivan (London: Pickering and Chatto, 2012), pp. 79-95 (p. 88).

expectations, generalizations, aesthetics, even ordinary language on the image of nature'.[79] They suggest that '*mechanical objectivity*' is a key characteristic of mid to late nineteenth-century representation in science, 'the insistent drive to repress the wilful intervention of the artist-author, and to put in its stead a set of procedures that would, as it were, move nature to the page through a strict protocol, if not automatically'.[80] Live demonstrations allowed people to see for themselves, but as with all popularizations, they needed a translator, someone with a personality big enough to make the subject appealing. This is rather at odds with the drive towards the removal of the human agent from the scientific process. This contradiction, it will be shown, was a constant presence in lectures by scientific naturalists.

When we turn from the performer's presentation to the audience's reception of information, we encounter further problems. It will never be possible to know whether the original listening audience interpreted the lecture as its speaker would have liked; individual recollections cannot represent the experience of a collective whole. Lecturers improvised, changed the order of demonstrations, and made references to the local area or to dignitaries in the audience. Sometimes demonstrations failed, forcing performers to move swiftly on to the next one, and to explain that the demonstration would have been marvellous if only it had worked. Sometimes lecture halls were so crowded that the audience could neither see nor hear the speaker.[81] On such occasions, were scientists still successful in arguing that seeing is believing? Such problems reoccur when the lecture is transferred to the page, compounding the potential for misunderstanding. Texts took a wide variety of forms, and each version was

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[79] Lorraine Daston and Peter Galison, 'The Image of Objectivity', *Representations*, 40 (Autumn 1992), 81-128 (p. 81).

[80] Lorraine Daston and Peter Galison, *Objectivity* (New York: Zone Books, 2007), p. 121.

[81] Failed lecture demonstrations and misheard speeches will be discussed in detail in chapter four and chapter two respectively. The spaces in which science was experienced during the nineteenth century have received increasing critical attention from geographers and historians of science: D. N. Livingstone, *Putting Science in its Place: Geographies of Scientific Knowledge* (Chicago: University of Chicago Press, 2003); Livingstone, 'Science, Site, Speech: Scientific Knowledge and the Spaces of Rhetoric', *History of the Human Sciences*, 20 (2007), 71-98; Diarmid Finnegan, 'Placing Science in an Age of Oratory', in *Geographies of Nineteenth-Century Science*, ed. by Livingstone and Charles W. J. Withers (Chicago: University of Chicago Press, 2001), pp. 153-177; *Staging Science: Scientific Performance on Street, Stage and Screen*, ed. by Martin Willis (London: Palgrave Macmillan, 2016).

constructed by multiple agents. Supposedly verbatim accounts of lectures depicted successful demonstrations, where newspaper reports say that they failed. Punctuation in order to mimic speech is down to subjective editing, and in itself will affect how the text is read, as will other editorial choices such as which other texts are printed alongside the lecture. The printing of a spoken discourse – or the introduction of 'literary technology', as Shapin and Schaffer would term it – allows for the extension of a potential witnessing audience. But while it may be possible to collect some empirical data on publication (number of copies printed, number of editions, prices, library acquisitions) we can never know how they were read, in silence or out loud, whether the science was understood or whether audiences simply admired the pictures.[82]

The number of agents involved in the transition between performance and print, meant that the lecturer had increasingly little control over what was read, how, and by whom. Add to this the practical contingencies of the lecture hall itself, and the scientific naturalists were presented with two problems: how to ensure that the audience possessed the minimum information required level of understanding, *and* how to communicate with that audience in the most effective way. This crux forms the basis of much scholarship on scientific naturalism within the history of science. As part of their investigation into how scientists established a relationship with their popular audience, Aileen Fyfe and Bernard Lightman write of:

> *horizons of expectation* (the idea that readers' education, experiences etc. will help determine how they react to particular texts) and of *interpretative communities* (groups of readers who see things in broadly the same way)[83]

Fyfe and Lightman suggest that these terms are useful when considering experiences of popular science which go beyond the page. Writers in their volume, *Science in the Marketplace*, engage with their editors' proposition and look more broadly at the spaces of science, including the lecture

[82] Greg Myers has noted this problem for critics in the field of discourse studies: 'texts are irreducibly material: words are essentially the same in a new font or on poorer quality paper, but the glossy picture, or the museum exhibit, or the lecture performance is likely to be missing something when reproduced on the page'. 'Discourse Studies of Scientific Popularization: Questioning the Boundaries', *Discourse Studies*, 5 (2003), 265-279 (p. 273). But I argue that the strategies scientific naturalists adopted to try to prevent this loss, are the intersection at which the key issues at the heart of materialism are revealed.
[83] *Science in the Marketplace: Nineteenth-Century Sites and Experiences*, ed. by Aileen Fyfe and Bernard Lightman (Chicago: University of Chicago Press, 2007), p. 9.

theatre and the museum. I wish to devote a thesis-length study to the lecture alone, and to examine the impact of this form on the dissemination of scientific naturalism. The term 'horizon of expectations' has been adopted and modified by a number of twentieth-century thinkers. Sociologist Karl Mannheim originally wrote of the horizon of expectations, or *Erwartungshorizont*, in his 1935 work, *Man and Society in an Age of Reconstruction*. The term allowed Mannheim to distinguish between politically and socially stable and unstable societies; a member of a stable society is able to feed new information into a framework of existing experiences in order to determine its meaning. In an unstable society, that framework is unreliable because it is always changing, and cannot therefore be used to interpret new information.[84] In 1948, the philosopher of science Karl Popper delivered a lecture in which he applied the term to scientific progress. 'Science', he said, 'never starts from scratch; [...] for at every instant it presupposes a horizon of expectations – yesterday's horizon of expectations, as it were'.[85] The concept entered the vocabulary of historians and literary theorists after 1960, when in his *Truth and Method* the historian Hans-Georg Gadamer described the 'horizon' as 'the range of vision that includes everything that can be seen from a particular vantage point'.[86] For Gadamer, the horizon of expectations is the set of experiences brought by a reader to an historical situation, and it is constantly undergoing modification as it mingles with the "historical horizon" of that situation. Gadamer's idea that the meaning of an historical event was constituted not just by the experiences of its contemporaries, but by the combination of these experiences with those of the subsequent reader, was influential in the formation of *Rezeptionsgeschichte* (Reception Theory) in

[84] Karl Mannheim, *Man and Society in an Age of Reconstruction: Studies in Modern Social Structure* (London: Kegan Paul, Trench, Trubner & Co., Ltd., 1942), pp. 178-179.
[85] Karl R. Popper, 'The Bucket and the Searchlight: Two Theories of Knowledge', in *Objective Knowledge: An Evolutionary Approach*, rev. ed. (Oxford: Clarendon Press, 1979), pp. 341-361 (p. 346). This lecture was delivered in August 1948 and first published (in German) in 1949 as '*Naturgesetze und theoretische Systeme*' in *Gesetz und Wirklichkeit*, ed. by Simon Moser.
[86] Hans-Georg Gadamer, *Truth and Method*, trans. by William Glen-Doepel (London: Sheed and Ward, 1979), p. 269.

literary theory, particularly in the work of Hans Robert Jauss.[87] Jauss argued that the greater the distance between a reader's horizon of expectations, and the horizon established by the literary text, the greater the text's aesthetic value.[88] The difference between the horizon of expectations of a literary text, and that of 'historical lived praxis', Jauss argued, was that 'it not only preserves actual experiences, but also anticipates unrealized possibility [...] and thereby opens paths for future experience'.[89] Thus an important distinction between literary and non-literary texts came from the argument that the former *invites* interpretation.

The constantly shifting nature of the horizon of expectation as defined by Gadamer, and the literary text's openness to interpretation discussed by Jauss, are brought together in the ideas of Wolfgang Iser. In *The Act of Reading* Iser argues that the understanding of a literary text is predicated on the relationship between 'theme' and 'horizon'. The 'theme' is the particular viewpoint the reader confronts at a given moment; the 'horizon' 'is made up of all those segments which had supplied the themes of previous phases of reading'.[90] The combination of the two 'actively involves the reader in the process of synthesizing an assembly of constantly shifting viewpoints, which not only modify one another but also influence past and future syntheses'. Iser's theory pertains specifically to literary texts, but the argument that readers can bring a horizon of expectations to popular scientific texts (or performances), which may influence how they read, and which may itself change throughout the reading process, is compelling. I argue that it is not the case, as Iser states, that non-literary texts resist interpretation.[91] Nineteenth-century popular science texts and lectures were composed by scientists who were acutely aware

[87] See Robert C. Holub, *Reception Theory: A Critical Introduction* (London: Routledge, 2003); Holub, 'Horizon of Expectation' in *Encyclopedia of Contemporary Literary Theory*, ed. by Irene Rima Makaryk (Toronto: University of Toronto Press, 1997), pp. 552-553; D. W. Fokkema and Elrud Kunne-Ibsch, *Theories of Literature in the Twentieth Century: Structuralism, Marxism, Aesthetics of Reception, Semiotics* (London: C. Hurst & Company, 1979), pp. 138-149.
[88] Hans Robert Jauss, 'Literary History as a Challenge to Literary Theory', in *Toward an Aesthetics of Reception*, trans. by Timothy Bahti (Sussex: Harvester Press, 1982), pp. 3-45 (p. 25). Essay first published (in German) in 1970.
[89] Ibid., p. 41.
[90] Wolfgang Iser, *The Act of Reading: A Theory of Aesthetic Response* (Baltimore and London: Johns Hopkins University Press), p. 97.
[91] Iser writes that 'total combination and comprehension may be possible in scientific texts, but not in literature, where the text does not reproduce facts but at best uses such facts to stimulate the imagination of the reader', *The Act of Reading* p. 87.

that their arguments could be interpreted in different ways. While we cannot always access these interpretations (other than through a rare letter or notebook), we can observe the linguistic, performative and textual strategies employed by scientists to limit interpretative possibilities. For the Reader-response theorist Stanley Fish, even the act of choosing to read a factual text *as* a factual text, is itself part of the process of meaning-making: 'ordinary language is extraordinary because at its heart is precisely that realm of values, intentions, and purposes which is often assumed to be the exclusive property of literature'.[92] Furthermore, through Fish we return to Fyfe and Lightman's invocation of the idea of '*interpretative communities*':

> Interpretive [*sic*] communities are made up of those who share interpretive strategies not for reading (in the conventional sense) but for writing texts, for constituting their properties and assigning their intentions. In other words, these strategies exist prior to the act of reading and therefore determine the shape of what is read rather than, as is usually assumed, the other way round.[93]

Fish's concept of 'interpretive communities' can help us, partly, to build a framework through which to read lectures, as it suggests that an audience's shared experiences might to some extent condition reception. This knowledge was certainly advantageous to the lecturer. The audience's understanding that, for example, the auditorium of the Royal Institution was home to the scientific elite who were more likely to present current ideas rather than metaphysical illusions, made it easier for a scientist to convince that audience of the scientific validity of what was performed there.

Historians are acutely aware of the fact that the success of a lecture was contingent upon whether the lecturer understood his audience as a community of listeners with shared interests and understanding of the context in which they received information.[94] Throughout this thesis great emphasis will be placed on how lecturers made conscious use of their surroundings to add credibility to their arguments. But the flip-side of relying on an interpretive community to

[92] Stanley Fish, 'How Ordinary is Ordinary Language?', in *Is There a Text in This Class? The Authority of Interpretive Communities* (Cambridge, Massachusetts: Harvard University Press, 1980), pp. 97-111 (p. 108).
[93] Stanley Fish, 'Interpreting the *Variorum*', in *Is There a Text in This Class?* pp. 147-173 (p. 171).
[94] For example Iwan Rhys Morus, '"More the aspect of magic than anything natural": The Philosophy of Demonstration', in Fyfe and Lightman (eds.), pp. 336-370.

make the same meaning is that, as Fish points out, the 'norms' within which language is perceived, '[are] not abstract and independent but social'.[95] Because a framework of interpretation has been learned and is not something with which we are born, it can always be reformed and replaced by a new structure of understanding. Every time a lecture is heard or read, it is heard or read within a slightly different interpretive framework, not just across groups but also by individuals. So while the lecture form offered scientific naturalists an opportunity to play out their commitment to empirical methods on stage (and to expand their original audience in print), both performance and text became, increasingly, open to interpretation.

How, then, were scientific speakers supposed to access interpretive communities and direct them towards a particular meaning? The author, as Fish says, 'hazards his projection, not because of something "in" the marks [on the page], but because of something he assumes to be in his reader'.[96] But the scientific lecturer can do more than 'hazard' at how his listening audience will react. In the novel, writes Mikhail Bakhtin:

> The speaker strives to get a reading on his own word, and on his own conceptual system that determines this word, within the alien conceptual system of the understanding receiver; he enters into dialogical relationships with certain aspects of this system. The speaker breaks through the alien conceptual horizon of the listener, constructs his own utterance on alien territory, against his, the listener's apperceptive background.[97]

Just like the novelist, the scientist always speaks in light of his audience's horizons, and he frequently attempts to pre-empt their questions by weaving answers to imagined questions into his discourse. Further, the scientific lecturer does this not only in relation to his listeners, but also in relation to a second generation audience, the readers. The shifting ground on which meaning is mediated necessitates a complex series of negotiations which take place before, during, and after the lecture.

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[95] Fish, 'Is There a Text in This Class?', in *Is There a Text in This Class?* pp. 303-321 (p. 318).
[96] Fish, 'Interpreting the *Variorum*', p. 173.
[97] M. M. Bakhtin, 'Discourse in the Novel', in *The Dialogic Imagination*, trans. by Caryl Emerson and Michael Holoquist (Austin: University of Texas Press, 2008), pp. 259-422 (p. 282).

Consequently, we might read the text for signs that the lecturer is attempting to maintain control over meaning. By paying attention to person and tense, deixis, descriptions of the conditions of speech, illustrations, rhetoric, the positioning of the speaker with reference to his or her audience, tone, and whether the audience's response is included or excluded from the text, it becomes apparent that some scientists (and publishers, editors, journalists) sought to restage the performed lecture within the text. In so doing, they strove to replicate the authority that was commanded from the lecture stage, to replace, as Wallace Chafe calls it, the '*desituated*[*ness*]' of writing,[98] with speech's '*situatedness* – the closeness language has to the immediate physical and social situation in which it is produced and received'. However, in a live lecture, just because speaker and auditor are in the same room, does not mean that the latter will hear correctly, understand, or interpret the information received in the way intended (or even agree with it). Indeed, this disjunction leaves room for creativity, as will be explored in chapter two. Lecture texts can create the illusion of presence or absence depending on the author's intentions, or even by accident (and the extent to which the text renders the relationship between scientist and reader more or less conversational will be dealt with in the next chapter). How do paratexts work to fill in the gaps that the text fails to describe – for example location and size of audience – and how much do they tell us about the editorial construction of the text as separate from the original performance? To what extent does the writer or editor engage his or her imagination when translating the performance into a text? Is the audience imagined (as Walter Ong says all literary audiences must be) and so constructed, or is it remembered, and so reconstructed?[99]

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[98] Wallace Chafe, *Discourse, Consciousness, and Time: The Flow and Displacement of Conscious Experience in Speaking and Writing* (Chicago: University of Chicago Press, 1994), pp. 44-45.
[99] Walter Ong, *Orality and Literacy* (1982), (London: Routledge, 2012), pp. 100-101.

Outline of Thesis

This thesis begins with case studies that seek to answer these theoretical problems. In particular it focuses on the translation onto the page of the performative aspects of the popular lecture, in the work of physicist John Tyndall and astronomer Robert Stawell Ball. Manuscript notes, published lectures and newspaper reports provide differing versions of performances; in turn, this creates problems for the scientific naturalist who is attempting to convey his method as sound and his findings as truth. Chapter two continues the theme of multiplicity and veracity, comparing journalistic and satirical responses to two scientific controversies with which Huxley was involved: the hippocampus minor debate with Richard Owen in the early 1860s, and Huxley's argument for the existence of a substance he termed 'protoplasm' (from 1868). This chapter looks first at how, what Martin Hewitt might term, the printed 'cultural afterlife' of a speech can alter intended meaning.[100] It considers the effect of these illegitimate texts on Huxley's attempt to challenge the propriety of his rival and consolidate his own status as a professional. The chapter closes by looking at performance conventions and language shared across the pulpit and platform, and the impact of this interaction on the relationship between science and religion more generally.

Chapters three and four situate scientific naturalism within broader Victorian scientific cultures. The first provides a counterpoint to the extreme masculinity promulgated in chapter two, exploring how female lecturers defied socially assigned gender roles and took to the lecture platform. It argues that the reaction against female presence on the lecture platform was led largely by professional male scientists' application of scientific theories on gender, which posited the 'healthy' female body as private and passive, and deemed hysterical those women who spoke in public. Catherine Buckton, Arabella Buckley, Eleanor Ormerod and Lydia Becker, worked

[100] Martin Hewitt, 'Aspects of Platform Culture in Nineteenth-Century Britain', *Nineteenth-Century Prose*, 29 (Spring 2002), 1-32 (p. 4).

both within and against male speaking traditions. Chapter four turns to two well-known lecturers: Reverend Charles Kingsley, and art critic John Ruskin. It considers their engagement with modern science in order to illustrate how scientific naturalism was promoted, debated, and challenged on the public stage by non-experts who nevertheless possessed sound scientific knowledge. While Kingsley embraced Darwin and contemporary geology (he saw in them a justification for natural theology), Ruskin attacked scientific naturalists – sometimes on a personal level – because he feared the consequences of the decentring of authority that materialism implied.

The final chapter takes us to the provinces, focusing on the city of Manchester and its spaces of scientific performance. It looks in more detail at how differing accounts of performances provide a composite, but by no means necessarily accurate, version of a performance. Through examination of three groups of performances (the 1861 BAAS meeting at Manchester, the *Manchester Science Lectures for the People*, and the *Health Lectures* organized by the Manchester and Salford Sanitary Association), this chapter suggests that science lectures were a vital tool in the consolidation of social and class structures, and that networks of scientific organization carried economic and cultural imperatives beyond the pure science that scientific naturalists claimed to pursue.

In examining the following factors – performance and personality, shared language and performance conventions, satire and journalism, gender, religion and theories of imagination, and class – I situate scientific naturalism more broadly within Victorian public life. While confining itself to scientific naturalism across just three decades, c. 1860-c.1890, this thesis remains intentionally wide-ranging across scientific fields. The public audiences for the different sciences would have attended a wide variety of lectures (and indeed a whole range of sciences were often included in the same series), and would therefore have compared zoology with physics, astronomy with chemistry. I too leave these areas open for comparison, allowing for an analysis of whether the arguments for empirical practices were the same across the sciences, or whether there were nuanced differences. Ultimately I demonstrate that the public performance of scientific authority, and the possibilities of audience expansion provided by print, meant that the popular lecture was an important, historically specific mode of popularization. The distinguishing characteristics of the form – sensorial immediacy, the sense of collective audience experience, and the personality and presence (even celebrity) of the lecturer – allowed for a unique presentation of scientific naturalism to the British public.

Chapter 1

Successful Showmanship and the Captivated Audiences of John Tyndall and Robert Stawell Ball

'[W]ithout an audience, the definition of the direct voice is destroyed by its echoes'.[1]

'There are eight ways of putting a slide into a lantern, seven of which are wrong!', the astronomer Sir Robert Stawell Ball would quip to the lanternist hired to support him during one of his popular lectures.[2] The consequences of something going wrong – slides being put in the projector the wrong way round, images shown in the wrong order, even explosions from mismanaged bags of volatile gases used to create a light source – were considerable. Failures in the performance of lectures implied that the lecturer himself was incompetent, and that therefore his science should not be taken seriously. A skilful lecturer was one whose performances were seamlessly organized, whose demonstrations worked, and yet who always showed humility towards nature's greater power. For Robert Ball (1840-1913) and physicist John Tyndall (c. 1820-1893), the execution of a successful lecture was important not just for their personal reputations. By putting on a show that people would want to watch (and carrying it off), they aimed to convince their audiences of the veracity of empirical scientific methods.

Both men have left behind them an extensive collection of textual traces of such performances, including manuscript notes, printed books, and reviews. Using this evidence we can begin to explore the theoretical implications of this genre of communication, in terms of

[1] John Tyndall, *Sound: A Course of Eight Lectures Delivered at the Royal Institution of Great Britain* (London: Longmans, Green, and Co., 1867), p. 18.
[2] *Reminiscences and Letters of Sir Robert Stawell Ball*, ed. by W. Valentine Ball (London: Cassell and Company, Ltd., 1915), p. 220.

what it meant for the public reception of science in the nineteenth century and, ultimately, whether it was effective in enabling one type of scientific method to gain validity over another. Through literary analysis of the language used, tone, modes of address, and the grammatical construction of the relationship between a speaker and his audience, my analysis of these texts takes us a step towards answering several important questions. What does, or did, "presence" mean on the nineteenth-century public platform, and how did it contribute towards convincing an audience of the scientist's authority? How might the potentially expansive effect that print has on the size of an audience help to consolidate, or complicate, the scientific naturalists' mantra, "seeing is believing"? As a consequence, what is the difference between experiencing live and textual presence, and how important are the concepts of authority and authorship in the (re)construction of a lecture?

The Lecturer Remembered: Sir Bob and Mr Banter

The three references to Robert Ball, Royal Astronomer of Ireland, in James Joyce's *Ulysses* (1922) perhaps best sum up the scientist's legacy. The first, '[f]ascinating little book that is of sir Robert Ball's. Parallax. I never exactly understood', gestures towards his impenetrable and obscure mathematical and astronomical research.[3] The second, Bloom's casual reference in *Circe*: '(*Carelessly*) I was just chatting this afternoon at the viceregal lodge to my old pals, sir Robert and lady Ball, astronomer royal, at the levee. Sir Bob, I said…' (p. 591), depicts the high-society, sociable Ball, whose career was characterized by stable establishment scientific positions. And in *Ithaca*, a particular book, '*The Story of the Heavens* by Sir Robert Ball (blue cloth)' (p. 832) is inventoried on Bloom's bookshelf, a symbol of Ball the popularizer, a familiar household name as

[3] James Joyce, *Ulysses*, introduction and notes by Declan Kiberd (London: Penguin, 2000), p. 194.

the writer of scientific bestsellers. Born in Dublin, Ball was educated at Trinity College. After working as a tutor to Lord Rosse's children at Birr Castle (from 1865 to 1867, where he also had access to Rosse's telescope for his own research), in 1867 Ball became Professor of Applied Mathematics and Mechanics at the Royal College of Science in Dublin. In 1874 he was appointed Royal Astronomer of Ireland, until 1892 when he was appointed to the Lowndean Professorship of Astronomy at the University of Cambridge. Throughout his career, Ball was also a prolific and financially successful popular lecturer, touring across Britain and the United States, as well as lecturing on behalf of the Gilchrist Trust for twenty years. The Trust, which began work in 1865, allocated funds from the legacy of Dr John Borthwick Gilchrist (1759-1841), to support new educational initiatives. The Gilchrist Lectures (1867-1939) were staged for working-class audiences in small, industrial towns, where such educational opportunities were scarce.[4] As a supporter of evolutionary theory, who suffered doubts about faith when in his thirties, Ball can be considered a scientific naturalist alongside his more vocal fellow countryman, Tyndall.[5]

The details of Tyndall's lecturing career are well known.[6] Having delivered his first Friday Evening Discourse at the Royal Institution (hereafter RI) on 11 February 1853, Tyndall was appointed Professor of Natural Philosophy there, in May of that year. From that point, until his retirement from the post in 1887, Tyndall forged a public image for himself as a skilled popular lecturer. During this period he delivered twelve Christmas Lecture series for children, and numerous other series and Discourses.[7] Ball, too, delivered Discourses and five Christmas Lecture series, and so knew the lecture hall there well – he also knew Tyndall, who 'placed the

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[4] See Bernard Lightman, 'Lecturing in the Spatial Economy of Science', in Fyfe and Lightman (eds.), pp. 97-132 (p. 99).

[5] Lightman, *Victorian Popularizers*, pp. 400-401.

[6] See for example chapters in *John Tyndall: Essays on a Natural Philosopher*, ed. by W. H. Brock, N. D. McMillan and R. C. Mollan (Dublin: Royal Dublin Society, 1981), such as Sophie Forgan, 'Tyndall at the Royal Institution', pp. 49-59, and Charles A. Taylor, 'Tyndall as Lecture Demonstrator', pp. 205-216. See also Ursula DeYoung's detailed study of Tyndall, *A Vision of Modern Science: John Tyndall and the Role of the Scientist in Victorian Culture* (Basingstoke: Palgrave Macmillan, 2011).

[7] See introduction to *Christmas at the Royal Institution: An Anthology of Lectures*, ed. by Frank A. J. L. James (Hackensack, NJ: World Scientific, 2007), pp. xi-xxv (p. xvii).

resources of his laboratory, and practically the resources of London at [Ball's] disposal'.[8] The RI, on London's Albemarle Street, was and is a purpose-built site of scientific instruction and demonstration; a lecture theatre was one of its focal points from the Institution's foundation in 1799.[9] The RI's position on London's entertainment scene meant that its largely middle- and upper-class audiences would expect not only instruction, but amusement too. Similarly, when Tyndall and Ball embarked upon lecture tours beyond the metropolis, they would invariably speak from multi-purpose platforms which also staged pantomime, music, and political debates. The scientific lecturer, addressing his audience from already theatrical platforms, was acutely aware that he was not just a scientist, but a performer too. Tyndall and Ball's recollections of their own early experiences as lecture attendees should, therefore, be read as part of the self-construction of the scientific persona. By presenting themselves first as popular lecture attendees, they could suggest that such lectures really could be a person's first step towards a professorship. For example, to an audience gathered at the Birkbeck Institution on 22 October 1884, Tyndall recalled the 'delight' with which he had witnessed 'the conversion of the limpid lime-water into a turbid mixture of chalk and water' during a lecture he attended as a young man, at the Preston Mechanics' Institution.[10]

Ball prepared notes on his lecturing career for an entire chapter of his memoirs, *Reminiscences*. This suggests that lecturing was, for him, an important part of his legacy. Frequent digressions into his experiences as an audience member may have also been designed to suggest a connection between them and his eventual career. Ball's father, Robert, was honorary secretary

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[8] *Reminiscences*, p. 207.

[9] Proposed was an 'Institution for Diffusing the Knowledge, and facilitating the general Introduction, of Useful Mechanical Inventions and Improvements; and for teaching, by Courses of Philosophical Lectures and Experiments, the application of Science to the common Purposes of Life.' Quoted in Frank A. J. L. James and Anthony Peers, 'Constructing Space for Science at the Royal Institution of Great Britain', *Physics in Perspective*, 9 (2007), 130-185 (p. 141). See also Anastasia Filippoupoliti, 'Aspects of a Public Culture of Science: The Uses of the Collections of the Nineteenth-Century Royal Institution of Great Britain', *Early Popular Visual Culture*, 7 (April 2009), 45-61. The first RI Children's Christmas Lecture series took place in 1825, and the Friday Evening Discourses were founded the following year.

[10] John Tyndall, 'Address Delivered at the Birkbeck Institution on October 22, 1884', *New Fragments* (London: Longmans, Green, and Co., 1892), pp. 224-247 (p. 227).

of the Dublin Royal Zoological Society, and his childhood home (which also housed many zoological specimens, dead and alive) was frequently visited by eminent scientists. On one occasion during a game of charades, Professor Edward Forbes 'appeared decked out in robes to give a scientific lecture on monkeys', while Ball's father, dressed as a gorilla, played the lecture specimen (p. 14). 'As well as I can remember', he writes, 'Professor Forbes continued the lecture by showing how this remarkable animal could actually be taken to pieces. He first removed the mighty paws, and then the head' (p. 15). Ball may have wanted us to read this moment as one in which the lecturer-to-be peels back the façade of the lecture to see its inner workings and the performer beneath; the young Ball certainly recognized the lecture as both a play and a form of playing, complete with costume changes from a dressing-up box. His later reminiscences of his time as a student during the 1860s focus less on the university lectures he attended (p. 34) and more on the popular lectures Dublin had to offer. His account of a lecture by the astronomer and physicist Dr Romney Robinson focused largely on the lanternist, 'who was not an adept' (p. 55), and who had allowed hydrogen to leak into the oxygen bag, following which 'the whole thing exploded with a tremendous report, and bits of glass were driven all over the room'. He also recalled attending a lecture by "Mr Banter":

> I rather fancy he had no very clear idea himself as to what kind of science it was to be; but he was clear on one point: it must be illustrated by experiments. He therefore went round the town and borrowed all sorts of scientific apparatus. He obtained an air-pump, a freezing machine, a coil and batteries, bags of oxygen and hydrogen, two Magdeburg hemispheres, and phosphorus, and goodness knows what else besides. With none of this apparatus was he familiar; I doubt whether he had any idea what he was going to do with it.
>
> (p. 57)

Ball described the failings of "Mr Banter" in detail. Both episodes emphasize the skill required in handling lecture equipment, particularly the oxy-hydrogen lamp, which became a staple part of Ball's lectures. His wry tone, the shopping-list of equipment without explanations of its workings, and the comment '[w]ith none of this apparatus was he familiar', draw the reader into a private understanding with the writer. They are as familiar with this equipment as the lecturer himself because they have been so well instructed by the famous Robert Ball.

When not lecturing, or playing golf, one of Ball's favourite pastimes was charades. He remembered one evening spent with Dr William Stokes during which:

> When I arrived there on a certain evening, one of the ladies – I think it was Mrs. Mahaffy – told me that they had spent the day in drawing diagrams for a lecture which I was to give. This was the first I heard of it. As to the subject of the lecture, I was to make that out as best I could from the diagrams. At this distance of time I have forgotten what the diagrams were, with one exception. It was a picture of an animal with an unusually large supply of legs, each of these legs being furnished with top boots. Half the legs were designed for walking one way, and the other half the other. However, I struggled through the lecture somehow.
>
> (p. 52)

Ball's improvisatory skills served him well when he arrived in one town with the wrong lecture slides, and was required to deliver a lecture on Krakatoa using slides of the Moon (pp. 196-7). He remarked, somewhat immodestly, that '[w]ith the aid of the globe, a blackboard and some of the moon slides I managed to worry through. Indeed, I may say that the lecture was most successful' (p. 197).

Obituaries of both scientists confirm that they would be remembered first and foremost, as excellent scientific communicators. Ball's long-term work on 'The Theory of Screws' did find mention in notices of his death, '[b]ut it was as the big, jolly-faced Irishman who lectured on the secrets of the stars that Sir Robert was best known to the world',[11] an image captured by *Vanity Fair* (fig. 2). Tyndall's research would be overshadowed by his fame as lecturer at the RI. A *Westminster Gazette* special issue, *The Life and Work of John Tyndall*, has as its striking cover illustration a depiction of Tyndall as a lecturer holding a pointer, in black print on vivid orange paper (fig. 3). He is pointing towards an almost abstract image which blurs a globe with an ice-capped mountain and snowflake. But Tyndall is not dressed for mountaineering, nor

[11] Cambridge, Cambridgeshire County Hall Archives (CCHA), Papers of the Richardson Family, and their descendants, the Sturge Family, R83/061 (uncat.), Cutting, unknown publication and date, 'Death of Sir R. Ball. A Great Astronomer and Lecturer. Some Amusing Stories of his Career'.

does he appear to be ready for original experimentation in the lab. Standing upright and confident, and looking earnestly and directly at the reader, Tyndall wears evening dress, ready to deliver a respectable evening discourse. Referred to simply as 'Tyndall', he is immortalized as a communicator rather than a discoverer.

Fig. 2.[12]

[12] 'Men of the Day No. 959 – Sir Robert Ball', *Vanity Fair*, 37 (1905), n.p.

Fig. 3.[13]

These examples show that both Ball and Tyndall treated lecturing as a performance, to be rehearsed and perfected; they knew that their audience had paid to see them, and they intended to give value for money. As D. Thompson puts it, Tyndall 'worked on the principle that

[13] *The Life and Work of John Tyndall, F.R.S., D.C.L., LL.D., with Personal Reminiscences by Friends, and Numerous Illustrations*, *Westminster Gazette 'Popular'*, No. 6 (December 1893), front page. Photograph of copy held at the British Library, British Library Board, General Reference Collection 1866.d.14. (6).

a public lecture should have the same exacting care in production as a play in a theatre'.[14] Ball's self-presentation as someone with a lifelong fascination with the performance of science, as well as someone with a unique insight into how it could be done well, indicates that these scientists were acutely aware of how important their presence on the lecture platform was. They knew that part of the excitement felt in attending a lecture was attached to uncertainty sbout whether the experiment would succeed or fail, and that another part was in being in the presence of a celebrity. Ball remembers attending a reading by Dickens, where '[g]reat was the desire to see Dickens himself' (pp. 55-56). Ball seems to be retrospectively casting himself as a Victorian celebrity inspired by Dickens, suggesting perhaps that in his own lectures, "great was the desire to see Ball himself". It is important to remember that there was a lot at stake, professionally, for these men in pursuing the role of popularizer. Even today their reputations are founded on their popular productions, and their research output is less well known. Tyndall's contemporaries made their less than complimentary opinions on this clear.[15] It might be adequate to say, especially in the case of Ball, that popular lecturing provided a generous income to surpass that of any university position, thereby justifying the choice to risk their professional reputations. In almost all cases Ball would not speak without a fee. But for both men, such dedication to popular lecturing also shows great commitment to the transmission of scientific knowledge to a wider public. If Tyndall and Ball were showmen, they were also salesmen, pitching not just the facts, but the philosophy of science, and in particular that of observation and experiment. Each benefited financially from this work, but so too did science itself, by gaining public admiration.

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[14] D. Thompson, 'Contributions to Scientific Education and the Teaching of Science', in Brock et al (eds.), pp. 145-156 (p. 149).

[15] Most famously P. G. Tait, in the Tyndall/Forbes glacial controversy (discussed in chapter four), wrote to *Nature* that: 'I have all along said, and still say, that I cordially recognise the services of Dr. Tyndall in popularising certain parts of Science. But his readers must be cautioned against accepting as correct great parts of what he has written. It is granted to very few men to do this useful work without thereby losing their claim to scientific authority. Dr. Tyndall has, in fact, martyred his scientific authority by deservedly winning distinction in the popular field. One learns too late that he cannot "make the best of both worlds"', 'Tyndall and Forbes', *Nature*, 8 (11 September 1873), 381-382 (p. 382).

Constructing the Lecture: Page to Stage

Tyndall's and Ball's lectures were carefully crafted performances. Projection using the lime light, or oxy-hydrogen lantern, constituted a fundamental part of Ball's lectures. This apparatus was the latest embodiment of the magic lantern. Put simply, the oxy-hydrogen lantern was a device in which a light source (usually burning oil and a wick) projected images from glass slides onto a screen or wall. From its origins in the seventeenth century, until the late eighteenth century, the magic lantern was mostly employed for private entertainment, as its light was not bright enough to project images to large groups of people.[16] Originally used to produce entertaining visual spectacle, by the late 1700s the magic lantern came into common use in scientific, or rather, philosophical, lectures. From this point on, the magic lantern began to develop into apparatus which could be used for both instruction and amusement. The lime light used by Ball and others was first used in the 1820s.[17] For this method of illumination, oxygen and hydrogen were pumped out of separate bags, and the resulting mixture was ignited; this in turn heated a cylinder or disc of lime, whose light shone through a glass slide and onto a screen. Such was the intensity of the light produced, that it became possible to project images to a much larger audience.[18]

The use of magic lanterns, especially by travelling lecturers, could be dangerous. As Martin Hewitt explains, the lamps were 'bulky', 'difficult to transport', '[t]he light was unreliable', there was a risk of explosion, and the delicate glass slide often broke.[19] Nevertheless, magic lantern shows were an extremely popular form of entertainment in the nineteenth

[16] Hankins and Silverman, p. 43.

[17] W. J. Chadwick, *The Magic Lantern Manual* (London: Frederick Warne and Co., [1878]), p. 27.

[18] The limelight was invented by Sir Goldsworthy Gurney, and was first used in 1826 by Lt Thomas Drummond in lighthouses. See Altick, *The Shows of London*, pp. 219-220. It is fitting that Ball, one of the biggest promoters of lime light for scientific slide lectures, worked for the Irish Lights Commission, checking the safety of lighthouses, and that many of the photographs he took while touring these lighthouses were turned into photographic lantern slides. See Mark Butterworth, 'A Lantern Tour of Star-Land: The Astronomer Robert Ball and His Magic Lantern Lectures', in *Realms of Light: Uses and Perception of the Magic Lantern from the 17th to the 21st Century*, ed. by Richard Crangle, Mervyn Head and Ine van Dooren (London: Magic Lantern Society, 2005), pp. 162-173 (p. 172).

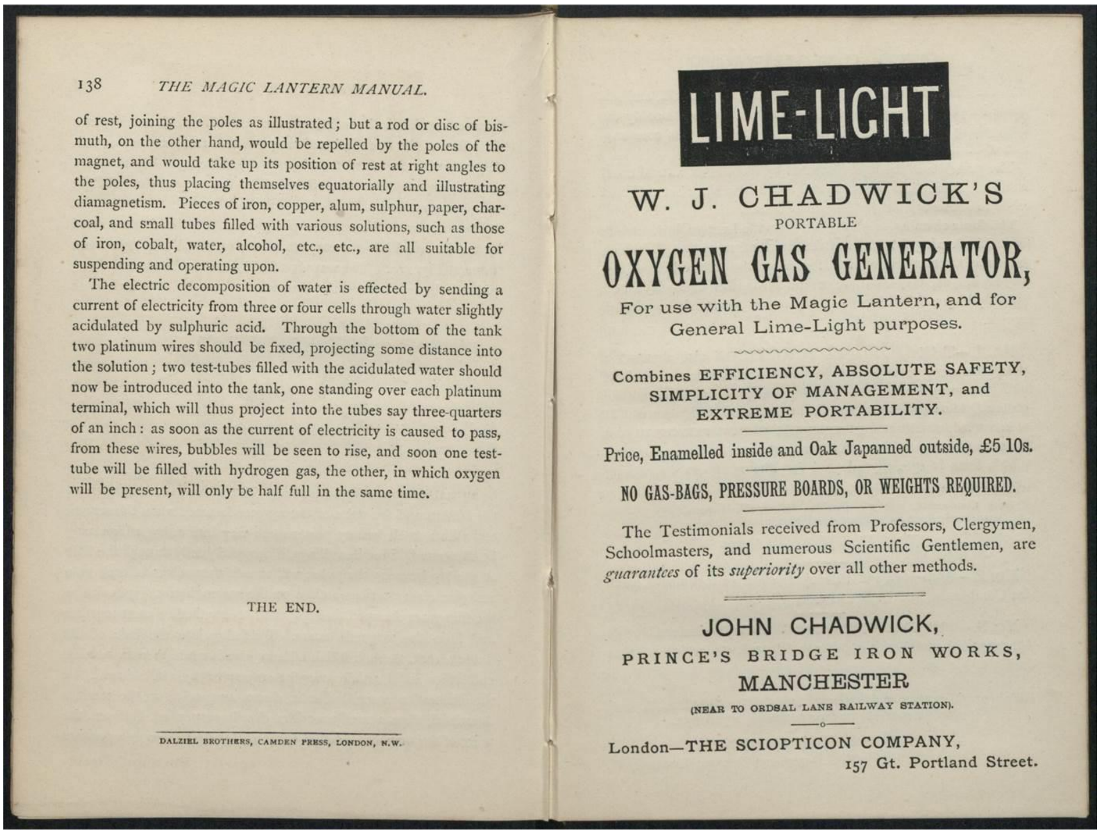
[19] Hewitt, 'Beyond Scientific Spectacle', p. 83.

century, strong in the public's consciousness not just as public entertainments, but also as do-it-yourself domestic pastimes. Manuals such as W. J. Chadwick's *The Magic Lantern Manual* (1878) and A. A. Wood's *Magic Lanterns: How Made and How Used* (1885) instructed amateurs on every aspect of production, from the best lanterns on the market, to how to hand-paint your own slides.[20] Home chemistry was encouraged, both in the process of projection and as a slide-subject in itself. Chadwick advises his readers that 'four cubic feet of oxygen may be obtained' by heating 'one pound of chlorate of potash in the form of crystals or powder, to which one-third of a pound of black oxide of manganese has been added'.[21] Instructions were given on how to project chemistry demonstrations performed in a "tank slide", a tank with glass sides that fitted into the slide holder of the lantern. Wood recommends dropping 'acid perchloride of tin [...] slowly into water in the tank [to] give the effect of a submarine volcanic eruption; when the solution has become pretty strong, immerse a strip of zinc, and long leaf-like blades of metallic tin will be seen to shoot out in all directions'.[22] Astronomy, the first scientific topic to be communicated using the magic lantern in England, was a popular subject for the amateur lanternist.[23] Wood describes how to make astronomical slides using only 'some blackened cards, a few punches of various sizes, some sheets of coloured gelatine or mica (the former may be saved from the bon-bon cases), and, lastly, a few different-sized needles'.[24]

The popularity of the lantern show led to a whole industry which combined the homemade with the readymade, the amateur with the professional. As well as the abovementioned manuals, the monthly journal *The Optical Magic Lantern Journal and Photographic Enlarger* (1889-1903), or general periodicals such as *Reynolds's Miscellany* and the children's magazine *The Boy's Own Paper* gave tips on how to make slides (the latter even marketed its own,

[20] A. A. Wood, *Magic Lanterns: How Made and How Used. With Practical Hints to Unpractised Lecturers* (London: E. G. Wood, 1885).
[21] Chadwick, p. 28.
[22] Wood, p. 88.
[23] Hankins and Silverman, p. 69.
[24] Wood, p. 73.

branded, lantern).[25] Chemists, opticians and scientific instrument makers sold both complete apparatus and slide sets, and the component pieces needed to make your own. Manuals and journals served as advertising opportunities for such businesses, and were also places in which professional lanternists advertised their trade. Advertisers stressed the clarity, safety, and portability of their products, and claimed to have positive testimonials from scientists (fig. 4). *The Optical Magic Lantern* aimed to keep its readers '*au courant* with all that transpires in the world of lanternists, and [to] supply useful practical information regarding every one of its numerous phases and applications, its mechanics, its optics, and its illumination'.[26]



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of rest, joining the poles as illustrated; but a rod or disc of bismuth, on the other hand, would be repelled by the poles of the magnet, and would take up its position of rest at right angles to the poles, thus placing themselves equatorially and illustrating diamagnetism. Pieces of iron, copper, alum, sulphur, paper, charcoal, and small tubes filled with various solutions, such as those of iron, cobalt, water, alcohol, etc., etc., are all suitable for suspending and operating upon.

The electric decomposition of water is effected by sending a current of electricity from three or four cells through water slightly acidulated by sulphuric acid. Through the bottom of the tank two platinum wires should be fixed, projecting some distance into the solution; two test-tubes filled with the acidulated water should now be introduced into the tank, one standing over each platinum terminal, which will thus project into the tubes say three-quarters of an inch: as soon as the current of electricity is caused to pass, from these wires, bubbles will be seen to rise, and soon one test-tube will be filled with hydrogen gas, the other, in which oxygen will be present, will only be half full in the same time.

THE END.

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Fig. 4.[27]

[25] 'The Lantern Alphabet' on *The Magic Lantern Society* website, <http://www.magiclantern.org.uk/alphabet/alphabetab.php> [accessed 1 April 2016].

[26] The Editor [J. Hay Taylor], 'To Our Readers', *Optical Magic Lantern Journal and Photographic Enlarger*, 1 (15 June 1889), 1.

[27] Chadwick, pp. 138-139. Image obtained from *Victorian Popular Culture* < http://ezproxy-prd.bodleian.ox.ac.uk:4030/Documents/Images/EXEBD_36629/71#Chapters> [accessed 19 September 2016].

Professional and professionalizing scientist were aware of the lantern's phantasmagorical associations – the "magic" in magic lantern, the emphasis on aesthetics and entertainment (even, or especially when, chemical demonstrations were shown), and the fact that scientific interest often lay in the mechanics of the apparatus itself. As Hankins and Silverman point out, when Tyndall used the lantern, he 'called it a "camera". Perhaps he did not want his demonstrations to be thought of as "magic"'.[28] Despite such attempts at distancing, lantern technology was a vital lecture tool for scientific naturalists. Improvements in light quality, leading to the potential for a much larger audience, provided an irresistible opportunity to spread the empiricists' message. The popularity of astronomy shows suggests that there was a public appetite for science lectures. This also meant that it was more important than ever that the show ran smoothly. Ball expected that a lamp would be provided by the venue,[29] but, as his son wrote, always made sure to give the lanternist 'some preliminary drill' if he 'was not familiar with astronomical matters'.[30] One professional lanternist who, we know, worked with Ball, was John Brandon Medland at the RI.[31] We also know that Ball requested and bought some of his slides from the Royal Astronomical Society.[32] His correspondence with William Henry Wesley, assistant secretary to the Society, even reveals Ball asking Wesley to select suitable slides for him, as well as write descriptive text.[33]

Taking as an example the manuscript of a lecture entitled 'The Telescope and Its Uses' (the content of this lecture is described in more detail later), we can see that Ball had access to a varied slide collection, from astronomical diagrams such as 'The great Bear and the little bear' (p.

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[28] Hankins and Silverman, p. 69.
[29] Hewitt, 'Beyond Scientific Spectacle', p. 84.
[30] *Reminiscences*, p. 220.
[31] An advert for a lecture series, 'Chapters from the Book of Nature', that Ball performed at the RI in 1901, notes that '[n]umerous lantern slides will be projected by Mr J. Brandon Medland', 'Chapters from the Book of Nature', *Optical Magic Lantern*, 12 (January 1901), 2. *LUCERNA*, The Magic Lantern Web Resource, notes that Medland was a professional lanternist who frequently advertised in *The Optical Magic Lantern*, <http://www.slides.uni-trier.de/person/index.php?id=6003153> [accessed 1 April 2016].
[32] See London, Royal Astronomical Society (LRAS), RAS Letters, 1872-1900, Sir Robert Stawell Ball.
[33] 'My dear Wesley, I am giving a lecture on "The Sun" next Wednesday in Dublin, I wish you would kindly choose from our collection the three slides that in your opinion are most instructive with regard to the Corona. Perhaps you would also just write about a dozen words for each to tell me what are the most essential features', LRAS, RAS Letters, 1872-1900, Sir Robert Stawell Ball, Observatory, Cambridge, 14 March 1898.

14), and drawings of apparatus like ‘Lord Rosse’s great reflector’ (p. 29), to photographs.[34] The latter are of particular importance. While amateur lanternists were increasingly favouring photographic slides because they depicted actual sites, or because high-level magnification highlighted painted defects more clearly, Ball projected photographs because he believed they offered a more objective depiction of nature.[35] In ‘Telescope’ he introduces a photographic slide of the moon: ‘[i]f the picture you now see be not actually the moon itself it is the most faithful portrait of the moon that could be exhibited’, ‘a photograph of the moon which has never been embellished by any human art’ (p. 40). Such an image exhibits the ‘mechanical objectivity’ by which Daston and Galison characterize scientific representations during this period. Ball is using the technology of the lecture to display to a popular audience an image which, at that time, represented scientific truth for a specific community of scientists. He then heightens the significance of this image by describing its production in detail:

> Some time ago the camera of a photographic apparatus was attached to the end of a telescope. That telescope was directed towards the moon. The object glass of the telescope depicted an image of the moon on the plate in the camera. After suitable exposure the plate was {?} from the telescope and carried into the photographic dark room. The plate was then developed by chemicals and a beautiful picture of the moon was produced. That picture was copied by photography on to a piece of glass. That piece of glass is now in the lantern and the picture it contains is magnified on the screen.

(p. 40)

Ball wants to convince his audience that there is an unbroken production line between the telescope and the image projected on the screen in front of them, that what they see is exactly what the telescope saw. The repetition of ‘glass’ through ‘object glass’ and ‘piece of glass’ linguistically connects the telescope and the lantern, with the telescope simultaneously both

[34] CCHA, Papers of the Richardson Family, and their Descendants, the Sturge Family, R83/061 (uncat.), ‘The Telescope and Its Uses’ MS lecture in small black untitled notebook. In-text page numbers refer to Ball’s own hand pagination. Illegible text is indicated by { }, and inserted text is given in square brackets. Underlining, italics etc. are present in original document. Retains Ball’s original capitalization.

[35] Ball’s commitment to photography is also illustrated by the fact that he was a member of the RAS Photographic Committee, whose responsibilities included the preservation of astronomical photographs held by the Society, and their reproduction for public sale (as prints and slides). LRAS, Photographic Committee Meeting Minutes 1888 April – 1934 November, RAS Papers 63. Thanks to Sian Prosser at the RAS for alerting me to the work of this Committee.

viewing and projecting technology. Its 'object glass' 'depicted', or projected, the image of the moon onto the photographic plate, just as the lantern now casts the same image on to the screen. Further, Ball captures the movement of the plate that contained the image, even noting that it was 'carried' into the dark room. The whole process is laid open as transparent, the kinetic description linking screen and telescope (and by extension the audience member's eye) in one unbroken chain. On this basis, Ball could ask his audience to *observe* phenomena for themselves, as though they were in the observatory.

This description of the moon slide exists in Ball's manuscript, suggesting that he felt it was an important component of the lecture. We can use his manuscripts to ascertain how Ball constructed his lectures, and from this, the extent to which he tried to control how his discourse was received by the listening audience. Although Ball held government and university science posts throughout his life, he had great commercial success through popular lectures. The financial motivation for lecturing had some impact on the overall content of his lectures which, unlike those of Tyndall, tended to avoid controversy. In 1897 he wrote to a friend: '[l]ecturing is a more permanent source of income than writing…for the same lecture will be available scores of times, while there is (or ought to be) a limit to the number of times the same thing can be written'.[36] Ball built up a repertoire of lectures which he could repeat multiple times for different audiences; this suggests important questions to consider when constructing the textual history of his lectures. In his *Reminiscences* Ball recalls the circumstances of his lecture, 'A Glimpse Through the Corridors of Time', delivered to the Birmingham and Midland Institute, 24 October 1881. At this point Ball had been lecturing for over a decade, but was just beginning the busiest lecturing period of his life. He wrote:

> On this occasion I did what I had not done before – I wrote out the lecture before it was delivered. In later years I often wrote out my lectures, but that was long after they had been given several times. Although I had written out "A Glimpse Through the Corridors of Time," I am not at all sure that I read it. When lecturing to the public, it was my invariable practice to trust to memory

[36] Quoted in Lightman, 'Lecturing in the Spatial Economy of Science', p. 102.

> for what I had to say. [...] My experience is that once the lecture has been put in order, and the lecturer has made up his mind as to what he wants to say, and how he will subdivide it, memory serves one as a matter of course.
>
> (*Reminiscences*, pp. 193-4)

This suggests that Ball did have a definite “text” which he repeated for each lecture, even if that text was in his head until he wrote it down several years later. Ball’s son, who edited the *Reminiscences* after his father’s death, wrote that his ‘father never used any notes when addressing an audience. By degrees, however, he reduced all his better-known lectures to writing. [...] He adhered more or less faithfully to what he had written down, but was always trying to improve’ (pp. 219-220). So even if they were written down later, he ‘adhered’ to a script of sorts. But Bernard Lightman, following P. A. Wayman, has suggested that the Lowell Lectures in October 1884 marked a turning point in Ball’s methods. ‘[A]fter a lecture in which he had “stammered and hesitated horribly” – he decided to experiment by writing and then reading his paper. He resolved in the future to write the lectures ahead of time and either memorize or read them, allowing for some improvisations along the way’.[37] There remains, therefore, ambiguity as to whether Ball’s lecture manuscripts were a product of, or an aid to, performance – or both. We can at least say that these texts played a complex and changing role in his performances.

There are several surviving lecture notebooks belonging to Ball. His notebooks for teaching at the University of Cambridge, as Lowndean Professor, are extremely neat, with tables of contents by topic. They are not divided into contained lectures, suggesting that they were designed for repetition, and as a university course the content of each lecture was not rigidly determined.[38] With regard to his popular lectures, two notebooks of particular interest are held by Cambridgeshire County Hall Archives, while the rest of his lecture notes remain in private

[37] Ibid.

[38] See 6 vols. in Cambridge, University of Cambridge, University Archives, Obsy F.1-6.

hands.[39] An undated, unpaginated notebook labelled 'Comets' contains a typewritten lecture of the same name, a printed syllabus, a typewritten list of slides, and numerous handwritten notes which show Ball arranging and rearranging a set text and slides to suit each venue. The lecture describes the appearance of comets, how astronomers look for them, and what they are made of, before describing a meteor shower and predicting when it will next occur. Ball opens with a description of a comet he had used in his 1889 work for children, *Star-Land*: '[c]omets visit us hardly we know from whence, except that it is from outer space, and they are adorned with a glittering raiment almost spiritual in its texture'.[40] From the comment, 'I sincerely hope you will borrow Starland from the library and read in connection with this lecture', and the prediction that a meteor shower will occur in 1899, we can ascertain that this version of the 'Comets' lecture was produced between 1889 and 1899. The typewritten list of twenty-five illustrations which follows includes 'General View of a Comet', 'How to draw an Ellipse', 'Jupiter and Satellites', and 'Head of Halley's Comet', presumably the lantern slides for this lecture. This list, with the lecture text, apparently forms the basis of a lecture which is adapted for different audiences. On the page following his slide list, Ball writes:

> Prepared for Leven.
>
> <u>Anti prologue.</u> It is indeed gratifying to a lecturer to see so thronged an audience assembled to hear him and to receive so cordial a welcome as that which you have just given me. I thank you for it from my heart. I always feel a peculiar pleasure when the duties of the Gilchrist Trust lead me to Scotland. I know that I am sure of having a highly intelligent audience. The Celtic blood which flows in your veins is not quite absent from mine and possibly this fact may have its influence in establishing an unconscious sympathy between lecturer and audience.
>
> (this might do for a "reply" + the crush at goole for the "anti-prologue" or vice versa according to circumstances.

[39] 'His most popular lectures were typed up by his daughter Minnie, and bound', Butterworth, p. 171. Butterworth's 2005 essay notes that, at that point, these notebooks were in the possession of Ball's great-grandson. He writes that there are 'large master copy volumes of five lectures and slim volumes of the individual lectures'.

[40] CCHA, Papers of the Richardson Family, and their Descendants, the Sturge Family, R83/061 (uncat.), 'Comets', small black notebook, Ball papers. A near-identical description is found in *Star-Land: Being Talks with Young People About the Wonders of the Heavens* (London: Cassell & Company, Limited, 1889), pp. 238-9.

In *Reminiscences* Ball gives a diary entry for 7 January 1890 in which he writes, '[a]udience of 1,000, many turned away' (p. 196) from a lecture at Goole; presumably this is the 'crush at goole'. This 'anti prologue' shows that Ball prepared each local greeting, and that he consciously set out to create a friendly atmosphere in the lecture hall by complimenting his audience (and shows some presumptuousness that they would welcome him enthusiastically). It suggests that all parts of his lectures were carefully constructed beforehand as discrete units which could be rearranged (which, judging from the messy handwriting at these points, took place on the train). The 'anti prologue' would sit before what he called the 'prologue' and the rest of the lecture would proceed thus: 'groups' of slides, one or more 'interludes' interspersed between the groups, concluding with an 'epilogue'. It seems likely that his 'interludes' were anecdotes or descriptive sections which did not require slides. In this way Ball planned his lectures like scenes in a play. On the page following the Leven anti-prologue Ball plans a lecture following this structure:

> <u>Prologue</u> Telegraphs. <u>Interlude</u> Meteors. <u>Epilogue.</u> Beauty and harmlessness of comets.
> Although I still think that where the subject admits of two good monotopical interludes that it is better to have two than one yet if as in the present case of comets there is a difficulty in getting two good interludes it is better to be content with one full and interesting one.

Indeed, for the audience at the Manchester Athenaeum, 20 December 1893, one interlude was all Ball believed they could tolerate: '[t]hey didn't believe in <u>long</u> lectures here 75 minutes is quite enough. They began to go out last time. I therefore make it a single interlude lecture'. By calling these non-visual sections 'interludes' Ball delineated the lantern 'groups' as the main event. As time went on it appears that the 'Comets' lecture tended even more towards the visual, and eventually Ball concluded that '[t]here {wd} be a good reason for having <u>one</u> lecture at all events wh[ich] sh[oul]d have <u>no</u> interlude and as comets does not easily suggest an interlude I will arrange that it shall be continued with the gas down all the time' (ibid.). Ball planned every aspect of his lecture, even down to the brightness of the lights.

There is also evidence that Ball planned the text of some lectures with fully integrated slides. Such a practice is not unusual, and Ball's notebooks suggest that he was a well organized, cautious performer. 'The Telescope and Its Uses', was described as '[a] lecture prepared for the Gilchrist course of lectures *to be delivered* in the towns and dates as follows' (my emphasis), for performance across ten towns throughout January 1882. The handwriting is very neat, suggesting that this was the final draft and, by noting that they are 'to be delivered' and not that they "have been delivered", Ball shows us that (unless the text was written some time after the contents page) he did indeed write out a lecture in full before delivering it and not, as he claimed, only several years later. 'The Telescope and its Uses' explores the history of the telescope, the moon and major constellations, Mars, Jupiter, and Saturn. Titles of slides are integrated into the body of the text:

> The dome can be turned round so that {thus?} no part of the heavens can escape the scrutiny of the astronomers within. Although
>
> 17 The Interior of the Dome
>
> the dome is so large yet it is mounted so beautifully a child of four or five years old can easily pull the dome round. By the stroke of the wand of the magician we have changed the view of the dome from the outside to the inside you see here the assistant who pulls the rope by which the Dome is turned round.
>
> (pp. 19-20)

'17 The Interior of the Dome' refers to a slide which is to be introduced mid-way through the sentence. Are these slide titles like stage directions, which Ball learnt as he was memorizing the script? Not only do titles cut through sentences to indicate that a change has to be made at that particular moment; Ball even scripts dialogue in which he, as a 'magician', causes the slides to change. At every stage of planning it is clear that Ball was acutely aware of his roles as performer, stage manager, and director. Constructed primarily around slides, the role of language in these performances was to augment and enhance the visual. The fact that he could construct his lectures in this way demonstrates the malleability of the lecture genre; the same core lecture could be rearranged to suit a different audience.

The "scripts" from Ball's lectures serve to complicate what is already a confusing narrative of notebook page to platform. The manuscript evidence for Tyndall's approach to planning and delivering his lectures is comparatively straightforward, in that it correlates with what witnesses said about his style: lucid and ornate descriptions of visual phenomena which were improvised (or at least made to appear totally fluid) around frequent demonstrations. Following Tyndall's death in 1893, the *Westminster Gazette* wrote that his lectures 'were never set discourses, scholastic and severe. Rather they were informal colloquies among [...] friends'.[41] The social and familiar atmosphere at the RI set it apart from other institutions whose intentions were overtly educational. While it was intended as a space for the diffusion of scientific knowledge to a wider public (and, increasingly throughout the nineteenth century as a place where that knowledge was created), it was also an extension of its middle- and upper-class members' social circle. Tyndall was therefore obliged to present scientific facts in the most engaging way possible. The failure of experiments, or the revelation of the clunkier inner workings of the lecture through bad timing and poorly delivered explanations, was not an option. Manuscript lecture notes can suggest how Tyndall might have planned and delivered his performances, although a degree of caution needs to be exercised when examining already fragmentary archival evidence. The RI Archives hold a substantial collection of Tyndall's lecture notes, which there is every reason to believe, would have been used on the platform.[42] The general trend of these notes is that the first lecture in a series – which often opened with a long narrative sweep across the history of man to the present – or parts of lectures which required historical exposition, are written in long form. The notes become increasingly brief as a series progresses, and consist merely of demonstration prompts. Such sparseness supports what we see in the printed versions of lectures. Long series of

[41] *Westminster Gazette*, p. 8.
[42] London, Royal Institution (LRI), John Tyndall Papers, RI MS JT 2-8.

demonstrations are punctuated by brief connecting statements; even the ornate descriptions for which Tyndall is well known, emanate from demonstrations that are actually taking place.

The centrality of demonstrations shows that Tyndall believed they were the most effective method by which to communicate science while at the same time arguing that the use of the senses is paramount. As he told an audience of teachers in 'An Elementary Lecture on Magnetism', '[e]xperiment [...] is the language by which we address Nature, and through which she sends her replies'.[43] Nevertheless, we must remember that this apparently effortless style was rehearsed; there may be no surviving detailed manuscript notes, but this does not mean that Tyndall did not know exactly what he was going to say beforehand. Further, while he might have argued that experiment is a language in itself, in popularizing, Tyndall could not have effaced himself or the interpretive role of spoken language, because the technicalities of the science had to be translated for the non-expert. Experiment may be the language of nature, but it must be translated through spoken commentary.

Constructing the Text: Stage to Page

Examination of manuscript lecture notes illustrates how much control both scientists wanted to have over their physical and verbal performance. Ball used the magic lantern to show how visual images of nature could be captured and observed, multiple times, by diverse audiences. The hundreds of lectures he performed in his lifetime using the same slides, to thousands of people, demonstrate how the popular lecture and its technologies were used to both enact, and to communicate, the scientific naturalists' version of truth and objectivity. Likewise, Tyndall was keen that his audience could *see* natural phenomena, and he too used modern projection

[43] John Tyndall, 'An Elementary Lecture on Magnetism', in *Fragments of Science for Unscientific People: A Series of Detached Essays, Lectures, and Reviews* (London: Longmans, Green, and Co., 1871), pp. 373-402 (p. 382).

techniques. *Nature* commented on the 'effective way in which several of the more subtle effects of electrical charge and power are made manifest to a large audience by the instrumentality of beams of electric light'.[44] Simon Schaffer has argued that Victorian physicists, beginning with Tyndall, were particularly concerned with the idea of 'transport phenomena', 'local movements of matter and energy in fluid systems'. Moreover:

> They were peculiarly concerned with capturing such phenomena as startling images whose apparently controlled display would simultaneously demonstrate their own command over the physics of energy, the devices of experiment and the circulation of commodities.[45]

As this and the *Nature* article make clear, physicists aimed to make the invisible visible; Tyndall's manipulation of the lecture technology in order to put into visible form phenomena such as sound waves, reinforced the importance of the act of witnessing. In one of his favourite experiments (and one which he often repeated, whether or not it was directly relevant to the lecture topic), Tyndall causes beautiful petal and star shapes to form on the screen as a block of ice is melted by the lamp. The action of the lamp upon the ice not only *makes visible* the phenomena to the audience on a large scale; it simultaneously *causes* the action to happen.[46] Similarly, the scientist is keen to point out that were it not for his manipulation of the lantern apparatus, many phenomena would remain invisible. In Lecture VI of *Heat Considered as a Mode of Motion* (a series performed at the RI in 1862), for example, he demonstrates to his audience how hot air rises:

> I have here a heavy iron spatula, heated to dull redness: as I hold it thus, you cannot see the currents of heated air ascending from it. But I can show them to you by their action on strong light. I place the spatula in the beam of the electric lamp; here is the shadow of the spatula on the screen, and those waving lines of light and shade mark the streaming upwards of the heated air.
>
> (p. 168)

[44] 'Professor Tyndall's Lectures at the Royal Institution, on Electrical Phenomena and Theories', *Nature*, 2 (21 July 1870), 243-244 (p. 243).
[45] Simon Schaffer, 'Transport Phenomena: Space and Visibility in Victorian Physics', *Early Popular Visual Culture*, 10 (2012), 71-91 (p. 75).
[46] John Tyndall, *Heat Considered as a Mode of Motion: Being a Course of Twelve Lectures Delivered at the Royal Institution of Great Britain in the Season of 1862* (London: Longman, Green, Longman, Roberts, & Green, 1863), pp. 108-9.

The first person – 'I have here', 'I hold it thus', 'I can show them to you' and 'I place' – emphasizes the power and control that the demonstrator wields over nature; it is as though by casting the visible realization of the phenomenon on the screen, the lecturer is shown to possess god-like powers of revelation.

In the opening lecture of *Heat* Tyndall sets out his aim that all apparatus used would in some way enhance the visual experience. 'I must devise some means of making indications of heat and cold visible to you all', he writes, 'and for this purpose an ordinary thermometer would be useless. You could not see its action; and I am anxious that you should see, with your own eyes, the facts on which our subsequent philosophy is based' (p. 2). For this reason Tyndall uses a 'thermo-electric pile' to detect temperature change.[47] This emphasis on seeing is both literal and metaphorical; in his RI lectures on *Sound* Tyndall speaks of "understanding" in terms of visibility, 'to give distinct *images* of the various phenomena of acoustics, and to cause them to be *seen* mentally in their true relations' (my emphasis).[48] Scientific training, he writes, 'ought to teach us to see the invisible as well as the visible in nature; to picture with the eye of the mind those operations which entirely elude the eye of the body' (p. 5). But he also literally illustrates the 'propagation of sound' by having five people stand in a row, pushing the first, and watching as the shock is sent down the line (fig. 5). In *Heat* Tyndall sings to gas flames and causes them to "sing" back. Predicting that 'if I am skilful enough to pitch my voice to the precise note, I am sure the flame will respond' (*Heat* p. 247), the lecturer asserts his authority over nature, causing it to respond to his spoken command. The flame 'cannot sing till I tell it to do so', it is 'obedient to my voice', and he could both 'command the flame to sing and to stop'. This controlled display is where theatre meets empirical science, and is the point at which Tyndall is most effective in communicating scientific naturalism to a wider audience. The person of the lecturer meets the visible display of natural phenomena.

[47] A thermo-electric pile measures temperature difference between two of its faces, generating an electrical current proportional to that difference.
[48] Tyndall, *Sound*, p. vii.

FIG. 2.

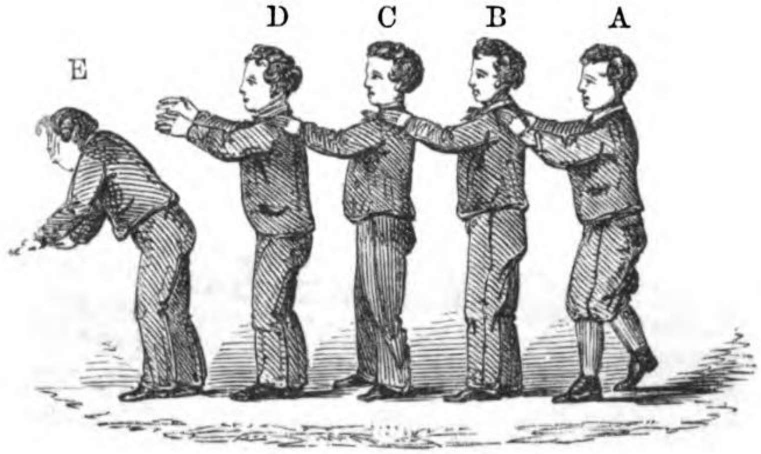

Fig. 5.[49]

Tyndall's outrageous experiments (including building a replica geyser in the RI lecture theatre which ejected water thirty feet into the air) were clearly visible and definitely memorable (p. 125). Simultaneously, he was renowned for his use of figurative language to enhance lecture slides and diagrams, thereby arguing that such images were a poor representation of reality. Tyndall uses figurative language to make visible, imaginatively, invisible phenomena, for example, that the photosphere of the sun 'may cut off those rays of the central incandescent orb, which the photosphere itself can emit' (p. 414). He describes, almost poetically, what is projected in front of both audience and reader, enhancing image through aesthetic commentary. Consequently it can be seen that, where visual depictions were used rather than demonstration, Tyndall saw some use for spoken language. An image of snowflakes taken from the work of astronomer and meteorologist James Glaisher, which was displayed during lectures and reproduced in several of Tyndall's books (fig. 6) is augmented:

[49] Tyndall, *Sound*, p. 4. Image sourced from the Google Books and Oxford Bodleian Libraries Scanning Project.

> The six-leaved blossoms assume the most wonderful variety of form; their tracery is of the finest frozen gauze; and round about their corners other rosettes of smaller dimensions often cling. Beauty is superimposed upon beauty, as if Nature, once committed to her task, took delight in showing, even within the narrowest limits, the wealth of her resources.
>
> (p. 180)

Tyndall was not the only popularizer to use language which verged on the poetic, but he was perhaps the best. His layering of description and repetition of 'beauty' mirrors nature's superimposition of beauty on beauty. The imagery of expense in 'gauze', 'rosettes', 'wealth' and 'resources', with the use of superlatives, stresses that nature has far greater powers than the best human artist. Finally, 'smaller dimensions' and 'narrowest limits' show that nature is able to perform this artistry in a way which is inconceivable to man; the inadequacy of even poetic language illustrates this power. In a recent study of scientific visual culture, Klaus Hentschel suggests that it is important to pay attention not just to the visual images of science, but also to the ways in which language is used to help the mind to visualize. Hentschel notes that '[t]he 4th century Byzantine scholar and bishop Nicholas of Myra said that a good ekphrasis turns the listener into an eye-witness'.[50] The poetic texture of Tyndall's language certainly earns it the title of ekphrasis, and this strategy enables his readers and listeners to become eye-witnesses of sorts, to his experimental methods. Furthermore, Hentschel suggests that an emphasis on the beauty of scientific images can be seen as an attempt to validate their scientific truth.[51] For Tyndall in particular the equation of beauty and scientific accuracy was important to both research and popularization. His descriptions of the snowflakes encapsulated Tyndall's complex and sometimes contradictory views on figurative language: it was a lens through which scientific objectivity was obscured, but it was also, paradoxically, the more effective way in which Tyndall could describe unobservable worlds.

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[50] Klaus Hentschel, *Visual Cultures in Science and Technology: A Comparative History* (Oxford: Oxford University Press, 2014), p. 42.

[51] 'Sometimes, "really good" or "beautiful" images also help to convince a scientific community of the existence of an unexpected phenomenon or a strange effect still under heavy dispute', ibid., p. 372.

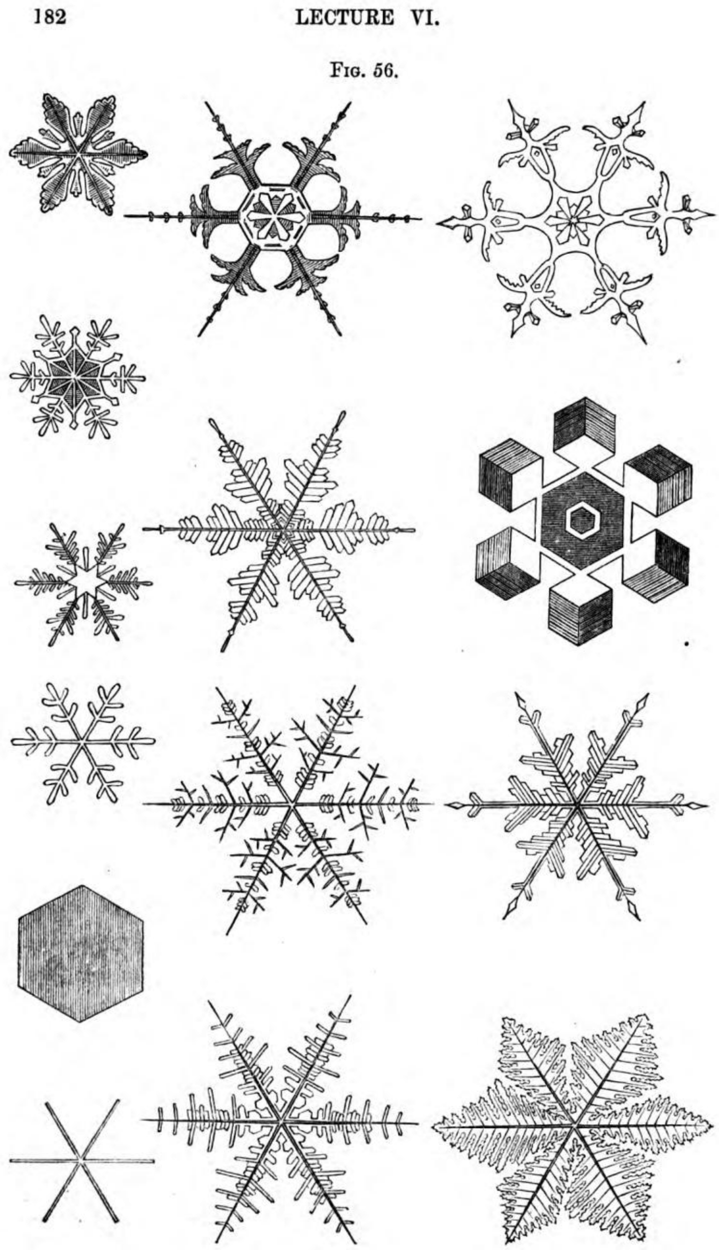


Fig. 6.[52]

As this interaction shows, the lecture text is a meeting of language, action, and script; descriptive language is just one part of a complex form. Scientific naturalists were all too aware

[52] Tyndall, *Heat*, p. 182. Note that this image also appears in the published *Notes of a Course of Six Lectures (Adapted to a Juvenile Auditory), on Ice, Water, Vapour, and Air* from Tyndall's Christmas Lectures 1871-2, (London: William Clowes and Sons, n.d.), p. 11. Image sourced from the Google Books and Oxford Bodleian Libraries Scanning Project. Here the image has been rotated 180º; like the moveable parts of Ball's lectures, it seems that this image was used and reused for a variety of lectures, and it mattered little whether the image was reproduced in the same way. It is likely that this image was drawn by James's wife, Cecilia Louise Glaisher.

of the limitations of each of these elements. How demonstrations and images were transferred into texts determined how successfully the visual elements of the lecture – which the scientist had worked so hard to achieve – were retained, and therefore how effective the form was in communicating the scientist's message. Outside of the RI, Ball's lectures were largely illustrated with slides rather than demonstrations. Of these, only two were published: *A Glimpse Through the Corridors of Time* (delivered at the Midland Institute, Birmingham, 24 October 1881 and first printed in *Nature*), and *Time and Tide* (two lectures delivered at the London Institution, 19 and 26 November 1888). Neither of these texts is heavily illustrated and no reference is made to slides. *Star-Land: Being Talks With Young People About the Wonders of the Heavens* (1889), the text of two RI Children's Christmas Lecture series, from 1881 and 1887 (the latter a repetition of the first), is, in contrast, generously illustrated with depictions of demonstrations. Ball's legacy of published lectures is sparse compared to Tyndall's whose lectures came in a wide variety of printed forms. *Notes of a Course of Six Lectures (Adapted to a Juvenile Auditory), on Ice, Water, Vapour, and Air* (1871-72), *Lessons in Electricity at the Royal Institution* (1875-76), and *Rough Notes of a Course of Juvenile Lectures on Heat: Visible and Invisible* (1877-78), are based on his Children's Christmas Lectures, and are all relatively brief summaries which move from one demonstration to the next with few narrative interludes. *Ice* and *Electricity* (both Juvenile) are divided into topics rather than individual lectures, while *Heat* (Juvenile), which was printed for private circulation only, retains its lecture divisions. In some cases paragraphs are numbered; in others, demonstrations are numbered. These – perhaps editorial – idiosyncrasies present the lectures in a formal and organized manner as a list of demonstrations devoid of the performer's flare. Tyndall does not specify why the juvenile lectures *Heat* and *Ice* were printed, unlike the *Notes* for his adult lectures on *Light* (8 April – 3 June 1869), and *Electrical Phenomena and Theories* (28 April – 9 June 1870). Attendees at these lectures received handouts which signposted experiments and gave additional historical detail. *Nature* believed that this could greatly improve the lecturer's performance, who could now 'give full attention and time to each step of his illustrative demonstration, without being hampered with the need of telling everything that he has marked out beforehand'.[53] Tyndall wrote in his preface to *Notes of a Course of Nine Lectures on Light Delivered* [...] *1869*, that he had decided to publish them because of '[e]nquiries and requests regarding them from teachers and students who have read them'.[54] Comparing the Longmans published version of the *Electrical Phenomena* notes, with lecture handouts in the RI archive, there appears to be little or no difference between them.[55] One cannot help but think that the reader of *Electrical Phenomena* was losing out, as he or she saw the same text as the live audience, but without the accompanying demonstrations. Such instructive pamphlets certainly gave a reader a completely different experience from the lengthy, illustrated and lucidly written published series such as *Heat* and *Sound*. Tyndall's lectures were therefore available in a wide variety of forms, for readers looking for entertainment and instruction.

In Tyndall's more narrative-heavy publications (those which purport to give the lecture in full rather than simply as stages of demonstrations), the way that the page is laid out, and the language used to describe demonstrations as they are happening, point to attempts to restage the lecture on the page. When Tyndall comes closest to achieving this, readers almost become members of the live lecture audience. Language fixes the lecture in a specific time and place. Texts retain addresses to the original audience which assume that they have travelled a distance to attend. 'Your reappearance here to-day', Tyndall writes in the opening to his third lecture on *Heat*, 'after the strain which has already been put upon your attention, encourages me to hope that our present experiment will not be entirely unsuccessful' (p. 59). Readers are not excluded from this group and can also feel that they have exerted effort in "attending". For Tyndall, the

[53] 'Professor Tyndall's Lectures at the Royal Institution', p. 244.
[54] John Tyndall, *Notes of a Course of Nine Lectures on Light Delivered at the Royal Institution of Great Britain April 8 – June 3 – 1869* (London: Longmans, Green, and Co., 1870), n.p.
[55] Copies of these handouts are held at the LRI, John Tyndall Papers JT/4/5/12, 'Royal Institution Notes of a Course of Seven Lectures on Electrical Phenomena and Theories. By Professor Tyndall, LL.D., F.R.S. April 28 – June 9, 1870'.

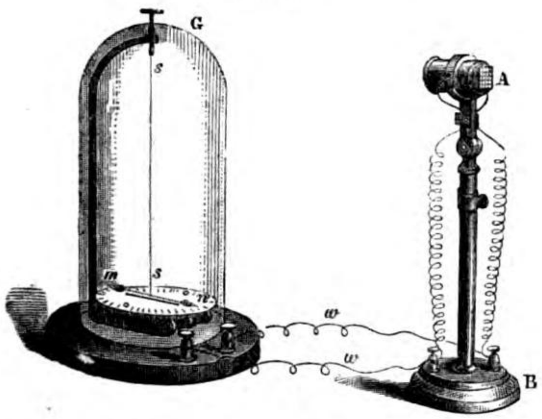
expenditure of effort on a particular task is a sure mark of one's success in accomplishing it: 'I need not tell an audience like this that nothing intellectually great is either accomplished or appropriated without effort'. Scientific naturalism demanded hard work from its disciples, including commitment to attending a whole lecture series.

In *Heat*, footnotes, which visually look like foundations on the page supporting the main text and images, lay bare the rudiments of the lecture's physical construction. In fig. 7 for example, a note describes exactly where the apparatus depicted in the illustration, was situated in the theatre, 'stood on a stool in front of the lecture table'. Phrases such as '[b]efore you I have placed such a needle', '[a]ll of you see these pieces of paper' and '[a]t the present moment', work in conjunction with the footnote and image to give a multi-dimensional experience of the lecture. Later notes even describe the specific equipment used: '[t]he galvanometer used in this experiment was that which I employ in my original researches: it is an exceedingly delicate one' (p. 30). The demonstration apparatus, named as the original experimental equipment, thus brings the laboratory into the lecture theatre. A demonstration using curved mirrors to cause balloons containing chlorine and hydrogen, and oxygen and hydrogen, to explode, illustrates most fully how text and image are synchronized (fig. 8). Punctuation goes some way to reproducing the pauses and exclamations of Tyndall's speech, and the present tense 'as I speak, the flakes of the balloon descending on the table' tries to recreate the immediacy of a demonstration which would have had a striking aural and visual impact. The full-length image of the demonstration (including a demonstrator who only very vaguely looks like Tyndall) running parallel to the column of text, produces an effect of simultaneity on the reader, both seeing and reading about the demonstration.

THE THERMO-ELECTRIC PILE AND GALVANOMETER. 3

By means of this instrument I cause the heat which it receives to generate an electric current. You know, or ought to know, that such a current has the power of deflecting a freely suspended magnetic needle, to which it flows parallel. Before you I have placed such a needle *m n* (fig. 1), surrounded by a covered copper wire, the

FIG. 1.



free ends of which, *w w*, are connected with the thermo-electric pile. The needle is suspended by a fibre, *s s*, of unspun silk, and protected by a glass shade, G, from any disturbance by currents of air. To one end of the needle I have fixed a piece of red paper, and to the other end a piece of blue. All of you see these pieces of paper, and when the needle moves, its motion will be clearly visible to the most distant person in this room.*

At the present moment the needle is quite at rest, and points to the zero mark on the graduated disc underneath it. This shows that there is no current passing. I now

* In the actual arrangement the galvanometer here described stood on a stool in front of the lecture table, the wires *w w*, being sufficiently long to reach from the table to the stool; for a further description of the galvanometer see the Appendix to this Lecture.

B 2

Fig. 7.[56]

[56] Tyndall, *Heat*, p. 3. Image sourced from the Google Books and Oxford Bodleian Libraries Scanning Project.

CONJUGATE MIRRORS. 267

gases; but look here! you see, as I speak, the flakes of the balloon descending on the table; the luminous rays went harmlessly through it, caused the gases to explode, and the hydrochloric acid, formed by their combustion, has actually preserved the inflammable envelope from sharing in the combustion.

I lower the upper mirror and hang in its focus a second balloon, containing a mixture of oxygen and hydrogen, on which light has no sensible effect; I raise the mirror, and in the focus of the lower one place this red-hot copper ball. The calorific rays are now reflected and converged above, as the luminous ones were reflected and converged in the last experiment; but they act upon the *envelope*, which I have purposely blackened a

Fig. 81.

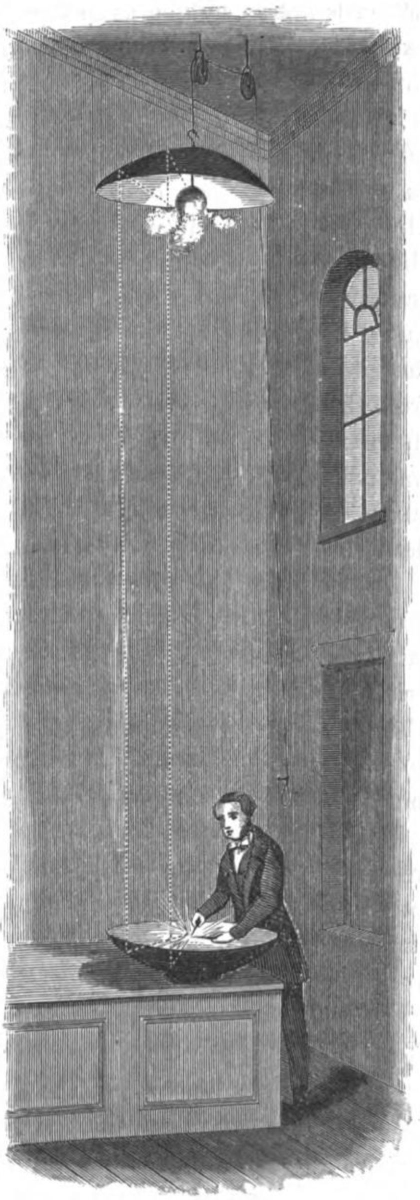


Fig. 8.[57]

[57] Ibid., p. 267. Image sourced from the Google Books and Oxford Bodleian Libraries Scanning Project.

As previously discussed, in *Sound* Tyndall renders many examples of invisible phenomena as visible demonstrations. But to do this for every example would perhaps lead some of his audience to query whether he was actually lecturing on sound at all. He did therefore give some aural demonstrations. These are much harder to depict on the page. In one instance Tyndall states that:

> The motion of sound, like all other motion, is enfeebled by its transference from a light body to a heavy one [...] when I fill my lungs with hydrogen, and endeavour to speak, the vocal chords impart their motion to the hydrogen, which transfers it to the outer air. The consequence is very curious. You have already formed a notion of the strength and quality of my voice. I now empty my lungs of air, and inflate them with hydrogen from this gasholder. I try to speak vigorously, but my voice has lost most wonderfully in power, and changed wonderfully in quality. You hear it, hollow, harsh, and unearthy: I cannot otherwise describe it.
>
> (*Sound*, pp. 8-9)

It is amusing for a reader to imagine that Tyndall actually spoke these words while he was inhaling the hydrogen, but the typeface cannot communicate the change in his voice, nor does the full stop communicate the actual length of time Tyndall paused to inhale the gas. The listening audience's familiarity with Tyndall's voice does not exist for the reader other than as imagined sound and, when the lecturer says '[y]ou hear it, hollow, harsh, and unearthy: I cannot otherwise describe it', he acknowledges that he cannot fully communicate the sound on the page. Furthermore, Tyndall recounts a demonstration in a lecture room which would only have direct relevance for listeners: before lecturing at Cambridge he performed 'some experiments' to determine 'the loudness of voice necessary to fill the room' and notes that 'without an audience, the definition of the direct voice is destroyed by its echoes'. It was the attendance of an audience which 'quenched the sonorous waves', allowing his voice to be 'plainly heard in all parts of the Senate House'. [58] The lecture is not possible without the listening audience; it is their physical presence that makes him intelligible, turning indistinct sound into words. Later, when Tyndall refuses even to include an image depicting vibrating wires because the 'rapid rippling of the

[58] See ch. 1, n. 1.

scrolls from one form of beauty to another cannot be rendered' (footnote, p. 110), we see another fissure between live experience and textual replication.

For much of Ball's lecture repertoire the textual reproduction of demonstrations was not a concern, because he relied mostly on slides. In his 1881 and 1887 RI Christmas lectures (reproduced in *Star-Land*) however, Ball was keen to make the mechanics of the universe visible to his young audience, and to recreate the action of the scene for his readers. The practical operations of having children volunteer from the audience are recorded in the text:

> I shall illustrate our method of measuring the actual distance of a body in the heavens by showing you how we can find the height of that large india-rubber ball which is hanging from the ceiling [...] I will ask the aid of a boy and a girl, who will please stand one at each end of the lecture-table. The apparatus we shall want will be very simple: it will consist of two cards and a pair of scissors. The boy will kindly shape his card to such an angle that when he holds it to his eye one side of the angle shall point straight at the little girl, and the other side shall point straight at the ball, just as you see in the picture (fig. 5).[59]
>
> (*Star-Land*, p. 19)

Ball simultaneously speaks to the volunteers to ask them 'please' to stand at either end of the table, and at the same time to the reader, 'you', and gestures towards an illustration of the volunteers (fig. 9). Within the image itself there are multiple levels of artifice, beginning with the dotted lines that form three sides of an invisible triangle, which will help the children to measure the height of the ball. The background is roughly shaded and only suggests the outline of the lecturer's entrance to the RI lecture theatre, stage left. The stick on the table in the foreground is likely to be a rule with which to measure the distance between the children. Other than this sparse bit of paraphernalia, the image could easily be of a domestic scene. When coupled with the very specific linguistic description of the demonstration, it conjures up a scene that is both entertaining and educational, a rainy-day activity and a mathematical exercise. This incongruity is also apparent if we look back to an image at the opening of *Star-Land*, which depicts the lecturer himself (fig. 10). The figure in this well-known image is clearly recognizable as the astronomer.

[59] '(fig. 5)' refers to Ball's original text.

Drawn from stage left, the viewer looks out to Ball and them past him to the audience on the other side of the RI horseshoe-shaped auditorium. Looking back at her is a mirror image of *Star-Land*'s readership: children, boys and girls, and a few curious adults sat at the back. Ball stands at his desk, surrounded by orreries and flasks, the magic lantern in clear view. Well-dressed and with the upright gait we saw in the *Westminster Gazette* depiction of Tyndall, Ball looks confident, in full command of his audience and apparatus. Such an image brings the reader into the auditorium, to sit amongst the young audience.

But throughout *Star-land* there are frequent images of a "demonstrator" who bears no physical relation to Ball at all (fig. 11). This bearded man could be an RI demonstrator or assistant, but this seems unlikely when Ball refers to himself performing his own demonstrations – 'for you see I have a small iron ball in one hand and a cork in the other (fig. 42)' (pp. 110-111).[60] Perhaps he is not based on anyone in particular, his anonymity designed to have readers focus on his actions rather than on Ball's celebrity. Or perhaps the illustrations have been lifted from elsewhere. Ball does not mention who the illustrator was (scientific illustrators often went unnamed) and, although it is signed, I have not been able to trace the illustrator.[61]

[60] '(fig. 42)' refers to Ball's original text.

[61] There are no entries for illustrators working with Ball in the University of Stuttgart's *Database of Scientific Illustrators 1450-1950*. The database lists over 10,000 scientific illustrators. <http://www.uni-stuttgart.de/hi/gnt/dsi2/index.php?function=show_static_page&id_static_page=1&table_name=dsi> [accessed 14 September 2016].

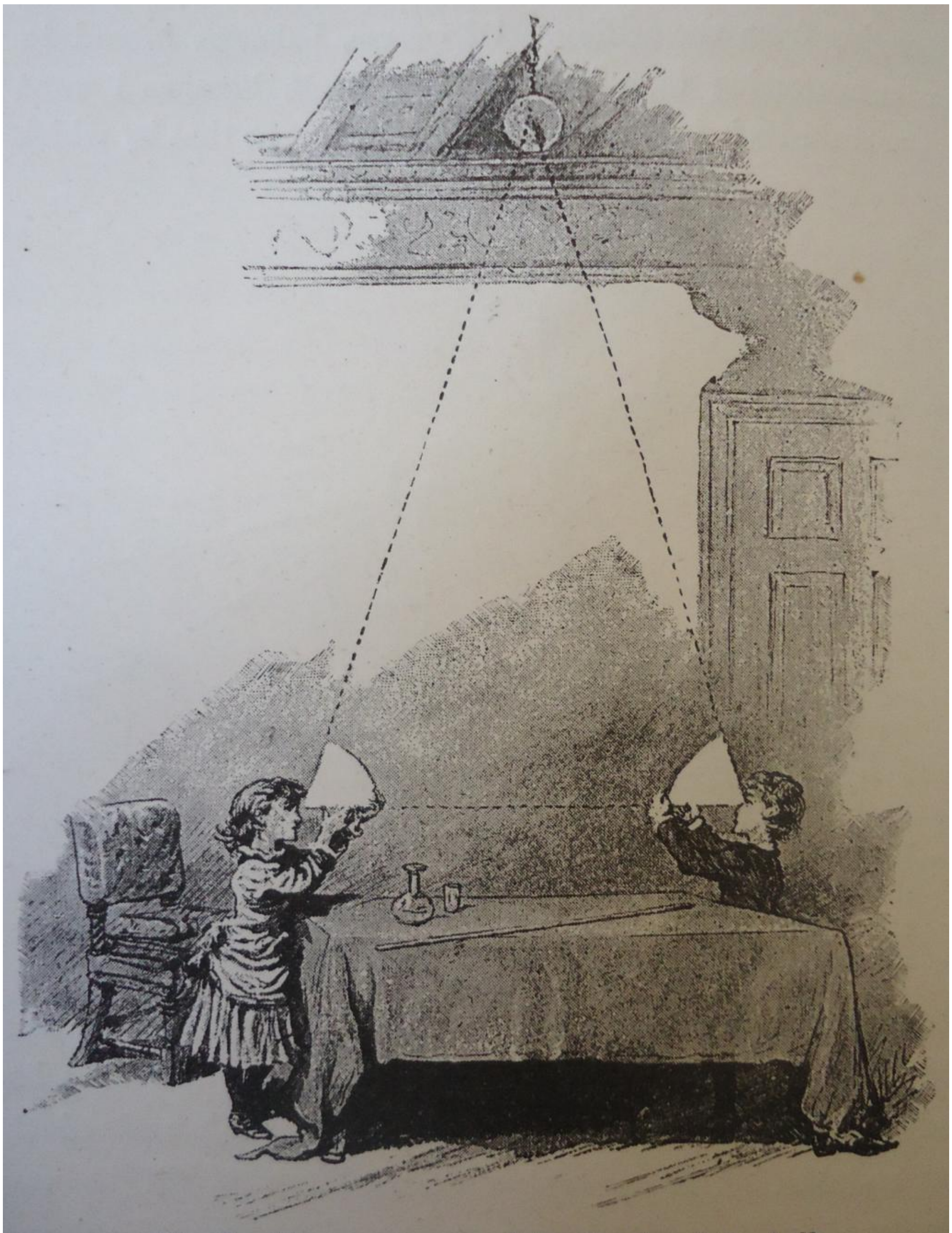
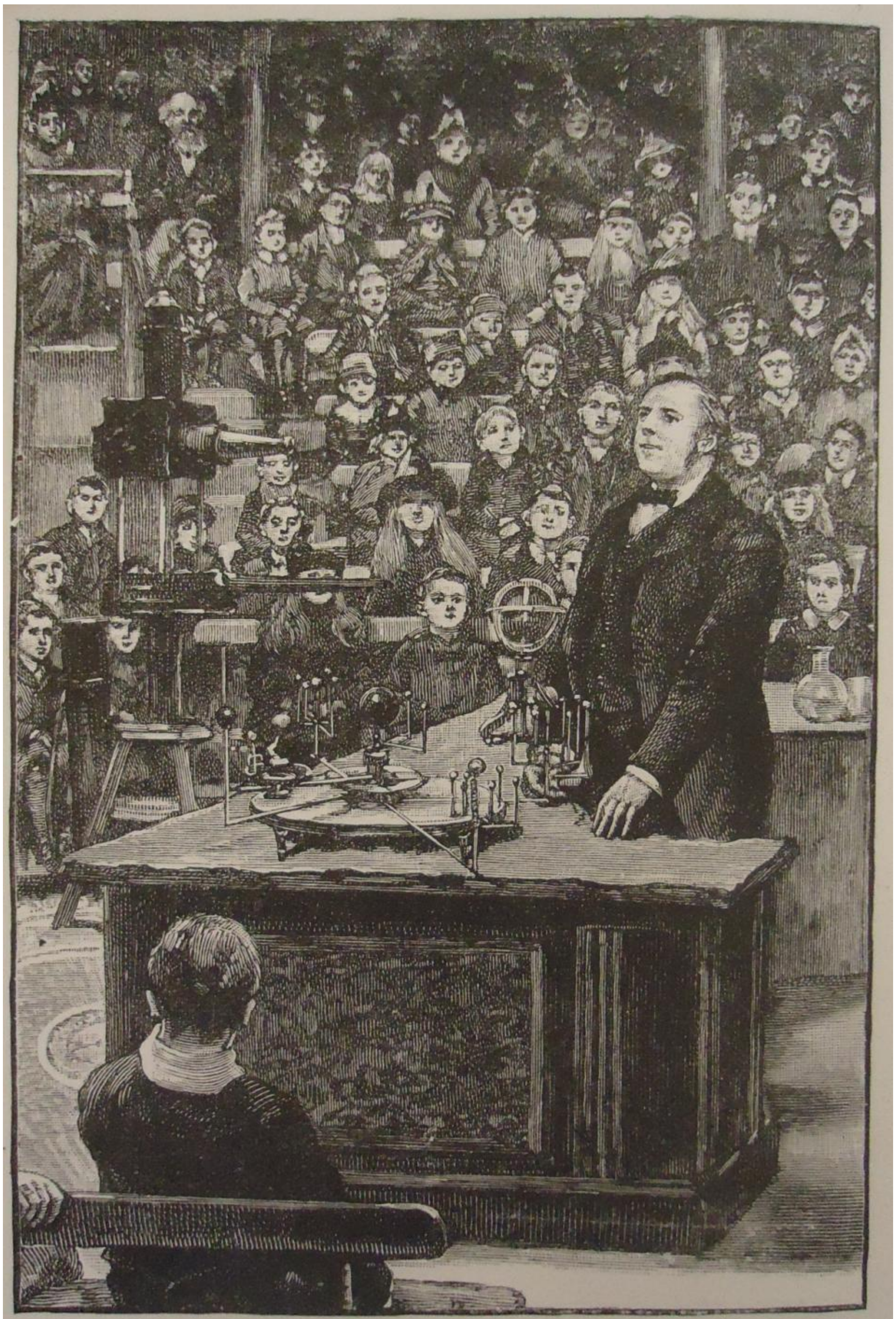


Fig. 5.—How we measured the height of the ball.

Fig. 9.[62]

[62] Ball, *Star-Land*, p. 20.



A JUVENILE LECTURE AT THE ROYAL INSTITUTION.

Fig. 10.[63]

[63] Ibid., n.p.

Fig. 42.—An Iron Ball and a Cork fall in the same time.

Fig. 11.[64]

Textual Apparatus

The textual depiction of demonstrations via images and language might represent a terminus in the chain of lecture communication: from manuscript plan, to actualization, and finally a return

[64] Ibid., p. 112.

to the text. But in some cases there is an extra link in this chain, where texts are designed to enable the real-world replication of demonstrations. In these cases the texts might be seen as transitional stages which are designed not to facilitate an imaginative re-staging of the lecture, but rather to act as an instruction manual. I want to suggest that in some cases texts can actually become part of the apparatus of scientific practice; without the text being present in the classroom or the home, demonstrations could not be replicated.

Ball's first book publication, *Experimental Mechanics*, was based on a series of twenty lectures given at the Royal College of Science for Ireland in 1870. While students were normally enrolled at the College for three years, this shorter series was 'addressed to artisans and others unable to attend ordinary classes'.[65] Like Tyndall, Ball believed that '[b]y actually seeing the truth of results with which you are theoretically familiar, clearer conceptions may be produced, and perhaps new lines of thought opened up' (p. 1). *Experimental Mechanics* contains no reference to the lecturer, who is referred to in the preface as the third person 'the Author' (p. vii) whose practice is 'to allow his pupils to share in the performance of the experiments'. This sharing is not, however, through a textual proxy for the empirical witnessing of the demonstrations themselves. Ball built lecture apparatus based on Robert Willis's *A System of Apparatus for the Use of Lecturers and Experimenters in Mechanical Philosophy* (1851), which could be rearranged in different ways for multiple experiments. By its second edition, *Experimental Mechanics* included an appendix detailing the specific dimensions of this apparatus, which 'generally have been chosen as to produce models readily visible to a large class'.[66] The teacher of natural science:

> wants [...] apparatus of substantial proportions visible from every part of the lecture room [...] He wishes it to be composed of well-designed and well-made parts that shall be strong and durable, and that will not easily get out of order. He wishes those parts to be such that even persons not specially trained in manual skill shall presently learn to combine them with good effect.
>
> (2nd ed. pp. vii-viii)

[65] R. S. Ball, Preface to *Experimental Mechanics: A Course of Lectures Delivered at the Royal College of Science for Ireland* (London: Macmillan and Co., 1871), pp. vii-ix (p. vii).
[66] *Experimental Mechanics* [...] 2nd edition, (London: Macmillan and Co., 1888), pp. 345-346.

Ball's language calls attention to the materiality of his volume and its intended role as a clear guide: just as Willis's apparatus is solid, reliable, and can be rearranged to perform a multitude of experiments, so *Experimental Mechanics*, with its clearly delineated sub-headings and numbered paragraphs, is a useful classroom tool. Visibility is central, and for Ball it is a literal and not a figurative image. Furthermore, we are reminded of Ball's own method of writing lectures: prologue, interludes, groups of slides, and epilogue, interchangeable units which could be restructured as required.

When *Experimental Mechanics* went into a second edition in 1888, twenty years after the original series had been delivered, it was published as part of Macmillan's *Manuals for Students*. As part of an instructive series, the work was definitely pitched as an educational tool, suited to the classroom. Such an environment suggests greater interaction between addresser and addressees: students are conceived of less as spectators of classroom demonstrations than the audience of a popular lecture, and more like active participants. Their involvement in the demonstrations was not just visual but also tactile. It is in this tradition that Tyndall published his *Lessons in Electricity at the Royal Institution 1875-6*, a small, profusely illustrated volume of just over 100 pages, based on his RI Christmas Lectures. It is packed with illustrations which show how the experiments should be carried out. Disembodied hands carry out each stage simultaneously:

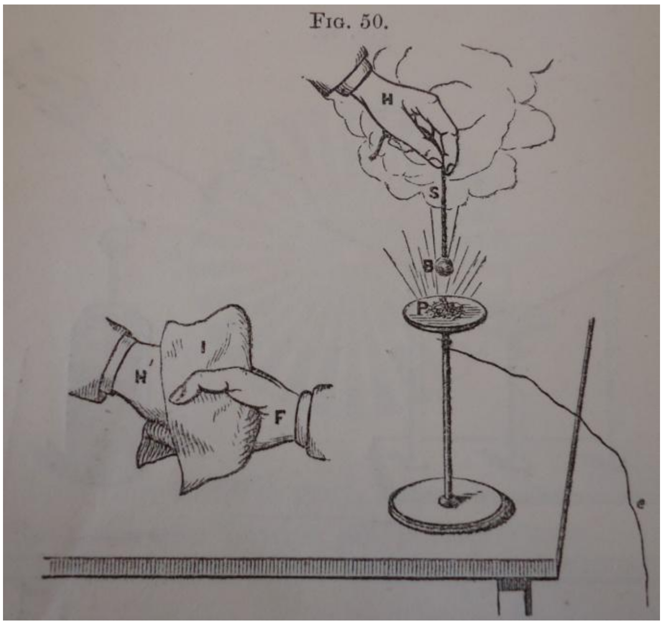


Fig. 12.[67]

By calling them "lessons" Tyndall turns what would have been large-scale lectures in which an authoritative scientist produces impressive and difficult displays, into smaller interactive exercises. His target audience is two-fold: teachers (to whom he makes a special plea in his conclusion to teach science to their pupils (pp. 111-112)), and children who might use their pocket money to perform science experiments of their own. These child-friendly experiments include how to make a lemon light up using sparks from a Leyden jar (p. 85), and how to cause gunpowder to explode (p. 88). His aim is to illustrate 'what could be done, in the way of discipline and instruction, by experimental lessons involving the use of apparatus so simple and inexpensive as to be within everyone's reach' (p. viii). Rather like the book-length versions of Tyndall's other lectures (as opposed to the pamphlet notes distributed both during and after the lecture), *Lessons in Electricity* details more than simply the demonstrations performed, although it does tend more towards a textbook style. It is an instruction manual both in doing electrical experiments *and* in scientific method. Like so many of Tyndall's popular works it is a manifesto for empirical science: '[t]he art of producing and extending [scientific] facts, and of enquiring into

[67] John Tyndall, *Lessons in Electricity at the Royal Institution 1875-6* (London: Longmans, Green, and Co., 1876), p. 88.

them by proper instruments, is the *art of experiment*' (p. 4), with skill in this art being acquired through repetition (p. 5). In referring to experiment as 'art' Tyndall paints the scientist as a craftsman, producing an object (or scientific theory) which is both beautiful and useful. It is here that we can see the asceticism and emphasis on morality of the scientific naturalist. In his final address to the teacher Tyndall calls skills in science a 'still more precious intellectual discipline' (p. 111) than the actual knowledge that is acquired.

With the responsibility for experiments transferred onto the reader, *Lessons in Electricity* is largely devoid of references to the original RI Christmas Lectures. Readers are addressed as though by a teacher, and where we are used to the first person narrative of the lecturer performing demonstrations, giving himself electric shocks etcetera, we get descriptions of what the *reader* ought to be feeling:

> I will now ask you to charge your Dutch metal electroscope (fig. 7) positively by rubbed gutta-percha, and to charge it negatively by rubbed glass. A moment's reflection will enable you to do it. You bring your excited body near: the same electricity as that of the excited body is driven over the leaves, and they diverge by repulsion. Touch the electroscope, the leaves collapse. Withdraw your finger, and withdraw afterwards the excited body: the leaves then diverge with the opposite electricity.[68]
>
> (p. 47)

Imperatives which instruct the reader are mingled with present tense descriptions, as though the experiments are being undertaken in real-time, the book lying open on the work bench. Tyndall, giving his reader a 'moment's reflection' to carry out his instructions, writes a pause into the text; the young experimenter is given time to read, understand, and perform. These linguistic markers and clear diagrams *inside* the book's cover, compliment *Lessons in Electricity*'s diminutive size; its linguistic and material forms advertise the book as experimental equipment. As such it exemplifies scientific naturalism's aim: the text is, as far as is possible, subordinate to experiment, even to the point of becoming an experimental instrument.

[68] '(fig. 7)' refers to Tyndall's original text.

Lessons in Electricity also includes a price list of apparatus which, although Tyndall writes that he 'should like to make these pages suitable for boys without much pocket-money' (p. 7), can be purchased in its entirety for the relatively large sum of 5*l* 10*s* – expensive even with substantial pocket money. While many of the experiments might be carried out without expensive equipment – and Tyndall was adamant that this should be the case – they may still only be carried out by teachers who have the time, and children who have the leisure time (very much like the children who could attend the RI Christmas Lectures). Both Tyndall and Ball did, however, believe in the widening of access to scientific education, and *Lessons in Electricity* and *Experimental Mechanics* serve to illustrate this. A note at the beginning of Tyndall's volume reads: '[a] Price List of the Apparatus suitable for the experiments described in these Lessons will be found at the end of the volume. The prices are very reasonable, but the teacher or learner may materially reduce the cost by becoming his own instrument maker' (n.p.). This comment hints at a Tyndall reluctant to shut any reader out of science on grounds of cost. It also, significantly, shows how much he values the skill of being able to produce one's own apparatus, and therefore to have a real understanding of it. Here we can see why, in his other texts, Tyndall is so eager to lay out the workings of his demonstrations to readers who cannot see them: to fully understand the science one must first understand the 'art of experiment'.

Here, as with the lecture form itself, Tyndall borrows from an existing tradition: science instruction for children, in which readers are encouraged to replicate experiments at home. *The Boy's Own Paper* (1879-1967), for example, included serialized fiction and non-fiction (often concerning exotic adventures with a moralizing outcome), poetry, games, and articles on history and science. Many of these latter in the nineteenth century were written by the popular lecturer J. G. Wood. Richard Noakes points out that 'recent bibliometric work by David Reed has shown that of fourteen leading popular magazines published in Britain and America in the 1890s, the *BOP* contained one of the highest percentages (approximately 6 per cent) of material on topics relating to science, technology, nature, and health'.[69] An analysis of the content of the *BOP* draws parallels with the multiple purposes of the science lecture for children. Taking as one example an issue from Saturday 15 February 1879, we find: instalment number 6, 'The Lime Light' of A. A. Wood's series 'Evenings at Home. Pleasant Hours with the Magic-Lantern' (much of which can be found word for word in his *Magic Lanterns* manual (1885)) (p. 80); 'Conjuring, by a Professor of the Art' (pp. 75-6), instructions on how to perform various magic tricks to an audience at home; a fold-out chessboard with card chess pieces; and a dialogue entitled 'A Talk About Tops'.[70] The latter is a dialogue between a pupil who is playing with a spinning top, and his teacher, who uses the occasion to teach the boy about centrifugal force, inertia, and friction. It is part of a tradition of a question and answer structure in nineteenth-century children's popular science texts: '"Why does it go round?" "'Cause it can't stop, I suppose." "Right again. But why can't it stop? I'll tell you [...]"'. The more knowledgeable teacher leads the child on a journey of understanding. This genre encourages the acquisition of scientific knowledge; it also aims to teach the child how to *think scientifically*:

> The boy who had answered the first two or three questions with readiness, opened his mouth again to reply, but shut it after a few moments without having said anything. He began to *think* instead, like a sensible fellow.

This is precisely what Tyndall wants his audience to do, illustrated by the passage quoted earlier in which he writes in a pause for 'reflection'. The *Boy's Own Paper* brings together science, teaching, showmanship (in performing magic lantern shows and magic tricks), and home experiment, in much the same way as Tyndall does in *Lessons in Electricity*. This tradition of making, doing, and observing, meant that Tyndall could encourage children, who were already enthusiastic, to perform their own scientific experiments. In Tyndall's hands this enthusiasm was redirected towards empiricism, whether or not his young audience knew it.

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[69] Richard Noakes 'The *Boy's Own Paper* and Late-Victorian Juvenile Magazines', in *Science in the Nineteenth-Century Periodical: Reading the Magazine of Nature*, ed. by Geoffrey Cantor et al, pp. 151-171 (p. 153).
[70] *Boy's Own Paper*, 1 (Saturday 15 February 1879), 70.

Conclusion

The demonstration lecture was an effective realization of the scientific naturalists' belief in empirical science, an opportunity for them to display a commitment to 'mechanical objectivity'. Putting demonstrations and photographic slides before their audience, Tyndall and Ball shortened the distance between the non-specialist and the research of the laboratory and observatory. But these were also cleaned-up versions of that experience, meticulously rehearsed and simplified; as such they could never be an adequate demonstration of scientific "truth" in the form which Tyndall, Ball and their colleagues would have recognized. Tyndall treated his lectures as dramatic performances, because he aimed to portray not the validity of his scientific argument (he was confident that was true) but to convince the audience of the validity of his methods and his own qualifications to perform them. Ball's reasons for planning his lectures so meticulously was more commercial: he needed to put on a good show. But he also believed, like Tyndall, that '[s]eeing is believing' (*Star-Land* p. 49), and his meticulous control over performance was an attempt to ensure that his audience would see exactly what he wanted them to see. To demonstrate with certainty that either scientist actually achieved these goals would be impossible. No amount of planning and rehearsal could entirely remove the possibility of an accident, a sudden attack of nerves, or a rowdy audience. Success was contingent upon many factors and so, when lectures were transferred to print, the temptation to present an idealized version of the performance would have been strong. But in print, the number of unknowns is multiplied even further. This is not only because intermediaries such as shorthand writers and editors influenced the text (when Ball objected to being recorded in shorthand for *Star-Land* because this would preserve his mistakes, his publisher replied that this was exactly what he hoped would be kept in the book).[71] A demonstration, described as perfect in every way, may not be understood by a number of readers because the light, smell, or sound produced could not be replicated by the text. Actions

[71] Quoted in Lightman, *Victorian Popularizers*, p. 408.

rendered as two-dimensional illustrations were certain to have a different impact on a reader, as would the temporal differences between reading a text and having the opportunity to return to passages at will, and the real-time narrative flow of a live lecture. Audiences other than those at which the original lecture was aimed might pick up a copy, and be put off by the simpler tone of a children's lecture, or the assumed knowledge of a longer adult series. It could be argued that texts such as Tyndall's *Lessons in Electricity* which were stripped of the details of performance, by allowing readers to replicate experiments in their own homes, provided the best chance that an audience would accept the validity of Tyndall and Ball's empirical methods. But, just as we cannot say who read the texts, where and how, we cannot ascertain whether these more instructive texts were practically put to use, or whether readers constructed a fantasy version in which the celebrity lecturer performed.

Celebrity status contradicted everything the ascetic, objective scientist stood for, but the confidence of these men meant they could present themselves as authoritative and in control over nature. Self-presentation, not self-effacement, was central to the image and rhetoric of the scientific naturalists. Tyndall and Ball therefore exemplify the paradoxical necessity that many scientific naturalists, apparently selflessly devoted to the higher causes of science, consciously engaged with a culture of celebrity, platform presence and rhetorical showmanship, to argue for a protected, even venerated, notion of pure and objective science. But can they be said to represent all professionalizing scientists during this period? Physics and astronomy were perhaps more appropriate subjects for demonstration lectures, and quicker to adopt modern scientific methods than, for example, botany or geology.[72] One could argue therefore that these scientists were in a better position to use the popular lecture to persuade their audiences. In the biological sciences, other strategies of speech were adopted, in particular by one of the fiercest advocates of scientific naturalism, Thomas Huxley.

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[72] Daston and Galison, *Objectivity*, p. 105.

Chapter 2

Sermons and Satire: Speaking for the Biological Sciences in the Mid-Victorian Popular Press

On 19 October 1861, a small cartoon appeared in *Fun* magazine, depicting a man standing before an audience, arm-in-arm with a gorilla (fig. 13).[1] The figure is not named, but is clearly meant to resemble the Baptist preacher Charles Haddon Spurgeon. Their stances mirror each other, arms raised as though at the height of oratorical fervour during the delivery of a sermon, their bodies of similar shape and their eyes looking out to adjacent corners of the room. The gorilla wears an amused expression. The audience's gaze is fixed on the pair, as is the reader's as she looks over the shoulders of those sitting in front. As a consequence of this perspective the reader is made to participate, indirectly, in an event which really did happen. Spurgeon had delivered a lecture entitled 'The Gorilla and the Land He Inhabits' on 1 October at the Metropolitan Tabernacle, his chapel in Elephant and Castle, London. During that lecture he was joined on stage by a stuffed gorilla. This particular specimen was on loan to Spurgeon from the French-American explorer Paul Belloni du Chaillu who, in the early 1860s, like Spurgeon and the gorilla itself, was nothing short of a celebrity. The convergence of all three at the Tabernacle (du Chaillu was in the audience), created a sensation.

[1] 'Scene at a Late Meeting', *Fun*, 19 October 1861, p. 50.

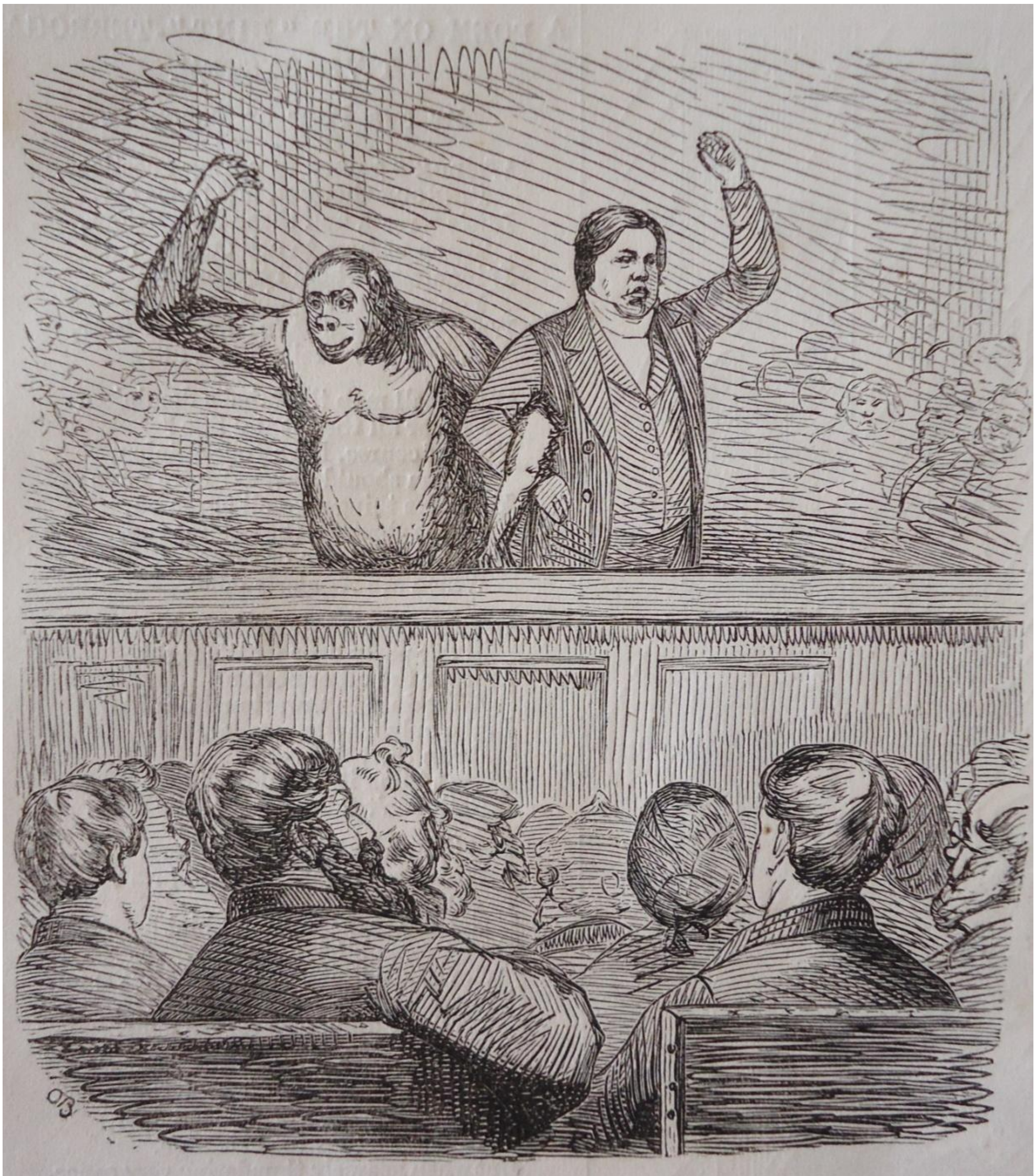

Fig. 13.

In May of that year, du Chaillu had published *Explorations and Adventures in Equatorial Africa*, a work which detailed the land, people, plants and animals (especially gorillas) he had encountered during an expedition through western equatorial Africa between 1856 and 1859.[2]

[2] Paul B. du Chaillu, *Explorations and Adventures in Equatorial Africa: With Accounts of the Manners and Customs of the People, and of the Chace of the* Gorilla*, Crocodile, Leopard, Elephant, Hippopotamus, and Other Animals* (London: John

The book whetted the appetite of a public already hungry for discoveries concerning the gorilla, and immediately caused mixed reactions among both expert and non-expert communities. Many leading members of the scientific establishment accused du Chaillu of inaccurate reporting and scientific fraud. Surprisingly, Spurgeon, a preacher who admitted that he had no expertise in the area, and that he had read the work first and foremost for the pictures, defended *Explorations* from many of these attacks. The fact that Spurgeon felt that he had something to say about the gorilla at all suggests that when science entered the public sphere, it became common currency. A preacher was not excluded from contributing to a collection of public scientific performances because there was no single, accepted model of scientific authority. This chapter explores the ways in which science was communicated to a non-expert audience through a performance by a non-scientist, before moving on to consider how a performance by an expert, to a largely expert audience, was (mis)translated via multiple textual versions, particularly in the form of satire. Spurgeon did not move in the same circles as Huxley. Both were prolific public speakers, however, and it is for this reason that a comparison is fruitful. Beginning with Spurgeon's turn upon the scientific stage, it suggests that speakers took advantage of the similarities between the platform and the pulpit. Scientists and preachers were engaging in acts of persuasion when they took to the public stage, and the ways in which speakers used their voice, body, and surroundings to enhance the rhetorical effect of their words were captured in written accounts. Through this process of (mis)translation, there was potential for meaning to be altered by an ever increasing number of reporters and editors. With the speaker physically separated from his reading audience, possibilities for interpretation were multiplied; if the speaker did have an intended message, it became increasingly difficult to find.

While the popular lecture was an extremely effective way to persuade a non-professional audience of the truth of a scientific idea, it was also particularly volatile when it moved into print.

Murray, 1861). Joshua Olivier-Mason has recently suggested that Huxley's *Man's Place in Nature* may be read 'as, in part, a response to Du Chaillu's text', '"These Blurred Copies of Himself": T. H. Huxley, Paul du Chaillu, and the Reader's Place Among the Apes', *Victorian Literature and Culture*, 42 (2014), 99-122 (p. 100).

In a period in which, as Diarmid Finnegan points out, oratory was an 'obsession' which 'wielded an immediate and more diffuse influence not separable from print culture',[3] the textual evidence of public oratorical events is vast. The existence of so many different textual versions of performances forces us to ask fundamental questions about the relationship between speech and writing and, for this chapter in particular, the influence that genre could have on scientific truth claims. What effect did the misreporting of information (accidental or deliberate) have on the success with which scientific meaning was communicated to a non-specialist audience? A focus on two public performances by the biologist Thomas Huxley, will help to answer these questions. As will become clear, speech of different registers, transposed into different settings, was of central importance both to scientific naturalists and to their opponents.

'THE HEIGHT OF EGOTISM. – SPURGEON Lecturing on the Gorilla'

Soon after returning to the United States from Africa, du Chaillu began delivering popular lectures on his findings.[4] These were illustrated with just a selection of the many thousands of specimens he had brought back.[5] Du Chaillu's popularity with the public who attended his lectures may be explained in part by the exotic nature of his specimens, and partly by the mysterious background of the lecturer himself. The date and place of his birth are unknown, and the veracity of his tales clouded by the hyperbole of adventure narrative.[6] Nevertheless, a writer who claimed to have endured fifty attacks of African fever, 'famine, long-continued exposures to the heavy tropical rains, and attacks of ferocious ants and venomous flies' (p. viii), to have heard

[3] Finnegan, 'Exeter-Hall Science and Evangelical Rhetoric', pp. 46-47.
[4] Title quotation from 'The Height of Egotism', *Punch*, 19 October 1861, p. 154.
[5] Preface to *Explorations* pp. iii-ix (p. viii). Du Chaillu claims to have shot over 2000 birds and 1000 quadrupeds.
[6] On fictional elements of travel writing published by Murray and established before du Chaillu's work, see *Travels into Print: Exploration, Writing, and Publishing with John Murray, 1773-1859*, ed. by Innes M. Keighren, Charles W. J. Withers, and Bill Bell (Chicago: University of Chicago Press, 2015), esp. chapter three, 'Writing the Truth: Claims to Credibility in Exploration and Narrative', pp. 68-99.

the chilling roar of the gorilla, and who lectured while flanked by the skulls of his prey was, at least, a worthwhile entertainment. The scientific elite also saw value in courting du Chaillu. His specimens, of gorillas in particular, were highly sought after. But the quality of those specimens, and the accompanying book, met with much criticism. The veracity of what appeared in *Explorations* was quickly disputed, from inaccurate dating (which the explorer claimed was because he chose to arrange his narrative so as 'not to take [his] reader backwards and forwards',[7] dealing with events thematically rather than chronologically), to plagiarized illustrations. John Edward Gray, Keeper of the Zoological Collections at the British Museum, criticized du Chaillu in the pages of the *Athenaeum*, arguing that *Explorations* contained 'improbable stories', and illustrations taken from specimens 'without acknowledgement'. Most damning of all, Gray claimed that du Chaillu had discovered nothing new.[8] Gray's criticisms centred on du Chaillu's failure to maintain basic standards of scientific practice and academic etiquette. '[T]ruth and science', he asserted, required him to point out these mistakes: '[w]e are overburdened with useless synonyma, and Natural History may be converted into a romance rather than a science by travellers' tales, if they are not exposed at the time'.[9] Gray believed that scientists had a responsibility to police the genre in which discoveries were reported, so that they might not become associated with fiction in the public's mind. As Janet Browne has vividly put it, du Chaillu 'was a charlatan whose reputation oscillated as wildly as the truth of his stories'.[10] When his findings were exposed to public and scientific scrutiny, it was not du Chaillu himself, but several other speakers, who rose to defend the work.

Spurgeon delivered his weekly sermons using very few notes. Taken down in shorthand, and revised by the preacher the following Monday, they were then published as pamphlets.

[7] Notice to Second Edition (June 1861) of *Explorations* pp. ix-x (p. ix).
[8] John Edward Gray, 'The New Traveller's Tales', *Athenaeum*, 1751 (18 May 1861), 662-663 (p. 662). For a detailed discussion of this debate see Stuart McCook, '"It May Be Truth, but It Is Not Evidence": Paul du Chaillu and the Legitimation of Evidence in the Field Sciences', *Osiris*, 2nd series, 11 (1996), 177-197 (p. 187).
[9] Gray, p. 663.
[10] Janet Browne, *Charles Darwin: The Power of Place*, 2 vols (London: Jonathan Cape, 2002), II, p. 156.

During the second half of the nineteenth century it was common for preachers to publish their sermons as pamphlets or in magazines. But Spurgeon was particularly prolific: his penny weekly sermons achieved an average circulation of 25-30,000, and between 1855 and 1917 around 3,500 of his sermons were published, reaching an international readership.[11] He may not have been a man of science, but Spurgeon's support of *Explorations* would have reached a wide audience of listeners, who had paid between 6*d* and 2*s* 6*d* for a ticket,[12] and readers of the 2*d* pamphlet version.

Spurgeon also encouraged his congregation to attend his popular evening lectures on history and science, the content of which had 'an eye to spiritual good as well as to secular education' at the college attached to his church.[13] He 'firmly believe[d] that lectures upon useful and scientific subjects in which the lecturer is able to throw out hints about dress, cookery, children, cleanliness, economy, temperance, and the duties of the household [...] may be very useful' (p. 2). Bringing the lecture audience out of the classroom and into the Tabernacle itself, Spurgeon adopted the act of lecturing upon scientific subjects in order to give moral teaching, suggesting that secular texts may provide material for the sermon. In *The Gorilla* he did this by levelling his relationship with his audience into one of familiarity and friendship, aligning spiritual work with physical:

> Casting aside all priestly pretences as mere superstition, I meet you as my friends and fellow-labourers every Sabbath-day, and I then endeavour to stir you up to holy labour; and now to-night, on a common week-evening, we meet by way of recreation to talk cheerfully upon an entertaining subject. We want common things treated religiously, and there may be almost as much good achieved by books and lectures on ordinary topics, thoroughly imbued with a religious spirit, as by sermons or theological treatises. All my heavenly

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[11] Robert H. Ellison, *The Victorian Pulpit: Spoken and Written Sermons in Nineteenth-Century Britain* (London: Associated University Presses, 1998), see pp. 44-47 for general publishing practices.

[12] The *Morning Post* puts admission between 6*d* and 1*s*, while the *Manchester Times* notes that the highest ticket price was 2*s* 6*d*. 'Mr. Spurgeon on the "Gorilla"', *Morning Post* (London), 2 October 1861, p. 6; 'Mr. Spurgeon on the Gorilla', *Manchester Times*, 5 October 1861, n.p.

[13] *The Gorilla and the Land He Inhabits. A Lecture Delivered by the Rev. C. H. Spurgeon, in the Metropolitan Tabernacle, Newington, on Tuesday, October 1st, 1861* (London: 1861), p. 2.

> Father's works are my textbooks, and, as a preacher, I have a right to select my subject from either of the great books of creation or revelation.
>
> (p. 1)

Spurgeon believed that du Chaillu's explorations had, indirectly, brought to light the 'demon-vice of slavery' (p. 15) and 'opened the path for the missionary of Christ' (p. 16) through Africa. The witchcraft and superstitions narrated in *Explorations* only served to highlight, Spurgeon believed, the 'ignoran[ce] of a God of love' (p. 14). He was therefore keen to support the book despite its many inconsistencies – it was, in fact, these very inconsistencies which led Spurgeon to trust the author. A liar would not have made so many glaring mistakes: 'if this man be an impostor', Spurgeon argued, 'he ought to have been sharp enough to look well to his pictures [...] The fact is, that this brave man can shoot gorillas, but he cannot sketch' (p. 4).

In a debate which was most concerned with the distinction between fact and fiction, and the scientific truth which Gray felt he must defend, it is fitting that Spurgeon then turned to literary example. In a line which was picked up by several newspaper reports of the lecture,[14] Spurgeon compared du Chaillu to a writer who is particularly known for his experimentation in fictional form:

> De Foe wrote Robinson Crusoe; but it would take ten De Foe's to write Du Chaillu's discoveries in Africa; in fact – he must excuse me – I don't believe that he, or any other man, is possessed of genius enough to compose such a book out of his own head.
>
> (p. 7)

In terms of writers of fictional literary travel narratives, Defoe is the arch-hoaxer. Spurgeon evoked *Robinson Crusoe* to suggest that *Explorations* was too fantastic to be fiction, even that invented by the imagination of Defoe. But as the archetypal faux travel narrative, *Crusoe* also shows that there is no way of telling whether an exotic narrative really is true; the reader cannot

[14] A search for "Spurgeon" and "gorilla" in the *Gale NewsVault* database, refined for publications between 1 and 31 October 1861, gave nineteen results. <http://ezproxy-prd.bodleian.ox.ac.uk:2119/dvnw/advancedSearch.do> [19 September 2016]. Of these and others, reports which mention Defoe include: 'Mr. Spurgeon on the "Gorilla"', *Liverpool Mercury*, 3 October 1861, n.p.; 'Speeches', *Examiner*, 5 October 1861, p. 637; 'Mr. Spurgeon on the Gorilla', *Daily News* (London), 2 October 1861, n.p.

judge its claims to veracity because they cannot travel to the place described. Spurgeon's reference to Defoe thus remains ambiguous, and the newspapers' reporting of this line suggests that contemporaries were aware of the precariousness of du Chaillu's text. Indeed, Spurgeon seemed to be willing to suspend his disbelief in du Chaillu's fanciful narratives because *Explorations* was such a useful tool for him in encouraging missionary work.

Spurgeon did not, however, agree with du Chaillu's conclusion that the gorilla, physiologically, could be placed 'nearer to man than any other anthropoid ape' (*Explorations*, p. 371). He certainly could not agree that animals were related to man through Darwinian evolution. Spurgeon could support du Chaillu's claim that he shot many gorillas, but what he could not support was the suggestion that these gorillas were cousins of man. He therefore staged the lecture, quite deliberately, in order to make clear where he drew this line. Dissolving views were painted for the occasion, but as Spurgeon preferred to lecture without them so as not to break the flow of his discourse, they were not displayed until the end.[15] This meant that it was more likely that the audience's full attention was drawn to the two figures at the pulpit. Reports of the lecture described the stuffed gorilla in several ways: the *Liverpool Mercury* remarked upon its 'formidable build' and 'ferocious grin, showing the whole extent of its huge mouth and teeth, or rather fangs, and holding its right arm in a menacing manner',[16] *The Examiner*, in contrast, noted that the gorilla was 'fixed in Mr. Spurgeon's usual place upon the platform, with one hand on the rail and the other uplifted in the attitude of preaching'.[17] One, a terrifying monster poised as though ready to strike, the other a comical animal inversion of the man of God stood next to him. Both reports are of the same event but they present two very different gorillas. The chairman, Mr Layard, referred to the immediate similarities between the human orator and the gorilla, calling

[15] Spurgeon, *The Gorilla*, p. 9. Spurgeon likened the lecturer who paused for every slide to 'a navigator toiling with a wheel-barrow up a narrow plank, emptying his barrow, then going back for another load'. He preferred to 'be compared to a charioteer, rein and whip in hand, with glowing wheels hurrying with accelerated speed on his journey'.
[16] 'Mr Spurgeon on the "Gorilla"', *Liverpool Mercury*, n.p.
[17] 'Speeches', *Examiner*, p. 637.

the latter (as reported in the London *Daily News*) 'their interesting acquaintance on his right – (laughter)' and discussing 'the probability of a period arriving when Mr. Gorilla would lecture on some Mr. Spurgeon, instead of Mr. Spurgeon lecturing on a gorilla. (Renewed laughter)'. The newspaper was clearly keen to represent the comic tone of the evening. Spurgeon initially colluded with Layard in this act of anthropomorphosis, addressing the specimen with the pronoun 'you', actually turning to face the gorilla as though in conversation: '[a]ny bearded gentleman here who chooses, may claim relationship with the oyster, [...] but I, on my own part, believe that there is a great gulf fixed between us, so that they who would pass from us to you (again turning to the gorilla) cannot' (*The Gorilla*, p. 9). However, after this point, when Spurgeon had fully set out his objections to Darwin, 'you' became 'this brute', then '[t]he gorilla' (p. 10) and '[t]he specimen before us', then a 'he', but a male of an entirely different species. The gorilla, deliberately placed on the stage to resemble the preacher, was emptied of comic potential, before being dehumanized once again.

Spurgeon exploited the physical similarities between humans and gorillas so that he might emphasize their differences, closely and comically embracing his platform partner in order to stress the vast gulf between them. The preacher is eloquent, while the stuffed gorilla is mute. Man communicates using a language system sophisticated enough to construct a lecture to an audience of thousands; if du Chaillu's claims are true, the gorilla roars. That roar was, the explorer wrote, 'an awful noise [...] It begins with a sharp bark, like an angry dog, then glides into a deep bass roll, which literally and closely resembles the roll of distant thunder along the sky' (*Explorations*, pp. 70-71). The gorilla's "speech" is bestial, closer to the sounds of the wild than it is to the human tongue. Another performance on the bill at the Tabernacle that evening, compounded this difference: '[d]uring the evening a choir of 500 children, accommodated in the gallery behind the pulpit, sang a selection of sacred music which had a special application to the object of the society [the event was a fundraiser for a temperance charity]'.[18] The human voice was used not to roar, but to praise God.

Most responses to Spurgeon's lecture were attuned to his light-hearted approach but also had little tolerance for it. Spurgeon had staged the event fully aware of its comic potential, emphasizing the incongruity between speaker and subject matter and yet their physical similarities in order to bring science into the church, to show that it was compatible with some, but in his eyes not all, Christian teaching. The *Daily News* called Spurgeon 'the most histrionic, and consequently the most amusing, of all our popular preachers', and noted that 'in perfect keeping with the character of the preaching is the very theatrical style of the magnificent building'.[19] Reading this report one is immediately struck by the theatricality of the event. The stuffed gorilla is transformed from a scientific specimen into an actor in the scene, and then finally into a stage prop, imbued with human likeness only to be stripped of it once again.[20] Through this process Spurgeon hoped to show how easy it was to make the evolutionary link between man and apes, but also how fragile this link was. However, the similarities between the preacher and the stuffed gorilla, picked up in the *Fun* cartoon, were not lost on *Punch*, who called his decision to lecture on the animal '[t]he height of egotism'. *Fun* suggested that Spurgeon was too late to the gorilla party:

> What sinful worldlings tire of, saints receive;
> The Tabernacle takes what the Ball-rooms leave;
> And last, to brim the creature's bitter cup
> Of misery – lo! Spurgeon takes him up
>
> […]
>
> Rejoice, ye men of sense! The monster's reign
> Is o'er! We ne'er shall hear of him again.
> Who rescues rubbish when 't has reached the gutter?
> So after Spurgeon comes Oblivion Utter!'[21]

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[18] 'Mr Spurgeon on the "Gorilla"', *Morning Post*, p. 6.
[19] 'Mr Spurgeon on the Gorilla', *Daily News*, n.p.
[20] For more on the theatrical nature of evolution and the use of evolution in theatre, see Kirsten Shepherd-Barr, *Theatre and Evolution from Ibsen to Beckett* (New York: Columbia University Press, 2015).
[21] 'The Lord Mayor's Show', *Fun*, 9 November 1861, pp. 74-75 (p. 75).

Their cartoon 'Spurgeon on the Gorilla' (fig. 14) acts as a meta-satire on the tired phrase which was used as the title to the majority of reports of the lecture, at the same time suggesting that Spurgeon was piggy-backing on the gorilla-mania, and compounding the sentiment that had been expressed in verse.[22] The gorilla was himself becoming a society dilettante who, as will be discussed later in this chapter, represented a complex array of Victorian anxieties about class, gender and race. Spurgeon becomes part of this history in the cover illustration to the sheet music for 'Mr Gorilla, the Lion of the Season' by Henry J. Byron (comic dramatist, master of the pun, and occasional contributor to *Fun* magazine) and F. Musgrave (fig. 16).[23] The gorilla-singer is well-read in scientific and popular literature: against a bust of du Chaillu rest works by the Comte du Buffon and Cuvier. Spurgeon appears, erroneously pictured as the author of the Voyage of Hanno (fig. 15). Hanno of the Carthaginians explored a region believed to be Libya in the fifth or sixth century BC, and in the nineteenth century scientists named the gorilla after the 'Gorillae' Hanno reported seeing. Mingling with scientists on the gorilla's bookshelf, Spurgeon is shown to have established his right to speak on the gorilla.

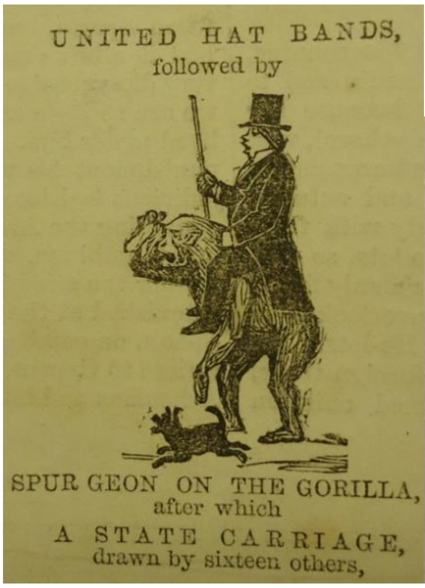

Fig. 14.

Fig. 15.

[22] 'A Fable', *Fun*, 16 November 1861, p. 84. Photograph of copy held by the British Library, British Library Board, General Reference Collection P.P.5273c.

[23] Henry J. Byron (words) and F. Musgrave (music), *Mr Gorilla. The Lion of the Season* (sung by Mr Howard Paul), (London: Hopwood & Crew, [1870?]). See Peter Thomson, 'Byron, Henry James (1835-1884)', *ODNB* <http://ezproxy-prd.bodleian.ox.ac.uk:2167/view/article/4280> [accessed 10 January 2017].

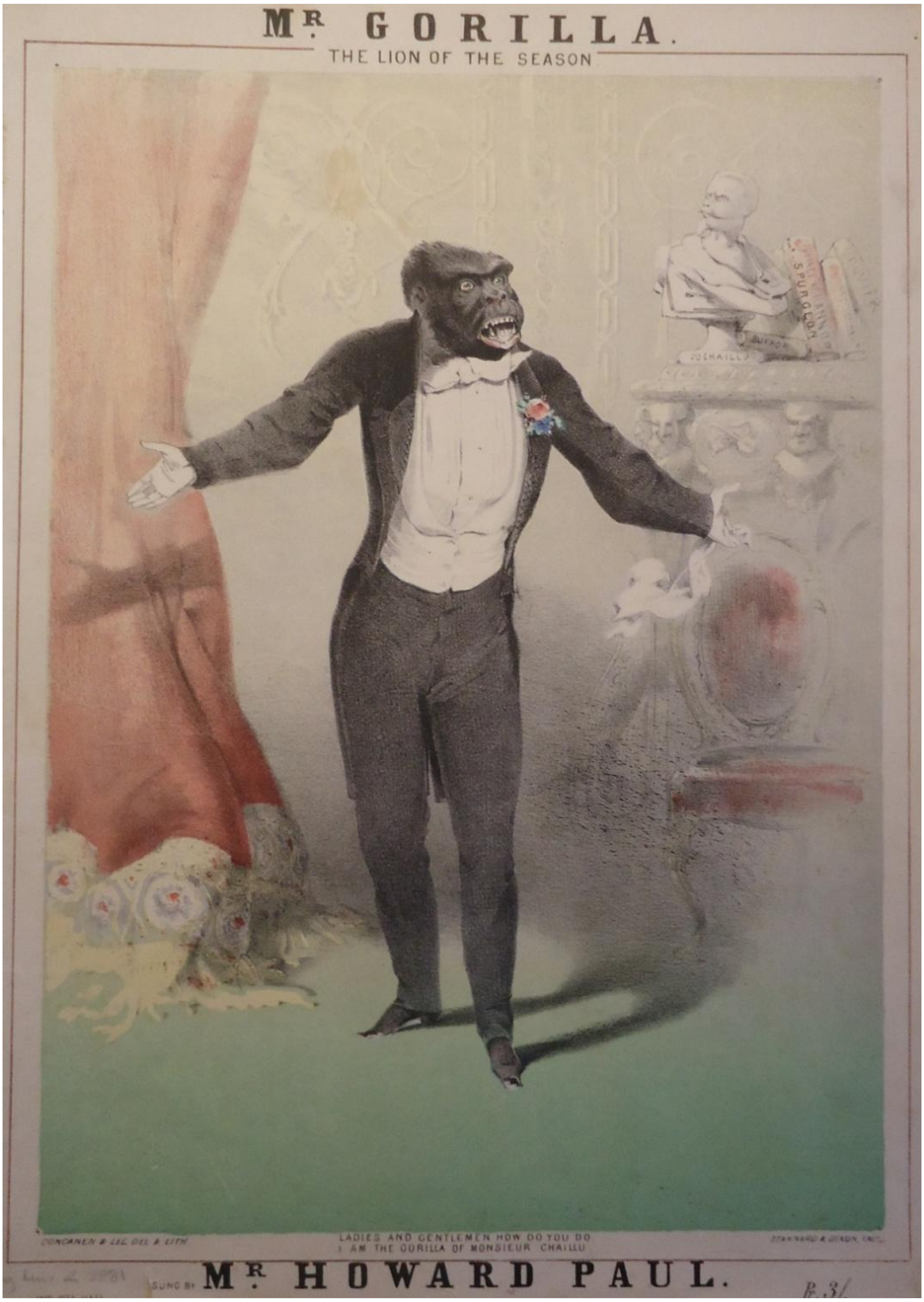
Mr. GORILLA.
THE LION OF THE SEASON
CONCANEN & LEE DEL & LITH
LADIES AND GENTLEMEN HOW DO YOU DO
I AM THE GORILLA OF MONSIEUR CHAILLU
STANNARD & DIXON IMP.
SUNG BY Mr. HOWARD PAUL.
Pr. 3/

Fig. 16.

Lost and Found: A Monkey's Brain and Huxley's Voice

Spurgeon's performance at the Tabernacle may be read as a satire on the popular scientific lecture; bringing the specimen into the pulpit he was able to tap in to the public's interest in the scientific controversy for his own gains. During the three years prior to Spurgeon's performance, the scientific elite had been engaged in a fierce debate about the evolutionary link between man and apes. The leaders of this debate, which was focused on the existence of the 'hippocampus minor' in the human brain, were Thomas Huxley and Richard Owen; their dispute was, as Nicholaas Rupke has put it, 'one of the fiercest, most bitter and most publicly sensational battles between scientific rivals of the nineteenth century'.[24]

The BAAS meetings of the 1860s gathered together eminent British scientists and foreign delegates in the same town to exchange papers and to socialize. The meetings made science an event, drawing attention as much to the quirks of the scientific elite as to the content of their papers. Huxley, in cultivating a reputation as a vociferous defender of Darwin, was acutely aware of the fact that BAAS meetings could provide a large audience, not just of hearers, but of readers of newspaper reports. The most famous of his BAAS performances, and the one which has received the most critical attention, was his clash with Bishop Samuel Wilberforce at the Oxford meeting in 1860. Their debate over evolution, which is supposed to have culminated with the Bishop asking Huxley whether he was descended from apes on his grandmother's or grandfather's side, has become legendary.[25] It is unclear whether those words were actually

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[24] Nicholaas Rupke, *Richard Owen: Victorian Naturalist* (New Haven: Yale University Press, 1994), p. 271.

[25] Adrian Desmond's biography of Huxley stresses that the memory of the event became increasingly vague and subject to hearsay: the Oxford meeting 'drew a huge crowd, 700, some said 1000', *Huxley: From Devil's Disciple to Evolution's High Priest* (Reading, Massachusetts: Addison-Wesley, 1997), p. 277. At the end of the nineteenth century Isabel Sidgwick referred to 'those tremendous words – words which no one seems sure of now, nor I think, could remember just after they were spoken', [Isabel Sidgwick], 'A Grandmother's Tales', *Macmillan's Magazine*, 78 (May 1898), 425-435 (pp. 433-434). Ian Hesketh has written the definitive work on the event: *Of Apes and Ancestors: Evolution, Christianity, and the Oxford Debate* (Toronto: University of Toronto Press, 2009); see pp. 81-82 for an account of the Bishop's famous words.

spoken, or how Huxley responded.[26] Leonard Huxley's *Life and Letters* of his father, published four decades later, persistently employs the language of battle, such as 'adversary', [27] 'force', 'fighting line' and 'field', 'fiercer battle', [28] 'open clash' and 'combat of wit', to describe the meeting, forever confirming Huxley's behaviour as that of attack. And yet, the oratorical skills for which Huxley was so famous, had to be cultivated. Writing to Francis Darwin in 1891, and looking back to 1860, Huxley recalled that '[Joseph] Hooker and I walked away from the meeting together, and I remember saying to him that this experience had changed my opinion as to the practical value of the art of public speaking, and that from that time forth I should carefully cultivate it, and try to leave off hating it. I did the former, but never quite succeeded in the latter effort'.[29] Huxley was therefore aware of the utility of public speaking. Although lecturing was, for him, a financial necessity,[30] the clarity of his lectures was praised by the likes of Darwin and Charles Lyell.[31] The verbal exposition of complex ideas to a non-specialist audience, of 'making things plain to uninstructed people',[32] as Huxley would later put it, 'was one of the very best means of clearing up the obscure corners of one's own mind'.

Two years after Huxley's clash with Wilberforce at Oxford, the BAAS meeting at Cambridge was to become yet another battleground, and it is on this event that I will focus. After Owen had delivered his paper 'On the Zoological Characteristics of Man, with Remarks on the Cast of the Brain of the Gorilla', Huxley responded vehemently. His dispute with Owen over the

[26] Huxley recalls responding: '[i]f then, said I, [Huxley wrote to Dyster] the question is put to me would I rather have a miserable ape for a grandfather or a man highly endowed by nature and possessed of great means and influence and yet who employs those faculties and that influence for the mere purpose of introducing ridicule into a grave scientific discussion – I unhesitatingly affirm my preference for the ape.' Quoted in James Paradis, 'Satire and Science in Victorian Culture', in Lightman (ed.), *Victorian Science in Context*, pp. 143-175 (p. 164).
[27] Leonard Huxley, *Life and Letters of Thomas Henry Huxley*, 2 vols (London: Macmillan and Co., 1900), I, p. 179.
[28] Ibid., p. 181.
[29] Letter from Huxley to Francis Darwin, 27 June 1891, quoted in Huxley, *Life and Letters*, I, p. 188.
[30] Huxley writes to Darwin on 2 July 1863, with a comical A-Z of his daily tasks, many of which involve lecturing, teaching, and editing lectures for print, in *The Correspondence of Charles Darwin*, 21 vols, ed. by Frederick Burkhardt et al (Cambridge: Cambridge University Press, 1985-2014), XI, pp. 515-519.
[31] Letter from Lyell to a friend, 15 March 1863, on the success of Huxley's *Evidence as to Man's Place in Nature* (based on lectures) quoted in Leonard Huxley, *Life and Letters*, I, p. 202; Letter from Darwin to Huxley, 18 December 1862, on Huxley's lectures to working men, 'On Our Knowledge of the Causes of the Phenomena of Organic Nature', *Correspondence of Charles Darwin* X, pp. 611-612 (p. 611).
[32] Preface to *Man's Place in Nature and Other Anthropological Essays* (London: Macmillan and Co., 1895), pp. v-xii (p. ix). *Man's Place* was first published in 1863.

'hippocampus minor' had begun several years before the Cambridge meeting.[33] In 1858 Owen published a paper, 'On the Characteristics, Principles of Division, and Primary Groups of the Class Mammalia', which he had delivered to the Linnean Society the previous year. In it he 'proposed that humans be distinguished from apes, partly on the grounds of a structure unique to their brains, the hippocampus minor, thus creating a new subclass, the Archencephala'.[34] Huxley objected to Owen's theory, denying the existence of the hippocampus minor, and arguing that such physiological differences between humans and apes were overstated. While this battle has attracted attention from historians of science, it would strongly benefit from literary analysis, focusing on the disparities between textual versions of the Cambridge event. The debate was characterized by stubborn repetition and consequent stagnation. Disagreements often stemmed from minutiae: inaccurate diagrams, spoiled samples, and failure to carry out scientific observation or accurate reporting.[35] Further, some of Owen's observations had been made using specimens supplied by du Chaillu, and so carried yet another layer of uncertainty. In the 1863 edition of his *Evidence as to Man's Place in Nature* Huxley repeatedly refers to the scientist's responsibility concerning accuracy; he calls Owen a 'responsible man' who 'might be supposed to have written under a sense of peculiar responsibility, and to have tested, with especial care, the statements he ventured to promulgate'.[36] This '[q]uestioning of evidence', as Adrian Desmond argues, 'rather than acquiescing to Christian authority, now marked a gentleman's moral uprightness'.[37] When Huxley asserted that the issue had become 'one of personal veracity',[38] he brought to the fore Owen's social position as a gentleman, questioning his suitability for this role

[33] I give a brief description of the argument here. For more on the science behind the dispute see Charles G. Gross, 'Huxley Versus Owen: the Hippocampus Minor and Evolution', *Trends in Neuroscience*, 16 (1993), 493-498.
[34] Paul White, *Thomas Huxley: Making the "Man of Science"* (Cambridge: Cambridge University Press, 2003), p. 54.
[35] See for example the debate between the two men in the pages of the *Athenaeum* in the spring of 1861, over the accuracy of the diagrams from Owen's Royal Institution lectures: Huxley, 'The Gorilla and the Negro', *Athenaeum*, 1743 (23 March 1861) 395-396; Owen's letter in response, 1745 (6 April 1861) 467; Huxley, 'Man and the Apes', 1746 (13 April 1861), 498.
[36] Thomas Huxley, *Evidence as to Man's Place in Nature* (London: Williams and Newgate, 1863), p. 114.
[37] Adrian Desmond, 'Redefining the X Axis: "Professionals", "Amateurs" and the Making of Mid-Victorian Biology – A Progress Report', *Journal of the History of Biology*, 34 (Spring 2001), 2-50 (p. 13).
[38] Huxley, *Evidence* (1863), p. 118.

due to what Huxley saw as inappropriate behaviour for a scientist. Owen had failed not only to make accurate observations, but also to uphold a moral responsibility to communicate truthfully to his audience. With Owen repeatedly promulgating what he took to be "lies", Huxley was itching to expose such irresponsibility.

At 11am on Friday 3 October 1862, Section D (Zoology and Botany) of the BAAS met in the hall of Gonville and Caius College, Cambridge. The audience anticipated a fight, and 'some time before the hour of the meeting [the hall] was well filled by ladies and gentlemen' and 'for some portion of the proceedings it was densely crowded'.[39] Quite which 'portion of the proceedings' attracted so much attention is not made explicit, a tacit recognition perhaps of the fame of the hippocampus dispute. In a report in *The Times*, attention is drawn to the scene of address, the illustrious audience which included du Chaillu, Professor Kingsley and William Whewell, and the appearance and manner of the speakers. There are only brief quotations from or summaries of Huxley and Owen's speeches. The report begins:

> Dr. Cookson, Master of St. Peter's College, one of the vice-presidents, in taking the chair, said he was sorry to announce that their President, Professor Huxley, was unable from the state of his voice to preside, and had devolved that duty on him as one of the vice-presidents of the action. He hoped that they should not be altogether deprived of the services of the Professor; perhaps he was reserving himself for those discussions which would form the principal business of the meeting. (Cheers.)

The formal disconnection between the written, third person report and the ephemeral speech which it tries, in part, to reconstruct, creates an atmosphere of anticipation which builds towards an event that is about to happen, that is about to unfold before the reader, rather than reporting that which has already taken place. Huxley's silence, it is implied, is a politically motivated move, here pitched in contrast to the aural resonance of the audience's '(Cheers.)'. Both listener and reader anticipate a crescendo, up to a vocal peak and entertaining finale. That tension is finally

[39] 'British Association for the Advancement of Science', *The Times*, 4 October 1862, p. 7.

released when, after Owen has delivered his paper, Huxley accuses him of repeated falsehood and deception:

> Professor Huxley observed that the paper just laid before the section appeared to him in no way to represent the real nature of the problem under discussion [...] Several years ago Professor Owen had made three distinct assertions respecting the differences which obtain between the brain of man and that of the highest apes [...] In a controversy which had lasted for some years, Mr. Owen had not qualified these assertions, but had repeatedly reiterated them. He (Professor Huxley), on the other hand, had controverted these statements [...] He (Professor Huxley) now appealed to the anatomists present in the section to say whether the universal voice of Continental and British anatomists had not entirely borne out his statements and refuted those of Professor Owen.

The necessary repetition of the third person 'Professor Huxley', so that the reader might know who said what, persistently situates the scientist's speech in relation to his profession and the authority that the title 'Professor' carries. Calling on that 'universal voice' Huxley insists that the wider scientific community must be, in its entirety, either for or against Owen. The anatomists George Rolleston and William Flower provided that voice; the former 'concluded by saying that if he expressed himself with any unnecessary vehemence he was sorry for it, but that he felt there were things less excusable than vehemence, and that the laws of ethics and love of truth were things higher and better than were the rules of etiquette or decorous reticence'. A commitment to scientific truth through empirical method was, during this period, increasingly accepted as correct practice, by contrast with the methods of an earlier generation of gentlemen of science. Like Huxley, Rolleston undermines the authority of conventional gentlemanly behaviour (thereby destroying the argument that Owen, as a gentleman, is making), and in its place posits the scientist who privileges truth over politeness. That the written version of his speech must necessarily lack the tone of delivery only emphasizes its 'vehemence', the limitations of reported speech further enhancing the effectiveness of Rolleston's attack, as readers can only speculate about just how cutting he was. Indeed, when one *Times* journalist questioned the propriety of the exchange, Flower quickly responded in a letter to the editor: '[t]he discussion arose entirely out of certain statements which were put forth by Professor Owen [...] and was confined to an investigation of the scientific value and accuracy of those statements'.[40]

The textual evidence of Flower's attendance highlights the instability of written reports of speech; further scrutiny reveals the anecdotal nature of such texts which may be as much fiction as fact. A year before the Cambridge meeting Flower had been appointed Conservator of the Hunterian Museum, Royal College of Surgeons, at which Owen was also Hunterian Professor. From that time onwards Flower performed dissections of the brains of apes, the results of which supported Huxley's view of the physiological continuity between the higher apes and man.[41] At Cambridge, Flower is said to have stunned the audience by producing a cast of a monkey's brain to support Huxley's attack. According to Charles J. Cornish in his 1904 biography of Flower, the anatomist rose from the crowd to announce, 'I happen to have in my pocket a monkey's brain'.[42] Cornish attributes these lines to a *Times* report of the event. Desmond notes in his biography of Huxley that the President 'had an ape brain brought in and Flower dissect out its hippocampus'.[43] Several scholars since then have assumed that such an act did take place.[44] Where in *The Times* Cornish found this quotation is unclear; a search on the *Gale NewsVault* database for articles relating to the 1862 BAAS meeting, in *The Times* and other newspapers, produces no results which mention Flower and the monkey's brain. The numerous other biographic articles and obituaries relating to Flower that I have consulted, also fail to reference this.[45] Perhaps, like Huxley's retort to the Bishop of Oxford in 1860, that he would

[40] William H. Flower, 'Apes and Orthodoxy: To the Editor of the *Times*', *The Times*, 9 October 1862, p. 11.

[41] 'On the Posterior Lobes of the Cerebrum of the Quadrumana', *Phil. Trans. Royal Soc.*, 152 (1862), 185-201, was read to the Royal Society in January 1862.

[42] Charles J. Cornish, *Sir William Henry Flower: A Personal Memoir* (London: Macmillan and Co., 1904), p. 66.

[43] Desmond, *Huxley*, p. 307.

[44] Jonathan Conlin writes that 'Huxley was pleased to spot [...] William Flower, in the audience. Flower happened to have a monkey brain in his pocket, which he was only too happy to dissect on stage, extracting the hippocampus', *Evolution and the Victorians: Science, Culture and Politics in Darwin's Britain* (London: Bloomsbury, 2014), p. 98.

[45] Some biographies and academic works, like Cornish, Desmond, Conlin, and Flower's *ODNB* entry author, Kate Fletcher, retain the anecdote. Others avoid reference to it, and correctly point out that Flower's published works influenced Huxley: R. Lydekker, *Sir William Flower* (London: J. M. Dent & Co., 1906), p. 104. Sherrie L. Lyons writes that '[t]he matter was finally put to rest in 1862, when Sir W. Flower, in a public dissection of ape brains demonstrated the existence of those cerebral characteristics that Owen claimed were unique to man', 'Convincing Men They Are Monkeys', in *Thomas Henry Huxley's Place in Science and Letters*, ed. by Alan P. Barr (Athens, Georgia:

rather be descended from an ape than from a man who treats scientific discussion so lightly, what Flower really said has become legend.

Whether or not *The Times* did report that Flower produced a monkey's brain, and whether Cornish wrongly ascribed textual evidence to the event to lend authority to anecdote, there is evidence that it really did happen, in a letter written by Flower's wife, Jane Georgiana Rosetta, to her mother. This letter, which has only been addressed briefly in previous scholarship,[46] offers a unique, personal perspective, with the same humorous anticipation of Section D as is found in *The Times*, and sheds new light on the event. Among the social bustle of the meeting we find Huxley and Owen in comically close textual proximity: 'in the midst of <u>such</u> a crowd we had the good fortune to come in the same railway-carriage as M^r^ Huxley, and then arrived at Cambridge, all the flys were engaged – the omnibuses full – however a gentleman in one of the latter held out his hand to assist me in and who should it be but Prof^r^ Owen!'[47] The letter has not previously been printed, so a lengthy extract is provided here:

> M^r^ Huxley had told us that he had been chosen President of a section on the same principle that a poacher is sometimes made a game-keeper, and he had intended preserving the Peace, but then Owen actually had the temerity to bring out a paper on the <u>old</u> subject – the monkey-brains – with all his old errors, and insinuations upon what had further been done by others! so that, as Huxley said, while he had any voice left, he felt it his duty to protest against what was false & maintain the truth – I cannot attempt now to describe the meeting, but it was most exciting & interesting: attracted partly by Owen's name, & partly by expectations of a <u>battle</u>, the other sections were almost entirely deserted and section <u>D.</u> thronged to excess, it holds its' [*sic*] meetings in the beautiful hall of Caius College, and that was as full as possible – indeed rather <u>fuller</u>, with ladies & gentlemen up in the windows, on tables, &^ce^ so that at last even such men as D^r^ Falconer could not gain entrance! then came Owen's paper, very fluently & well delivered, but with such contortions & grimaces & writhings as if even <u>he</u> had difficulty to bring out such untruths! however of course it would be very few of the audience who knew at all what

University of Georgia Press, 1997), pp. 95-118 (p. 108). As well as the Lydekker biography, other nineteenth-century biographies and obituaries of Flower I have consulted are: 'Professor W. H. Flower, F.R.S.', *Biograph and Review*, 6 (1881), 28-32; 'Death of Sir William Flower', *The Times*, 3 July 1899, p. 12; 'Sir William Flower', *Spectator*, 83 (8 July 1899), 47-48; 'Sir W. H. Flower, K.C.B., D.C.L., F.R.S.', *Athenaeum*, 3741 (8 July 1899), 68-69; 'Anthropological Notes', *Athenaeum*, 3743 (22 July 1899), 133. None of these contain reference to the anecdote.

[46] Louise Miskell, *Meeting Places: Scientific Congresses and Urban Identity in Victorian Britain* (Farnham: Ashgate, 2013), p. 123.

[47] Oxford, Bodleian Library (Bod), Letter from Rosetta to her mother, dated 3 October 1862, Papers of the British Association for the Advancement of Science, Dep. BAAS 142, 27-30 (27).

> were untruths, and the interesting paper closed in much applause, – but then Huxley rose, and in the most powerful, masterly manner drew the veil wide & showed the facts free from glamour, producing quite a sensation when he took up the casts of brains on which Owen had just been dilating, and wondered what the Professor could mean by bringing before the meeting what were not casts of real brains! &^{ce} &^{ce} &^{ce}, yet all in such a cool, resolute way as gave the greatest conviction, and he received full applause: then uprose D^{r} Rolleston, and in his bold, energetic manner showed Owen's neglect of the convolutions of the brain &^{ce} &^{ce} but there is not time to describe, only it was a real pleasure to hear his eloquence, and then some one [*sic*] else rose – and there were inquiries as to who he was, some ridiculous people exclaiming "Du Chaillu"! but there was clapping and others said "M^{r} Flower", and then the great crowd were all still to listen to William, only I felt so excited at first that I could scarcely hear, until I saw that he was quite clear & occupied with his subject, and then he enlarged on the hippocampus minor &^{ce} with a brain on the table that he had happened to bring with him! and there was one part of his speech which caused great laughter & applause, altogether it was quite successful – I cannot say how interesting: and this truth at {last?} seems at length established, for when Owen did speak – even with all his cleverness he could not extricate himself, he did not even attempt to disprove the facts that had been showed against him, he only endeavoured to turn the subject as it were; and when M^{r} Molesworth rose rather commending Owen, he was stamped down by the audience, so that his words were lost, – D^{r} Humphry (a Cambridge power & favourite) was listened to in some well-meant endeavour to throw oil on the troubled waters, but he only maintained what Huxley had already done, that the distinction between Man & the lower orders of animals was not to be found in physical but in moral distinctions, however it was a great pleasure to hear him referring in an audience like that, to "the eminent Anatomists Owen, Huxley, Rolleston & Flower"! it is wonderful to think of William's having – at his age too, entered such a group – Owen with his world-wide reputation & undeniable talents & power of work, and Huxley & Rolleston such shining lights not only ~~in~~ intellect, but also in nobleness of mind & fearless love of truth & sight.

Eloquence is equated with truthfulness, confident mannerisms with correct scientific research. Huxley, in his 'powerful, masterly manner' *reveals* scientific 'facts' through eloquent speech. Owen's outward composure cracks under the pressure of the practice of deception. Rosetta's focus on the manner in which Huxley and Owen performed, draws out the contradictory nature of the younger man's behaviour. In one sense Huxley is calm and restrained, relying on his abilities as a performer to expose the weaknesses in Owen's argument. He is, to return to Daston and Galison, the epitome of an objective scientific naturalist, who 'must, as a matter of duty, restrain themselves from imposing their hopes, expectations, generalizations, aesthetics [...] on the image of nature'.[48] Owen, in response, cannot restrain his physical outbursts. Huxley wrote to Darwin that:

> [all] the people present who could judge saw that Owen was lying & shuffling – : the other half saw he was getting the worst of it but regarded him I think, rather as an innocent old sheep, being worried by three particularly active young wolves – He rolled his eyes about and smiled so sweetly every time the teeth set sharp into his weasand![49]

Again 'shuffling' is equated with lying, just as Rosetta associates 'contortions & grimaces & writhings' with 'untruths'. Owen's outward composure cracks under the pressure of the practice of deception; his opposition, on the other hand, cannot pretend to be gentlemen, and give way to outbursts of honest, truthful emotion. This is the force behind Huxley's "going for the jugular", sinking his metaphorical teeth into Owen's throat, cutting off his opponent's ability to speak using his own (Huxley's) powers of speech. Hooker hears that Huxley 'apparently made short work of Owen at Cambridge. the latter H. says "trailed his coat" – !'[50] implying that Owen was looking for a fight. Huxley might plead that he had no choice but to defend the truth, but it seems that he rather enjoyed playing the wolf. Huxley (and Rolleston and Flower) revel in terrorizing Owen. Exhibiting behaviour that could not be further from restrained, they work as a pack to tear to pieces Owen's theory and reputation. In his letter to Darwin, Huxley's simile of the old sheep and young wolves maps the language of evolution, of the violence of nature, onto the scientific world in order to justify its own coup. It implies that there is something natural and therefore inevitable about Owen's demise. Their proud emphasis in private correspondence on their aggression, and their downplaying of it in public, illustrates a contradiction. Huxley and other scientific naturalists sought to denounce the upright, polite behaviour of the gentleman-scientist Owen, arguing that it was dishonest. At the same time, they needed to show that they were in control, and calm in the face of nature.

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[48] Daston and Galison, 'The Image of Objectivity', p. 81.
[49] Letter from Huxley to Darwin, 9 October 1862, *Correspondence of Charles Darwin* X, pp. 449-451 (p. 450).
[50] Letter from J. D. Hooker to Darwin, 12 October 1862, ibid., pp. 454-456 (p. 455).

Satire, Sense and Nonsense at the 'Brishashoshan'

For Huxley, maintaining the connection between his behaviour on a public stage, and his authority to determine what ought to constitute scientific truth, meant constant, and conscious, acts of self-fashioning.[51] Such overt performances were rich resources for satirists; live public *performances* carried the potential for mis-speech, for frustration to bubble over into angry outbursts, as the supposedly cold, objective scientists gave vent to human emotions. What better way to satirize concepts incomprehensible to all but the specialist, who tries to build his popular image through public speaking, than through a reduction of that spoken word to nonsense? Dickens famously parodied reports of the BAAS meetings (as the Mudfog Association for the Advancement of Everything) as early as 1837, in which the veracity of such reports were always uncertain, undermined from one report to the next, and the scientific discussions absurdly complex.[52] James Paradis argues that '[f]arce and satire worked well with scientific materialists, because scientific reduction offered subject matter that was rigid, narrow, and mechanical'.[53] The paradoxes inherent in satire are well suited to a depiction of the confusion that arises in the non-specialist's mind when presented with the complex scientific arguments within the hippocampus debate. Charles Kingsley, whose *The Water-Babies* contains a satire on the debate, attended the Cambridge meeting (his first) and,[54] as Rosetta noted when she encountered him the following day, was 'quite interested in the controversy yesterday, less on scientific grounds than on those of <u>honesty</u> & <u>truth</u>'.[55] Kingsley was sympathetic towards Huxley's scientific views, but chapter four of *The Water-Babies* (published in *Macmillan's Magazine* a month after the BAAS meeting) satirizes

[51] Title quotation from 'A Voice from Cambridge', *Punch*, 18 October 1862, p. 165.
[52] For example, "Boz", 'Full Report of the First Meeting of the Mudfog Association for the Advancement of Everything', *Bentley's Miscellany*, July 1837, pp. 397-413.
[53] Paradis, 'Satire and Science', p. 161.
[54] *Charles Kingsley: His Letters and Memories of His Life, Edited by His Wife*, 2 vols (London: C. Kegan Paul and Co., 1879), II, p. 129. Kingsley's satires on the BAAS are addressed in Charles S. Blinderman, 'The Great Bone Case', *Perspectives in Biology*, 14 (Spring 1971), 370-393. However, I focus in particular on the role of performance in these satires.
[55] Bod Dep BAAS 142, 27-30 (30).

the kind of wolfish behaviour Huxley adopted when trying to publicize that view. Rosetta recalls Huxley telling her and William that his (Huxley's) role that day was as poacher turned gamekeeper – ambiguously suggesting either a transformation of character, or the deceptive appearance of an attacker as a peacemaker. Kingsley is aware of the implications of the phrase, of the residual 'poacher' in every 'gamekeeper'. When Grimes is punished for salmon poaching in chapter four of *The Water-Babies*, the poacher is poached. After some 'trampling and struggling of the keepers and the poachers' he,[56] like Tom and Ellie, drowns. Gentlemanliness and the defence of truth are coupled with a sort of pickling (or preserving in spirits) in river water – and even with being cooked in that water – when the novel's moralizing narrative voice interprets Grimes's behaviour:

> it is quite certain that, when a man becomes a confirmed poacher, the only way to cure him is to put him under water for twenty-four hours, like Grimes. So, when you grow to be a big man, do you behave as all honest fellows should; and never touch a fish or a head of game which belongs to another man without his express leave; and then people will call you a gentleman, and treat you like one [...] instead of hitting you into the river, or calling you a poaching snob.
>
> (pp. 2-3)

That people might *call* you a gentleman purely from this outward behaviour (you might still be a poacher on the inside), reduces Owen's and Huxley's displays in the theatre of the BAAS to the absurd posturing that it really was. Indeed, Kingsley's amalgamation of Owen and Huxley to form Professor Ptthmllnsprts (put-them-all-in-spirits) makes their behaviour indistinguishable. The Professor:

> had even got up once at the British Association, and declared that apes had hippopotamus majors in their brains, just as men have. Which was a shocking thing to say [...] always remember that the one true, certain, final, and all-important difference between you and an ape is, that you have a hippopotamus major in your brain, and he has none; and that, therefore, to discover one will be a very wrong and dangerous thing.
>
> (p. 8)

[56] Chapter Four of *The Water-Babies*, first published in *Macmillan's Magazine*, 7 (November 1862), 1-13 (p. 2).

Here Ptthmllnsprts's view mirrors Huxley's, that the hippocampus minor is not unique to the human brain. The narrator emphatically responds that Ptthmllnsprts cannot possibly be right; the "hippopotamus major", above all other differences – including the ability to speak 'and know right from wrong' – is the only certain difference between the species. This absurd conclusion is emphasized by the response of Lord Dundreary, who was in the audience when Ptthmllnsprts made his speech. Dundreary concludes that 'nobody but men have hippopotamuses in their brains; so, if a hippopotamus was discovered in an ape's brain, why it would not be one, you know, but something else'.

Lord Dundreary made an earlier appearance in Kingsley's ten-page satirical pamphlet, 'Speech of Lord Dundreary in Section D on Friday Last, on the Great Hippocampus Question', this time as an audience member and contributor to the debate after Owen's Cambridge paper. It was written by Kingsley shortly after the event and quickly printed for private circulation, although it would later appear in his *Letters and Memories* edited by his wife. In the pamphlet Dundreary rises to give his views on the paper just delivered. Through meandering prose and constant diversions he tries, and fails, to understand the scientific basis of the hippocampus debate. *Dundreary* imitates nineteenth-century conventions for reporting public speech: an opening address to 'Mr PRESIDENT and GENTLEMEN',[57] frequent use of dashes to denote natural pauses in speech, and a closing description of the audience's response. But Dundreary's frequent linguistic muddles show that he has misunderstood the debate entirely, negating the certainty with which the scientists can claim their positions to be true, as well as showing that their arguments are too complicated for a non-specialist audience to understand. Reporting conventions are in fact employed for satirical means. Dundreary's speech opens with 'Mr PRESIDENT and GENTLEMEN, I mean LADIES and Mr PRESIDENT'; the speaker does not know to whom he makes his address. Pauses, replicated by dashes, denote not a natural fluidity to

[57] Charles Kingsley, *Speech of Lord Dundreary in Section D. On Friday Last on the Great Hippocampus Question*, 'Printed by Private Request', (Cambridge: Macmillan and Co., 1862), p. 3.

Dundreary's speech, but instead indicate when he has tied himself in knots, for example, '[n]o – stop. It wasn't a hippopotamus after all, it was hip – hip – not hip-hip hurrah, you know, that comes after dinner' (p. 4). The pamphlet directly relates scientific observation (the very issue at hand) tp the position of being in the audience of a live scientific debate, the scientific concepts of which one cannot understand, and the physical demonstrations of which one literally cannot see. That phrase long associated with scientific naturalism, 'seeing's believing' (p. 3) resurfaces here; as no non-specialist can, metaphorically, *see through* the science, nor can a reader penetrate Dundreary's self-contradictory prose:

> Because, you see, I see, I don't quite see, and no offence to honourable members – learned and eloquent gentlemen, I mean; and though I don't wish to dictate, I don't quite think ladies and gentlemen quite see either. You see that?
>
> (p. 10)

The debate centred on the differences between what Owen and Huxley could see, or could not see, in dissected brains. Dundreary cannot *see* the reason for this: 'if Professor Huxley can see the structure, why can't Professor Owen?' (p. 9). And, since Kingsley was present at the meeting, Dundreary's returning to the difficulties in seeing may also be understood as a reference to the poor visibility of the casts of brains with which Owen illustrated his paper, either for an audience member who was too far away from the platform, or as a direct criticism of the quality of the casts themselves. When Dundreary finishes his speech, the satire concludes, '(The Noble Lord, who had expressed so accurately the general sense of the meeting, sat down amid loud applause.)' (p. 10). Kingsley satirizes the scientific complexity of the hippocampus debate by imitating the parenthetical descriptions of audience response that were common to nineteenth-century newspaper reports of public speeches.

While *Dundreary* was intended for a select audience, Owen and Huxley's clash in 1862 also contributed material to an existing, substantial corpus of satires on the hippocampus debate, on human evolution generally, and in particular the "missing link". An extensive critical field has developed around these works, which brings to light the use of satire by such magazines as *Punch* and *Fun* to address middle-class anxieties about race and gender. Janet Browne's work on the anthropomorphized gorilla in Victorian satire illustrates how the gorilla was dressed up, placed uncomfortably in high-society settings, even given a voice.[58] Such studies in art and literature are a valuable accompaniment to other scholarly works by, for example, Diana Snigurowicz and Sadiah Qureshi, on the nineteenth-century vogue for "displayed peoples".[59] The practices of displaying physical difference in "freak" shows, and exhibiting living people in exhibitions of countries only recently explored by British and European travellers, appeared to justify Victorian prejudices on scientific grounds. Gillian Beer notes that while neither Darwin nor Huxley believed in the existence of a "missing link", for many Victorians the image nevertheless embodied anxieties surrounding the 'distance and closeness between kinds, classes, and peoples'.[60] It was this closeness that Spurgeon so successfully exploited when he appeared on stage with the gorilla.

Several satires that appeared in *Punch* in the weeks following the Cambridge meeting serve to illustrate how the performative, oral nature of the event provided satirists with a unique way in which to explore these anxieties. The forms of public speech are employed by satirists to render nonsensical, and thereby neutralize, several perceived threats. Paradis identified in *Punch* a 'dispersed theatre of farce that used dramatic conflict and dialogue to burlesque the forms and ideas of contemporary society'.[61] When those ideas had already been expressed in a theatrical

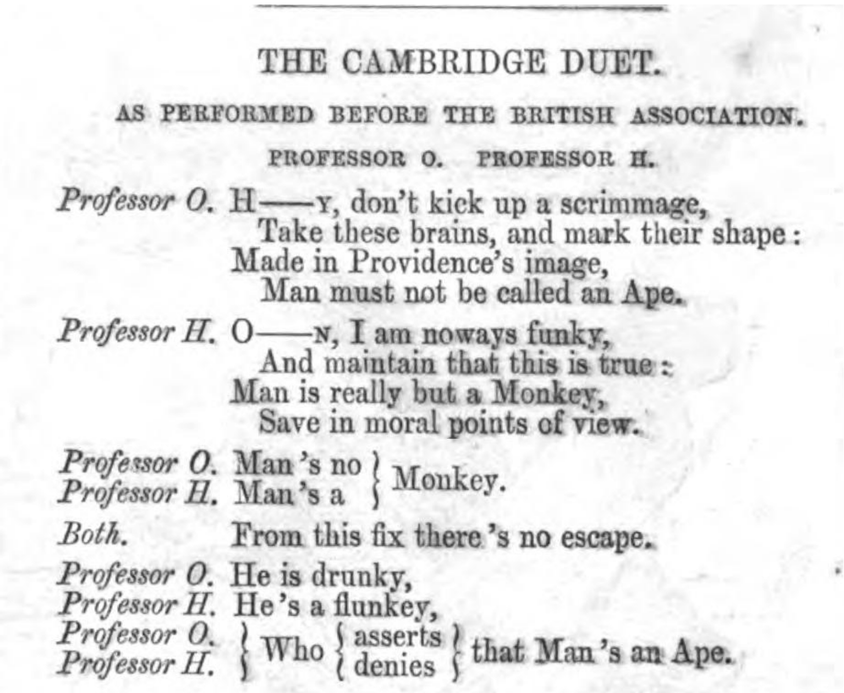
[58] Janet Browne, 'Constructing Darwinism in Literary Culture', in *Unmapped Countries: Biological Visions in Nineteenth-Century Literature and Culture*, ed. by Anne-Julia Zwierlein (London: Anthem Press, 2005), pp. 55-70, and 'Darwin in Caricature: A Study of the Popularization and Dissemination of Evolutionary Theory', in *The Art of Evolution: Darwin, Darwinisms and Visual Culture*, ed. by Fae Brauer and Barbara Larson (Hanover, New Hampshire: Dartmouth College, 2009), pp. 18-39.

[59] Diana Snigurowicz, 'Sex, Simians and Spectacle in Nineteenth-Century France; Or, How to Tell a Man from a Monkey', *Canadian Journal of History*, 34 (April 1999), 51-81; *Freakery: Cultural Spectacles of the Extraordinary Body*, ed. by Rosemarie Garland Thomson (New York: New York University Press, 1996). Sadiah Qureshi's 'Peopling the Landscape: Showmen, Displayed Peoples and Travel Illustration in Nineteenth-Century Britain', *Early Popular Visual Culture*, 10 (2012), 23-36, and *Peoples on Parade: Exhibitions, Empire, and Anthropology in Nineteenth-Century Britain* (Chicago: University of Chicago Press, 2011), explore the ways in which anxieties about racial otherness were neutralized by turning displayed peoples into entertaining spectacle.

[60] Gillian Beer, *Forging the Missing Link: Interdisciplinary Stories* (Cambridge: Cambridge University Press, 1992), p. 10.

[61] Paradis, 'Satire and Science', p. 149.

form, on the scientific stage of the BAAS, the satirists' work was done for them. 'The Cambridge Duet: As Performed Before the Meeting of the British Association' (fig. 17) appeared in the pages of *Punch* in the week following the meeting.[62] Professor O and Professor H's squabble ends with a clash of awkwardly rhymed insults, a perfect example of what Paradis has termed *Punch*'s 'rhymed doggerel'.[63] A mock play script, this piece presents Owen and Huxley as players in a farce, not only aligning their serious scientific debate with popular entertainment, but also suggesting that the hippocampus dispute was (because it could almost be scripted) predictably familiar. Their rhyming stalemate, indicated by the use of brackets, is an oral cancelling out; spoken simultaneously, their lines become interchangeable when, on the page, both their names and their theories become an exercise in filling in the gaps. Such uncertainty ensures that the relationship between man and apes remains ambiguous, and the missing link can remain a useful satirical tool.



THE CAMBRIDGE DUET.

AS PERFORMED BEFORE THE BRITISH ASSOCIATION.

PROFESSOR O. PROFESSOR H.

Professor O. H——Y, don't kick up a scrimmage,
Take these brains, and mark their shape:
Made in Providence's image,
Man must not be called an Ape.

Professor H. O——N, I am noways funky,
And maintain that this is true:
Man is really but a Monkey,
Save in moral points of view.

Professor O. Man's no } Monkey.
Professor H. Man's a }

Both. From this fix there's no escape.

Professor O. He is drunky,
Professor H. He's a flunkey,
Professor O. } Who { asserts } that Man's an Ape.
Professor H. } { denies }

Fig. 17.

[62] 'The Cambridge Duet: As Performed Before the Meeting of the British Association', *Punch*, 11 October 1862, p. 155. Image sourced from the Google Books and Oxford Bodleian Libraries Scanning Project.
[63] Paradis, 'Satire and Science', p. 149.

A week later Professor H's 'I am noways funky' is picked up by a talking gorilla (an already common trope in this debate thanks to du Chaillu's findings) who,[64] in its confusion states that '[t]o speak with decision I'm funky | […] | […] in some points if man's above monkey':

> But from all points of difference one turns
> To this crowning divergence to come,
> Not one man in a thousand e'er learns
> To keep silent – *all* monkeys are dumb![65]

Endless empty speech, blustering hot air, issues forth from these bickering scientists; at least the animal subjects of their research restrain themselves from such public embarrassment. In the same issue another verse satire, 'A Voice from Cambridge' (fig. 18) presents a Mudfog-esque parody of reporting conventions, this time of the opening address of the 1862 meeting.[66] The "Voice" is simultaneously that of the imagined reporter, and the presidential speaker whose soporific 'discourse', like dry toast, 'wants buttering'. The atmosphere is stiflingly hot. The reporter, trapped physically and parenthetically – '(We can't get away)' – lulls the reader to sleep with the repetitive 'uttering, uttering' just as he too is rocked into a sleepy state of boredom by half-heard and only vaguely understood scientific speech. This address at the gibberish 'Brishashoshan' linguistically shushes its audience into a stupor with its repetition and expert vocabulary. On the same page 'The Missing Link', one in a long line of racist Irish caricatures to stem from the debate (especially in the pages of *Punch*),[67] is textually juxtaposed against 'A Voice from Cambridge'. Purporting to provide evidence to support Huxley, it claims to have found the 'missing link' between 'the Gorilla and the Negro': '[a] creature manifestly

[64] Even before 1862, scientist/gorilla role reversal was common in magazine satire. *Punch* depicts a gorilla in a dinner suit in 'The Lion of the Season', 25 May 1861, p. 213, and famously picks up the anti-slavery slogan 'Am I Not a Man and a Brother?' in 'Monkeyana', 18 May 1861, p. 206. A decade later the lecturing gorilla still appears: [Richard Grant White], *The Fall of Man, or the Loves of the Gorillas, A Popular Scientific Lecture Upon the Darwinian Theory of Development by Sexual Selection, by a Learned Gorilla*, 1871, see Browne, 'Constructing Darwinism', p. 59. Aside from overt satire, *The Times* report of the Cambridge meeting gives, unusually, the events in Section D their own subheading to distinguish it within the full meeting report of that day, 'THE GORILLA AND MAN', suggesting that the two were actual adversaries in the BAAS debate.

[65] 'The Gorilla's Dilemma (To Professor Owen and Huxley)', *Punch*, 18 October 1862, p. 164.

[66] 'A Voice from Cambridge', *Punch*, 18 October 1862, p. 165. Image sourced from the Google Books and Oxford Bodleian Libraries Scanning Project.

[67] Michael de Nie, *The Eternal Paddy: Irish Identity and the British Press, 1798-1882* (Madison, Wisconsin: University of Wisconsin Press, 2004); L. Perry Curtis Jr., *Apes and Angels: The Irishman in Caricature*, rev. ed. (Washington: Smithsonian Institution Press, 1997).

between the Gorilla and the Negro is to be met with in some of the lowest districts of London and Liverpool by adventurous explorers. It comes from Ireland [...] the lowest species of Irish Yahoo'. That they will 'howl for their own liberty to do what they please' enforces the Swiftian idea of lack of linguistic maturity. The article repeatedly refers to the 'Irish Yahoo' in terms that designate apes, and is accompanied by a cartoon which conforms to the standard 1860s Irish stereotype. As L. Perry Curtis points out, '[a]fter the launching of *Punch* [...] in 1841 [...] the equation between snub-nosed, big-mouthed, and prognathous faces and Irish Celts became as complete as caricature could hope to achieve'.[68] This widely recognized 'type', with mouth wide open as if to illustrate its 'howl[ing]' of a 'sort of gibberish' is particularly significant when its proximity to 'A Voice from Cambridge' is considered. The accompanying quatrain on the American Civil War, and a notice to cab drivers on 'language and manners', confirm 'The Missing Link' as yet another racist and classist assertion that particular groups have a deficiency of speech that is the mark of savagery. And yet, the technical language of the 'Brishashoshan' is also held up as 'gibberish'. *Punch* uses the Cambridge meeting to frame its satires of any and all forms of speech, poking fun at the scientist's attempts to cast himself as a figure of learning and authority.

[68] L. Perry Curtis Jr., *Apes and Angels* p. 31. The second chapter of Mary Cowling's *The Artist as Anthropologist: The Representation of Type and Character in Victorian Art* (Cambridge: Cambridge University Press, 1989), pp. 54-86, is an excellent survey of the ways in which phrenology and physiognomy were widely used by artists in the nineteenth century to depict character types.

A VOICE FROM CAMBRIDGE.

Guildhall, 1862, *Oct.* 1*st*, 8·30 P.M.
THE place is as hot
As a chimney-pot,
And somebody there is uttering, uttering—
What does he say?
(We can't get away)
Verily that discourse wants buttering.

"No less than twenty thousand pounds,
For excellent reasons, on glorious grounds,
We have lent or spent or given or lost,
To men of the stamp of old ZERDOST,
Who waste their lives and eke their livers,
To find out why the lightning quivers,
And how the heat comes out of the sun,
And whither the tremulous meteors run,
And whence the wind its anger draws,
To find, in short, some physical cause
That superintends all physical laws.

"Where thy cleaner waters glide,
O Thames, above the London tide,
Stands the Association's pride;
A Dome of Science, fair to view,
Among the flowery walks of Kew."

(Here the President sought to drink,
Somebody helped him in less than a wink.)

"At Kew the Photo-Heliograph—"
(Great applause; too much by half;
And a man behind me dared to laugh.)
"The Photo-Heliograph at Kew,
As everybody knows, is due
To MR. WARREN DE LA RUE,
He took it out to Spain,
In a fleet of ships,
To observe the eclipse,
And brought it back again.
Here are Barometers,
Here are Thermometers,
Here are Hygrometers,
Carefully tested.
With all that is extant
In Quadrant or Sextant,
With all Anemometers,
All Dynamometers,
All Goniometers,
Kew is infested.

"Wide researches have been made,
Some on shore, and some in ocean;
The cost of instruments is paid
Out of the funds of the Brishashoshan.

"A vessel, specially fitted out
For the purpose, did survey
The British coast all roundabout,
And the colonies far away,
Very magnetically
Hydrotheoretically;
Don't forget what I say.

"A word or two about the progress
Of Science, sweet celestial ogress.

"MONSIEUR DELAUNAY, the man of the moon,
Has made up his book, and will print it soon.

"The name of the great sky-scraper, GLAISHER,
That name already is known
Through Europe, America, Africa, Asia;
And not on this globe alone,
But e'en in the starry heights o' heaven;
For he journeyed upward, six or seven
English miles,
Above the house-tiles,
In mortal flesh and bone.

"Chemistry thrives:—
A man who dives
Into its darkest deepest nooks
Says he has blended,
Heaven-befriended,
Carbon with hydrogen." (Oh, Gadzooks!)
"And hence other compounds, more composite still,
Have answered the call of alchemical skill;
And he bids fair soon to produce such mixtures
As only are found in organical fixtures."

(The President, uniformly dry,
Here grew thirsty and so did I.)

"Why need we tell you how MR. SCOTT RUSSELL
Has been exerting his mental muscle,
In finding relations of force and form,
Between a model ship in a storm
And waves as high as huge Cairn Gorm?

"Artillerymen at Shoeburyness
Have made away with—I should guess—
Five hundred thousand, more or less,
Projectiles. MR. FAIRBAIRN knows;
But cannot very well disclose.

"The International Exhibition
Shows the good of competition
In things of mechanical power;
There's many a locomotive engine,
Would run from London to Stonehenge in
Less than a solar hour."

And still the place
Grows hotter apace:—
A flue—and a chimney-sweep—
Voluptuous feeling—
The brain is reeling—
And I'm—a—going to sleep.

THE MISSING LINK.

DOUBT not which is the preferable side in the Gorilla controversy. It is clearly that of the philosophers who maintain themselves to be the descendants of a Gorilla. This is the position which commends itself to right-minded men, because it tends to expand the sphere of their affections, inasmuch as it gives them a broader view of their species. Hitherto, however, there has been one argument against the Gorilla theory very difficult to get over, namely, that there is no known fact whatever which affords it the least foundation. This is a deficiency which we trust we are about to supply.

A gulf, certainly, does appear to yawn between the Gorilla and the Negro. The woods and wilds of Africa do not exhibit an example of any intermediate animal. But in this, as in many other cases, philosophers go vainly searching abroad for that which they would readily find if they sought for it at home. A creature manifestly between the Gorilla and the Negro is to be met with in some of the lowest districts of London and Liverpool by adventurous explorers. It comes from Ireland, whence it has contrived to migrate; it belongs in fact to a tribe of Irish savages: the lowest species of the Irish Yahoo. When conversing with its kind it talks a sort of gibberish. It is, moreover, a climbing animal, and may sometimes be seen ascending a ladder laden with a hod of bricks.

The Irish Yahoo generally confines itself within the limits of its own colony, except when it goes out of them to get its living. Sometimes, however, it sallies forth in states of excitement, and attacks civilised human beings that have provoked its fury. Large numbers of these Yahoos have been lately collecting themselves in Hyde Park on a Sunday, and molesting the people there assembled to express sympathy with GARIBALDI and the cause of United Italy. The Yahoos are actuated by an abject and truculent devotion to the POPE, which urges them to fly at all manner of persons who object to grovel under the Papal tyranny, and all others who assist or even applaud them in the attempt to throw it off. Nevertheless they will howl for their own liberty to do what they please like so many *Calibans*. They were organised by the Pontifical Government to fight the Italians, at Castelfidardo, where they failed, perhaps from want of sufficient dexterity to handle a rifle. Here they assail the friends of the Italian monarchy with the weapons which come more natural to them; clubs and stones. In this sort of warfare they are more successful than they were on the field of battle; and their numbers, strength, and ferocity have struck such terror into the minds of the authorities, that the latter have judged it expedient to yield to them. They have accordingly succeeded in the attempt to stifle the expression of public sentiment by intimidation. It is not wonderful that creatures so like the Gorilla should frighten anybody; let alone the LORD MAYOR.

The somewhat superior ability of the Irish Yahoo to utter articulate sounds, may suffice to prove that it is a developement, and not, as some imagine, a degeneration of the Gorilla.

It is hoped that the discovery, in the Irish Yahoo, of the Missing Link between Man and the Gorilla, will gratify the benevolent reader, by suggesting the necessity of an enlarged definition of our fellow-creatures, conceived in a truly liberal and catholic spirit.

Too Bad, Really!

LOOK alive, Yankee! work is not so slack
That you with fancied wrongs should hold communion,
Think of a fellow with a good broad back,
Whining because he's turned out of the Union!

REFINEMENT OF THE COARSER CLASSES.

WE are authorised to state that all Candidates for the position of cabman, omnibus conductor, and railway official, ought to be required to pass an examination in language and manners, satisfactorily testing their qualifications for employment in the Civil Service.

Fig. 18.

Prattling About Protoplasm in the Periodical Press

Remediated by reporters and satirists, *what* was said in public scientific speeches was frequently lost amid a focus on *how* it was said. However, as has been previously noted, many of Huxley's addresses were printed in full in general periodicals, pamphlets and books, enabling a non-specialist audience to access his ideas, seemingly free from a fictional framework or filtered through newspaper reporters and editors. Attention to the origins of these texts and the ways in which they replicate or interpret the physical and oral elements of speech, sheds light on the ways in which Huxley fashioned a public image beyond the walls of the lecture theatre. Gowan Dawson argues that '[w]hile rupturing the erstwhile relation between [...] gentlemanly civility and scientific authority was at the fore of the reformist agenda of Huxley and other Darwinian men of science, the nineteenth century's new scientific ideal of self-denying asceticism nevertheless ensured that a similarly propositional form of moral propriety remained highly significant'.[69] Dawson's account of the shift of moral responsibility correctly recognizes Huxley's adoption of existing moral forms of communication to further his own claims to scientific authority, and the contradictions inherent within this act. I want to argue that Huxley's behaviour in the protoplasm debate presented an extreme affront to these existing notions of morality, going further than he had ever gone before when confronting the scientific establishment. Further, Huxley's borrowing of language from literature and religion (with which he was, as any Victorian gentleman, well versed),[70] while enabling him to win rhetorical ground for empiricism through the metaphorical nature of the former and the authority of the latter, gave his opponents a language through which to attack the framing of his theories.

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[69] Gowan Dawson, *Darwin, Literature and Victorian Respectability* (Cambridge: Cambridge University Press, 2007), p. 14.

[70] Timothy Larsen, *A People of One Book: The Bible and the Victorians*, *Oxford Scholarship Online* (May 2011), <www.oxfordscholarshiponline.com> [accessed 2 August 2016], pp. 195-218, discusses Huxley's familiarity with biblical texts.

By the end of the 1860s, the hippocampus minor debate had been laid to rest. What now began to occupy Huxley was the question not just of the origins of man, but of life itself. Of what substance were living things made, and what breathed life into molecules? In his well known 1868 lecture, 'On the Physical Basis of Life', Huxley gave a shockingly materialist answer. While it is one of his best known expositions, I focus on 'Physical Basis' for its specifically performative elements, for the ways in which Huxley not only argues for, but demonstrates, his protoplasmic theory. Any notions of morality here undoubtedly belong to an existing religious orthodoxy. Huxley delivered the lecture on Sunday 8 November 1868 at the Hopetoun Rooms, Edinburgh, as part of a series of non-theological addresses organized by Rev J. Cranbrook. It first appeared in print on 1 February 1869 in the *Fortnightly Review*, a liberal publication open to scientific and theological debate.[71] The argument of his discourse is as follows: Huxley introduces the term "protoplasm" as a substance which constitutes '"the physical basis of life"' (p. 129).[72] A series of rhetorical questions presents the binaries, 'dense', 'resisting' and 'strong' against 'mere films', and 'pulsati[on]' against 'calm' (p. 130), to ready his audience for the seemingly contradictory arguments he is about to present. Protoplasm is a 'semi-fluid matter, full of innumerable granules of extreme minuteness' (p. 131); this fluid is in a state of 'unceasing activity', 'so minute that the best microscopes show only their effects, and not themselves' (p. 132). Both plants and animals are made from this substance, he argues, and therefore 'the difference between the powers of the lowest plant, or animal, and those of the highest is one of degree, not of kind'. Huxley famously argues that plants create protoplasm from 'carbonic acid, water, and ammonia' (p. 138) (while animals can only consume it ready-made), by linguistically likening his own digestion of mutton, to transubstantiation, with powers to 'convert the dead protoplasm into living protoplasm, and

[71] Thomas H. Huxley, 'On the Physical Basis of Life', *Fortnightly Review*, 5 (1 February 1869), 129-145. For more on the politics and readership of mid-century periodicals see *Science in the Nineteenth-Century Periodical: Reading the Magazine of Nature*, ed. by Geoffrey Cantor et al (Cambridge: Cambridge University Press, 2004), pp. 16-21.

[72] For more on the "protoplasmania" of the mid-nineteenth and early twentieth century, see Robert Michael Brain, 'Protoplasmania: Huxley, Haeckel, and the Victorian Vibratory Organism in Late Nineteenth-Century Science and Art', in Brauer and Larson (eds.), pp. 92-123, and Nicholaas Rupke, 'Bathybius Haeckelii and the Psychology of Scientific Discovery', *Studies in History and Philosophy of Science*, 7 (1976), 53-62.

transubstantiate sheep into man' (p. 137). One of Huxley's primary concerns is that of language use, of linguistic consistency and continuity in the description of both living tissues and the elements from which they are made. It is logical, he argues, to use the same terminology because, ultimately, every living thing is made from the same elements: '[i]f scientific language is to possess a definite and constant signification whenever it is employed, it seems to me that we are logically bound to apply to the protoplasm, or physical basis of life, the same conceptions as those which are held to be legitimate elsewhere. If the phenomena exhibited by water are its properties, so are those presented by protoplasm, living or dead, its properties' (p. 140). Such lines of reasoning are applied throughout, making definitional debates central to Huxley's anticipation and denial of accusations of materialism. This too is an issue of language: '[m]atter and spirit are but names for the imaginary substrata of groups of natural phenomena' (p. 143). The *terminology* of materialism is 'preferred' because 'it connects thought with the other phenomena of the universe' (p. 145). To forget that language is merely a sign – the nexus between matter and thought – would be to behave like 'the mathematician, who should mistake the *x*'s and *y*'s, with which he works his problems, for real entities'. Huxley's emphasis is on unification, on the continuation of language use as well as a logical progression from theological to scientific explanations. 'Physical Basis' is not a break with the past, Huxley argues, just as his decision to "sermonize" on a Sunday is a continuation and evolution of the form. These linguistic illusions, and allusions, poorly conceal the fact that Huxley's protoplasm is a radical transformation of a religious past.

Religious ideas are woven into the formal and linguistic fabric of 'Physical Basis' to an almost heretical extent. We are never allowed to forget that Huxley is imitating the act of religious speech from the pulpit. It was a secular Sunday evening address (and was later reprinted in *Lay Sermons*, 1870), but Huxley asserts that his argument will reveal a 'threefold unity – namely, a unity of power, or faculty, a unity of form, and a unity of substantial composition' (p.

130). Even the simplest organisms are afforded creative agency as 'the greatest rock builders' (p. 134). But protoplasm is also the material with which a creative force works:

> Protoplasm, simple or nucleated, is the formal basis of all life. It is the clay of the potter: which, bake it and paint it as he will, remains clay, separated by artifice, and not by nature, from the commonest brick or sun-dried clod.
>
> (p. 135)

The biblical allusion here is clear,[73] even as Huxley evolves religious language to suit an argument in favour of materiality: protoplasm 'remains clay'. His Holy Trinity is chemical, 'carbonic acid, water, and ammonia' (p. 138), 'the matter of life, so far as we know it', while his 'catholicity of assimilation' (p. 137) of 'sheep into man' is a purely material transubstantiation. Performing this transformation before his audience's very eyes, Huxley's speech becomes a meta-textual commentary on the lecture as performance:

> Every word uttered by a speaker costs him some physical loss; and, in the strictest sense, he burns that others may have light – so much eloquence, so much of his body resolved into carbonic acid, water, and urea.

This is at once an allusion to the powers of the scientific lecturer, masterfully performing a demonstration on the platform (we are reminded of Tyndall and Ball's similar actions), making an automatic process into something which requires skill. He also shows, however, the superior skill of nature itself, performing with ease a demonstration which the most experienced scientist might struggle to complete. This claim to a Christ-like sacrifice – the lecturer exhausting himself so that others might see the light of science – must have been delivered with full knowledge of its heretical implications. Such an affront had also been apparent in reports of his 1862 clash with Owen.

These references to performance pepper both the text itself and, in the *Fortnightly Review* version, its editorial framework. This version retains the phrase 'the substance of which I

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[73] Genesis 2.7, 'then the Lord God formed man from the dust of the ground', *King James Bible. Oxford Biblical Studies Online* <http://www.oxfordbiblicalstudies.com/article/sidebyside/bibref/KJV/commref/NRSV/Gen/2?verse=#verse> [accessed 6 March 2014].

am about to speak' (p. 129). He asks his audience to 'picture to yourselves the great Finner whale' (p. 130), the plural pronoun corresponding to a live audience of more than one – it might also signal confidence too that single readers together constitute a large group, and that that group joins continuously to the original live audience, as a coherent and unified congregation of scientific believers. Huxley's footnote in the *Fortnightly* acknowledges that:

> I have, here and there, endeavoured to express my meaning more fully and clearly than I seem to have done in speaking – if I may judge by sundry criticisms upon what I am supposed to have said, which have appeared. But in substance, and so far as my recollection serves, in form, what is here written corresponds with what was there said.
>
> (p. 129)

This gives no indication of precisely what was changed from the original address; this disconnection is particularly significant as it becomes apparent that editing did not alter every marker of performance, focusing rather on clarity of content, and on responding to criticism. This focus exists, I argue, because these markers of performance were useful in convincing and widening Huxley's audience, through the 'yourselves' of a wider readership, and the authority to 'speak' on a scientific subject as though from a pulpit. This use of an existing, culturally recognized form of teaching, did not sit well with several critics, especially after its publication in *Lay Sermons*.[74] William Allingham made the connection between the proliferation of such 'lectures to working-men, lectures to the fashionable world, Sunday afternoon discourses, "lay sermons" of all sort', and the texts through which 'atheism' was spread: the 'half-crown *Fortnightly Review* and [...] twopenny *National Reformer* [...] and the flavouring of countless novels and poems'.[75] Huxley's listening and reading audience is, economically, universal, his damaging influence wide-reaching. One reviewer characterized Huxley's style as 'fluctuating' and 'hazy', typical of

[74] See T. W. B., 'The School of Tyndall, Huxley, and Darwin: What and Whither?', *Wesleyan-Methodist Magazine*, 20 (December 1874), 1099-1110, and F. Power Cobbe, 'The Scientific Spirit of the Age', *Contemporary Review*, 54 (July 1888), 126-139, who notes an 'anti-religious tendency' in science (p. 138). James Thursfield is fully aware of Huxley's overt attempts to take on the mantle of moral authority from the church: 'it is obvious that the spirit of the work is to be found in its main title *Lay Sermons* and that its writer wishes to speak not specially as a man of science, but as the advocate of a new culture, and the apostle of a new gospel', Review of *Lay Sermons* and Tyndall's *On the Scientific Use of the Imagination*, *Academy*, 2 (22 October 1870), 12-14 (p. 12).
[75] [W. Allingham], 'Modern Prophets', *Fraser's Magazine*, 16 (September 1877), 273-292 (p. 273).

'scientific men since Darwin's theory [...] They see things in a state of "flux", or endless "becoming"'.[76] Huxley's manipulation of religious imagery is regarded as an operation of 'stealth' that misleads his readers (p. 199). There is the sense here that the scientist is seen to have abused his position of moral authority by evading the truth, and avoiding clear language.

Morus argues that '[v]ery often, Victorian scientific performances were described in aesthetically loaded language of wonder',[77] and, while these comments apply specifically to descriptions of demonstrations, they are equally relevant to 'Physical Basis'. Not only does Huxley assimilate language which describes religious creation, he also frequently employs that of aesthetic wonder and literary creativity. The subtext of his chosen vocabulary is that the natural world is beautiful, and that scientific discovery is as great a form of creativity as is poetry. He discusses the 'exquisitely delicate' hairs of the nettle (p. 131), uses sensuous language to describe the needle which 'tapers from a broad base to a slender summit', 'beautiful' scientific researches (p. 136), and the 'spectacle' visible only under the microscope (p. 132). Such images are 'not easily forgotten by one who has watched its display, continued hour after hour, without pause or sign of weakening'. This description could refer equally to the perpetual movements of the protoplasm, and the endless energies of the scientist who is committed to hours of observation. Gillian Beer's work on literature and science points towards the use of literary metaphors by Victorian scientists to 'poise necessary contradictions';[78] here, Huxley continually returns to what might be described as literary language to communicate specialist work on a microscopic level, that appears to contradict the static world seen by the naked eye. Further, the majority of his examples are of activity and movement, reflecting in his language the form in which he communicates. 'Speech, gesture' (p. 131) are the two 'human action[s]' he chooses in order to

[76] 'Protoplasm; or the Physical Basis of Life', unsigned review, *London Quarterly Review*, 33 (October 1869), 179-188 (p. 188).
[77] Morus, 'Worlds of Wonder', p. 813.
[78] Gillian Beer, *Open Fields: Science in Cultural Encounter* (Oxford: Clarendon Press, 1996), p. 197. See also George Levine, 'Paradox: The Art of Scientific Naturalism', in *Victorian Scientific Naturalism: Community, Identity, Continuity*, ed. by Gowan Dawson and Bernard Lightman (Chicago: University of Chicago Press, 2014), pp. 79-97.

demonstrate muscular activity. Protoplasm is in a 'condition of unceasing activity' in the hair of the nettle; 'colourless corpuscles [...] exhibit a marvellous activity, changing their form with great rapidity' (p. 133). Such close attention to the kinetic creates a visual image through language. We are reminded continually that the act of public speaking is itself a scientific process such as that being described.

Huxley therefore brings attention back to the act of speaking; he literally embodies the processes he describes, standing at the pulpit of science and enacting his own form of transubstantiation. This act of '*Lay-sermonising*'[79] of course could not avoid the satirical jibes routinely directed at Huxley's theories and public behaviour. John Allan's *Protoplasm, Powheads, Porwiggles* (1875, printed anonymously), as the title suggests, satirically takes to task both theories of protoplasm and evolution. Part prose, part verse satire in imitation of Samuel Butler's *Hudibras*, Allan's text renders absurd the *speech* in which these ideas are communicated. Litotes compounds the ironic tone, when Huxley is described as 'a bit of a preacher himself' (p. 9), implying that his amateurish, part-time sermonizing lacks the moral solemnity attached to that role. It is the act of speaking that 'poison[s] the nation with scepticism' (p. 10); preaching 'balderdash to the young' is an irresponsible act (a particularly pressing issue, Allan asserts, as Huxley had become Rector of the University of Aberdeen and therefore had a young, impressionable audience). 'Protoplasm, | Is very plastic in nature' (p. 21), while according to evolutionary theory plants and animals 'change their state' and some 'jump about *in name of* frogs' (my emphasis). This satire hinges on the notion of "seeming", on the deceptive use of language, on the 'conjuring tricks with matter' with which the scientist attempts to 'Resolve the truths God hath revealed | Into deceptive idle chatter' (p. 35) – a line which pivots on Huxley's previous Christ-like transformation, 'so much body *resolved* into carbonic acid, water, and urea' ('Physical Basis', p. 137, my emphasis). Huxley's own choice of more figurative language therefore aids his

[79] [John Allan], *Protoplasm, Powheads, Porwiggles, and the Evolution of the Horse from the Rhinoceros, Illustrating Professor Huxley's Scientific Mode of Getting Up Creation and Upsetting Moses* (Aberdeen: A. Brown and Co., 1875), p. 6.

critics, its malleable character (cast as deceptive) mirroring the metamorphosis of chemicals into life, plants into animals.

Scientific speech can so easily become nonsense, especially when an impressionable audience is '[b]amboozled by learned-looking noise' (p. 18). Its malleability, and the authority commanded by the scientific speaker, means that it can easily be picked up, passed on through spoken discourse, its moral significance reduced to 'prattle' (p. 3) between 'young prospective' and 'young atheistic' 'prattler[s]' (p. 4). In this sense, it becomes highly significant that Allan picked up "prattling about protoplasm" from *another* public speech. *The Times* records a parliamentary debate on university education in which Disraeli argued:

> if there ever was a period in which a Minister founding a new University should hesitate before he discouraged the study of Metaphysics and Ethics, it appears to me to be the age in which we now live. This is essentially a material age. The opinions which are now afloat, which have often been afloat before, and which have died away as I have no doubt these will die in due time, are opposed in my opinion to all those sound convictions which the proper study of moral and mental philosophy has long established. (Hear, hear.) [...] We live in an age when young men prattle about Protoplasm and when young ladies in gilded saloons unconsciously talk Atheism. (Laughter.)[80]

The use of the term 'Protoplasm' in parliamentary speech, one of the most widely reported forms of public speech in the nineteenth century, may be used as an index of its social recognition, of a scientific term entering popular discourse. But to "prattle" about it too, shows that the concept of public scientific speech had itself become a familiar trope, and that language from the platform could easily enter conversation. The title of Huxley's lecture was even adopted by one critic of parliamentary speech, who labelled an assessment of Bright's successful political oratory in relation to his physical self-control, 'The Physical Basis of Oratory'.[81] Through its use in parliament, we return to the wider cultural phenomenon of public speech in the mid-nineteenth century, placing Huxley in a continuum of linguistic exchange. This example guides us through the many guises of the scientific spoken word, from full discourse printed in a liberal

[80] 'House of Commons', *The Times*, Wednesday 12 March 1873, p. 5.
[81] 'The Physical Basis of Oratory', *Saturday Review*, 29 (15 January 1870), 78-79.

periodical with editorial notes from the speaker, through the mention of protoplasm (and talking about it) in parliament, to a satire on the irresponsibility of preaching the doctrine of science. It must be mentioned, however, that Huxley's protoplasmic theory was short-lived. Having claimed to have observed a creature he named *Bathybius*, which exhibited traits of the protoplasm, he was later forced to acknowledge that *Bathybius* did not exist. The HMS *Challenger* voyage had failed to dredge any such slime from the bottom of the sea; it transpired that the "protoplasm" Huxley believed he saw, was in fact calcium sulphate formed by a reaction with the alcohol he had used to preserve his specimens.[82]

'The Physical Basis of Life' *was* delivered as part of a series organized by Rev Cranbrook, but it was of course a lecture and not a sermon, and delivered in the Hopetoun Rooms and not in a religious building. According to the *Scotsman*, admission was 6*d*, and the lecture was originally supposed to take place in a Music Hall. Huxley spoke from a 'small platform' at the 'end of the hall, on which a black board was put up for the use of the Professor in illustrating his lecture'.[83] Before the lecture began, Cranbrook reiterated that the forthcoming series 'would not in the least degree be connected with him, nor would the lecturers in the least degree be responsible for any opinions of his'. Ticketed, originally planned for a music hall, set up with basic lecture paraphernalia, and disassociated from the religious figure who organized it, 'Physical Basis' was not performed in an overtly religious setting. It is Huxley's language, and his later publication of the speech as a lay sermon, which draws specific religious parallels. The conscious borrowing from the sermon in order to undermine its philosophical assumptions is Huxley's own.

[82] Huxley published a letter sent to him by Wyville Thomson from the *Challenger* in *Nature*: 'Prof. Wyville Thomson further informs me that the best efforts of the *Challenger*'s staff have failed to discover *Bathybius* in a fresh state, and that it is seriously suspected that the thing to which I gave that name is little more than sulphate of lime, precipitated in a flocculent state from the sea-water by the strong alcohol in which the specimens of the deep sea soundings which I examined were preserved. [...] since I am mainly responsible for the mistake, if it be one, of introducing this singular substance into the list of living things, I think I shall err on the right side in attaching even greater weight than he does to the view which he suggests.' 'Notes from the "Challenger"', *Nature*, 12 (19 August 1875), 315-316 (p. 316).

[83] 'Professor Huxley on the Basis of Physical Life', *Scotsman*, 9 November 1869, p. 7.

Conclusion

The texts which emanated from Spurgeon's lecture, and from Owen and Huxley's very public hippocampus dispute, demonstrate how important the relationship between public speech and popular print had become by the middle of the nineteenth century. Scientific discourse surrounding the gorilla and its relation to man was not confined to expert circles. Nor was the popular science lecture the preserve of scientific practitioners. Spurgeon chose to lecture on scientific topics because he believed that they were not incompatible with his religious message; indeed, it was the very cultural familiarity of the lecturing scientific naturalist that the preacher was capitalizing on when he performed in October 1861. Du Chaillu was in the audience, just as he was at the RI or the BAAS when scientists used his specimens. Within both the subject of human evolution, and the genre of the popular lecture through which science was so often communicated, Spurgeon saw a potential vehicle for his religious messages. Well aware of the controversy that surrounded the validity of du Chaillu's claims, Spurgeon exploited the obvious similarities and dissimilarities between the gorilla and man, and those between the pulpit and the scientific lecture platform. The controversial gorilla caught the public's attention first; Spurgeon's condemnation of slavery and his belief that slavery existed where the Christian missionary had not yet reached, then followed. By joining the debate over whether du Chaillu was a scientific fraud, Spurgeon was also contributing to a wider discussion about the moral implications of scientific truth claims and the public behaviour of those claiming to speak for those truths.

Du Chaillu was an explorer, operating at the peripheries of the public imagination on the one hand, and the scientific elite on the other. On more than one occasion, he broke the rules of polite behaviour which governed that scientific elite. During his exchange with John Edward Gray in the *Athenaeum* du Chaillu wrote that he had 'had only one interview' with Gray, 'in which, brief as it was, [Gray] informed [him] that he considered "Dr. Livingstone to be a great humbug"'.[84] Furious that du Chaillu had made public a comment that had been uttered in private, Gray responded: 'I need not comment on the paltry trick of attempting to divert attention from the real question at issue, by misreporting the words of a private conversation, the repeating of which would have been disgraceful, even had his story been true!'[85] The act of making public a private conversation was, for Gray, worse than changing what was said into a lie.

Within the confines of a more conventionally scientific theatre, the connection between gentlemanly conduct and outward appearances, and the validity of scientific truth claims, went even further. In the spoken public performances that made up the hippocampus debate, the physical appearance of speakers and how they delivered their arguments, played a fundamental role in determining who came out on top. Composure and eloquence marked out an assured scientist (because confident of the truth of his claims (from an awkward and 'shuffling' opponent whose discomposure betrayed him. The young scientific naturalists – Huxley, Rolleston and Flower – relished goading the older Owen, believing that his visible discomfort at so public an attack, confirmed him as a liar. Huxley made a direct connection between the *manner* in which Owen presented his findings to the public, and his scientific methods. Owen must have known, Huxley claimed, that his failings as an objective observer had been exposed – otherwise he would not have behaved in such a way. The lecture form meant that these scientists had to address an audience who would judge the validity of their claims on how impressively they performed. However, this spoken form of communication also facilitated a particular kind of public scrutiny, which turned the scientists' serious intentions into a farcical theatre of confusion. Their essentially ephemeral original speech was transcribed and quoted numerous times. The fact that what was actually said became increasingly uncertain the further away it was from the original context of delivery, was merely proof that for most non-experts the scientific content of

[84] P. B. du Chaillu, 'The New Traveller's Tales', *Athenaeum*, 1752 (25 May 1861) 694-695 (p. 695).
[85] John Edward Gray, 'The New Traveller's Tales', *Athenaeum*, 1753 (1 June 1861) 728.

the debate was nonsense to begin with. Satirists mimicked the textual forms of reported speech to show that meetings of the scientific elite such as those of the BAAS were nothing but hot air.

In many ways the popular perception of Huxley the speaker was as an aggressive, uncompromising and cantankerous figure waging war on existing structures of authority. This may be precisely the image that Huxley desired. Emphasizing the religious aspects of his 'Physical Basis' lecture in the *Fortnightly*, even though the original performance may have been ticketed and taken place in a secular setting, Huxley antagonizes his opponents by claiming quasi-clerical moral authority. Where Huxley imitated religious authority in order to undermine it, however, Spurgeon's act shows that he had to expect that the modes of communication sacred to his field could, likewise, be mimicked by those he sought to challenge.

What unites the performances that have been discussed so far, is a pervading awareness of the physicality of the male performer: the tirelessness with which Tyndall and Ball performed so many lectures, the differences and similarities between a preacher and a gorilla, the "performance" of respiration on stage as an apparently deliberate and controlled demonstration. Scientific naturalists used this consciousness to enforce the intellectual strength of their ideas – the successful persuasion of an audience was contingent upon those attributes of the lecturer considered to be most masculine.

Chapter 3

'[A] Welcome Auxiliary to Labours of a More Original Kind': Women on the Scientific Stage

In his address to the RI, 'On the Importance of the Study of Physics' (1855), Tyndall described the solitary scientist who removed himself from society to devote his life fully to the contemplation of science. 'Believe me', he wrote, 'a self-renunciation which has something noble in it, and of which the world never hears, is often enacted in the private experience of the true votary of science'.[1] Only through this commitment to a quasi-monastic lifestyle could he make original discoveries. Tyndall depicted a selfless figure working tirelessly and without the recognition of fame; ultimately science came first. This 'true votary' embodied the asceticism which scientific naturalists consciously presented to the public as the key characteristic of the modern scientist, and it clashed dramatically with the lurid reality of showmanship that has been explored in the previous two chapters of this thesis.

Tyndall's comment revealed something else about the reality of scientific practice: it was overwhelmingly male. To be able to remove oneself from domestic concerns was a luxury that few Victorian women could afford. Further, the idea that women preferred to pursue softer mass-cultural entertainments while men favoured higher intellectual activity, was culturally ingrained.[2] The figure of the masculine lecturer in control of his demonstrations (thereby

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[1] John Tyndall, 'On the Importance of the Study of Physics as a Branch of Education for All Classes', *Lectures on Education: Delivered at the Royal Institution of Great Britain* (London: John W. Parker and Son, 1855), pp. 171-211 (p. 190). Title quotation from 'Economic Entomology', *Saturday Review*, 57 (10 May 1884), 622-623 (p. 623).

[2] Bernard Lightman notes that '[d]uring this period, when socialism and the women's movement challenged traditional male dominated culture, mass culture became associated with women, while genuine culture was considered to remain the prerogative of men', Lightman, *Victorian Popularizers of Science*, p. 165. Such a division was not unique to the end of the nineteenth century, although Lightman is correct to point out that these specific historical factors intensified the division.

exercising control over nature too), was a persona which the likes of Tyndall and Huxley had carefully cultivated. Emphasis on the male body on the political stage was also something which, Elaine Hadley notes, was an important element of British politics towards the end of the century.[3] The few British women who did choose to lecture, therefore, presented a potential challenge not just to the notion that women could not practice science, but also to the belief that they did not have the authority to speak for it.

This chapter considers the work of four women: education reformer Catherine Buckton (1826/7-1904), natural science popularizer Arabella Buckley (1840-1929), entomologist Eleanor Ormerod (1828-1901), and botanist and women's rights campaigner Lydia Becker (1827-1890). It examines the ways in which these women, by addressing the public from the traditionally male lecture platform, were perceived as either masculine or feminine. Reciprocally, their presence challenged traditional gender assumptions about the platform itself; as a result this had implications for male scientists who used the popular platform to consolidate their professional authority. The female voice and body on stage presented an opposing image to the masculine, composed and authoritative lecturer that scientific naturalists cultivated. Further, traditions in popular science writing in which female authors wrote for women and children, produced introductory works rather than presented original research, and tended to promote natural theology, were reconceived in the works of these women.[4] What did these women have to gain from lecturing, and to what extent did they work within or against traditional feminine popular science genres? Particular attention will be paid to the ways in which they addressed issues of professionalization and expertise. What did it mean to be considered an expert in a scientific field, and how did this compare to bearing the mantle of "professional"?

[3] Elaine Hadley, *Living Liberalism: Practical Citizenship in Mid-Victorian Britain* (Chicago: University of Chicago Press, 2010), pp. 307-308. Hadley argues that this was most strongly embodied by W. E. Gladstone.

[4] Although religion did feature in Buckley's work, the relationship between female science popularizers and religion, which has been well-documented by Lightman, is not explored here. Lightman, *Victorian Popularizers of Science*, pp. 95-165.

'Ladies' Tickets'

In what ways did women participate in nineteenth-century scientific cultures? The stratified nature of Victorian society meant that participation within it was possible on a wide spectrum, from popular entertainments, and education in schools, institutes and universities, through to elite professional societies. Yet these latter two locations – the venues in which serious knowledge exchange took place – imposed restrictions on women's access. As a consequence of being barred from entering the societies in which original research was discussed and the role of the professional scientist was mapped out, women were overwhelmingly prevented from enjoying equal scientific status with men. Women were barred, for example, by Huxley from the Ethnological Society.[5]

By contrast, women were admitted as members to the Zoological Society of London (1829), the Royal Entomological Society (1833), and the Botanical Society of London (1836). However, in terms of being awarded fellowships (and thereby acquiring recognition of their scientific achievements from fellow practitioners), they had to wait until the twentieth century before enjoying such status in the Linnean Society (1905), the Royal Microscopical Society (1909) and the Society of Antiquaries and the Chemical Society (both 1920). It was not until 1944 that the physicist Kathleen Lonsdale (1903-1971) and biochemist Marjorie Stephenson (1885-1948) were elected as the first female Fellows of the Royal Society.[6] Women's exclusion

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[5] Evelleen Richards, 'Huxley and Woman's Place in Science: The "Woman Question" and the Control of Victorian Anthropology', in *History, Humanity and Evolution: Essays for John C. Greene*, ed. by James R. Moore (Cambridge: Cambridge University Press, 1989), pp. 253-284 (pp. 255, 261, 275); Lightman, *Victorian Popularizers of Science*, p. 99.

[6] Joan Mason, 'The Admission of the First Women to the Royal Society of London', *Notes and Records of the Royal Society of London*, 46 (1 July 1992), 279-300 (pp. 279, 293, 294).

from professional societies even meant that they were often unable to read their own work before expert audiences.[7]

Societies which encouraged a non-professional interest in science were more welcoming. The RI accepted female members from its foundation in 1799; the managers of the Institution agreed that women could become members on the same terms as men except that '"the ladies will not be called upon to take any part in the management with the officers of the Institution"'.[8] By 5 April 1800, one third of the RI's total subscribers were women, proving that scientific performances attracted a substantial female audience, whether for entertainment or instruction.[9] However, the fact that the first Friday Evening Discourse delivered by a woman did not take place until the third decade of the twentieth century (and it was not on a scientific topic), suggests little participation in the scientific aspects of the Institution, other than as audience members.[10] Similarly, when the BAAS was founded in 1831, women were admitted to evening but not sectional meetings. From 1837 they were allowed to attend Sections C (Geology) and D (Zoology and Botany), although in many cases women ignored their prohibition from other sections.[11] When, by 1839, it became apparent that their exclusion was impossible (not to mention the fact that women's attendance lightened the entertainments and lined the Association's pockets), women were invited to all sections but confined to a separate area of the room.[12] They could become members of the BAAS from 1848, although when, twenty years

[7] Notably, Beatrix Potter had to have her mycological work read for her at the Linnean Society, see Barbara T. Gates, *Kindred Nature: Victorian and Edwardian Women Embrace the Living World* (Chicago: University of Chicago Press, 1998), pp. 83-86.
[8] Quoted from a meeting (23 March 1799), in Patricia Phillips, *The Scientific Lady: A Social History of Women's Scientific Interests 1520-1918* (London: Weidenfeld and Nicolson, 1990), p. 194.
[9] Ibid, and Rebekah Higgett and Charles W. J. Withers, 'Science and Sociability: Women and Audience at the British Association for the Advancement of Science, 1831-1901', *Isis*, 99 (2008), 1-27.
[10] Art historian Joan Evans delivered the paper 'Jewels of the Renaissance' on 8 June 1923. It was not until 1994 that Susan Greenfield became the first woman to deliver the RI Christmas Lectures, 'Journey to the Centre of the Brain'.
[11] Jack Morrell and Arnold Thackeray, *Gentlemen of Science: Early Years of the British Association for the Advancement of Science* (Oxford: Clarendon Press, 1981), pp. 154-155.
[12] Margaret Alic, *Hypatia's Heritage: A History of Women in Science from Antiquity to the Late Nineteenth Century* (London: The Woman's Press, 1986), p. 180.

later, Lydia Becker delivered her first paper there, she was one of only two female members.[13] The rare female-authored paper was often delivered by a man, and was likely to appear in the economics section (considered to be the least "scientific").[14] The first female sectional president was not elected until 1913, when Ethel Sargant (1863-1918) headed the botanical section, while Lonsdale became the first female BAAS president in 1966.[15]

The exclusion of women from higher education was a major barrier against their entrance into scientific professions. In London, Queen's College and Bedford College provided science courses for women from 1848 and 1849 respectively; in 1868 University College London allowed women to attend lectures, and from 1878 they were able to take degree courses.[16] At Girton College, Cambridge (founded 1873) female students could study and take exams, but were not awarded degrees until 1948. In the Balfour Laboratory at Cambridge, built in 1884, female students performed experiments to accompany their studies for the natural science *tripos*.[17] In Manchester, women could attend lectures at Owen's College from 1883, in order to obtain degrees from Victoria University – but only in some subjects in the faculty of arts.[18] In fact, so concerned were the college authorities that university study was injurious to female health, that between 1884 and 1903 women taking a '"regular course of study"' at Owens 'were required to furnish a written statement from parent or guardian that "such course [...] may be entered upon without the prospect of injury to her health"'.[19] Overall it is clear that there was a (very) gradual trend towards women's admission to higher education as the century progressed,

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[13] Susan David Bernstein, '"Supposed Differences": Lydia Becker and Victorian Women's Participation in the BAAS', in *Repositioning Victorian Sciences: Shifting Centres in Nineteenth-Century Scientific Thinking*, ed. by David Clifford et al (London: Athenaeum Press, 2006), pp. 85-94 (p. 88).
[14] Ibid., pp. 88-89.
[15] Phillips, p. 206.
[16] Ibid., p. 209.
[17] See Claire G. Jones, *Femininity, Mathematics and Science 1880-1914* (Hampshire: Palgrave Macmillan, 2009); Marsha L. Richmond, '"A Lab of One's Own": The Balfour Biological Laboratory for Women at Cambridge University, 1884-1914', *Isis*, 88 (September 1997), 422-455 (p. 439).
[18] Mabel Tylecote, *The Education of Women at Manchester University, 1883 to 1933* (Manchester: Manchester University Press, 1941), p. 26.
[19] Ibid., p. 31.

and that the debates surrounding women's fitness to receive scientific education often returned to questions of physical and intellectual stamina (and indeed the two were considered to be related).

AN AWFUL DEMONSTRATION

OF THE POWER OF A LARGE MAGNET AT OLD BUNGER'S SCIENTIFIC CONVERSAZIONE.

Fig. 19.

The popular representation of women who attended scientific meetings was equally unsympathetic. Audaciously taking notes with which to regale their friends in salon-talk, women were presented as a fashionable audience who uncritically consumed what they were told. In *Punch*'s cartoon 'An Awful Demonstration' (fig. 19) at 'Old Bunger's scientific conversazione',[20] those drawn closest to the magnetic demonstration are women. One woman faints, while several others are floored by the force of attraction between the magnet and the steel frames of their dresses, reinforcing the perception of women's attendance as merely fashionable. It is

[20] 'An Awful Demonstration', *Punch*, 25 March 1865, p. 124. Image sourced from the Google Books and Oxford Bodleian Libraries Scanning Project.

noteworthy that the only woman whose attention remains fixed on the experiment is given a severe masculine expression and spectacles.

Punch's fictional correspondence from 'Mary Ann' and 'Louisa', entitled 'Mary Ann's Notions' and 'Food for the Female Mind', further emphasize such fashion and frivolity.[21] Their addresses to 'Dearest' and 'My Dear' Punch suggest a chatty familiarity incompatible with serious scientific content. Louisa writes of a lecture series for women performed by Huxley; the association of women with consumption is clear in 'I am *so* fond of mental food. Chocolate isn't to be compared with it for a moment. It is *so* nice' ('Food for the Female Mind'). Mary Ann attends a lecture by Faraday at the famously fashionable RI, which she describes in aesthetically feminine terms as 'lovely' and 'most beautiful' (Mary Ann's Notions'). These adjectives are attached as much to Faraday as to his demonstrations; indeed, she remarks, '[i]t was quite a treat to look at dear Dr. Faraday's earnest face and silvery hair'. It was 'ladies' only who 'came and asked him questions' at the end, 'and if we did not understand [his answers] it was our own faults, not his, or rather it was the fault of the system of education you men give us, which makes us either quote like parrots, or stare like owls, when philosophy comes up'. In the context of this satirical piece, Mary Ann's criticism of restrictive female education is made to seem itself parroted from education campaigners. These depictions by the socially conservative *Punch* present a female audience incapable of distinguishing between theatre, social chatter, and serious science. Such critiques would continue to appear, across the popular press, when women began to organize scientific speech of their own.

A significant influence on several female lecturers was the association between the pulpit and the platform. While it was not considered appropriate by the majority of Christian denominations that women preach, there were a few exceptions. Catherine Booth (1829-1890), a founder of the Salvation Army, believed that female religious speech was sanctioned by the

[21] 'Mary Ann's Notions', *Punch*, 14 March 1857, p. 109; 'Food for the Female Mind', *Punch*, 10 December 1870, p. 250.

Bible. God had 'given to woman a graceful form and attitude, winning manners, persuasive speech, and, above all, a finely-toned emotional nature, all of which appear to us eminently *natural* qualifications for public speaking'.[22] Quakers also recognized women's spiritual equality and allowed them to speak at meetings, while at the end of the eighteenth century John Wesley had decreed that, in some circumstances, women could preach the Methodist faith.[23] George Eliot's *Adam Bede* (1859) is set at the turn of the nineteenth century when the Methodist Conference voted to ban women preachers (1804). In the novel Dinah Morris is imbued with the characteristics of Booth's ideal female preacher: a 'clear but not loud voice',[24] and, with words flowing 'out as tears come' (p. 82), a calling to religious speech that is beyond her control. These earlier traditions established by Methodists and nonconformists were continued by women who spoke on social purity and the morals of medical practices in the second half of the century. Most notable were the Anglican Evangelical Josephine Butler (1828-1906), who campaigned for the repeal of the Contagious Diseases Acts (1864, 1866, 1869), and social-purity movement leader Jane Ellice Hopkins, founder of the male chastity society, the White Cross Army (1882).[25] Hopkins in fact believed that, as a woman, she was better suited than men to speak on moral and religious issues.[26]

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[22] Catherine Booth, 'Female Ministry; or, Woman's Right to Preach the Gospel' (1870 revised version), digitized through the *Victorian Women Writers Project, Indiana University* <http://webapp1.dlib.indiana.edu/vwwp/view?docId=VAB7105> [accessed 20 September 2016].

[23] See Pamela J. Walker, '"With Fear and Trembling": Women, Preaching and Spiritual Authority', in *Women, Gender and Religious Cultures in Britain, 1800-1940*, ed. by Sue Morgan and Jacqueline deVries (London: Routledge, 2010), pp. 94-116; Christine L. Krueger, *The Reader's Repentance: Women Preachers, Women Writers, and Nineteenth-Century Social Discourse* (Chicago: University of Chicago Press, 1992); Susan Mumm, '"I Love My Sex": Two Late Victorian Pulpit Women', in *Women, Scholarship and Criticism: Gender and Knowledge c. 1790-1900*, ed. by Joan Bellamy et al (Manchester: Manchester University Press, 2000), pp. 204-221.

[24] George Eliot, *Adam Bede*, ed. by Carol A. Martin (Oxford: Oxford University Press, 2008), p. 22.

[25] Judith R. Walkowitz, *Prostitution and Victorian Society: Women, Class, and the State* (Cambridge: Cambridge University Press, 1980), pp. 114-115, notes that Butler was a charismatic leader. See also Helen Rogers, *Women and the People: Authority, Authorship and the Radical Tradition in Nineteenth-Century England* (Aldershot: Ashgate, 2000), esp. pp. 209, 216-217.

[26] Mumm writes that Hopkins 'placed great emphasis on quietness and the avoidance of sensationalism', thereby emphasizing feminine qualities, p. 208.

Philanthropy: Sanitary Associations and Science in the Schoolroom

> "I am a School lady, I am a Visiting lady, I am a Reading lady, I am a Distributing lady, I am on the local Linen Box Committee, and many general Committees [...] My young family [...] have attended as many public meetings, and listened to as many lectures, orations, and discussions, as generally fall to the lot of few grown people." [27]
>
> Mrs Pardiggle, *Bleak House* (1852-3)

In *Bleak House* Mrs Pardiggle emphatically defines herself, through repeated 'I am's, in terms of her public philanthropic work. Dickens's satire famously rests on the way in which this public activity pushes its way into Pardiggle's, and Mrs Jellyby's, family life, causing both women to neglect maternal duties at home. The former's five young sons, in being forced to attend lectures, are forced into public life, and therefore premature adulthood.

As Perry Williams points out, middle- and upper-class Victorian women could enjoy a greater degree of social freedom by engaging in such philanthropic works, than they would otherwise receive at home.[28] Not only could these women exert authority and social responsibility, they also experienced the interaction and exchange of ideas which men enjoyed in many of the scientific societies from which, as has been demonstrated, women were excluded. Much philanthropic work was concerned with working-class, female, and sanitary education, and a large part of this was devoted to imparting scientific, usually practical, knowledge. This took the form of the "laws of health". These laws, as Williams notes, combined 'the laws of physiology and chemistry' with 'the commandments of a divine lawgiver'.[29] The Ladies National Association for the Diffusion of Sanitary Knowledge, founded in 1857 and which was affiliated with the

[27] Charles Dickens, *Bleak House*, ed. by Stephen Gill (Oxford: Oxford University Press, 2008), p. 115.
[28] Perry Williams, 'The Laws of Health: Women, Medicine and Sanitary Reform, 1850-1890', in *Science and Sensibility: Gender and Scientific Enquiry, 1780-1945*, ed. by Marina Benjamin (Oxford: Basil Blackwell, 1991), pp. 60-88 (p. 66).
[29] Ibid., p. 77.

National Association for the Promotion of Social Science (NAPSS), promoted everyday good sanitary practices. These included a healthy diet, fresh air, clean clothes (including non-restrictive clothes for women), and the best care of infants. Its members, largely middle- and upper-class women from evangelical and nonconformist backgrounds, paid home visits and distributed pamphlets to the working classes. Titles included: 'How to Manage a Baby', 'Why Do Not Women Swim?', and 'The Evils of Perambulators'. The Association shared its offices with the *English Woman's Journal*, who often printed the Association's tracts and speeches.[30] This relationship demonstrates how the production and distribution of women's sanitary work was supported by a network of other female workers, keen to demonstrate that women could work independently of men.

It is important to differentiate between two distinct types of female public speech – to different audiences – which took place *within*, or *in the name of*, such organizations. The former was constituted by, for example, women delivering papers at conferences such as those organized by NAPSS and styled on associations such as the BAAS. They addressed audiences who belonged to the same class as themselves, and discussed medical statistics, and social and sanitary reform. During these congresses, as in the male-dominated equivalent meetings in the hard sciences, women consolidated their intellectual authority in the social sciences through the exchange of ideas.[31] The other type of speech, *in the name of* sanitary organizations, took the form of women delivering lectures to the working classes. In these didactic lectures, women took on the role of teachers, translating physiological knowledge into domestic practice.

Inevitably, when women took part in Social Science congresses they were exposed to ridicule from the usual corners. *Punch* predictably labelled those who attended the Economics and Statistics Section of the Edinburgh BAAS meeting in 1871 '[l]adies with the gift of the gab', and suggested some "sciences" that are 'strictly social, and eminently suitable for harangues'. These

[30] Ibid., pp. 68. The *English Woman's Journal* (1858-1864) was an early feminist monthly magazine.
[31] See Lawrence Goldman, *Science, Reform and Politics in Victorian Britain: The Social Science Association 1857-1886* (Cambridge: Cambridge University Press, 2002), pp. 113-142.

included '[t]he Science of so thoroughly disguising your old greengrocer, that your most intimate connections mistake him for your butler'.[32] The implication that social science was less science more social, allowed critics to separate the "serious" masculine discussion of the hard sciences which took place at the BAAS from (what were perceived as) the largely female social science gatherings. Congresses, it was suggested, were created merely to fill in gaps in middle-class women's social calendars. Their discussions were not debates, but feminine conversation.

Writing in 1861, Frances Power Cobbe rejected such an accusation. She argued that the social sciences ought to be treated with the same intellectual respect as the hard sciences, because they proposed the 'vast accumulation of facts and observations, statistics and experiments', out of which 'gradually, by induction, larger generalizations will be reached [...] and the laws regulating public health, crime, pauperism, &c., will be discovered'.[33] The social scientist, like 'a geologist at a quarry' who finds 'many worthless stones along with some precious fossils', uses the same methods of scientific enquiry. Cobbe's strongest criticism, however, is reserved for those who ridicule women's participation:

> "Ladies must not meddle with this school. Ladies must not interfere with that hospital. [...] Ladies ought not to write papers about paupers, and women's employment, and children's education. And oh! above all earthly things, ladies ought not to read such papers, even if they write them. [...] and write (if they *must* write) papers about babies and girls, and then get some man to read the same (of course losing the entire pith and point thereof) while they sit by, dumb and "diffident," rejoicing in the possession of tongues and voices which, of course, it cannot have been "the intention of nature" should ever be heard appealing in their feminine softness for pity and help for the ignorant and the suffering.
>
> (p. 89)

Cobbe's criticism is not merely of the system which meant that women could not read their own papers before male-only scientific societies. Rather, Cobbe points out the absurdity of the idea

[32] 'Social Science', *Punch*, 19 August 1871, p. 67.

[33] Frances Power Cobbe, 'Social Science Congresses, and Women's Part in Them', *Macmillan's Magazine*, 5 (December 1861), 81-94 (p. 84).

that women's speaking on topics which directly concern them – women's employment, children's education – is somehow against nature. Performing public acts of philanthropy might be considered properly feminine. But to expand that activity to include the large-scale administration of health and education, and worst of all to speak about it in an official public capacity, was to go beyond the boundaries of the home and woman's sphere of influence. This ingrained belief was a significant barrier to women.

A different type of speech which women performed under the guise of sanitary work, was the delivery of sanitary lectures which were grounded in physiology. The Ladies' National Association for the Diffusion of Sanitary Knowledge aimed to highlight the physiological links between poor sanitation and poor health, and believed that women were better suited than men to lecturing to working-class women on delicate topics. As the secretary of the Association, Susan Rugeley Powers, wrote, the female lecturer's role was 'merely to translate into popular language, and illustrate, the truths she has learned from the writings of medical men'.[34] This distinction is important in understanding the role of women's sanitary work in tackling national public health issues. It was seen as an important, but distinct, partner to specifically male, large-scale sanitation projects. Men designed and built sewers, and women spoke personally to fellow women in their own homes to change domestic, everyday practices. Male scientists worked in laboratories and created knowledge about the transmission of disease, and studied medicine at university; women translated that knowledge into practical and individual instruction. The Earl of Shaftesbury, in his role as the chair of the first public meeting of the LSA on 21 June 1859, defined these gendered roles as follows:

> That part of Sanitary Reform which this Society has undertaken is peculiarly women's work. No man could undertake it with a reasonable hope of anything like success. It is extremely well for boards of health and for learned and scientific men to set forth great sanitary principles, to enforce them by powerful arguments, and illustrate them by a great array of facts [...] But for

[34] S.R.P., *Remarks on Woman's Work in Sanitary Reform: Addressed Specially to Mothers, Educators, Tract-Distributors, and Visitors of Schools, Cottages and Workhouses* (London: Ladies' National Association for the Diffusion of Sanitary Knowledge, [c. 1858]), p. 11.

> the purpose of fully carrying into effect all these principles, which are of little or no value unless they are applied to every home, we require something more minute; we require workers who are more qualified to deal with detail, and more conversant with the peculiar wants and necessities of the class in which the evil principally prevails. These workers must, I maintain, be women.[35]

Referring to his audience as 'workers', Shaftesbury praised their diligence, and in some ways empowered them to use their apparently unique skills. At the same time however, he discretely enforced limitations on their powers; they were only imparting knowledge, not making it. His language rigidly demarcated gender on intellectual and physical lines: 'great', 'principles', 'enforce[ment]' and 'power' versus 'minute[ness]', attention to 'detail' and being 'conversant'. Men were still operating on larger scales and dealing with scientific theory and new knowledge, women distributing that knowledge in domestic "conversation".

Home visits and tract distribution were indeed activities which required women to 'deal with detail'; their familiarity with the domestic scene, and the ability to talk to individual women without overwhelming them with 'a great array of facts' apparently suited them to this. Small lectures and meetings likewise emphasized the personal nature of this work. However, some systematically organized lectures were also printed and distributed in order to widen access to sanitary education. One ardent campaigner for sanitary improvement and education reform was Catherine Buckton.[36] A real-life Pardiggle, Buckton was a founding member of the Leeds Ladies' Educational Association (1868), a supporter of women's higher education, and a member of the Yorkshire Ladies' Council of Education, which from 1871 organized evening classes for girls who worked in factories and domestic service. In 1873, 1876 and 1879 she was elected to the Leeds School Board, and from 1874 she gave lectures to board school pupils, with particular emphasis on cookery. Several of Buckton's printed lectures became standard board school textbooks in Leeds and beyond.

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[35] Shaftesbury's speech recorded in *The Second Annual Report of the Ladies' National Association for the Diffusion of Sanitary Knowledge. With an Account of the Proceedings at the First Public Meeting of the Association, Held in Willis' Rooms, on Thursday, July 21st, 1859* (London: Published by the Ladies' National Association [...] Sanitary Knowledge, 1859), p. 4.
[36] Janet Shepherd, 'Buckton, Catherine Mary (1826/7-1904)', *ODNB* [accessed 2 July 2016].

Examining one lecture text in particular, *Health in the House* (1875), it is abundantly clear that Buckton wanted her lectures to be re-performed. Perhaps because of her Unitarian faith, Buckton firmly believed that education should be open to all; her emphasis on replication demonstrates how she utilized the genre of the lecture and print technology in order to do this. *Health* was a series of twenty-five lectures delivered to an audience of around ninety children, boys and girls, in Standards IV, V and VI of the Leeds Board Schools.[37] It may be considered an expanded version of multiple lecture series that Buckton had performed to working-class adults in Leeds and Saltaire, in the winters of 1872 and 1873. The organization of the Leeds lectures was described by the author in *Two Winters' Experience in Giving Lectures to My Fellow Townswomen on Physiology and Hygiene* (1873).[38] This pamphlet, priced at 2*d*, could be purchased by ladies who wished to follow Buckton's example and deliver lectures themselves. Because of this *Two Winters'* includes statistical and nutritional tables and a plan of ten lectures. In the winter of 1872 (i.e. the beginning of that year), Buckton delivered lectures to eighty 'working-men's wives, mill-girls, dressmakers, &c' (p. 7) at Holbeck Mechanics' Institute, a second course 'in the adjoining locality' to an audience of sixty, and a course of 'mothers' meetings' (p. 9) in Crossland Street, Holbeck. Recounting the three series she delivered the following winter to audiences in 'parts of the town rarely free from fever and other epidemics' (p. 10), Buckton cast herself as a brave – or simply no-nonsense – sanitary crusader.

Saltaire, near Bradford, was a purpose-built village designed for the workers at the textile mill belonging to Sir Titus Salt. It boasted its own Institute, with a laboratory, library, lecture theatre and concert hall. In her preface to *Health*, Buckton claims that it was at the personal request of Salt's wife that she was invited to deliver lectures there 'during six winter nights' to an audience varying from 'two to five hundred working women and their daughters'

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[37] Catherine M. Buckton, *Health in the House: Twenty-Five Lectures on Elementary Physiology in its Application to the Daily Wants of Man and Animals, Delivered to the Wives and Children of Working Men in Leeds and Saltaire* (London: Longmans, Green, and Co., 1876). Preface to *Health* pp. vii-xii (p. vii).

[38] Catherine M. Buckton, *Two Winters' Experience in Giving Lectures to My Fellow Townswomen on Physiology and Hygiene* 2nd edition, (Leeds: Ladies' Council of the Yorkshire Board of Education, 1873).

(*Health*, p. xi). According to the *Bradford Observer* Buckton's lectures were so popular at Saltaire that the lecture theatre was 'inconveniently crowded [...] whilst others have not been able to gain admission', and the lectures were therefore to be moved to the 'large hall'.[39] Comparing this to Buckton's estimates of audience size in *Two Winters*', we can estimate that she lectured to audiences ranging from forty to five hundred.[40] The 'mothers' meetings' were likely addressed to smaller groups, and they show that Buckton engaged with both traditionally female, conversational, sanitary education, and with bigger lectures.

Of the twenty-five lectures which make up the text of *Health*, almost half of them concern digestion, nutrition and cooking. Other topics include: 'The Skeleton', 'Respiration', 'The Nerves and the Sense of Hearing' and 'Sight and Sunshine'. Buckton was deeply concerned about animal cruelty and, as well as devoting her final lecture to 'The Treatment of Animals', frequently returned to the physiological similarities between humans and animals throughout the whole course.[41] At the end of each lecture text Buckton provided a list of apparatus used and some questions related to the topic, to which pupils could submit written answers. All of her topics, whether on 'The Brain and the Nervous System' or 'Cooking (boiling)' were taught through the lenses of chemistry and physiology. As Buckton maintained, '[p]hysiology, when practically applied, becomes a most interesting study to persons of all ages, but when taught alone is [...] uninteresting and soon forgotten by all except medical students' (p. viii). Like the majority of sanitary reformers Buckton made a direct connection between physiology (in the form of the laws of health) and morality. Evaluating her first experience of lecturing in 1872 she wrote:

> My experience this winter has been both a delightful and a painful one. I have felt overwhelmed by the conviction that the sin, sorrow, and suffering that

[39] 'Local and District', *Bradford Observer*, 11 December 1873, p. 8.
[40] Her third series in Leeds, winter 1873, was the least popular and for unnamed reasons was cut short after four lectures, *Two Winters*', p. 15.
[41] Many women were involved in animal protection, such as the RSPCA. See Gates, *Kindred Nature*, pp. 113-130.

> exist might be immensely reduced if women would only do the work I have attempted to do.[42]

Above all, Buckton believed that the most effective way to do this work was through lecturing: 'I attributed my success', she wrote, 'in arousing the interest of my hearers to the pains I took to make the matter intelligible and attractive, by having models, illustrations, and experiments, and by giving the information orally' (*Health*, p. x). She even ended the series by taking seventy-three of her ninety pupils to a museum (pp. ix-x).[43] These elements of clear oral delivery and the use of visual illustrations and experiments are retained throughout the lecture text, reinforcing the idea that she is not just giving her readers scientific information, but is also telling them how to perform.

One of the most striking stylistic traits of *Health* is the repeated use of anecdote, ending in a moral message, which gives the book an aphoristic tone. Personal stories were gathered by Buckton from the attendees of her earlier lectures in Leeds (such as a woman whose son was cured of bronchitis after she had, on Buckton's advice, opened the top of the window during washing-days to allow steam to escape (pp. 16-17)). Others are stories which Buckton picked up during the course of her reading, or from medical acquaintances. Her friend, the medical man Mr Wheelhouse, for example, had told her that his own daughter's shoulder was dislocated because '[t]he nurse had been swinging the child by its arms, and had pulled the ball out of the cup' (p. 34). On the one hand this technique consolidates Buckton's authority to speak on these subjects because she had achieved positive results, she has gained the trust of working women, and conversed with them at a personal level. Further, she directly relates the medical advice of doctors. On the other hand, Buckton's didactic tone and apparent proofs of her own correctness, verge on the patronizing. With only Buckton's own paratexts to corroborate her claims about how well the lectures were received, working-class women and children are presented as two-

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[42] Buckton, *Two Winters'*, p. 9.

[43] Buckton estimates that there were ninety pupils in total, but that the average attendance at each lecture was fifty, *Health*, p. viii.

dimensional, uneducated characters that are only too grateful to receive sanitary enlightenment. Buckton, like other sanitary reformers, was apparently presented with the paradox that working women, as women, were supposed to be the upholders of morality in the family. But as working women, they were apparently ignorant of basic sanitary and therefore moral standards.[44]

Some of Buckton's more unusual claims are asserted with alarming confidence. The higher mortality rates of girls than boys is, she assures us, due to the fact that because girls are made to wear short sleeves, '[t]he skin that is exposed to the cold air gets chilled, and then the pores become closed, and the sweat is thrown in and poisons the blood and brings on illness' (p. 70). It is imperative that the audience understands that 'it is very bad – indeed, dangerous to some people – to eat the skin of a roast potato' (p. 151) – perhaps this is a warning against eating green potatoes. Tonally, Buckton's relating of anecdote is highly ambiguous. In one instance she writes:

> Some people make cheese of skimmed milk – that is, milk that has had all the cream taken from it. This is very poor cheese, so poor that dogs, when they see it, bark at it, pigs grunt at it, but neither the dog nor the pig will bite it. This kind of cheese is made in Suffolk and Wales.
>
> (p. 123)

We might read this passage as mock-serious; adapting the stern authority of the middle-class female sanitary lecturer, Buckton creates humour from hyperbole. This suggests that she was aware of the conventions of the form in which she worked, and that she was so familiar with this and her subject matter, that she could subvert it for effect.

At the same time, the medical authority of male doctors is a major part of the scaffolding which holds Buckton's own authority together. Her warning to women not to administer medicine without medical advice is reinforced by the personal recollection that her own father, a doctor, had given his own children 'very little medicine' (p. 188). Several doctors had advised her on *Health* and earlier lectures, particularly the aforementioned Wheelhouse.

[44] See Priti Joshi, 'Edwin Chadwick's Self-Fashioning: Professionalism, Masculinity, and the Victorian Poor', *Victorian Literature and Culture*, 32 (2004), 353-370 (p. 366).

Buckton relished the opportunity to 'use the name of a leading medical man' (*Two Winters'*, p. 16) wherever she could, 'as it gave [her] an opportunity of removing the universal idea among the poor that the medical profession desire to keep their art a secret'. Buckton reaffirms male medical authority while maintaining that as a woman she is best suited to communicating practical knowledge to women. Occupying this middle ground, Buckton occasionally strays into brutal criticism of female ignorance of physiology, lambasting the 'mothers and nurses who have unfortunately never been taught physiology' who believe that water on the brain is caused by washing a baby's head (p. 29), and mothers who neglect to wash their children's heads until it is too late and, '[b]y trying to remove this dirt when they get older, [...] frequently give their children very sore heads' (p. 31). But her deference for male scientific authority is not impermeable. Buckton includes a reading list of recommended texts by such scientists as Huxley (*Yeast* and *Elementary Physiology*), Tyndall ('Dust and Disease') and W. B. Carpenter (*Animal Physiology*).[45] She also includes Florence Nightingale's *Notes on Nursing*. But the book she finds most useful is G. H. Lewes's *The Physiology of Common Life*, because 'it points out the conflicting opinions held by different medical men, and prevents one from being led away by any one theory' (*Two Winters'*, p. 15). Even though these men are cast as authorities, Buckton still tells her female readership to approach them with a critical eye.

Ultimately Buckton urged women to take a leading role in translating this knowledge by undertaking the responsibility of public performance. This might be a daunting task; Buckton knows this, and therefore she makes the text of *Health* a manual in lecture performance. When Buckton narrates her performance of experiments (or even when she simply gestures towards an object or diagram), she uses footnotes to enforce the fact that the action took place: 'I showed a single cell', 'I showed the wheat in a tumbler', 'I put some lumps of sugar in water' (p. 103), for example, accompany the lecture on 'Digestion and Carbonaceous Foods'. The repetition of the first person pronoun 'I' reinforces the fact that she is the demonstrator. The reader's attention is

[45] See Appendix II in *Health*, p. 234.

drawn away from the main body of text, forcing them to acknowledge that in addition to the spoken word, Buckton performed a physical demonstration.

Buckton's lectures were illustrated using many techniques: large diagrams, tables of mortality rates and nutrition, anatomical models, an orrery, and even cooking demonstrations. Several of her lectures from the winter of 1873 utilized the oxyhydrogen lamp (*Two Winters'*, p. 10). Buckton's diagrams, many of which were reproduced in the text, were not original. Instead she used diagrams by Mr Marshall, noting that 'they are the best, and large enough for any lecture room' (*Health*, p. 235), and may be purchased from Smith, Elder, & Co. It is likely that Buckton is referring to illustrations from *Description of the Human Body* by surgeon John Marshall (1818-1891), a text designed for physiology teaching. Likewise, Buckton used papier mâche anatomical models made by French model-maker Louis Thomas Jérôme Auzoux, and even gave the prices in francs of the models she used, and Auzoux's Paris address (p. 235). Every point on domestic practice is backed up by recourse to these models, diagrams, or experiments. For example, when discussing the importance of fresh air in the first lecture Buckton announces:

> I must now explain the wonderful effect oxygen gas has on our blood. You all know you have a heart, but I daresay you don't know what it is like, nor where it is placed in your bodies. I am glad to tell you I can now show you a beautiful model of a heart; here it is [...] Directly we take in a breath of fresh air, the oxygen that is in it turns the blood into a beautiful bright red. I have written down oxygen gas here in red letters, because it makes our blood such a beautiful red colour. Look how it is spelt.
>
> (p. 3)

Buckton's attention to aesthetics – the 'beautiful' red blood – was not, as I discussed in chapter one, exclusive to female popularizers. The sense of wonder at nature's beauty, evoked by such language, was equally if not more common in Tyndall's works. But Buckton's instruction to her viewers to admire the words 'Oxygen Gas' (written on a large sheet of calico (p. 9)) is unusual. So strong is her desire that the audience recognize the difference in colour between oxygenated and non-oxygenated blood, that in a later lecture she performs a demonstration which simply represents the colour change:

> You see these two glass pipes which are intended to represent an artery and a vein, and between them there is a small twisted pipe. Now, it is the twisted pipe which is the capillary, through the coat of which the blood escapes. [...] I will now pour into the artery what we will suppose to be pure blood. You see that the blood continues a beautiful red colour until it comes to the vein, when it becomes a dark bluish-black colour [...]
>
> (p. 51)

There is no indication in *Health* as to how Buckton caused this colour-change. In *Two Winters'* however she reveals that it was at 'the suggestion of the glass-blower' who made the apparatus, that she put a piece of bismuth into the "vein", to cause the red liquid to become darker (p. 12). This striking visual demonstration is a repetition of Buckton's point in the first lecture, as though she is most keen that the audience associate oxygenated blood with something aesthetically appealing, a technique to persuade them to implement her changes.

The cumulative effect of Buckton's style, demonstrations and diagrams, is one of reproducibility. Like Ball's *Experimental Mechanics*, *Health in the House* is designed to effect real change in the lives of its working-class audience. But in instructing the presumably female middle-class reader in how to perform the role of scientific communicator, the book also enables these women to claim the knowledge and skill to speak on sanitation with authority. Because of its dual function, therefore, *Health in the House* tends to exhibit discordance between the empowerment of middle-class women, and the silencing of its working-class audience.

Finally, it is important to consider the extent to which Buckton was promoting the tenets of scientific naturalism as pure science. For her, the importance of chemistry, physiology, and close observation, lay in their everyday application to improving the mundane practices of home economics. However, in her lectures Buckton both enacts, and argues for, the case that middle-class women can understand science. Indeed, not only do they understand it, they are also uniquely placed to apply it. Buckton was hugely successful in disseminating physiology-based practical knowledge; if anyone earned the epithet "authority" in sanitary science, it was her.

Arabella Buckley: Scientific Naturalist?

The traditions from which Buckton worked stressed fact over fiction. But this was just one branch of female-authored popular science; other genres gave more authority to female illustrators than authors, and several used fiction to communicate scientific fact. A wealth of critical material documents women's involvement in popular science publishing in the nineteenth century. Grey Myers has discussed the work of Jane Marcet (1769-1858), whose *Conversations on Chemistry* repackaged Davy's work for an audience of women and children.[46] Marcet's books, like those of botany writer Jane Loudon (1807-1858), were part of a tradition of women popularizing male discovery. Importantly, women chose genres which evoked the domestic scene – 'conversations, letters, tales', as opposed to men who 'w[rote] treatises and g[ave] lectures and d[id] demonstrations'.[47] Women were most prominent in the popularization of botany, often as illustrators. Emily Gosse (1806-1857) illustrated her husband Philip's work, while Marianne North (1830-1890) and Eliza Brightwen (1830-1906) were artists in their own right.[48] Women also blended fact and fiction in their science writing – Margaret Gatty's parables are a notable example of this.[49]

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[46] Grey Myers, 'Fictionality, Demonstration, and a Forum for Popular Science: Jane Marcet's *Conversations on Chemistry*', in *Natural Eloquence: Women Reinscribe Science*, ed. by Barbara T. Gates and Ann B. Shteir (Madison, Wisconsin: University of Wisconsin Press, 1997), pp. 43-60.

[47] Ibid., p. 46. See also Bea Howe, *Lady With Green Fingers: The Life of Jane Loudon* (London: Country Life Ltd., 1961).

[48] For North see Suzanne Le-May Sheffield, *Revealing New Worlds: Three Victorian Women Naturalists* (London: Routledge, 2001), pp. 75-138; for Gosse see Barbara T. Gates, 'Those Who Drew and Those Who Wrote: Women and Victorian Popular Science Illustration', in *Figuring it Out: Science, Gender, and Visual Culture*, ed. by Bernard Lightman and Ann B. Shteir (Hanover, New Hampshire: Dartmouth College Press, 2006), pp. 192-213 (p. 193); for Brightwen see ibid., pp. 198-207, and Lightman, *Victorian Popularizers of Science*, pp. 438-449. Gates's *Kindred Nature* (1998) is an excellent study of women's engagement with science.

[49] Tess Cosslett, *Talking Animals in British Children's Fiction, 1786-1914* (Hampshire: Ashgate, 2006), p. 110.

As Lightman points out, female popularizers often wrote 'narrative[s] of natural history [which] made science accessible to a popular audience by stressing the plant and the animal (not the activity of the scientist), the singular (rather than the typical), and the emotional response of the observer'.[50] These narrative techniques were often used to present aesthetic views, and moral and religious instruction. Arabella Buckley believed that the 'forces of nature' are 'one and all the voice of the Great Creator', but she nevertheless reinforced the authority of leading male scientific naturalists.[51] Buckley was Charles Lyell's secretary for nearly ten years, and following his death in 1875 she became a successful popularizer.[52] Buckley knew several scientific naturalists, including Darwin himself, through her connection with Lyell. Accepting of Darwin's theory, she was one of the key writers who stressed that evolution was unselfish at heart, and therefore compatible with a religious view.[53]

Buckley's *Fairy-Land of Science* (1879) was apparently based on ten lectures delivered to children at St John's Wood in the spring of 1878. Many key aspects of the original lecture series remain a mystery. I have been unable to find supporting textual evidence for the performances beyond Buckley's own preface. We cannot therefore ascertain where exactly in St John's Wood the lectures took place, the size of the audience, or specific performance dates. Were they performed to a class of school children, or did they take place out of school? If so, were they ticketed? To which social classes did the audience belong? Such questions are important because they can tell us how formal the lectures were, and the extent to which Buckley was presenting herself in public as an authority. As I will demonstrate, an authoritative teacher-figure (Buckley), guides readers through the text of *Fairy-Land*; but the facts around Buckley's literal embodiment of that role may never be known.

[50] Bernard Lightman, 'Depicting Nature, Defining Roles: The Gender Politics of Victorian Illustration', in Lightman and Shteir (eds.), pp. 214-239 (p. 220).
[51] Arabella Buckley, *The Fairy-Land of Science* (London: Edward Stanford, 1879), p. 237.
[52] For Buckley's biography and her views on spiritualism and evolution see Lightman, *Victorian Popularizers of Science*, pp. 238-253.
[53] A[rabella] B[uckley], 'Darwinism and Religion', *Macmillan's Magazine*, 24 (May 1871), 45-51.

Fairy-Land was addressed to young children. A broad range of scientific ideas is explored using the narrative structure of a "journey" through a magical land in which forces are called "fairies", and scientific reality is, it is hoped, shown to be more wonderful than fairy tales. Melanie Keene has demonstrated that *Fairy-Land* fitted into multiple existing educational traditions: those which reacted against Gradgrindian rigidity to provide both instruction and amusement; a tradition of female popularizers who wrote rudimentary primers to entice children into further study; and a broader nineteenth-century interest in fairy tales.[54] Buckley's epigraph reads:

> For they remember yet the tales we told them
> Around the hearth, of fairies, long ago,
> When they loved still in fancy to behold them
> Quickly dancing earthward in the feathery snow.
>
> [...]
>
> *Folk Lore*.

As 'Folk Lore' and fairy tales told '[a]round the hearth', this stanza calls to mind a very different type of oral tradition from the public lecture: the domestic setting of storytelling. Buckley is overtly metaphorical; by personifying forces as fairies she allows the curious child to embark on an imaginative excursion like 'the knight or peasant in the fairy tales' (p. 12) and to speak to them in the 'language of science' (p. 14). The lecturer, as storyteller, is their guide: '[i]f you have this gift of imagination come with me, and in these lectures we will look for the invisible fairies of nature' (p. 8). It is this simultaneity which enables Buckley to be part of both female and male publishing traditions at the same time.[55] She asks her audience to experiment for themselves, a call echoed time and again by the scientific naturalists: 'if you ask why the rain dries up from the

[54] Melanie Keene, 'Object Lessons: Sensory Science Education 1830-1870', (Unpublished PhD Thesis, University of Cambridge, 2008), pp. 91-96, and *Science in Wonderland: The Scientific Fairy Tales of Victorian Britain* (Oxford: Oxford University Press, 2015), pp. 100, 140-144. On the fairy tale in Victorian culture and education see Caroline Sumpter, *The Victorian Press and the Fairy Tale* (Hampshire: Palgrave Macmillan, 2012); Nicola Bown, *Fairies in Nineteenth-Century Art and Literature* (Cambridge: Cambridge University Press, 2001); Laurence Talairach-Vielmas, *Fairy Tales, Natural History and Victorian Culture* (Hampshire: Palgrave Macmillan, 2014).

[55] Barbara Gates has written on how Buckley was able to promote empirical science, and overcame the problems of representation that came with it, by using fictional forms. She also drew on a tradition of female-authored books on microscopes and telescopes, 'Revisioning Darwin With Sympathy: Arabella Buckley', in Gates and Shteir (eds.), pp. 164-176 (pp. 172, 174).

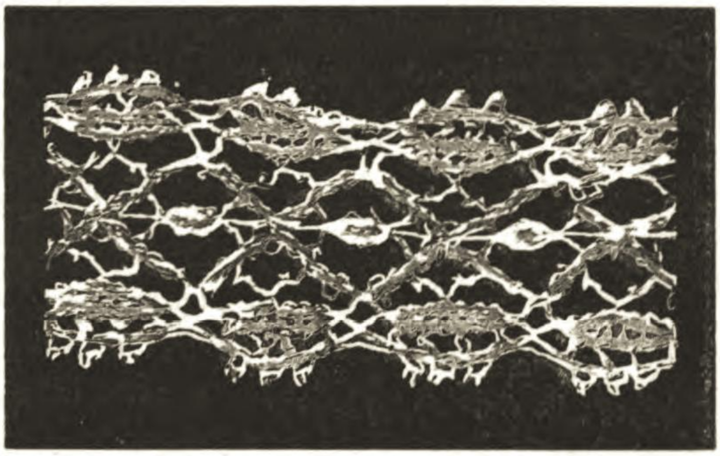
ground, most likely you will be answered, "that the sun dries it", and you will rest satisfied with the sound of the words. But if you hold a handkerchief before the fire and see the damp rising out of it, then you have some real idea how moisture may be drawn up by heat from the earth' (p. 14). Her disdain for words as mere signifiers, and her enthusiasm for empirical demonstration, bear the mark of scientific naturalism.

In her preface Buckley writes that '[t]he lectures have been entirely rewritten from the short notes used when they were delivered' (p. v). Yet the text is heavily studded with exclamations calling on the audience to notice experiments: repeatedly '[s]ee!' (pp. 16, 39, 40, 128) is used not just as an imperative but as an exclamation. Punctuation is used to replicate an exclamatory tone: 'I have here a round piece of cardboard [...] when I whirl it quickly round – see! – the cardboard looks quite white' (p. 40). Deictic markers, like those found in Tyndall and Ball, are also used: 'this gas-jet' and '[i]f I break or bend this wood' (p. 14), and '[i]f this kettle were transparent you would not *see* any steam above the water' (p. 75). Buckley retains, perhaps even adds, language which suggests the presentness of performance because the success of her lectures depends on her reader's ability to experience the content as though they were there. Her relative physical position to her audience – '[n]ow suppose I wish to touch you from this platform where I stand' (p. 33) – is enforced to show that she is the teacher giving scientific instruction, and imperatives such as '[n]otice the wind-ripples on the pond' (p. 3) indicate both Buckley's authority to compel her audience to observe the natural world, and her confidence that she knows what they will see when they do. Her use of pronouns defines their relationship simultaneously as that of teacher and pupils, in 'I' and 'you', and as someone who, while guiding the children through fairy-land, in 'us' and 'we', also experiences its wonders. In this her work is much like that of earlier female popularizers such as *The Young Naturalist's Journey* (1840) by Loudon.

Buckley is therefore able to combine the roles of masculine lecturer and feminine writer of journeys of discovery through the natural world. The journey is narrated in the present tense, allowing Buckley to reveal the natural world in her own time. Delivering *Fairy-Land* as a lecture series, Buckley also performs experiments in present tense, allowing both listening and reading audiences to experience the phenomena which she describes. In choosing to lecture, and to publish those lectures, Buckley combines the two forms to evoke the authority of the male practitioner, while remaining within a feminine tradition, thereby staking a claim without being threatening. Despite, therefore, the fact that *Fairy-Land* is rewritten from 'short notes', Buckley retains the temporal structure of the lecture; *doing* the demonstration means she is able to *reveal* the results before the audience just as the fairy-land is revealed:

> Before I began this lecture, I put a piece of paper, which had been dipped in nitrate of silver, under a piece of glass; and between it and the glass I put a piece of lace. Look at what the sun has been doing while I have been speaking. It has been breaking up the nitrate of silver on the paper and turning it into a deep brown substance [...]
>
> (p. 47)

Fig. 9.



Piece of lace photographed during the lecture.

Fig. 20.[56]

Combining image and text (fig. 20), Buckley proves that her demonstrations took place, suggesting that they and the journey through fairy-land happened at the same time. Like Ball's

[56] *Fairy-Land*, p. 48. Image sourced from the Google Books and Oxford Bodleian Libraries Scanning Project.

combining of photograph and rhetoric to make a direct link between the telescope trained on the moon, and the lantern slide his audience sees, Buckley transposes demonstration to page with seemingly perfect fluidity.

One of Buckley's tactics for establishing her authoritative role is, however, to evoke the higher authority of male scientists; as Lightman notes, '[f]emale popularizers erected a façade of deference toward male practitioners as it became increasingly difficult for them, in an era when practitioners were touting professionalization, to withstand challenges to their authority'.[57] She refers to Herschel (pp. 31, 35), Clerk Maxwell (p. 35), Tyndall, (pp. 75, 76, 90, 128), Lyell (p. 110), Huxley (pp. 21, 104), Geikie (p. 117) and Lubbock (p. 216). More often than not the texts she recommends to her audience are published lectures. These include Herschel's 1868 *Familiar Lectures on Scientific Subjects* (a collection of both spoken and written discourses), Huxley's 'Coral and Coral Reefs' in the *Manchester Science Lectures for the People*, and Tyndall's lectures on *Sound*. She performs 'an experiment suggested by Dr Tyndall' (p. 76) to distinguish water vapour, and replicates his observations of ice crystals (p. 90), and one of his demonstrations from *Sound*.[58] In this latter demonstration Tyndall uses glass marbles to explain the concept of sound vibrations. He includes the illustration below:

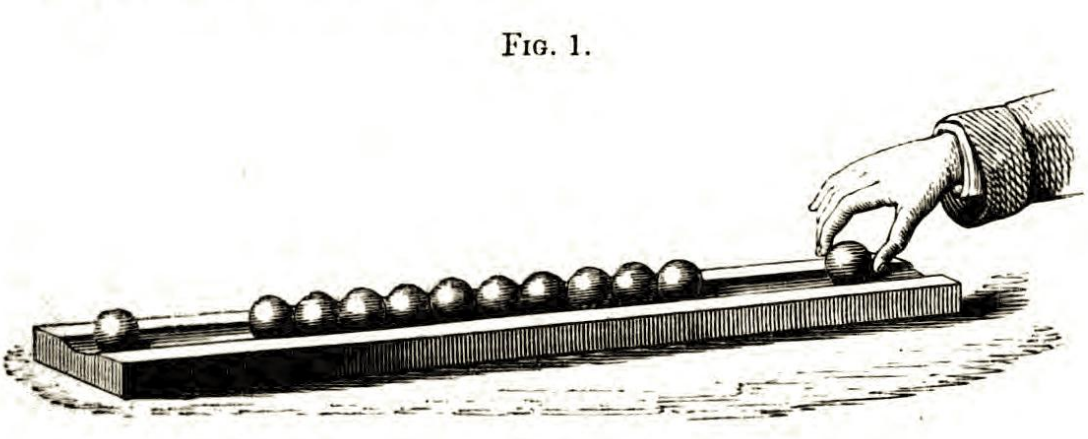


Fig. 21.[59]

[57] Lightman, *Victorian Popularizers of Science*, p. 155.
[58] Gates makes a different comparison between *Fairy Land* and Tyndall: she compares the frontispiece of Buckley's work with that of Tyndall's *Fragments of Science* (1879), Gates, *Kindred Nature*, pp. 54-55.
[59] Tyndall, *Sound*, p. 3. Image sourced from the Google Books and Oxford Bodleian Libraries Scanning Project.

Buckley's equivalent demonstration is similarly depicted in graphic form:

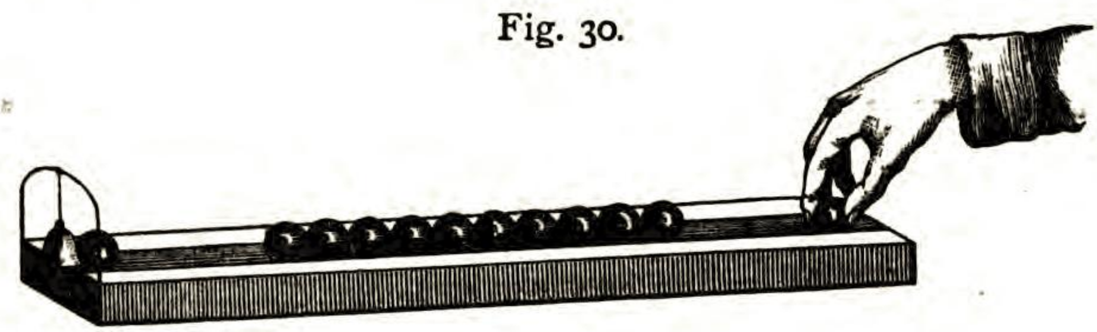


Fig. 22.[60]

There are striking similarities between these diagrams, suggesting that Buckley relied on Tyndall's printed text as the basis for her own. When describing the experiment, however, Buckley's language is pitched in a lower register than Tyndall's. She tells her audience, 'I want you to notice carefully what happens. See! the ball at the other end has flown off and hit the bell, so that you hear it ring. Yet the other balls remain where they were before. Why is this?' (p. 129). '[K]nocked forward' and 'bound back' (ibid.) are less abstract than 'the propagation of motion' and 'motion thus imparted' in Tyndall's text, and her inclusion of a bell reminds her audience that the demonstration is a translation of the aural into the visual. In '[w]hy is this?' Buckley suggests a tone of questioning and investigation, whereas Tyndall merely explains the meaning of his results without any sense of curious inquiry. Buckley adapts male printed performances for a new audience, showing an understanding of the science, and a willingness to participate in a traditionally masculine mode of popularization. However, the lecture form also enhances her traditionally feminine role as translator of more complex masculine works. Buckley is not only working within the tradition of popular lectures herself, she is engaging in a dialogue with those who have lectured before her.

[60] Buckley, *Fairy-Land*, p. 129. Image sourced from the Google Books and Oxford Bodleian Libraries Scanning Project.

However, in *Fairy-Land*'s sequel, *Through Magic Glasses and Other Lectures* (1890), we find that Buckley presents a challenge to the balance she struck in the first book.[61] *Through Magic Glasses* 'travels over a wide field, pointing out a few of the marvellous facts which can be studied and enjoyed by the help of optical instruments' (p. v). Its range of topics includes 'Fairy Rings and How They Are Made', 'The Life-History of Lichens and Mosses', 'An Hour With the Sun', and 'The Dartmoor Ponies, or The Wanderings of the Horse Tribe'. Despite the suffix '*and Other Lectures*', and its being pitched as the sequel to *Fairy-Land*, this second work is a series of ten definitely *fictional* science lectures which take place in a boys' school. A man whom initially we believe to be a magician is revealed as 'a rich man and Founder and Principal of a large public school for boys of the artisan class' (p. 4). The fictional lecturer reinforces Buckley's earlier empirical message, instructing his pupils that '[y]ou must open your eyes and ears, and use your intelligence to test carefully what your senses show you' (p. 29) and 'if you question your instruments honestly and carefully, they will answer truly and faithfully' (p. 54).

Through Magic Glasses then departs from *Fairy-Land* in significant ways. The process of defamiliarization which occurs when Buckley asks her young audience to imagine that forces are fairies, is transferred to the 'implements of [the magician's] art' (p. 1). The lectures are themselves placed within a fictional framework. We enter to find the magician alone in his 'turret chamber' where 'on looking down the turret stairs a lecture-room might be seen below'. We are then moved from a third person past tense narrative voice to the first person speech of the magician delivering his lecture. This boundary-crossing enables the reader to witness scientific discovery, not just its translation into lecture demonstration. This distinction is demonstrated as the lecture is pitched as a theatrical performance, with scientific apparatus as props:

> It was the lecture hour, and the subject of the day was, "Magic glasses, and how to use them." As the large clock in the hall sounded twelve, the Principal gathered up a few stray lenses and prisms he had selected, and passed down the turret stairs to his platform. Behind him were arranged his diagrams, before him on the table stood various instruments, and the rows of bright faces

[61] Arabella Buckley, *Through Magic Glasses and Other Lectures* (London: Edward Stanford, 1890).

> beyond looked up with one consent as the hum quieted down and he began his lecture.
>
> (p. 27)

Buckley's emphasis on personal discovery and the solitary, male scientific practitioner, is established in the magician's opening speech to his pupils. Using the first person pronoun 'I' he stamps his mastery over the nature he sets out to understand: 'I work spells as did the magicians of old [...] by the help of my magic glasses I peer into the secrets of nature [...] I read the secrets of the distant stars; I catch the light of wandering comets [...] I penetrate into the whirlpools of the sun' (p. 28). The magician works in a magical realm like *Fairy-land* but he is not a guide; rather, he is an explorer and conqueror. The most significant development, however, between *Fairy-land* and *Through Magic Glasses*, is the fact that Buckley retrospectively erases herself as lecturer from the first volume. She first creates a fictional historical relationship between teacher and pupils, through the magician's references to previous lessons, such as 'we pass on to use two extra lenses to assist our eyes, and come to this compound microscope (Fig. 14) through which I have before now shown you the delicate markings on shells which were themselves so minute that you could not see them with the naked eye' (p. 37).[62] She then incorporates demonstrations that took place in *Fairy-land* as though they too had been carried out by the magician: '[w]e now come to our last magic glass – the Spectroscope; and the hour has slipped by so fast that I have very little time left to speak of it. But this matters less as we have studied it before [n. lecture two of *Fairy-land*]' (p. 50), and later '[y]ou have already learnt [n. chapter two of *Fairy-land*] a good deal as to the size, the intense heat and light, and the photographic power of the sun' (p. 119). Buckley wants her readers to be able to move seamlessly from her own, real lectures, to *Through Magic Glasses*, but in so doing she suggests that the role of teacher – certainly at a more advanced level – is best carried out by a man. In this way Buckley conforms to the widely held belief that women play a vital role in nurturing very early interests in the sciences, in boys who will become

[62] '(Fig. 14)' refers to Buckley's original text.

men of science. The last chapter, 'The Magician's Dream of Ancient Days', is entirely made up of the magician's 'waking dream' (p. 210) in which he envisions the history of man. This takes place before the lecture, and '[t]he boys wondered as he began his lecture at the far-away look in his eyes. They did not know how he had passed through a vision of countless ages; but that afternoon, for the first time, they realised, as he unfolded scene after scene, the history of "The Men of Ancient Days"' (pp. 225-226). The lecturer is depicted as a visionary, like Tyndall's 'true votary of science', making discoveries through solitary thought. We are reminded that this is a largely male trait by the historiated initial letter which opens the chapter, depicting Palaeolithic man looking remarkably like Darwin:

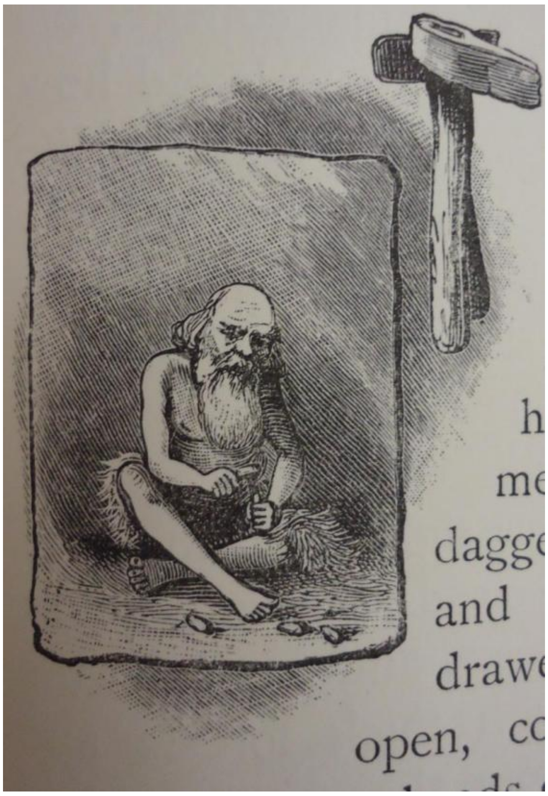


Fig. 23.[63]

This image also suggests a timelessness to human scientific curiosity, such that the male solitary geniuses of the nineteenth century could trace a direct ancestry through all men who had ever contributed to the sum of human knowledge. Darwin had himself wondered whether it were

[63] Buckley, *Through Magic Glasses*, p. 225.

better for a 'man of science' to remain unmarried and without children; 'for then there would be nothing in this wide world worth caring for & a man might (whether he would is another question) work away like a Trojan'.[64] While this comment should not be taken particularly seriously – Darwin is really expressing relief at the recovery from illness of one of his children – it highlights the fact that domestic responsibilities were a significant distraction. If woman's work was primarily that of looking after her family (even Cobbe did not dispute that the 'home duties of *such women as have them* are, beyond all doubt, their first concern' ('Social Science Congresses', p. 89)), she had little time for original scientific work. In a sense then, while Buckley had greater access to the masculine world of London-centric scientific naturalism than most women, her popular writing perpetuated traditional gender values. By replacing her own lecturing voice with that of a fictional male teacher, and immortalizing the solitary genius of Darwin in the final image of *Through Magic Glasses*, Buckley reverts to the traditional deference for male scientific authority found in so many women-authored popularizations.

Education, Entomology and Expertise: Eleanor Ormerod and Lydia Becker

Buckton and Buckley drew heavily on traditionally female scientific roles when carving out a niche in the lecturing arena. But some women focused their energies on gaining access to male professional realms, establishing scientific authority not just as communicators of knowledge to a lay audience, but also as creators of that knowledge. Two examples of such women were botanist and suffrage campaigner Lydia Becker, and economic entomologist Eleanor Ormerod, who seemed to embody Becker's ideal scientific woman, but who firmly rejected being connected to

[64] Letter from Darwin to Asa Gray, 23[-4] July [1862], *Correspondence of Charles Darwin*, X, pp. 330-334 (p. 330).

the women's movement. The two met when Ormerod read a paper on injurious insects, at the Richmond Athenaeum in March 1882:

> "At the close of the lecture" (Lady Hooker writes) "Miss Lydia Becker, at that time a vigorous upholder of 'Woman's Rights,' rose to speak, and while praising Miss Ormerod's able lecture, instanced her work as 'being proof of how much a woman could do without the help of man.' Miss Ormerod, in her reply, thanked Miss Becker, but begged to say that she had no right to the praise accorded to her on the ground of her work being so entirely that of a lone woman, for, she said, 'No one owes more to the help of man than myself. [...]'"[65]

This section considers the vastly different ways in which Ormerod and Becker conceived of women's roles in professional science; how they saw their work, and their public speaking, in relation to their fields of expertise; and how they were treated in the popular press in light of their aims and methods.

In 1924 Virginia Woolf published a short story in *The Dial* magazine entitled 'Miss Ormerod', inspired by key events in Ormerod's posthumously published autobiography (1904). Through several short, fictional moments Woolf crafted a modernist, feminist work out of the personal recollections of a somewhat conservative Victorian scientist. Ormerod's complex and sometimes contradictory relationship with the scientific establishment, from which she enjoyed receiving recognition for her work but by whom she did not want to be labelled a "professional", is read by Woolf as an example of men's silencing of women's intellectual achievements. Recounting the death of Ormerod's father, Woolf laments, '[o]h, graves in country churchyards – respectable burials – mature old gentlemen – D.C.L., LL.D., F.R.S., F.S.A. – lots of letters come after your names, but lots of women are buried with you!'.[66] Significantly however, Ormerod *did* have letters after her name, and she used them. Whereas Woolf used Ormerod as an example of a tireless yet underappreciated Victorian woman of science, Ormerod's actual

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[65] Quoted in *Eleanor Ormerod, LL.D. Economic Entomologist. Autobiography and Correspondence*, ed. by Robert Wallace (London: John Murray, 1904), p. 86.

[66] Virginia Woolf, 'Miss Ormerod', *Dial*, (December 1924), 466-474 (p. 470).

relationship with both the field of entomology and the scientific establishment, was much more complex.

Ormerod was born into a wealthy family in Gloucestershire and, as a child, received little encouragement to follow intellectual pursuits (although she aided her brothers in theirs). In 1870 however, she won the Royal Horticultural Society silver medal, and after her father's death in 1873, began publishing in such periodicals as the *Linnean Society Journal*. Ormerod had sustained and direct involvement in several amateur and professional societies, and was also involved in university entomology. She was the first woman to be elected fellow of the Meteorological Society (1878), she was elected to the Royal Entomological Society of London in the same year, and in 1882 became honorary consulting entomologist for the Royal Agricultural Society of England (RASE). Her 'honorary' status is significant here; men in equivalent positions were paid, and her refusal to accept payment is acknowledged to be because she did not think it appropriate for a woman of her social status to receive a salary. Her expert knowledge was highly valued by the government, farmers, and amateur gardeners alike. As in her RASE position, Ormerod worked voluntarily as the Agricultural Advisor to the Board of Agriculture between 1885 and 1890. She acted as an examiner in agricultural entomology at the University of Edinburgh between 1896 and 1899, and in 1900 was the first woman to be awarded an honorary LL.D. degree at that university. Between 1877 and 1900, using data collected from a wide correspondence network, Ormerod published annual agricultural reports which were highly valuable to farmers. Through personal and professional networks, she was friends with the Hookers and carried out studies at Kew, and she considered Huxley 'a valued friend' (*Autobiography*, p. 78).

Ormerod remains an understudied scientific figure, despite the fact that her work was of national importance, and was recognised as such during her lifetime. Her uncertain status on the boundary between populariser and professional, means that she remains something of a crux in the history of science. J. F. M. Clark, who has perhaps written more extensively than most on Ormerod, writes that her 'obituaries indicate "success" as measured by the standards of the scientific community. She publicly accepted these male standards and rebuffed women's attempts to make her a model for feminist causes'.[67] Suzanne Le-May Sheffield has argued that Ormerod 'went out of her way, time and again, to convince others that she was a practical worker and thus a popularizer, not a professional scientist'.[68] It is certainly true that Ormerod refused the status of professional, even while working within expert science. Further, Ormerod's published agricultural reports reached a wide audience, aimed at the practical application of science, and helped to popularize economic entomology. But it is equally true that her expertise was highly valued, and that many of the roles she took on involved the communication of new findings which she herself had gathered.

Much of the ambiguity of Ormerod's position may have come from the status of the field in which she worked. Gates believes that Ormerod 'worked to authorize herself in an area just outside "high" science, an arena in which she could readily interact professionally with both scientists and agriculturalists. [...] A friend to experts [...] she nevertheless had no compunctions about criticizing those who were inaccurate in their observations or conclusions'.[69] Economic, or agricultural, entomology, stressed the application of chemistry and entomology to agriculture. It developed throughout the nineteenth century, but came to particular prominence in the 1880s. Its emphasis on the application of science to food production – of feeding a nation and an empire – meant that the work of economic entomologists had national importance.[70] Judging on this criterion we can see similarities between the aims of economic entomologists and the ambitions of scientific naturalists, in that they believed science had a national importance and therefore

[67] J. F. M. Clark, *Bugs and the Victorians* (New Haven: Yale University Press, 2009), p. 156. See by the same author, 'Eleanor Ormerod (1828-1901) as an Economic Entomologist: 'Pioneer of Purity Even More than of Paris Green', *British Journal for the History of Science*, 25 (December 1992), 431-452.
[68] Sheffield, p. 173.
[69] Gates, *Kindred Nature*, pp. 89-90.
[70] See J. F. M. Clark, 'Bugs in the System: Agricultural Science, and Professional Aspirations in Britain, 1890-1920', *Agricultural History*, 75 (Winter 2001), 83-114 (p. 86).

should have an institutionalized, protected status. But so much of economic entomology was in the application. It is, therefore, possible that Ormerod saw an opportunity in economic entomology to make a national contribution to science without overstepping the role appropriate to an upper-class woman. Doing science might be seen as a duty to her country.

Perhaps in order to maintain this status as a genteel woman – only giving lectures because she *had* to – Ormerod recounts that her lectures induced in her much anxiety and physical suffering. On delivering a series of six lectures to around 120 students and staff at the Royal Agricultural College, Cirencester (between 1881 and 1884), '[s]he declared that while walking from the drawing-room to the large lecture theatre at the opposite end of the college quadrangle she could not utter a word, and on this, as on other somewhat similar occasions, she experienced a drumming in her head which she failed to moderate by any attempted remedial measures' (*Autobiography*, p. 83). In a separate incident, delivering a lecture on 'Insects Injurious to Farm Crops, and Their Prevention' to 500 people at the Institute of Agriculture, South Kensington (April 1883), she mistook the loss of vision in one eye, caused by standing directly in front of a bright light used to illuminate her diagrams, for one of her frequent migraines (p. 84). Ormerod's physical suffering from performance nerves, even injuring herself with the projection equipment, suggests that she was never comfortable on the lecture platform. This could, however, be a retrospective attempt to portray herself as a woman physically unsuited to public appearances.

One lecture series, delivered to school teachers at South Kensington, was published as *Guide to the Methods of Insect Life* (1884), later becoming *A Textbook of Agricultural Entomology* (1892). The book is a very general guide to types of insect, beginning with the most basic question, "what is an insect?". There was a hint of scientific naturalism in Ormerod's motivations for publishing these lectures:

> I complied with the request in the hope that the work might be useful for farm service; and that in its published form it might be carried to the field, or taken up at an odd minute [...][71]

Ormerod hoped that her book would serve as a reference work, and this seems to contradict the aspect of scientific naturalism which would make the book secondary to direct observation. But in translating her spoken word to the page, Ormerod hoped that her spoken authority might be carried in a farmer's pocket into the field, to act as an aid to observation and enable him to put science into practice. In this way, *Methods of Insect Life/Textbook of Agricultural Entomology* was a tool to accompany and enhance, and not to replace observation. Like the textbooks of Tyndall and Ball discussed in chapter one, and Buckton's *Health* lectures, it preserves the lecturer's authority by making the text part of the reader's scientific apparatus.

As with her other published lectures, such as *A Lecture on Effects of Weather on Insects* (1882) and *A Lecture on Injurious Insects* (1881), the title page to *Methods of Insect Life* includes many letters after Ormerod's name. To name a few, they include her fellowship to the Royal Meteorological Society, her lectureship at the Royal Agricultural College, and her consulting position at the RASE.[72] Here, like male scientists, Ormerod advertises her expert status. She considered male entomologists to be her colleagues; in the introduction to the English translation of Dr J. Ritzema Bos's *Agricultural Zoology* (1894), Ormerod wrote that she had 'especial pleasure' in contributing the introduction because she had 'had the advantage of many years of colleagueship' with Bos.[73] She also describes her relationship with her sister Georgiana (who assisted her in collecting and illustrating specimens) as one of 'sisterly affection and colleagueship' (*Autobiography*, p. 90). Rather than suggesting that Ormerod's was a somewhat generous usage of the word, this shows that she held *both* Georgiana's, and her own work, in high regard.

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[71] E. A. Ormerod, Preface to *A Textbook of Agricultural Entomology; Being a Guide to Methods of Insect Life and Means of Prevention of Insect Ravage. For the Use of Agriculturalists and Agricultural Students*, 2nd edition (London: Simpkins, Marshall, Hamilton, Kent & Co., 1892), pp. vii-xii (p. vii).

[72] Eleanor A. Ormerod, *Guide to Methods of Insect Life; and Prevention and Remedy of Insect Ravage. Delivered for the Institute of Agriculture, December, 1883* (London: Simpkin, Marshall & Co., 1884).

[73] Eleanor Ormerod, Introduction to Dr J. Ritzema Bos's *Agricultural Zoology*, trans. by J. R. Ainsworth Davis (London: Chapman & Hall, 1894), pp. ix-xi (p. ix).

Contemporaries of the entomologist recognised Ormerod's achievements as much as she did. However, while articles about her in the popular press were eager to stress her accolades, they also tended to paint Ormerod as a retiring worker, not an original genius, of science. One article praised 'her unflagging industry in collecting materials, and her unmistakeable talent for putting into a popular form the results of scientific research', and asserted that such work formed 'a welcome auxiliary to labours of a more original kind'.[74] An obituary in the *Athenaeum* observed that 'much of the work done was of a private character; it did not lend itself to publicity, and Miss Ormerod was not one to desire it, and always seemed to choose the subordinate *rôle* of prompter rather than play a leading part'.[75] The editor of Ormerod's *Autobiography*, in a line which was picked up by Woolf, remarked of the many 'ladies [who] came to make enquiries' (p. 86) after a Farmers' Club lecture delivered in 1889, that 'probably the lecturer would have been equally well pleased had none of her own sex put in an appearance' (p. 87). This circumlocutory comment suggests, in equally modest prose, that Ormerod could hold her own in front an audience of men, but was too modest to admit it. Certainly, Ormerod was a conservative Victorian woman with conservative views on the public roles of women of her class. But, probably, she would not have felt that other women should be denied recognition of their expertise. It is with this in mind that we should read Ormerod's interaction with Becker.

Lydia Becker (1827-1890) was herself a frequent lecturer and, like Ormerod, addressed both amateur societies and experts. Unlike Ormerod, Becker has received a fair amount of critical attention.[76] As an early campaigner for female suffrage however, Becker's political work has tended to overshadow her earlier enthusiasm for botany; indeed, one obituary in the *Women's*

[74] 'Economic Entomology', *Saturday Review*, p. 623.
[75] 'Eleanor A. Ormerod', *Athenaeum*, 3849 (3 August 1901), 161.
[76] See Bernstein; Lightman, *Victorian Popularizers of Science*, pp. 158-163; Caroline Jackson-Houlston, '"Queen Lilies"? The Interpenetration of Scientific, Religious and Gender Discourses in Victorian Representations of Plants', *Journal of Victorian Culture*, 11 (2006), 84-110; Tina Gianquitto, 'Botanical Smuts and Hermaphrodites: Lydia Becker, Darwin's Botany, and Education Reform', *Isis*, 104 (June 2013), 250-277.

Suffrage Journal detected in Becker's scientific work 'the power of clear, concise description which later marked her political writings'.[77] Her lifelong interest in botany led her to correspond with Darwin and, when she established the Manchester Ladies' Literary Society in 1866, she asked him to send her some of his papers to be read at the first meeting.[78] In an inversion of the usual man reading out a paper authored by a woman, Becker read two of Darwin's papers, 'On the Movement and Habits of Climbing Plants' and 'Three Forms of *Lythrum salicaria*'. Thanking Darwin she added, 'I made large copies of the diagrams and dived into my herbarium for specimens of each class of climbers, bringing up enough to make a goodly show'.[79] This suggests that Becker had sufficient scientific proficiency to produce visual aids of her own. Although firmly committed to the Anglican faith, Becker's passion for nature study through observation, her emphasis on the importance of science education (even though many high-profile scientific naturalists would not have approved of her extension of this education to women), and her respect for Darwin, demonstrate concordance with aspects of scientific naturalism which stressed the professional importance of scientists in society.

Becker went on to deliver five papers of her own at meetings of the BAAS, in 1868, 1869, 1871, 1872 and 1874. Four of these were on female education and were delivered before the Statistical Section, but her second paper was read to the Botany and Zoology Section, an unusual forum for female speech. In this paper, 'On Alternation in the Structure of *Lychnis Diurna*, Observed in Connection with the Development of a Parasitic Fungus', Becker presented specimens of the common red campion, or *Lychnis diurna*, a plant whose flowers normally contained either female *or* male reproductive parts. In some cases however, Becker observed that normally female flowers had become hermaphroditic. She suggested that a parasitic fungus caused mutation to occur: 'as the fungus which pervades the tissues of the campion cannot produce spores without anthers to fructify in, it compels the plant it inhabits to develope [sic] these for its

[77] Obituary for Lydia Becker, *Women's Suffrage Journal*, 21 (August 1890), 11.
[78] Letter from L. E. Becker to Darwin, 22 December 1866, *Correspondence of Charles Darwin*, XIV, pp. 435-436.
[79] Letter from Becker to Darwin, 6 February 1867, *Correspondence of Charles Darwin*, XV, pp. 68-69.

accommodation'.[80] Becker's suggestion was later found to be correct, but at the time many male audience members disagreed with her findings:

> Dr DIXON thought Miss Becker's theory unsupported by the evidence [...]
> Dr WILLIS questioned the notion that a fungous parasite could help in developing the organs of a plant. Professor BALFOUR, while acknowledging the excellence of the paper, disagreed with Miss Becker's conclusion. If Miss Becker was right, the instance was the first known to the botanical world.
> Miss BECKER replied cleverly. Perhaps it was the first instance, but why might not she make the discovery of it? (Applause.) She was quite prepared to hear that they disagreed with her view, for, as far as she had observed, that section was remarkable, for everybody disagreed with everybody else. (Laughter and cheers.)[81]

The cumulative effect of her detractors' titles – Dr, Dr, Professor – weighs heavily against Miss Becker's conclusions. But her taking Balfour's comments on the precedence of her findings, should they be correct, and turning them into an argument for female scientific endeavour, suggests that Becker was acutely aware of the political potential of scientific rhetoric. Here, a scientific paper provides an opportunity to speak for gender equality.

When Becker began delivering papers on female education, and used science to back them up, newspaper reports of the discussions that took place afterwards showed an equally divided audience, but her opponents were less content to allow her comments to slip by in clever wordplay. 'Supposed Differences' between male and female minds was delivered before Section F (Economic Science and Statistics) of the BAAS at the Norwich meeting in 1868. It merits further attention because its self-reflexive nature is illustrative of the connection between women's political and educational equality. Becker enacts her very point about gender equality by speaking from a traditionally male platform. In her lecture she argued that there is no difference between the intellectual capabilities of men and women; if there seemed to be an apparent deficiency in female intellect, this was down to educational disadvantages placed upon girls. Further, physical strength that had allowed men to assert authority over weaker females, as,

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[80] *Report of the Thirty-Ninth Meeting of the British Association for the Advancement of Science, Held at Exeter in August 1869* (London: John Murray, 1870) <http://www.biodiversitylibrary.org/item/93114#page/672/mode/1up> [accessed 5 July 2014], p. 106.

[81] 'British Association for the Advancement of Science', *Morning Post* (London), Thursday 26 August 1896, p. 3.

she argued, was apparent in some but not all of the animal kingdom, would gradually diminish as the use of physical force as a means of control also decreased.

Becker presents her argument as being based entirely on scientific fact, and as one which warrants empirical investigation: '[w]hether any distinction exists between the minds of men and women seemed to be a proper subject of investigation by a scientific society, more especially as the question involved practical consequences of a very important nature to many millions of British subjects'.[82] The national importance of science was at the core of the BAAS's ideology and, by backing up her argument using examples from nature, Becker ensures that her paper is tailored to her audience.[83] This zoological analogy is criticized however by '[t]he Rev. A. Jessop [who] did not see the force of the illustration drawn from bee-land – (laughter) – we were not bees, but men and women'.[84] Jessop is perhaps trying to undermine Becker's argument by challenging the validity of its science (dispelling anxieties about the speaker's intellectual capabilities through the fairy-like 'bee-land') rather than its implications for the balance of power between the sexes.[85] Other responses to the paper were less ambiguous; 'Mr. Heywood' resorted to outright innuendo when he 'stated that the University of London proposed next year to confer degrees upon ladies in the event of their passing a rather stiff examination. (Laughter)'.[86] Such comments pour ridicule on the lecturer. It is possible that the audience's reactions to Becker's witticisms after the *Lychnis* paper (1869), were warmer because it was not her first BAAS paper. But these responses to 'Supposed Differences' do, I think, express the

[82] 'VII – Miss Becker's Paper Read Before the British Association for the Advancement of Science', *Englishwoman's Review*, 9 (1868), 48-55 (p. 50).
[83] Becker argued that the physically stronger sex dominated across the animal kingdom. However, '[t]his superiority was not always on the side of the male, as in raptorial birds, and some species of insects, such as ants and bees'. Ibid., p. 51.
[84] Ibid., p. 53.
[85] Further, a *New York Times* report hoped 'that when she next addresses a scientific audience, she may be able to plead the cause of her sex to manly rights and manly responsibilities with greater evidence of having surmounted the difficulties which "circumstances" have placed in the way of the development of her mind'. 'The British Association and Women's Rights', *New York Times*, 11 September 1868, p. 4.
[86] 'Miss Becker's Paper…', pp. 53-54.

hostility with which a significant minority of scientific men regarded a paper which so overtly challenged the perception of female intellectual weakness.

Several newspaper responses, even those which were broadly in agreement with Becker's argument, employ language which suggests that male and female public speech are fundamentally different. A *Times* editorial noted that it was a 'carefully prepared and very able paper', but that it presented '[a]gainst an entire world of fact [...] a *pretty* phalanx of ingenious remarks, *tender* remonstrances [...] *elegantly* expressed and *nicely* turned out' (my emphasis).[87] Less sympathetic pieces argued that the exhausting 'brain-work' of a male public world was not really what 'Miss Becker and her friends would desire to undertake'. [88] Days spent 'in the hot courts of Westminster' and in the 'stormy debates' of parliament would damage the 'beautiful frame and fibre of woman'. The occasional paper read before a scientific society was not the same as sustained participation in a masculine oratorical world. Indeed, Becker was persistently a victim of attacks which depicted female speakers as masculinised women. Writing against her suffrage campaign, one publication directed its readers to its own caricature (fig. 24) of Becker as an example of her exaggeratedly masculine features: '[y]ou have only to glance at the portrait which our artist has drawn to see at once that MISS BECKER exhibits in her face and features all those distinguishing points which belong to the countenance of man'.[89]

[87] 'Miss Becker presents herself to an Association...', *The Times*, Thursday 27 August 1868, p. 6.
[88] H. L., 'Women and Men', *Belgravia: A London Magazine*, 7 (November 1868), 59-66 (pp. 66, 64).
[89] 'Friends of Ours: No. 4. – Miss Lydia Becker', *Comus*, 4 (28 October 1877), 10.

Fig. 24.

Lecturers like Becker were categorized as a distinct 'race of lady lecturers',[90] an unknown species with exaggerated masculine traits. She 'wears her hair cut short and parted on the side like a man' and is 'of the kind which emulates men while scorning them'.[91] These 'bold, masculine spirits, with lank hair and wearing spectacles, of uncertain age [...] no more feared to speak in crowded halls than they did to appear on public thoroughfares in bloomer trousers'.[92] Unsexed and apparently of another species, women lecturers posed a danger to the status quo that was deflected through ridicule. That same discourse, however, was used in more serious scientific writing; a caricature of a masculine woman was amusing in the popular press, but the notion that women who practised science might become less feminine, was a real concern to

[90] 'Lady Lecturers', *Saturday Review*, 33 (29 June 1872), 826-827 (p. 826).
[91] Ibid., p. 827.
[92] 'Female Lecturers', *The Round Table*, 226 (22 May 1869), 324.

many in scientific circles. In 1860 Thomas Laycock wrote that women accomplished in the physical sciences were 'quite as rare as bearded women',[93] a comment which, while arguing that these women were a rarity, also implied that there was something not quite woman, even not quite human, about them. Many scientists theorized physical and mental differences between the sexes along evolutionary lines – any attempts to deviate from them would therefore be contrary to nature and potentially dangerous. In 'Emancipation – Black and White' (1865) Huxley asserted: '[l]et us have "sweet girl graduates" by all means. They will be none the less sweet for a little wisdom [...] [but] [t]he big chests, the massive brains, the vigorous muscles and stout frames of the best men will carry the day'.[94] At the highest level women will always be outdone by the best men.

It was, however, Darwin in his *Descent of Man* (1871) who consolidated ideas on the relative intellectual weaknesses of women under the banner of evolution. While recent work from the Darwin and Gender Project at the University of Cambridge, which brought together Darwin's published work with his correspondence, has demonstrated that on a personal level Darwin encouraged women's work in the sciences (even their publishing in scientific journals),[95] *Descent* was nevertheless one of the definitive texts to set out gender differences. 'It is generally admitted that with woman', Darwin wrote, 'the powers of intuition, of rapid perception, and perhaps of imitation, are more strongly marked than in man; but some, at least, of these faculties are characteristic of the lower races, and therefore of a past and lower state of civilization'. Feminine characteristics are primitive, while the 'higher mental faculties, namely, observation,

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[93] Thomas Laycock, from *Mind and Brain: or, The Correlations of Consciousness and Organization: Systematically Investigated and Applied to Philosophy, Mental Science and Practice (1860)* in *Embodied Selves: An Anthology of Psychological Texts*, ed. by Jenny Bourne Taylor and Sally Shuttleworth (Oxford: Clarendon Press, 1998), pp. 176-179 (p. 176).
[94] Thomas H. Huxley, 'Emancipation – Black and White' (1865), *Science and Education: Essays* (London: Macmillan and Co., 1893), pp. 66-75 (p. 73).
[95] See the Darwin and Gender Project blog at <darwinproject.ac.uk>. In a letter to Elinor M. Dicey Darwin writes, 'I regret that any girl who wished to learn physiology sh[ould] be checked, because it seems to me that this science is the best or sole one for giving to any person an intelligent view of living things', Letter 10746 (1877) [accessed 5 October 2016]. He encouraged Mary Treat to publish her findings on the sexes of butterflies 'in some well-known scientific journal', Letter 8146 (5 January 1872) [accessed 5 October 2016]. As previously mentioned, he lent his support to Becker when he sent her papers to be read at the Manchester Ladies' Literary Society.

reason, invention, or imagination' have evolved in man who has had 'to avoid enemies, or to attack them with success, to capture wild animals, and to invent and fashion weapons'.[96] It is when men reach maturity that they develop these characteristics, which are passed on to sons, while women stop developing intellectually at a younger age in order that their bodies might mature for reproduction.[97] Henry Maudsley famously summarized this balancing act in his 'Sex in Mind' (1874): '[w]hen Nature spends in one direction, she must economise in another direction'.[98] Too much mental exertion during menstruation or pregnancy will have a seriously detrimental effect on the health of women and children. The kinds of mental activity which were deemed most unsuitable were of course those which required Darwin's 'observation, reason, invention, or imagination'. It should be noted, however, that Maudsley was drawing on ideas from energy physics, rather than evolution or anthropology, in arguing that the 'energy of a human body' was of 'a definite and not inexhaustible quantity'.[99]

Becker was faced with a dilemma; her own excellent capabilities as a botanist threatened many male scientists, who used science itself to argue that Becker's actions were against nature, even dangerous to an unborn generation. She felt that both men and women 'in any branch of science', 'must go through the same training, and have their qualifications and capacities tested by precisely the same rules'.[100] It was this belief in equality which caused her to venture onto a traditionally male platform, to stake an equal claim to it. But at the same time such an action was likely to add fuel to the fire of opposition. Becker argued that women's equal intellectual capabilities were proof that they should be able to enjoy equal status elsewhere: education, political suffrage, access to professions.

[96] Charles Darwin, from *The Descent of Man, and Selection in Relation to Sex (1871)* in *Evolutionary Writings*, ed. by James A. Secord (Oxford: Oxford University Press, 2010), pp. 231-348 (p. 304).
[97] Ibid., p. 305.
[98] Henry Maudsley, 'Sex in Mind and in Education', *Fortnightly Review*, 15 n.s. (1 April 1874), 466-482 (p. 467).
[99] On the application of the conservation of energy to gender, see Janet Oppenheim, *'Shattered Nerves': Doctors, Patients, and Depression in Victorian England* (Oxford: Oxford University Press, 1991), pp. 182-201.
[100] Lydia Becker, 'On the Study of Science by Women', *Contemporary Review*, 10 (1 January 1869), 386-404 (p. 386).

Ormerod on the other hand, while she might be seen as a living example of Becker's professional woman scientist, refused to put her name to the women's rights movement. An upper-class woman might be an expert, but not a professional. Her example demonstrates how, even when women were able to speak from professional platforms, they did not always support the extension of women's rights which their participation implied. Ormerod and Becker were both, however, praised for their powers of observation. One reporter in the *Glasgow Herald* remarked, of Becker's *Lychnis* paper at the BAAS that it 'showed that she was as good an observer as a botanist as she is persistent and zealous in advocating women's rights'.[101] Sir Ludovic Grant, Dean of the Faculty of Law at the University of Edinburgh, said of Ormerod, on her receiving her honorary doctorate: '[t]he pre-eminent position which [she] holds in the world of science is the reward of patient study and unwearying observation' (*Autobiography*, p. 96). In their commitment to empirical method, Becker and Ormerod furthered the cause of scientific naturalism. We might see in both, then, Tyndall's 'true votary of science'.

Beyond Science: The New Women

As Ormerod's example shows, we need to be careful not to judge Victorian women's motivations for lecturing through the lens of the women's movement; it is clear that Ormerod's passion lay in the science and its application. However, the reading of a scientific paper by a woman, whether or not it addressed the question of women's intellect, was undeniably a political act, whether the lecturer intended it or not. Defying the norm by moving out of the audience and on to the platform, contributed to the debate over who had ownership of scientific knowledge, who could distribute it, and to whom. Many commentators on later nineteenth-century

[101] 'British Association Meeting', *Glasgow Herald*, Saturday 28 August 1869, n.p.

campaigns for women's causes recognized that female political speakers belonged to a tradition of intellectual women. While Lightman is correct to say that, with the exception of Becker and Phebe Lankester, female science popularizers overwhelmingly avoided women's rights issues, it must be noted that there was inevitably a close connection between the two traditions.[102] In her 1884 article 'Platform Women', the journalist Margaret Lonsdale distinguished a new generation of over-excitable speakers who were a 'more pushing and exaggerated sort of woman' from older '"blue-stockings"'. 'These kindly ladies still get up, spectacled and scientific-looking, and read papers at Social Science Congresses, or mildly address young women on abstruse and purely intellectual subjects, but they are not to be spoken of in the same breath with their more advanced sisters'.[103] Lonsdale almost looks back with fondness on the severe and unsexed women who ventured to deliver original findings. George Gissing gave a more sympathetic presentation of women's political and social independence in *The Odd Women* (1893). In this novel Miss Barfoot who, with Rhoda Nunn, runs a "school" to train women in such skills as typing and clerical work, 'held the conviction that whatever man could do, woman could do equally well – those tasks only excepted which demanded greater physical strength'.[104]

One way in which critics attacked these women was by eliding the deepness of the male voice with the "depth" of topics suitable only for male discussion. This charge was made throughout the period of the development of scientific naturalism. An anonymous article in the *Saturday Review* entitled 'The Shrieking Sisterhood' denounced women who publicly campaigned for educational and political rights. It was their public speech which clearly most galled the writer, who argued that 'deed not declamation', quiet, feminine and selfless acts, were more effective than hysterical screeching.[105] Through 'frantically', 'shrieking', 'prolonged cackle' and

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[102] Lightman, *Victorian Popularizers of Science*, p. 158.
[103] Margaret Lonsdale, 'Platform Women', *Nineteenth Century*, 15 (March 1884), 409-415 (p. 415).
[104] George Gissing, *The Odd Women*, ed. by Patricia Ingham (Oxford: Oxford University Press, 2008), p. 63. See *George Gissing and the Woman Question: Convention and Dissent*, ed. by Christine Huguet and Simon J. James (London: Routledge, 2013).
[105] 'The Shrieking Sisterhood', *Saturday Review*, 29 (12 March 1870), 341-342 (p. 341).

'babble', women are denied the composure of measured public speech. Instead they are given a domestic, and politically meaningless, cluck: 'there has been talk, much talk [...] and heaven and earth called to witness that an egg has been laid wherein lies the germ of a future chick – with proper incubation'. In 1887 when the debate about brain size and intelligence still raged, George John Romanes argued that in judgement the female mind 'is much more apt to take superficial views of circumstances calling for decision, and also to be guided by less impartiality'.[106] Traditionally female virtues such as 'religious feeling, and general morality',[107] should be protected from the advances of the women's movement and, Romanes hopes, the 'deep strong voice of social opinion will always be raised against any innovations of culture which may tend to spoil the sweet efflorescence of evolution'. That 'deep strong' authoritative voice was distinctly masculine.

These anxieties were even more developed in North America, where both a longer tradition of female scientific education and professionalization, and a more established female platform culture, exposed worries that such public activity degraded the female sex.[108] In Henry James's *The Bostonians* (1886), marriage ultimately domesticates and thus silences Verena Tarant, a public speaker on women's political rights. Basil Ransom's own voice and appearance are depicted as traditionally masculine and therefore naturally suited to public work: his 'was a head to be seen above the level of a crowd, on some judicial bench or political platform'.[109] Simultaneously this masculinity is in opposition to the *kinds* of political speech of Bostonian women, who speak from the tradition of the anti-slavery movement.[110] Ransom's 'discourse was pervaded by something sultry and vast, something almost African in its rich basking tone,

[106] George John Romanes, 'Mental Differences Between Men and Women', *Nineteenth Century*, 123 (May 1887), 654-672 (p. 656).
[107] Ibid., p. 658.
[108] North American women enjoyed a richer tradition of public speaking in the nineteenth century than did British women; by the end of the century there was a significant number of female lecturers in America. See Margherita Arlina Hamm, 'Women in the Lyceum', *Peterson Magazine*, 5 (June 1895), 629.
[109] Henry James, *The Bostonians*, ed. by R. D. Gooder (Oxford: Oxford University Press, 2009), p. 2.
[110] On the tradition of women speaking in slavery debates see Judith Mattson Bean, 'Gaining a Public Voice: A Historical Perspective on American Women's Public Speaking', in *Speaking Out: The Female Voice in Public Contexts*, ed. by Judith Baxter (Hampshire: Palgrave Macmillan, 2006), pp. 21-39.

something that suggested the teeming expanse of the cotton-field' (p. 2), a deep tone which pits southern traditions of masculinity against the northern, feminized political speech which Ransom detests. As he despairingly notes later in the novel:

> The whole generation is womanized; the masculine tone is passing out of the world; it's a feminine, a nervous, hysterical, chattering, canting age, an age of hollow phrases and false delicacy and exaggerated solicitudes and coddled sensibilities, which, if we don't look out, will usher in the reign of mediocrity, of the feeblest and flattest and the most pretentious that has ever been.
> (p. 322)

Female speakers are a national threat; like Romanes's plea for the deep voice of masculine public opinion to curtail the women's movement, Ransom worries that the strength of a feminized society is only artificial. Deepness implies depth of thought and therefore the depth of the foundations on which society is built. When Verena describes a convention at which she spoke, Basil imagines the scene: 'he seemed to see the crowded, overheated hall, which he was sure was filled with carpet-baggers, to hear flushed women, with loosened bonnet-strings, forcing thin voices into ineffectual shrillness' (p. 227). Basil's imagination is vivid yet his picture of individual women is totally indistinct, and he is only able to imagine a 'vulgar multitude' (p. 227) swarming around the platform. James's verbosity imitates this unity; with their 'unsightly strainings and clappings and shoutings, in wordy, windy iteration of inanities' (p. 227), these women's actions are strung into one sound through the repetition of 'and', neutralizing the distinction between individual words.

Women's public speaking on scientific topics did continue in the last decades of the century. Several studies have been carried out on female travel writers at the turn of the century, who were also successful public speakers.[111] Most famously Mary Henrietta Kingsley (1862-1900) promoted her books through cleverly orchestrated platform performances. Her consciously anachronistic manner and costumes on stage (her black silk dress was considered to be old-

[111] See Lila Marz Harper, *Solitary Travelers: Nineteenth-Century Women's Travel Narratives and the Scientific Vocation* (Madison, Teaneck: Fairleigh Dickinson University Press, 2001), p. 143. For Kingsley, see Cheryl McEwan, *Gender, Geography and Empire: Victorian Women Travellers in West Africa* (Aldershot: Ashgate, 2000) and Julie Early English, 'The Spectacle of Science and Self: Mary Kingsley', in Gates and Shteir (eds.), pp. 215-236.

fashioned by the 1890s, making her appear older than she really was and her adventures in Africa, therefore, more impressive), created a distinct and unforgettable platform persona.[112] This chapter has been unable to touch upon the work of female lecturers in Europe and North America. Russian mathematician Sóphia Kovalévsky (b. 1850) lectured at the University of Stockholm,[113] and French philosopher of science (translator of Darwin into French) Clémence Royer (1830-1902) lectured in France and Switzerland on women's suffrage, economic theory, and Darwinism.[114] In North America Helen Hamilton Gardner paralleled Becker's later campaigns with her own papers to women's congresses on brain size in relation to intellect.[115] Mary Proctor, daughter of the astronomy popularizer Richard Proctor, continued to lecture on astronomy and do her own research well into the twentieth century. These examples demonstrate the determination of individuals to lecture on the same platform as men, but they might also suggest that women did not experience the same kinds of opposition in every country or at different times.

Conclusion

Further study of female scientific lecturers would greatly enhance the study of Victorian women in science as a whole. This chapter has been confined to white, British, middle-class women, speaking primarily on science in the British Isles. Papers on the Commonwealth and on Britain's relationship with European science could be looked at in conjunction with male authored papers. Women's collaboration, or lack thereof, with male scientists in the organization of large-scale popular lecture series, would also be an interesting avenue of study. For example, in her recent

[112] English, pp. 215, 219.
[113] Alic, pp. 163-170.
[114] Joy Harvey, *'Almost a Man of Genius': Clémence Royer, Feminism, and Nineteenth-Century Science* (New Brunswick, NJ: Rutgers University Press, 1997), pp. 62, 69, 105.
[115] Kimberly A. Hamlin, *From Eve to Evolution: Darwin, Science, and Women's Rights in Gilded Age America* (Chicago: University of Chicago Press, 2014), chapter two, pp. 57-93.

work on the organization of Sunday Lecture Societies, Ruth Barton has found that women delivered lectures in the same series as men.[116] Particularly as Sunday lecture societies were set up in opposition to Sabbatarians, they may provide an interesting case study for nonconformist women.

I have demonstrated that women who spoke publicly on scientific topics, borrowed from as varied a range of traditions as did men. Catherine Buckton recognized that she could, without fear of censure, carry out philanthropic reforms via the socially acceptable mode of women teaching fellow women and children. Publishing her lectures simply meant reaching out to an audience of teachers who could replicate her lessons and therefore extend the scope of reform. Arabella Buckley used fiction and a homely, conversational style, aligning her work with an earlier maternal tradition of women popularizers. She embraced the role of teacher of young children, but when the scientific content became more advanced she was unwilling to take responsibility, through her own voice, for teaching boys on the brink of becoming practising scientists. That role is assigned to a male, fictional teacher, someone who reaffirms the stereotype of the solitary man of science. Eleanor Ormerod and Lydia Becker sought equal status in entomology and botany. However, Ormerod complicated the distinction between expert and professional, desiring recognition for her work, but never using that work to support herself. Becker's example shows that some female involvement was tolerated, but that there was a tacit limitation to how far women could go. Becker negotiated this unknown and, unlike Ormerod, pushed for equal recognition, in spite of the ridicule she had to endure as a result.

By comparing these case studies we can see that social and structural limitations imposed on women's public behaviour, had a strong influence on whether and how they spoke. Scientific societies differed wildly in the extent to which they allowed female participation; audience and press responses both illustrated and conditioned public opinion; and those who did

[116] Ruth Barton, 'Sunday Lecture Societies: Naturalistic Scientists, Unitarians, and Secularists Unite Against Sabbatarian Legislation', in *Victorian Scientific Naturalism: Community, Identity, Continuity*, ed. by Gowan Dawson and Bernard Lightman (Chicago: University of Chicago Press, 2014), pp. 189-219 (p. 202).

speak often had different reasons for doing so. Women faced conflicting opinions on the propriety of speaking in public. What types of science were appropriate for discussion? Could that knowledge ever be original, or must it derive from a man's research? In terms of what they spoke about, we cannot say that female scientific lecturers were any more or less in favour of scientific naturalism or theology than men. Yes, they often emphasized moral justifications for their presence on the platform, but men like Charles Kingsley also talked about moral purity in relation to sanitation. Not all male scientists used the platform for the same reasons as Huxley. Likewise, some women decided to lecture in order to bring about reform on female issues, while others did it to convince the public of women's ability to do science. The lecture form, which was used by scientific naturalists to establish their authority as scientists, however, was necessarily tinged with a gender bias: they emphasized their masculine command over nature and the authority of a male scientific voice. If women were to use the same form of communication, they had to overcome the opposition to and distaste for their higher voices being heard, and their bodies being present on the platform.

Chapter 4

Viewing Nature Through the Public Speeches of Charles Kingsley and John Ruskin

As I have so far illustrated, scientific naturalism provided some scientists with a fitting vocabulary with which to further their professional interests. Equally, I have demonstrated that the use of platform rhetoric associated with scientific naturalism, was not restricted to that one group of practitioners. Spurgeon lectured on the gorilla; Huxley sermonized on protoplasm. Just as competing interests in the public arena argued for and against the validity of this empirical epistemology, so too did competing *voices* debate its merits using a common vocabulary. This chapter considers such rhetorical transfer in the public performances of Anglican clergyman Charles Kingsley (1819-1875) and art critic John Ruskin (1819-1900).

Kingsley and Ruskin are excellent examples of non-professional scientists engaging with the philosophy of scientific naturalism as method; both were, if not experts, certainly highly knowledgeable amateurs in natural history. Both men had reputations as public speakers to a wide variety of audiences, from working men to Oxbridge students. Both were committed to working-class education reform. Most importantly, Kingsley and Ruskin developed theories on the relationship between scientific observation and religious belief. They combined existing styles of preaching and art lecturing in order to respond to the formation of scientific authority during the period, particularly with regards to the moral and aesthetic imperatives which accompanied scientific, religious, and artistic acts of observation. Where Kingsley saw that modern science – even Darwinian evolution – was compatible with religion, Ruskin developed a complex, often contradictory perspective. His theories on the act of seeing saw it as, simultaneously, both a religious and aesthetic experience. As such, Ruskin perceived the advances of scientific naturalism to be a dangerous threat to the authority of God.

Evidence of Ruskin's opinion of Kingsley is ambiguous. As an art teacher at F. D. Maurice's London Working Men's College (1854 to 1858, and intermittently for a few years after that), Ruskin came into contact with Christian Socialists, but Kingsley was not involved in the College project. In two letters to the *Pall Mall Gazette* Ruskin criticized Kingsley's writing. Assessing the deceased novelist's work in 1886, Ruskin wrote of Kingsley that 'his sentiment is false and his tragedy frightful. People who buy cheap clothes are not punished in real life by catching fevers; social inequalities are not to be redressed by tailors falling in love with bishops' daughters [...]'.[1] Likewise in 1887, regarding a letter he had received from W. L. T. Brown, from Homerton Grove Young Men's Institute, in which Brown said that Ruskin's and Kingsley's works were of most use to the Institute's members, the art critic responds:

> That two such opposite authors should take hold of the same minds is entirely probable if the opposites are both a part of the world and its sky. Kingsley liked east wind; I like west. Kingsley stepped westward – Yankee way. I step eastward, thinking the old star stands where it used to. There was much in Kingsley that was delightful to raw thinkers, and men generally remain raw in this climate. He was always extremely civil to me, and to Carlyle, but failed in the most cowardly way when we had the Eyre battle to fight. He was a flawed – partly rotten, partly distorted – person, but may be read with advantage by numbers who could not understand a word of me, because I speak of things they never saw or never attended to. I extremely dislike Kingsley's tragedy myself, but if other people like hearing of girls being devoured or torn to pieces, that is their affair.[2]

In a sense Ruskin's pairing of 'the world and its sky' acknowledges that both men's work had its uses, but his dismissal of Kingsley's character bears the mark of a man who felt betrayed. Ruskin's reference to the 'Eyre battle' concerns the events which followed the Morant Bay Rebellion in Jamaica. Edward John Eyre (1815-1901) became Governor of Jamaica in 1864. The poor conditions experienced by freed slaves, coupled with the country's economic difficulties,

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[1] John Ruskin, 'The Choice of Books', *Pall Mall Gazette*, 6527 (15 February 1886), n.p.

[2] John Ruskin letter to *Pall Mall Gazette*, 24 June 1887, quoted in *The Works of John Ruskin: Library Edition*, 39 vols, ed. by E. T. Cook and Alexander Wedderburn (London: George Allen, 1903-1912), XXXIV, p. 609. All subsequent references are given as: Ruskin, *Library Edition*, volume number.

led to an uprising on 11 October 1865. The rebellion was quickly put down by Eyre: nearly 500 people were killed and hundreds more were injured. Eyre suspected that the politician George William Gordon was responsible for the rebellion. Gordon was tried, arrested, and hanged. Many believed that Gordon had been falsely accused and unfairly tried, and that his execution amounted to murder. In Britain a Royal Commission, set up to investigate the event, was highly critical of Eyre's actions, and he was dismissed from his post in 1866. A Jamaica Committee consisting of J. S. Mill and others attempted to have Eyre tried for murder, while the Eyre defence committee, which included Carlyle, thought that Eyre had done important work for the empire. Ruskin sided with Carlyle, as did Kingsley (which tested his relationship with Huxley),[3] although the latter was more ambivalent and did not aid in fundraising for the defence committee. That Kingsley sided with Eyre at all might seem surprising; his commitment to social reform would surely have led him to side with other left-leaning figures. But this, somewhat uncomfortable, contradiction is revealing of Kingsley's complex beliefs. That Ruskin deemed this to be 'cowardly', illustrates his steely commitment to Carlyle and conservativism, even as it co-existed with his proto-socialist visions.[4]

Kingsley's Performances

Anglican clergyman and amateur naturalist, novelist and poet, and lecturer and campaigner for sanitary science, Charles Kingsley's progressive attitude towards science and religion is well

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[3] Huxley supported the Jamaica Committee on the grounds of justice. He felt that support for Eyre was 'hero-worship', see letter from Huxley to Kingsley, 8 November 1866, in *Life and Letters of Thomas Henry Huxley*, I, pp. 281-282, p. 282.

[4] Mark Frost, *The Lost Companions and John Ruskin's Guild of St George: A Revisionary History* (London: Anthem Press, 2014), pp. 16-37, discusses the multi-strand motivations behind the foundation of Ruskin's Guild of St George, a society founded on principles of agrarian communism but inflected with notions of Tory, aristocratic hierarchy.

documented.[5] I am interested, however, in how Kingsley presented those beliefs from the platform, and in how he attempted to persuade audiences that the authority of God was not compromised, but in fact was enhanced, by modern science. First, therefore, it is necessary to establish his credentials as a public speaker. His fame as a lecturer is encapsulated in a letter dated October 1857, quoted in his *Letters and Memories*. One correspondent recalls the response of a friend with whom she had attended Kingsley's Bristol lecture, 'Great Cities, Their Influence for Good and Evil':

> When the lecture was going to begin, she said, 'Oh, I forgot there was to be a lecture, I only thought of hearing Mr. Kingsley'. And it was all along more than I knew how to meet all at once – to follow the lecture itself and watch him in it – for he is a lecture in himself. [...] I think what struck me most was the intensity of feeling in the man, expressed in countenance, figure, and every movement![6]

The friend cares little for the content of the lecture: distracted by the celebrity of the speaker, her anticipation of being in Kingsley's presence takes her out of the lecture room, leading her even to forget that she is to hear a lecture at all. The correspondent herself records an even more uncanny reaction: her inability to 'follow the lecture itself *and* watch him in it – *for he is a lecture in himself*' (my emphasis). She cannot separate performer from performance. Kingsley *embodies* his topic; or rather, his emotional attachment to his subject matter is in such earnest that it is betrayed in his external features. Using this metaphor to describe Kingsley, the writer stresses

[5] For Kingsley and the relationship between science and religion see: Charles H. Muller, 'Spiritual Evolution and Muscular Theology: Lessons from Kingsley's Natural Theology', *University of Cape Town Studies in English*, 15 (March 1986), 24-34; David M. Levy and Sandra J. Peart, 'Charles Kingsley and the Theological Interpretation of Natural Selection', *Journal of Bioeconomics*, 8 (2006), 197-218; John C. Hawley, 'Charles Kingsley and the Book of Nature', *Anglican and Episcopal History*, 61 (December 1991), 461-479; Piers J. Hale, 'Darwin's Other Bulldog: Charles Kingsley and the Popularisation of Evolution in Victorian England', *Science and Education*, 21 (2012), 977-1014; Francis O'Gorman, '"More Interesting Than All the Books, Save One": Charles Kingsley's Construction of Natural History', in *Rethinking Victorian Culture*, ed. by Juliet John and Alice Jenkins (Hampshire: Macmillan, 2000), pp. 146-161; A. J. Meadows, 'Kingsley's Attitude to Science', *Theology*, 78 (January 1975), 15-22; Gillian Beer, *Darwin's Plots: Evolutionary Narrative in Darwin, George Eliot and Nineteenth-Century Fiction* (1983), (Cambridge: Cambridge University Press, 2000), pp. 120-129. For Kingsley's thoughts on sanitation and industrialization see: Elizabeth D. McCauseland, 'Dirty Little Secrets: Realism and the Real in Victorian Industrial Novels', *American Journal of Semiotics*, 9 (1992), 149-169; Naomi Wood, 'A (Sea) Green Victorian: Charles Kingsley and *The Water-Babies*', *Lion and the Unicorn*, 19 (1995), 233-252; Valentine Cunningham, 'Soiled Fairy: *The Water-Babies* in its Time', *Essays in Criticism*, 35 (April 1985), 121-148; Bruce Haley, *The Healthy Body and Victorian Culture* (Cambridge, Massachusetts: Harvard University Press, 1978).

[6] Kingsley, *Letters and Memories*, II, pp. 32-33.

inseparability: her interest in what is said, how it is said, and who is saying it, are bound through figurative language.

The Bristol lecture is just one example of the wide variety of platforms from which Kingsley spoke. Ordained into the Anglican Church in 1842, Kingsley took a curacy in the village of Eversley, Hampshire; he was then Canon of Chester Cathedral and Westminster Abbey, and in 1859 became a Chaplain to the Queen, and subsequently preached in several of the royal houses.[7] In 1860 Kingsley became Regius Professor of Modern History at Cambridge. His constant passion for sanitary improvements found voice in both his sermons, and his addresses to sanitary associations. This interest in sanitation was part of Kingsley's firm commitment to working-class welfare. In 1866 he instituted Penny Readings in Eversley, and allowed 'widows and poor overburdened mothers' free entry, and established a scientific society in Chester in 1871.[8]

But what of the 'intensity' of Kingsley's platform presence, which had so captivated the Bristol correspondent?[9] James Martineau, who stayed with the Kingsleys from 1850 to 1851, remembered that, though 'he had sometimes scarcely a dozen hearers', he possessed 'a strong man's intensity and clearness of conviction, and a command of words, not easy or rapid, but sure and unhesitating'.[10] Again, his speech is noted for its 'intensity', perhaps because Kingsley was so convinced of the truth of his words. His lack of hesitation may have been carefully cultivated: following childhood illness, Kingsley spoke with a stammer; however, 'in preaching', Martineau notes, 'and in speaking with a set purpose, he was wholly free from it'. Reading aloud, or delivering a discourse which had been prepared, actually focused Kingsley's speech and made it more powerful.

[7] Ibid., p. 71.
[8] Ibid., p. 231.
[9] For an excellent study of Kingsley's rhetoric as lecturer and preacher see Caroline Rose, 'Charles Kingsley Speaking in Public: Empowered or at Risk?', *Nineteenth-Century Prose*, 29 (Spring 2002), 133-150.
[10] Kingsley, *Letters and Memories*, I, p. 303.

Kingsley wrote at length about his struggle to overcome his stammer in 'The Irrationale of Speech' in *Fraser's Magazine* (1859).[11] In this article Kingsley reviews *A Manual of the Philosophy of Voice and Speech* by Dr James Hunt, from whom he had received speech therapy. Kingsley was convinced of the efficacy of Hunt's technique, proclaiming that his book 'should be in the hands, not only of surgeons, but of public singers, public speakers, schoolmasters, and above all, of preachers'.[12] The way in which a preacher delivered his message was just as important as the message itself; his rhetoric was vital because he was essentially a salesman, whose 'dull talk [...] would destroy the custom of a barrister, an auctioneer, and even of a penny pieman, or a cheap Jack at a country fair'.[13] This concern for the quality of preaching was not unique to Kingsley,[14] but it does demonstrate an affinity with scientists such Tyndall and Huxley, who were aware that in speaking in public they were engaging in acts of persuasion.

Kingsley's Natural Theology

On 10 January 1871 Kingsley delivered a lecture at Sion College. This London institution, founded in 1630, provided support for, and promoted conversation amongst, the Anglican clergy. The address to the audience as 'my clerical brethren' suggests that the original hearers were largely clergymen, although Lightman writes that the lecture was public.[15] Kingsley's lecture was entitled 'The Natural Theology of the Future', and in it he attempted the ambitious task of uniting natural theology, revealed religion, *and* modern science. Kingsley opens by

[11] [Charles Kingsley], 'The Irrationale of Speech. By a Minute Philosopher', *Fraser's Magazine*, 60 (July 1859), 1-14.
[12] Ibid., p. 9.
[13] Ibid., p. 12.
[14] For example, Archibald Campbell Tait, who at this time was the Bishop of London, was particularly interested in the quality of church oratory, and in reaching a wider audience. Furthermore, according to Joseph Meisel, in the second half of the century 'mainstream religion [...] increasingly came to centre on public oratorical display'. Meisel, *Public Speech and the Culture of Public Life*, pp. 116, 166.
[15] Lightman, *Victorian Popularizers of Science*, p. 80, n. 94. The lecture was also printed in *Macmillan's*, so would have reached a general audience. [Charles Kingsley], 'The Natural Theology of the Future', *Macmillan's Magazine*, 23 (March 1871), 369-278.

asserting that '[m]ost of you, I doubt not, have made up your minds already, and in consequence have no fear of natural science, no fear for natural theology'.[16] In 'I doubt not' and his repetition of 'no fear', Kingsley flatters his audience that they are rational, fearless and logical men; consequently, they should not find anything in the ensuing discourse with which to disagree.

Lightman notes that several Anglican clergymen who were popular science writers, like Kingsley, 'were not willing to concede dominion over science to the scientific naturalists', aiming instead to 'frustrate' the latter's 'plans [...] to secularize nature', and that Kingsley's approach to this was through unifying science with natural theology.[17] Natural theology, the belief that evidence for the existence of God is found in nature (as opposed to revealed theology, in which proof of God is found in Scripture), originated in seventeenth-century Christian thought.[18] In the early nineteenth century the natural theological argument was put forward by William Paley in his *Natural Theology* (1802). Later it was used by William Buckland to consolidate geology as a new subject at Oxford,[19] and was celebrated in the *Bridgewater Treatises* (eight volumes published between 1833 and 1836; the volume on geology was contributed by Buckland).[20] Natural theology was a useful tool with which to demonstrate harmony between science and religion. However, it was not a universally held belief and its use as evidence for some less orthodox views on creation did not do the natural theologians' arguments any favours. The naturalist and popular writer Philip Henry Gosse's *Omphalos* (1858) drew on Scripture and geology to argue that natural indicators of the age of the earth (such as fossils and tree rings) had existed at the moment of

[16] Charles Kingsley, 'The Natural Theology of the Future', *Scientific Lectures and Essays* (London: Macmillan and Co., 1885), pp. 313-336, p. 317.
[17] Lightman, *Victorian Popularizers of Science*, p. 94. Lightman discusses the inclusive nature of Kingsley's science and natural theology, pp. 71-81. I want to look more closely at how Kingsley communicates this belief via performances aimed at theological and non-theological audiences.
[18] Jonathan R. Topham, 'Natural Theology and the Sciences', in *Cambridge Companion to Science and Religion*, ed. by Peter Harrison (Cambridge: Cambridge University Press, 2010), pp. 59-79; John Brooke, *Science and Religion: Some Historical Perspectives* (Cambridge: Cambridge University Press, 1991 [1993]), esp. pp. 192-216; John Brooke and Geoffrey Cantor, *Reconstructing Nature: The Engagement of Science and Religion* (Edinburgh: T & T Clark, 1998).
[19] Brooke, *Science and Religion*, p. 203.
[20] See Buckland's contribution to the series, *Geology and Mineralogy Considered with Reference to Natural Theology* (1836).

Creation – he termed this idea 'prochronism'.[21] The fossil record was therefore an illusion of deep time.

Kingsley, who was a close friend of Gosse, like so many other Christian commentators, refuted such ideas. On the one hand the idea that Noah's flood accounted for the appearance of highland rocks on lower ground was unconvincing.[22] On the other hand, the idea that 'God [...] put shells upon mountain-sides only to befool honest human beings' (p. 62), was even more unacceptable. Gosse's theory was an extreme interpretation of nature, and one which was not held by the majority of the clergy. It is important to recognise that a feeling of openness towards science generally prevailed.[23] The fact that many of his audience at Sion College – the epicentre of Anglican thought – were not completely hostile towards evolution, meant that Kingsley might successfully persuade them.

In 'The Natural Theology of the Future', therefore, Kingsley is pragmatic. He accepts aspects of natural and revealed theology, and modern science. '[O]ur Lord's parables, drawn from birds and flowers' (p. 320), he argues, are surely evidence of a connection between the Bible and the natural world. Calling Psalm 139 'that marvellous essay on Natural Theology' (p. 323) Kingsley asks his audience to judge whether that text was written by someone who had as deep an interest in embryology 'as an Owen, a Huxley, or a Darwin'.[24] This is a bold step on Kingsley's part, to hold the latter two in such high regard; the names Huxley and Darwin were

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[21] Philip Henry Gosse, *Omphalos: An Attempt to Untie the Geological Knot,* ed. by David Knight (London and New York: Routledge, 2003), p. 125.

[22] Charles Kingsley, *Town Geology* in *Scientific Lectures and Essays* pp. 3-151, p. 51.

[23] Exemplified by the many sermons delivered during BAAS meetings in which the speaker emphasizes continuity, such as: C. Pritchard, *The Progressive Character of Man's Knowledge of God* [...] *Salford* [...] (Oxford: James Parker and Co., 1887); *The Advance of Science. Three Sermons Preached at Manchester Cathedral* [...] (Manchester: John Heywood, 1887); W. C. Magee, *The Christian Theory of the Origin of the Christian Life: A Sermon Preached in Norwich Cathedral* [...] (London: Simpkin, Marshall & Co., 1868); Rev G. Deane, *The Relations of Christianity and Science* [...] *Bristol* [...] (Bristol, W. Whereat, 1875); Rev Robert Main, *A Sermon Preached at the Church of St Mary, Redcliff, Bristol* [...] (Oxford: James Parker and Co., 1875); James M. Wilson, *Two Sermons on Some of the Mutual Influences of Theology and the Natural Sciences* [...] *Dover* [...] (London: Macmillan and Co., 1899); Herbert Edward Ryle, *Physical Science and the First Chapter of Genesis* [...] *Liverpool* [...] (London: Macmillan and Co., 1896).

[24] '[15] My substance was not hid from thee, when I was made in secret, and curiously wrought in the lowest parts of the earth. [16] Thine eyes did see my substance, yet being unperfect; and in thy book all my members were written, which in continuance were fashioned, when as yet there was none of them'. Psalm 139, *King James Bible* <www.oxfordscholarlyeditions.com> [accessed 4 October 2016].

seen by many as an affront to Christian authority.[25] But by referring to embryology, and naming leading contemporary scientists, Kingsley aligns the modern investigation of nature with religion; scientific enquiry becomes a form of worship. If nature displays evidence that it was made by God, and if that evidence points towards evolution, then evolution is what God intended: '[w]e knew of old that God was so wise that he could make all things; but behold, He is so much wiser than even that, that he can make all things make themselves' (p. 332). The idea that the Bible is compatible with science because it describes as accurately as possible the state of nature, *using the knowledge available at the time that it was written*, was not uncommon.[26] But Kingsley does, I think, express an unusual willingness to accept new scientific theories:

> All, it seems to me, that the new doctrines of Evolution demand is this. We all agree, for the fact is patent, that our own bodies, and indeed the body of every living creature, are evolved from a seemingly simple germ by natural laws, without visible action of any designing will or mind, into the full organisation of a human or other creature. Yet we do not say on that account: God did not create me; I only grew. [...] If there be evolution, there must be an evolver.
>
> (p. 330)

This apparent ease may be accounted for by his personal relationship with Huxley, and his experience as an amateur naturalist.

In 'The Natural Theology of the Future' Kingsley uses rhetoric to create shared ground: '[w]e all agree', he asserts, 'that evolution is a logical explanation for what is observed in nature'. He is then able to argue from this apparently universal agreement, that evolutionary theory demands the existence of God. Its operation requires a creative impulse instigated by God and, as a result, to study nature *is* to praise Him. Kingsley's clerical audience at this lecture,

[25] It is important to note, however, that while Darwin and Huxley's views on evolution and the age of the earth tended to be more extreme, the divide between science and religion has been exaggerated. Much geological work was carried out by clergymen in the first half of the nineteenth century. See Peter J. Bowler, *Fossils and Progress: Palaeontology and the Idea of Progressive Evolution in the Nineteenth Century* (New York: Science History Publications, 1976), and Martin J. S. Rudwick, *Earth's Deep History: How it Was Discovered and Why it Matters* (Chicago: University of Chicago Press, 2014), p. 207.

[26] For example Rev A. Frewen Alyward, 'Scripture and Science', (Hinckley: Printed by J. Baxter, 1884), used the common argument that the Mosaic story is remarkably similar to what geologists had discovered, but that it was written in what would now be deemed non-scientific language, because that was the framework of understanding in place at the time.

therefore, plays a vital role if mankind is to have a complete perspective on nature. If scientists (and indeed the clergy) study nature 'to find out the How of things', the clergy are overall far better equipped 'to find out the Why' (p. 328). If materialists are to continue advancing scientific theories, 'beneath all these theories – true or false – still lies the unknown *x*' (p. 334).[27] Religion and science are thus mutually beneficial. Speaking in a forum devoted to promoting debate amongst the Anglican clergy, Kingsley presents a logical argument by drawing upon ideas with which his audience is already likely to agree. Such a systematic and positive argument epitomizes Kingsley's overall approach to modern science and religion – cohesion rather than conflict; scientific study as the worship of, rather than a challenge to, God.

Kingsley's Authorities

For Kingsley, modern science's continuity with natural theology was clear: a pebble is 'a thought of God's'.[28] But to study it properly, one must be well trained. In the early 1870s, as Canon of Chester Cathedral, Kingsley instigated natural history classes for men of every rank. But his commitment to science education can be traced back several decades earlier; his 'How to Study Natural History', a lecture delivered in Reading in 1846, is both a precursor to these lessons, and a continuation of a tradition of science teaching that dates back to the beginning of the century. Again, Kingsley makes use of his rhetorical powers, this time seeming to undermine the value of the lecture form, in order to enhance its efficacy. Lectures are 'very often a very dangerous method of teaching', he says, because the hearer 'has been forced to take facts and results on trust' (p. 289). Demonstrations are chosen because they are 'startling and amusing, rather than important' (p. 290) and are therefore more entertaining than educational. This is a conscious

[27] We are reminded of Huxley's 'mathematician, who should mistake the *x*'s and *y*'s' in 'The Physical Basis of Life', p. 145.
[28] Charles Kingsley, 'How to Study Natural History', *Scientific Lectures and Essays*, pp. 289-312, p. 296.

evocation of the cultural form of the lecture, using the audience's familiarity with and expectation of demonstrations; drawing the audience's attention to the fact that they have come to hear a lecture, their interest is piqued, especially as it could be 'dangerous'.

Lectures do, however, 'relax' the mind and spark interest in subjects for further study. They are healthful in a Kingsleyan Muscular Christian sense, teaching people to 'learn to face facts manfully' (p. 291). It may even be seen as Kingsley's attempt to ingratiate himself with his audience: they should believe him because he has openly drawn attention to the limitations of the lecture. Kingsley's warning for his audience to be on their guard against deceptive lecturers is also, however, an attempt to persuade them to cast a discerning, critical eye on popular expositions. Such rhetoric reminds us of the caveats that scientific naturalists used in their lectures: facts told to you by others or read about, should be verified through direct observation.

Taking a pebble that he claims to have 'picked up out of the street' (p. 296) on his way to the lecture hall, Kingsley makes the case for geology as a science suitable for all. He evokes the idea that the scientist must be morally upright, more than a decade before Tyndall, Huxley and Darwin would claim the same, in asserting that the observer must be 'patient and honest'. This unites the amateur and professional in a common aim, but the implication here is also deeply religious: stemming from natural theology, scientific pursuits take as their subjects the work of God, and therefore a moral character is required to follow them. Initially the pebble is a stage prop – Kingsley instructs his audience to '[s]ee this pebble which I hold in my hand', emphasizing its solidity and its age. But Kingsley then gives the pebble a voice, allowing it to deliver in first person a narrative of its life:

> Aeons and Aeons since, thousands on thousands of years before there was a man to till the ground, I the little pebble was a living sponge [...] I lay buried in the nether dark [...] I have been part of an island [...] And now I am a pebble here in Reading street [...]
>
> (pp. 297-298)

Repetition ('Aeons and Aeons'), one of Kingsley's favourite rhetorical effects, here compounds the vast age of the pebble, and evokes a storytelling mode, emphasizing the wonderful aspects of its narrative. On the page this personification appears to be a magical narrative of the distant past; Kingsley's audience may have been captivated by the pebble's tale, although we will never know whether in the lecture hall it felt rather like an awkward ventriloquist's act.

For a piece of rock that lay for millennia in the 'nether dark' the pebble possesses a remarkably sound knowledge of English literature, quoting from Coleridge's *Rime of the Ancient Mariner* – 'And it grew wondrous cold; | And ice mast-high came floating by, | As green as emerald' (p. 298) – while reminiscing about an ice age. Reciting lines from a poem whose central themes are those of eternal wandering, divine omnipotence, and being at the mercy of the ice and sea, the pebble displays a familiarity with human cultural production, while simultaneously claiming to have actually experienced the vastness and cyclical scope of geological time, which its listeners would struggle to comprehend even when expressed in poetry. Kingsley is here drawing on a tradition of It-narratives that stretched back to the eighteenth century.[29] This genre originated in a fashion for satirical narratives told in first person by an object, often concerning the less reputable aspects of their owners' lives. The eighteenth-century It-narrative was largely aimed at adults, but during the first half of the nineteenth century the form was used to teach moral lessons to children. A common trope in these narratives was the "how I was made" section, in which objects recounted their journeys up to the point at which they were claimed by their child owners.[30] Lynn Festa notes that this journey was the 'process by which objects gain value', and the intention was that children would read them to find out how they too might become valuable, moral members of society. For Kingsley to take a technique that, by 1846 would certainly have been equated with the education of children, seems risky. 'How to Study Natural

[29] See Lynn Festa, 'The Moral Ends of Eighteenth- and Nineteenth-Century Object Narratives', in *The Secret Life of Things: Animals, Objects, and It-Narratives in Eighteenth-Century England*, ed. by Mark Blackwell (Lewisburg: Bucknell University Press, 2007), pp. 309-328, and Elaine Freedgood, 'What Objects Know: Circulation, Omniscience and the Comedy of Dispossession in Victorian It-Narratives', *Journal of Victorian Culture*, 15 (April 2010), 83-100.
[30] Festa, p. 318.

History' was addressed to 'LADIES AND GENTLEMEN', not to boys and girls. Perhaps he was borrowing from the genre because the idea that a journey from creation to the present could be associated with moral improvement, was one which Kingsley hoped his audience would associate with geological time. Rather than prehistory representing uncertainty and danger, and threatening the Biblical Creation story, its narrative is embedded in a distinctly Christian moral writing tradition. Perhaps, also, the pebble is seen to "preach" to the audience, with Kingsley deferring to its authority as an object that was formed far closer to the first moment of creation than were humans.

Kingsley's metonymic use of the pebble to discourse on grander scientific themes was not original. Such "object lessons" are seen in other popular science lectures during this period, such as Faraday's 'The Chemical History of a Candle' (1848) and Huxley's 'On a Piece of Chalk' (1868). Melanie Keene has written on the nineteenth-century scientific object lesson and its roots in the domestic sphere, and in the previous chapter I discussed Arabella Buckley's object lessons in *The Fairy-Land of Science*.[31] Twenty-five years after 'How to Study Natural History', and as a veteran of the pulpit and the popular scientific platform, Kingsley delivered a series of lectures entitled *Town Geology*.[32] Their individual titles show that he was still working in the tradition of object lessons: 'The Pebbles in the Street', 'The Coal in the Fire', 'The Slates on the Roof'. The six lectures that make up *Town Geology* were delivered in 1871 to young men and women in the Chester Natural Science Society (the young men for whom the classes were intended were 'allowed to bring a lady friend').[33]

Mrs Kingsley's account of these lectures, although somewhat hyperbolic, gives the essence of Kingsley's performance:

> The black-board was in constant use. Many of those who were present must recall the look of inspiration with which his burning words were accompanied,

[31] Keene, 'Object Lessons: Sensory Science Education, 1830-1870'.
[32] For Kingsley's lecturing activities during this period see Kingsley, *Letters and Memories*, II, pp. 32-34, 47, 71, 231-232.
[33] Ibid., p. 349.

> as he went through the various transformations of the coal, till it reached the diamond, and the poetry he threw into his theme as […] he lifted a lump of coal off the table […]
>
> "A diamond, nothing less!"
>
> (p. 351)

The performance is highly visual. The piece of coal, like the pebble, is a dull, innocuous object until Kingsley mixes it with poetry and its beauty is revealed. Of course, this kind of rhetoric was a favourite of scientific naturalists; Kingsley's use of the technique points to the fact that modern science shared much of its methods of communication with natural theologians.

As well as imitating professional scientists in his choice of titles, Kingsley frequently refers to Charles Lyell's *Student's Elements of Geology* (1871) throughout *Town Geology*. In so doing he draws a line of descent from the respected scientist to his own pupils. In a letter to Lyell dated 22 June 1871, Kingsley informs the geologist that his pupils have all been issued with a copy of *Student's Elements*. He asks whether Lyell, amongst several other 'great names' would be willing to become an honorary member of the Chester Natural Science Society: '[t]hat will give my plebs', Kingsley writes, 'who are men of all ranks and creeds of course, self-respect; the feeling that they are initiated actually into the great freemasonry of science, and that such men as you acknowledge them as pupils'.[34] Lyell complied, as did such men as Huxley, Tyndall, and Hooker. Kingsley seems here to want even the lowest 'ranks' to become part of a scientific community, and in this sense science as he conceives it is democratic. Nevertheless, the system which he implements at Chester is still hierarchical. As defined in the *OED* the term 'pleb' refers to 'a member of the ordinary people or working classes […] Freq. *derogatory*: an unsophisticated or uncultured person'.[35] Kingsley's use of the word seems affectionate as he paternalistically refers to them as '*my* plebs', but he sees them as, culturally, rough around the edges, and in need of

[34] Ibid., p. 350.
[35] 'pleb', 1 n. and adj., *OED* <www.oed.com> [accessed 4 October 2016].

intellectual leadership from scientific authorities. Such leadership, though, was ultimately to be presented to the public not as a hierarchy but as a fraternity.

As discussed in chapter one, the acceptance of such hierarchies was presented by practising scientists, to the public, as an act of freedom. Tyndall and Huxley urged their audiences to do their own experiments and to see for themselves – *not* to trust to authority figures. Ultimately however, they were persuading the public of the authority of their own methods of scientific practice. While supporting many aspects of this argument, Kingsley diverges from the professionals in one significant respect. He asserts, just as the scientific naturalists did, that 'in becoming scientific men, in studying science and acquiring the scientific habit of mind, you will find yourselves enjoying a freedom, an equality, a brotherhood, such as you will not find elsewhere just now'.[36] But he does not use this argument to persuade people to accept the authority of scientists. *His* condemnation of obedience to human experts comes from a belief that true freedom is gained from obedience to nature itself and, therefore, to God. Professional scientists are a kind of authority in the sense that their example should be followed, but at the same time by taking part in this man-made hierarchy, the students of the Chester Natural Science Society will ultimately be on the same plain as the professionals, because they are all celebrating God. Kingsley takes the metaphors used by scientific naturalists and deploys them in a unification of natural theology and modern science, thereby replacing the authority of the professional with God:

> [Y]oung men must remember always, that neither this book, nor all the books in the world, will make them geologists. No amount of book learning will make a man a scientific man; nothing but patient observation, and quiet and fair thought over what he has observed. He must go out for himself, see for himself, compare and judge for himself, in the field, the quarry, the cutting [...] He must verify – as far as he can – what he reads in books, by his own observation; and be slow to believe anything, even on the highest scientific authority, till he has either seen it, or something like enough of it to make it seem to him probable, or at least possible.
>
> (p. 4)

[36] Preface to *Town Geology*, pp. 3-28, p. 13.

Are we to understand that, as no book will make a man a geologist, not even the Bible will make him a true Christian? If so, Kingsley's borrowing from scientific naturalism, in observing nature for oneself and not trusting to written authority, forms an anti-Scriptural argument. Revealed religion must be verified by natural theology: the 'laws of physical science [... are] the Word of God revealed in facts' (p. 9). Geology itself is 'the mere rind of this earth-fruit which has, countless ages since, dropped, as it were, from the bosom of God' (p. 29). Kingsley's metaphor reminds his audience of Genesis, here with the whole earth as the fruit; in a reversal of the Fall however, the audience is invited to be curious and peel back the rind for 'reverent study'. The rhetorical tools that he uses to make this argument are already present in works of scientific naturalism; for example, Huxley opened 'On a Piece of Chalk' by asserting that, '[a] great chapter in the history of the world is written in the chalk'.[37] Paralleling Huxley, and 'The Natural Theology of the Future', we see that Kingsley neither argues for anything particularly radical (many Anglican clergymen praised the work of professional scientists), nor does he use particularly unusual methods. Kingsley uses existing techniques to marry existing views, making science and religion compatible through the use of the same language (although he only asks that the theories be 'probable, or at least possible', a smaller degree of certainty than that required by Huxley). Furthermore, by arguing that God is present in nature, he can argue that to study nature with the same scrupulosity as would a scientific naturalist, is to engage in a form of worship.

[37] T. H. Huxley, 'On a Piece of Chalk', *Lectures and Lay Sermons* (London: J. M. Dent & Sons Ltd., 1913), pp. 1-21 (p. 2).

Kingsley's Sanitary Science

Geology was not the only scientific discipline in which Kingsley sought to emphasize the compatibility of science with religion. A more pressing concern, he believed, was that of the application of sanitary science to the relief of a moral problem: the perceived causative relationship between insanitary living and immorality. Early nineteenth-century religious responses to epidemics tended to treat disease either as the result of individual sin (and therefore the responsibility of the individual), or as a punishment for the Fall (and so an inevitable consequence of sin). In her study of responses to cholera during this period, however, Pamela Gilbert asserts that, by the cholera epidemics of the 1860s, '[a]lthough some clergy were offended by the materialism of science, many more were supportive and often engaged in scientific pursuits themselves'.[38] By this point it became more commonly accepted than it had been during earlier cholera outbreaks that 'it was the failing of a "civilized" society to keep itself clean' that spread the disease, rather than individual sin.[39]

Kingsley himself had believed that personal sin had some part to play in the 1849 cholera epidemic in Britain. In his three sermons on cholera in the autumn of that year Kingsley argued that cholera spread through insanitary practices, and that such practices were a form of sin: 'if we do believe this Pestilence to be God's judgement, then it is a spiritual matter most proper to be spoken of in a place like this church'.[40] By 1857 however, the year in which his novel *Two Years Ago* was published, the practical aspects of Kingsley's stance on sanitary science had intensified.[41] *Two Years Ago* depicts the effects of the 1854 cholera epidemic in Britain on the West Country

[38] Pamela K. Gilbert, *Cholera and Nation: Doctoring the Social Body in Victorian England* (Albany: State University of New York Press, 2008), p. 42. See also Christopher Hamlin, *Cholera: A Biography* (Oxford: Oxford University Press, 2009).
[39] Gilbert, p. 47.
[40] Charles Kingsley, 'Second Sermon on the Cholera', n.d. but follows from previous Sunday's sermon, 27 September 1849, *Sermons on National Subjects* (London: Macmillan and Co., 1890) (1st ed. 1880), pp. 144-152 (p. 144).
[41] This is perhaps because he came into direct contact with the worst affected areas. Shortly after delivering the cholera sermons in 1849 Kingsley visited 'the cholera districts of Bermondsley' and was horrified by what he saw. Kingsley, *Letters and Memories*, I, p. 216.

sea-side village of Aberalva. With cholera an imminent threat, the doctor Tom Thurnall tries to persuade the curate, Frank Headley, to preach a sermon on the importance of sanitation.[42] Frank replies that the parishioners simply would not listen to him:

> "I have been hinting to them, ever since I came, improvements in cleanliness, in ventilation, and so forth: but I have been utterly unheeded: and bully me as you will, Doctor, about my cramming doctrines down their throats, and roving like a Pope's bull, I assure you, on sanitary reform, my roaring was as of a sucking dove, and ought to have prevailed, if soft persuasion can."
>
> "You were a dove, when you ought to have been a bull, and a bull where you ought to have been a dove. But roar now, if ever you roared, in the pulpit and out. Why not preach to them on it next Sunday? [...] I have half-a-dozen specimens of water already which will astonish them. Let me lecture, you must preach."
>
> "You must know, that there is a feeling, – you would call it a prejudice, – against introducing such purely secular subjects into the pulpit."
>
> [Tom argues that for Frank not to preach on cholera would be to murder his own parishioners.]
>
> So Frank preached a noble sermon, most rational, and most spiritual withal; but he, too, like his tutor, took little by his motion.[43]

Tom's response to Frank's work so far – to tell him to 'roar now' – stresses that only a confident and manly authority (and that authority *performed* from the pulpit) will be effective. As Charlotte Sleigh rightly points out, Kingsley, '[l]ike many realist writers, [...] found the figure of the lonely hero a promising vehicle for the moral truth of science. For Kingsley this figure originated in religious discourse; its prototype was Christ himself'.[44] In *Two Years Ago* Tom appears to distinguish between two kinds of truth – material and spiritual: the doctor must 'lecture' on the former and the curate 'preach' on the latter. However, the villagers' failure to heed Frank's advice, leading to devastation during the cholera epidemic, illustrates that these two types of

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[42] One P. H. Moore read *Two Years Ago* as a manifesto for sanitary work. Publishing sermons on cholera he had delivered to his congregation, Moore wrote that: '[t]hese sermons do not pretend to any literary merit, and the idea which gives them any claim upon the printer was furnished by Professor Kingsley's "*Two Years Ago*". But the sanitary condition of Pill [Moore's parish] is now being put upon a sound foundation, and, therefore, the Author ventures to publish his rough Commentary on Mr. Kingsley's text, in the hope of being able to raise a small sum towards the proper drainage of his late parish', *Prevention is Better Than Cure: Five Sermons Preached at Christ Church, Pill, Near Bristol, Before and During an Outbreak of Cholera in 1866, by P. H. Moore* (Stockport: Printed by Claye, 1868), n.p.

[43] Charles Kingsley, *Two Years Ago* (1857), (London: Macmillan and Co., 1879), pp. 216-218.

[44] Charlotte Sleigh, *Literature and Science* (Hampshire: Palgrave Macmillan, 2011), p. 138.

truth are one and the same. Sanitation is not a 'purely secular' subject, and Frank can preach a sermon that is both 'rational' and 'spiritual'.[45] Here we can see the symbiotic relationship between religion and science that Kingsley promoted in 'The Natural Theology of the Future'; both are required for genuine Christian worship, and neither one could exist without the other.

Transposed into the pulpit and into Kingsley's own words, the message that there is a relationship between the spiritual and physical causes of cholera becomes one of even greater urgency. No longer fictionalized as the result of the ignorance of the inhabitants of Aberalva, cholera is brought into the present. Preaching in September and October 1849, Kingsley made a direct link between uncleanness and pestilence (thereby emphasizing the former as a sin and the latter as punishment for that sin) that was happening at that very moment. Living in filth, adulterated food, bad air, have brought on the disease and, 'as surely as drunkenness punishes itself by a shaking hand and a bloated body, so does filth avenge itself by pestilence'.[46] There is certainty in Kingsley's statement here, but when he returned to preaching on cholera in 1866, his beliefs on the relationship between sin and pestilence had evolved. This time he makes a more urgent appeal to his parishioners to see physical uncleanness as a sin *because* God had equipped them with sanitary knowledge, of which they *chose* to remain ignorant. Enforcing his argument through the repeated 'we know' he states: '[w]e know that this cholera comes by no miracle, but by natural causes. We can more or less foretell when it will break out. We know how to prevent its breaking out at all, save in a scattered case here and there [...] But that does not prevent its being a visitation of God'.[47] Scientific knowledge and religion are not at odds; rather, scientific

[45] See also Kingsley's article on sanitary sermons and the importance of increased church and government involvement in reform, [Charles Kingsley], 'A Mad World, My Masters. By a Sanitary Reformer', *Fraser's Magazine*, 57 (January 1858), 133-142.
[46] Charles Kingsley, 'First Sermon on the Cholera', delivered Sunday morning, 27 September 1849, *Sermons on National Subjects*, pp. 134-143 (pp. 135, 141).
[47] Charles Kingsley, 'Cholera, 1866', *The Water of Life and Other Sermons* (London: Macmillan and Co., 1897), pp. 189-202, pp. 189-190. Kingsley would state a similar argument regarding natural disasters, and the inefficacy of prayer alone, in his well-known refusal to pray for the end of months of rain in 1860. Kingsley, *Letters and Memories*, I, pp. 110-114.

understanding has been gifted to man, by God, in order that he may avoid pestilence. It is the ignoring of this gift, which constitutes sin.

The differences and similarities between the roles of doctor and clergyman in the prevention of disease, as embodied by Tom and Frank, are elaborated in a sermon entitled 'The Physician's Calling' delivered in aid of St George's Hospital. Kingsley argues that the separation of the professions has 'saved the doctor from one great danger – that of abusing, for the purpose of religious proselytizing, the unlimited confidence reposed in him [...] It has enabled him to devote his whole intellect to physical science, till he has set his art on a sound and truly scientific foundation'.[48] This division removes bias, but it does not separate the two roles absolutely (Kingsley himself demonstrated this inseparability by the very fact that he was a clergyman lecturing on sanitation). The doctor, occasionally accused of being 'too materialistic' in fact, '[i]n his exclusive care for the body, [...] may be witnessing unconsciously, yet mightily, for the soul, for God, for the Bible, for immortality' (p. 18). 'If Christ were a healer', he states, 'His servants must be healers likewise [...] with such power as he revealed to them' (p. 21).

Such a connection is also made by the fact that Kingsley spoke on both religious and sanitary topics from the pulpit and the lecture podium; despite the difference in platform, his message was the same. Kingsley brought scientific naturalism across the threshold of the church, not to denounce, but to actively promote it. Likewise, when he delivered lectures in secular institutions, his tone nevertheless remained religious. Such lectures were an opportunity to persuade audiences of the immorality, not of dirt itself, or of being unclean, but of being aware of sanitary laws and not applying them. In a lecture entitled 'The Two Breaths', delivered to a female audience in Winchester, 31 May 1869, Kingsley concludes that '[h]e [...] who obeys the laws of nature with his whole heart and mind, will find all things working together to him for

[48] Charles Kingsley, 'The Physician's Calling', *The Water of Life*, pp. 14-26 (p. 17).

good. He is at peace with the physical universe'.[49] Obedience to nature, by following the laws of health, is obedience to God. Consequently no physiological topic is unsuitable, even for women, be it 'digestion, nature of food, absorption, secretion, [or] structure of the nervous system'.[50] When addressing female listeners and readers, Kingsley repeatedly apologises for his use of scientific terminology, stating that 'I shall try to be as simple as possible; to trouble you as little as possible with scientific terms; to be practical; and at the same time, if possible, interesting' ('Two Breaths', p. 49). Even the title of his lecture suggests a fundamental and simple topic. He hopes not 'to load [their] memories with scientific terms' (p. 53) and speaks in short, simple sentences, for example, 'every time you breathe you breathe two different breaths; you take one in, you give out another. The composition of these two breaths is different. Their effects are different' (p. 50). Such a style of delivery, almost patronizing, may be explained by Kingsley's evangelical belief in the importance of sanitation. His work with the Ladies' Sanitary Association,[51] his preoccupation with unsanitary living and immorality through his fiction, such as *Yeast* (1851), *Two Years Ago* and *The Water-Babies* (1863), and recurrent anxieties about disease in his sermons, urgently call for the basics of sanitation to be understood by all.

Why was this so important? 'The Science of Health' is an essay based on a lecture delivered at the Birmingham and Midland Institute in 1872. In it Kingsley prescribes nationwide changes to sanitary education, targeting both men and women. But it is also a lecture in which Kingsley comes to some problematic conclusions, for the modern reader, about the implications of evolution. Kingsley's understanding of evolution was that in earlier generations '[t]hose terrible laws of natural selection, which issue in "the survival of the fittest," cleared off the less fit' (p. 22). Industry led to a population increase, and sanitary reforms themselves kept alive weaker members of society who otherwise would not have survived – in this sense, improved sanitation

[49] Charles Kingsley, 'The Two Breaths', *Sanitary and Social Lectures and Essays* (London: Macmillan and Co., 1889), pp. 47-74 (p. 74).
[50] Charles Kingsley, 'The Science of Health', *Sanitary and Social Lectures and Essays*, pp. 19-45 (p. 33).
[51] Kingsley spoke, alongside Shaftesbury, at the Ladies' National Association for the Diffusion of Sanitary Knowledge in 1859, *The Second Report of the Ladies' National Association*, pp. 10-15.

had overridden natural selection. He also believes that ill health and weakness are hereditary and are leading to social degeneration; sanitary education is therefore, paradoxically, imperative if degeneration is to be reversed. We may detect similarities here with Herbert Spencer. In his 1851 *Social Statics*, Spencer wrote that:

> there exists a fatal non-adaptation; and it matters not in the abstract whether it be a moral, an intellectual, or a corporeal one. Being thus imperfect are nature's failures, and are recalled by her laws when found to be such. Along with the rest they are put upon trial. If they are sufficiently complete to live, they *do* live, and it is well they should live. If they are not sufficiently complete to live, they die, and it is best they should die.[52]

Kingsley picks up "the survival of the fittest" from later Spencer, but the idea that hereditary weakness in individuals leads to the degeneration of an entire nation, seems to draw on these earlier ideas. While Gilbert argues that '[b]y the end of the '50s, Kingsley would be much closer to Spencer's hard-nosed doctrines than he was at the beginning, though he never accepted Spencer's Social Darwinism',[53] Kingsley asks in his lecture, '[d]o I say that we ought not to save these people if we can?' he asks, 'God forbid' (p. 27). This compassionate exclamation may show that, luckily, Kingsley stops short of Spencer's most extreme statements.

Ruskin's Performances

Kingsley's love of nature is encapsulated in a letter he wrote to Rev Peter L. H. Wood, telling his friend how much he looked forward to visiting him and exploring the local countryside. He calls himself 'a man [...] who wanders the moorlands till I have all but exhausted their flora, fauna, and geological features, though I hope to stumble on fresh wonders some day, by the aid of the microscope'.[54] Ruskin shared these interests but,[55] unlike Kingsley, he did not accept that

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[52] Herbert Spencer, *Social Statics; or, the Conditions Essential to Human Happiness Specified, and the First of them Developed* (London: Williams and Norgate, 1868), p. 415.
[53] Gilbert, p. 159.
[54] Letter dated 5 April 1857, Kingsley, *Life and Letters*, II, pp. 20-21.

anything new or more wonderful could be revealed by the microscope. For Ruskin, nature brought the observer closer to God but only if the eye was trained to see aesthetically. The microscope was a technology which threatened to obfuscate such seeing and as such represented the dangers that modern science posed. As he would argue in his geology text *Deucalion*, '[i]n the old times it was not thought necessary for human creatures to know either the infinitely little, or the infinitely distant; nor either to see, or feel, by artificial help'.[56]

Ruskin had an informal education in sermonizing; as a child he read out Bible passages to his mother and preached his own miniature sermons to her friends,[57] and spent Sunday afternoons writing abstracts of the sermons he heard in the morning.[58] His father held out hopes that Ruskin would join the clergy: '"I don't care to see you allied with the platform", he wrote, "– though the pulpit would be our delight"'.[59] As an adult Ruskin enjoyed touring different churches with his father to hear a wide variety of sermons, and for a time in the early 1850s their favourite speaker was Charles Haddon Spurgeon.[60] Ruskin struck up a friendship with the Baptist preacher, and he would often go to Spurgeon's house where they would argue about theology. When Ruskin's and Spurgeon's opinions began to diverge significantly, Spurgeon recalled a conversation he had had with 'a very eminent man', who had said to him, '"Why, how foolish you are, and all the company of preachers. You tell people to think about the next world, when the best thing they could do would be to behave themselves as well as they can in this!"'. Ruskin's editors, E. T. Cook and Alexander Wedderburn, note that Ruskin retained the issue of the *Metropolitan Tabernacle Pulpit* in which the sermon appeared, and wrote on it, '"Spurgeon on me"'.[61] He was clearly flattered by the mention, albeit anonymously, and there appears to be no

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[55] Ruskin recounts the origins of his interests in geology in *Praeterita*, ed. by Francis O'Gorman (Oxford: Oxford University Press, 2012), pp. 61-64.
[56] John Ruskin, *Deucalion* (1875-1883), *Library Edition*, XXVI, pp. 89-371 (p. 115).
[57] Dinah Birch, '"Who Wants Authority?": Ruskin as a Dissenter', *Yearbook of English Studies*, 36 (2006), 65-77, (p. 67).
[58] Ruskin, *Praeterita*, p. 47.
[59] Quoted in Tim Hilton, *John Ruskin: The Early Years 1819-1859* (New Haven: Yale University Press, 1985), p. 205.
[60] This sermon-tourism was common in the second half of the century, Meisel (2001), p. 166.
[61] Ruskin, *Library Edition*, XXXIV, pp. 659-661 (pp. 660, 661).

animosity in either Spurgeon's remembrance of Ruskin, or vice versa. To have formed such a friendship with a figure so notorious for his religious public performances, suggests that Ruskin was fascinated by the qualities that made a convincing preacher.

While he saw the pulpit as a noble stage, Ruskin's father was worried about the propriety of his son's taking to a non-religious platform. John James expressed this concern when his son was to give a small lecture series on architecture in 1863. Ruskin retorted that '"I do not mean at *any* time to take up the trade of a lecturer…all that I intend to do is merely, as if in conversation, to say to these people, who are ready to listen to me, some of the simple truths about architecture and painting which may perhaps be better put in conversational than literary form"'.[62] Ruskin seems to be distancing himself from lecturing as a profession, in calling it a 'trade', perhaps denying that it could provide monetary reward. He instead emphasizes that the lecture is a purer form of communication; illustrating his performances with numerous visual aids, he could show his audience that which he described, and could form a more direct relationship with them as a speaker than as a writer.[63] The lecture broke down the barrier of the page which was preventing the audience from receiving Ruskin's 'simple truths'. The wide variety of lectures that Ruskin gave throughout his career is testament to this commitment to performance: as a student he drew diagrams for the geologist William Buckland to use in his Oxford lectures; delivered art classes at Maurice's Working Men's College, of which the content was often spontaneous;[64] gave three lectures at the RI; and as Slade Professor of Fine Art at Oxford delivered a total of eleven lecture series (1869-1878, and occasionally after 1880), until he resigned from the post in 1885, allegedly in protest at the university's decision to allow

[62] Quoted in Dinah Birch, 'Lecturing and Public Voice', in *Cambridge Companion to John Ruskin*, ed. by Francis O'Gorman (Cambridge: Cambridge University Press, 2015), pp. 202-215 (pp. 208-209).

[63] On Ruskin's use of lecture diagrams see Donata Levi and Paul Tucker, '"A Line of Absolute Correctness": Ruskin's Enlargements from Greek Vases and the Drawing Classes at Oxford', in *Ruskin and the Dawn of the Modern*, ed. by Dinah Birch (Oxford: Oxford University Press, 1999), pp. 87-110.

[64] Hilton, *John Ruskin: The Early Years*, p. 205.

vivisection in its laboratories.[65] Further, Ruskin lectured on a huge variety of topics: from art history and aesthetics, to architecture, science, and social policy. Often, single lectures included all of these.

The fact that Ruskin enjoyed an enthusiastic following in life and shortly after his death, that he inspired such strong commitment from his followers, means that a substantial, albeit biased, collection of anecdotes survives from several lecture attendees. E. T. Cook remembered the unusual sartorial appearance of Ruskin as Slade Professor, the 'quaintness of his costume [...] the ill-fitting and old-fashioned frock-coat [... which] accurately reflected something of the originality of his mind and talk'.[66] This eccentric costume seems to be deliberately chosen as part of the performance. Ruskin was fond of using stage tricks when delivering these art lectures. For example, paintings were covered up and then revealed at the last minute.[67] In one instance Ruskin demonstrated his disgust at modern industry and pollution by painting onto the glass of a Turner landscape 'a handsome iron structure', 'tall factory chimneys', 'black smoke', 'a gaol and a lunatic asylum'.[68] The paint was then wiped away as Ruskin concluded that '"for my part, I prefer the old"'. His use of paintings and enlargements to visually illustrate his art lectures, was an unusual technique at the time; in fact the practice was far more common in science lectures.[69]

W. G. Collingwood wrote of Ruskin's oral delivery that he had 'two styles essentially distinct, and not well blended – a speaking and a writing style; the former colloquial and spoken off-hand; the latter rhetorical and carefully read in quite a different voice'.[70] He also noted that Ruskin's 'dress and manner of speaking' were 'eminently clerical'. This suggests that Ruskin was more animated when he improvised, and solemn when he spoke from a script. G. W. Kitchen recalled that, while Ruskin's 'lectures were carefully prepared [...] from time to time some key

[65] The university had agreed to fund laboratories for Sir John Burdon-Sanderson, Professor of Physiology, who was licensed to practice vivisection.
[66] E. T. Cook, Intro to Ruskin, *Library Edition*, XX, pp. xvii-lxi, (p. xxiii).
[67] Ibid., p. xxvi.
[68] Ibid., pp. xxvii.
[69] Trevor Fawcett, 'Visual Facts and the Nineteenth-Century Art Lecture', *Art History*, 6 (December 1983), 442-460.
[70] W. G. Collingwood, *The Life and Work of John Ruskin*, 2 vols (London: Methuen & Co., 1893), I, p. 170.

was struck which took his attention from the page, and then came an outburst'.[71] These remembrances paint an image in which Ruskin's complex and often contradictory opinions, were given corporal shape in the body of the lecturer, while his changing speaking style gave an indication of the dualistic nature of his views.

While improvisation may have animated his Slade lectures, it could lead to failure in his other public performances. On 19 April 1861 Ruskin delivered a lecture at the RI entitled 'Tree Twigs'.[72] As it consisted of material which Ruskin knew well, he did not script (or did not fully script) his performance beforehand. Writing to the girls at Winnington School (with whom he had stayed at the end of the 1850s), Ruskin voiced regret that he had not lectured on a different topic, for which he had asked the girls to prepare diagrams:

> It was a great pity I did not go on as I intended with your diagrams: for the branches broke with me last night – I found I had no command of my subject & my brains, and was obliged to give in, half way: and talk upon general results of it. I had not *altogether* to give in and walk out of the room, but I broke fairly down in the middle – and I have no doubt caused much pain to all my friends there […][73]

Ruskin felt acutely the embarrassment of breaking down during his lecture, the loss of control over his thoughts and the near loss of physical control, attempting to downplay the feeling through the pun 'the branches broke'. Thomas Carlyle (whom Ruskin greatly admired) was a witness to this breakdown at the RI, but would give Ruskin the benefit of the doubt. In a letter to his brother John, 23 April 1861, Carlyle wrote:

> Friday last […] I was persuaded – in fact had unwarily compelled myself, as it were – to a lecture of Ruskin's at the Institution, Albemarle Street – lecture on Tree Leaves as physiological, pictorial, moral, symbolical objects. A crammed house, but tolerable to me even in the gallery. The lecture was thought to 'break down,' and indeed it quite did '*as a lecture*': but only did from *embarras des richesses* – a rare case. Ruskin did blow asunder as by gunpowder explosions his leaf notions, which were manifold, curious, genial;

[71] G. W. Kitchen, *Ruskin in Oxford and Other Studies* (London: John Murray, 1904), p. 40.
[72] The lecture was reported in the *London Review* (27 April 1861) with illustrations. That report, and Ruskin's own abstract of the lecture (which was circulated to the audience), are reproduced in Ruskin, *Library Edition*, VII, pp. 467-478.
[73] Letter 136, John Ruskin to the children at Winnington Hall, Saturday 20 April 1861, in *The Winnington Letters: John Ruskin's Correspondence with Margaret Alexis Bell and the Children at Winnington Hall*, ed. by Van Akin Burd (London: George Allen & Unwin Ltd., 1969), pp. 297-298.

> and, in fact, I do not recollect to have heard in that place any neatest thing I liked so well as this chaotic one.[74]

Carlyle depicts a chaotic scene – but the lecture was all the more entertaining because of its disorganized appearance. In a sense Ruskin's genuinely disorganized performance was more entertaining than, for example, Tyndall's well-rehearsed and coherent narratives. The improvisatory character of Ruskin's lectures would, however, lead to notoriety, not (as at the RI) because they were crammed with unstructured but relevant information, but because Ruskin's digressions would become increasingly disorganized and vitriolic. Robert Hewison notes that, towards the end of his Slade Professorship Ruskin's lectures 'became a spectacle for his undergraduates'.[75] Tim Hilton, whose biography of Ruskin tends overwhelmingly towards praise of the art critic's work, acknowledges nevertheless that towards the end of his time at Oxford, Ruskin's lectures 'were undignified and sometimes ludicrous', with many audience members attending simply because they 'expected controversy'.[76] Ruskin's outspokenness had developed into spectacle.

Ruskin's Aesthetic Eye and Objectivity

Ruskin's work on nature was always informed by religion and, even as his beliefs evolved (and as dominant scientific thought also changed), he maintained speech 'strategies [that] were fundamentally those of the preacher'.[77] Questioning the heavily Biblical teaching he received as a

[74] Quoted in Ruskin, *Library Edition*, VII, p. lix.
[75] Robert Hewison, 'Ruskin, John (1819-1900)', *ODNB* [accessed 5 October 2016].
[76] Tim Hilton, *John Ruskin: The Later Years* (New Haven: Yale University Press, 2000), p. 316.
[77] Birch, 'Lecturing and Public Voice', p. 205. The direct relationship between Ruskin's theories on art, religion, and nature, is especially complicated because his views did not remain the same throughout his life. Van Akin Burd has gone so far as to say that Ruskin 'should be seen as what we today call a "creationist", a believer in the beneficent design of the universe he had found in Buckland'. 'Ruskin and His "Good Master", William Buckland', *Victorian Literature and Culture*, 36 (2008) 299-315 (p. 313). Mark Frost questions Burd's 'assertion that Ruskin agreed with Buckland that 'a non-literal reading of Genesis could conform to the investigations of science', '"The Circles of Vitality": Ruskin, Science, and Dynamic Materiality', *Victorian Literature and Culture*, 39 (2011) 367-383 (p. 369).

child, Ruskin would come increasingly to read nature as a divine text. As Kingsley felt that a close study of nature is the first step in realizing a greater, religious truth behind objective vision, Ruskin too believed that scientific observation of nature did not reveal the complete truth. There *was* a higher, divine truth behind what the senses detect, but this can only be achieved through a kind of *aesthetic* seeing.[78] Thus artistic vision and religious vision were inextricably linked. Jonathan Smith summarizes the relationship between Ruskin's notions of religious and artistic vision:

> Great artists [...] may [...] as Turner did, sometimes depart from strict adherence to what they see in nature, but the grounding of their "subjective" vision in physical truths is what enables them to elucidate the higher ones. Since for Ruskin nature is the creation of God, such faithful art is simultaneously an act of praise, a confirmation of divine attributes, and an uncovering of divine lessons for humankind.[79]

In other words Ruskin's is a natural theology which incorporates the artistic eye into the observation of nature. Truth in nature is not empirical, but is rather a combination of the physical world viewed through the subjective artistic eye (an eye which, as Ruskin states in *The Elements of Drawing*, must be trained).[80] Many critics have pointed out this connection, for example Hewison, who asserts that 'Ruskin does not regard science and feeling as mutually exclusive; rather science provides a firmer basis for aesthetic response'.[81]

But how does Ruskin's belief that accurate observation could only be achieved when the viewer was active, correlate with that other dominant Victorian epistemology of observation:

[78] Elizabeth K. Helsinger provides an excellent study of Ruskin's theories on art and the imagination: *Ruskin and the Art of the Beholder* (Cambridge, Massachusetts: Harvard University Press, 1982).

[79] Jonathan Smith, 'Grant Allen, Physiological Aesthetics, and the Dissemination of Darwin's Botany', in Cantor and Shuttleworth (eds.), *Science Serialized*, pp. 285-305 (p. 296).

[80] Preface to John Ruskin, *The Elements of Drawing; in Three Letters to Beginners*, Ruskin, *Library Edition*, XV, pp. 9-19.

[81] Robert Hewison, *John Ruskin: The Argument of the Eye* (London: Thames and Hudson, 1976), p. 20. See also: Katharine Anderson, 'Looking at the Sky: The Visual Context of Victorian Meteorology', *British Journal for the History of Science*, 36 (September 2003), 301-322; Frederick Kirchhoff, 'A Science Against Sciences: Ruskin's Floral Mythology', in *Nature and the Victorian Imagination*, ed. by U. C. Knoepflmacher and G. B. Tennyson (Berkeley: University of California Press, 1977), pp. 246-258. Jonathan Smith writes that '[f]or Ruskin, the study of nature for scientific purposes, properly pursued, was complementary to the properly-pursued study of nature for artistic purposes', *Charles Darwin and Victorian Visual Culture* (Cambridge: Cambridge University Press, 2006), p. 26; Jason H. Lindquist, '"The Mightiest Instrument of the Physical Discoverer": The Visual "Imagination" and the Victorian Observer', *Journal of Victorian Culture*, 13 (2008) 171-199; Peter Garratt, 'Ruskin's Modern Painters and the Visual Language of Reality', *Journal of Victorian Culture*, 14 (2009), 53-71.

the scientific naturalists' association of objectivity with ascetic detachment? We may test Ruskin's theory against Daston and Galison's version of objectivity, the 'blind sight, seeing without inference, interpretation, or intelligence', the 'insistent drive to repress the wilful intervention of the artist-author'.[82] In physics and zoology, the areas in which Tyndall and Huxley worked, this mechanical objectivity was quickly accepted. It was slower to catch on in other fields such as botany. Daston and Galison are keen to point out that, as with any new scientific method, '[s]ome disciplines were won over quickly to the newest epistemic virtue, while others persevered in their allegiances to older ones'.[83] They also persuasively demonstrate how, at any period in history, different beliefs about what constitutes scientific objectivity are practised in parallel. In considering Ruskin we can see not just how these competing epistemologies operated across professional scientific disciplines, but also how they were received by non-experts. As I will show, it is clear in his later works that Ruskin firmly opposed mechanical objectivity, positing instead his own version of active, aesthetic seeing. Before proceeding, however, it must be noted that it is immensely difficult to pin down any absolute, consistent views that Ruskin may have held. In the biographical work *Praeterita*, Ruskin recalls that as a child in Switzerland around 1842, when doing nature study: '[m]y entire delight was in observing without being myself noticed, – if I could have been invisible, all the better' (pp. 110-111). This retrospective appears to support the objectivity of scientific naturalism; however, considered in light of the fact that Ruskin often found his parents to be overbearing, it is more likely that he was recalling the delight he felt in the illicit, because totally unbounded, activity.

One of Ruskin's most striking spoken expositions on the relationship between nature, science, and art, 'The Work of Iron', delivered in Tunbridge Wells on 16 February 1858, defines this preference for aesthetic interaction with, rather than cold detachment from, that which is observed. At the same time, it proposes an ideal mode of seeing which combines the artistic with

[82] Daston and Galison, *Objectivity*, pp. 17, 121.
[83] Ibid., p. 28.

the natural theological. 'The Work of Iron' examines three different roles for the metal: in nature, in art, and in policy. Ruskin famously argues that rusted iron ought to be prized more highly than polished iron, because 'in that condition it fulfils its most important functions in the universe […] iron rusted is Living; but when pure or polished, Dead'.[84] That iron can "breathe" is a divine gift; the formation of iron oxide is both an aesthetic and a divinely ordained act because the transformation makes something 'noble' and beautiful:

> The iron keeps all that it gets; we, and other animals, part with it again; but the metal absolutely keeps what it has once received of this aerial gift; and the ochreous dust which we so much despise is, in fact, just so much nobler than pure iron, in so far as it is *iron and the air*.

The iron honours God because it keeps that which it has been given. Rusted iron is recast as living nature, partly in opposition to its industrial uses, with ochre presented as a more natural colour than metallic grey. Ruskin contrasts the natural world with an industrial alternative by posing a rhetorical question: '[h]ow would you like the world', he asks his audience, if it were made of meadows of 'iron wire' instead of 'grass', if that 'green and glowing sphere, rich with forest and flower, showed nothing but the image of the vast furnace of a ghastly engine – a globe of black, lifeless, excoriated metal?' (p. 107). Ruskin alliteratively pairs images of heaven and hell ('forest' and 'flower' with 'furnace'; 'green' and 'glowing' with 'ghastly'). His use of 'image' implies that this hellish alternative is a world of deception. Later, in borrowing the trope of "nature as book" (p. 110) common to nineteenth-century religious and scientific writing, Ruskin converts reading and writing into seeing and painting; his is a 'picture-book' and nature is active in 'painting' the landscape within. In doing this, Ruskin aligns nature, religion and art. Observation of nature in a natural theological sense is augmented, so that it is the artistic impulse in seeing, that is ultimately the way to God. If this is the case, then an intrinsic part of worship is an appreciation of beauty.

[84] John Ruskin, 'The Work of Iron', in *Selected Writings*, ed. by Dinah Birch (Oxford: Oxford University Press, 2009), pp. 105-135 (p. 106).

Ruskin was happy to conflate modern science with the effects of modern technology in order to picture it as the worship of all things ugly and dangerous.[85]

But by far Ruskin's most urgent call for the importance of artistic (and through it religious) vision over the scientific – more specifically, the materialist, came twenty-six years after 'The Work of Iron', suggesting an intensification of his frustration. *The Storm Cloud of the Nineteenth Century* was a lecture delivered at the London Institution on 4 February 1884, and repeated on 11 February. *Storm Cloud* was printed as two lectures, but in fact the second "lecture" is not a spoken discourse, but a commentary on the first. In the first lecture Ruskin expresses a fear that, in recent years, a type of cloud he terms a 'plague-cloud', accompanied by a 'plague-wind', have appeared. These clouds are 'dark' and 'malignant', and the wind blows '*intermittent*[*ly*]' and '*tremulously*', making the 'trees shudder as if they were aspens'.[86] In the lecture Ruskin reads out a description of these clouds, that he had written earlier, in *Fors Clavigera*:

> "It looks partly as if it were made of poisonous smoke; very possibly it may be: there are at least two hundred furnace chimneys in a square of two miles on every side of me. But mere smoke would not blow to and fro in that wild way. It looks more as if it were dead men's souls – such of them as are not gone yet where they have to go, and may be flitting hither and thither, doubting, themselves, of the fittest place for them."
>
> (p. 33)

The menacing kinetic character of the clouds is caught in 'to' and 'fro', and the use of the present tense suggests direct threat. In likening them to 'dead men's souls [...] doubting, themselves, of the fittest place for them' Ruskin continues the hellish metaphor from 'The Work of Iron', but in this case the by-product of industrialization is caught in purgatory. With these ominous clouds comes doubt, and an association between modernity, chaos, and a decentring of authority (to

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[85] Edward Alexander writes that '[t]here seems little doubt that by the 1870s Ruskin had come to think of science as largely destructive in its influence upon human life. It seemed to love what was ugly, to be enthralled by what was abominable, and to apply most of its newly acquired knowledge to destructive ends'. 'Ruskin and Science', *Modern Language Review*, 64 (July 1969), 508-521 (pp. 516-517).

[86] John Ruskin, *The Storm Cloud of the Nineteenth Century*, Ruskin, *Library Edition*, XXXIV, pp. 1-80 (pp. 33-34).

which I will return). By using personal anecdote Ruskin casts his own critical eye. In saying that the clouds looked like smoke but that they could not be such, he depicts his thought processes which went from observation, to a comparison with what he knows to be true of smoke, to a rejection of his first hypothesis. Ruskin is applying here a blend of scientific method and imagination. In doing so he discerns that the cloud is not what it seems, but is in actual fact something more spiritual. The artistic eye can, therefore, see religious truths beyond the point at which scientific observation can see no more.

Observation must, therefore, be combined with the use of the imagination. And both of these faculties must be honed through training in aesthetic comprehension. In the preface to *Storm Cloud* Ruskin assures his readers that he is able to 'use or refuse [his] power of contemplative imagination, with as easy a command of it as a physicist's of his telescope' (p. 7). But the telescope was not the only tool at the physicist's disposal; the equation of observation and imagination was also closely associated with the scientific naturalists themselves. As we have seen, Tyndall, perceived by Ruskin as the archetypal ascetic, soulless scientist, was one of the loudest advocates for the use of the imagination in science.[87] One of the most problematic and most humbling aspects of scientific naturalism was the fact that the imagination could never be struck out of scientific method. It is therefore strange that Ruskin would take issue with modern scientific method when it had so much in common with art. Both required detailed observation blended with imagination; both required repetition, training and hard work;[88] both sought to understand fundamental aspects of nature. But modern science, Ruskin believed, aimed to dissect

[87] John Tyndall, *On the Scientific Use of the Imagination: A Discourse Delivered Before the British Association at Liverpool, on Friday Evening, 16th September 1870* (London: Longmans, Green, and Co., 1870).

[88] Caroline Levine writes that '[t]o see and represent the reality of the natural world calls for practice, self-denial, rigorous discipline, "necessary labour." Ruskin's realism, in other words, is a *labouring aesthetic*'. 'Visual Labour: Ruskin's Radical Realism', *Victorian Literature and Culture*, (2007), 73-86 (p. 75).

and therefore to destroy what it observed.[89] It is Ruskin's aesthetic impulse which, he believes, keeps that which is observed whole even as it is being looked at in detail.[90]

The supremacy of the artistic eye over the scientific is further enforced by Ruskin's blending of scientific terminology with artistic analysis; the former attempts to describe nature, but only the latter can do it accurately and retain the coherence of the whole. Part-way through describing refracted colours in *Storm Cloud*, Ruskin stumbles. The 'main reason' for this, he tells us, 'is that, whenever I try to find anything firm for you to depend on, I am stopped by the quite frightful inaccuracy of the scientific people's terms' (p. 25). Instead, a combination of visual art and linguistic description using aesthetic terms must be used. Part-science lecture, part-art lecture, *Storm Cloud* was illustrated by a number of sketches drawn by Ruskin and enlarged by Arthur Severn, alongside several paintings. The lecturer's treatment of these images wavers between great satisfaction at their quality and a confidence that they adequately portray nature, and an awareness that the artistic medium falls short: '[n]o colours that can be fixed in earth can ever represent to you the lustre of these cloudy ones. But the actual tints may be shown to you in a lower key, and to a certain extent their power and relation to each other' (p. 20). On a diagram of Coniston Old Man, enlarged by Severn, Ruskin is forced to elaborate on the visual prop because it inadequately conveys the true colours. The clouds are 'flying, failing, melting, reappearing; spinning and unspinning themselves, coiling and uncoiling, winding and unwinding', the colours are of 'emerald and ruby and pale purple and violet melting into a blue that is not of the sky, but of the sunbeam; – purer than crystal, softer than the rainbow, and brighter than the snow' (p. 24). His list of verbs heightens his audience's kinetic experience of the image, while the comparatives challenge them to use their own imaginative faculties and to call up images far more

[89] Alexander, p. 511.

[90] Sheila Emerson notes that for Ruskin the 'problem for physicists – that a system of representation inevitably registers the involvement of the perceiver' is in fact 'the advantage of art [...] For it requires the expressiveness of the greatest artists to make others see that the present aspect of a thing, whether in nature or on canvas, expresses its own past'. 'The Authorization of Form: Ruskin and the Science of Chaos', in *Chaos and Order: Complex Dynamics in Literature and Science*, ed. by N. Katherine Hayles (Chicago: University of Chicago Press, 1991), pp. 149-166 (p. 153).

intense than those on display. '[F]ailing' is a striking way to describe a cloud; its delicacy and ephemeral nature described in a verb of absence.

Having demonstrated the use of the artistic eye, Ruskin turns to the direct denunciation of the scientific. He recalls visiting the Oxford Observatory to get a better look at the 'plague-clouds', where he found that 'observation by instruments, or machines, instead of eyes' (p. 38) was inadequate. The 'anemometer can only record for you how often it has been driven round, not at all whether it went round *steadily*, or went round *trembling* [...] the sun-measurer can't tell you whether the rays are stopped by a dense *shallow* cloud, or a thin *deep* one' (p. 39). A 'trembling' wind sounds as though it could be alive, but the machine could not detect whether it had life in it. Natural phenomena such as 'light and sound' are '*sensations* of the animal frame, which remain, and must remain, wholly inexplicable, whatever manner of force, pulse, or palpitation may be instrumental in producing them' (p. 27). Only the human observer, who has been given by God the powers to see and hear, can understand such natural phenomena, and never the machine. In attempting to "see" using the machine – the microscope, the telescope – man has 'blasphemed the name of God deliberately and openly' (p. 40). The darkness of the 'plague-cloud' was predicted by 'every seer of old', who proclaimed that '[t]he light shall be darkened in the heavens thereof, and the stars shall withdraw their shining' (pp. 40-41, Joel ii. 10). Ruskin's conclusion here is biblical and prophetic, quoting Scripture to suggest inevitable and righteous punishment. Atone for this blasphemy, he proclaims, by returning to 'the paths of rectitude and piety' (p. 41). Abandon modern scientific beliefs; they are the most blasphemous of all. In Lecture II he elaborates:

> And the universal instinct of blasphemy in the modern vulgar scientific mind is above all manifested in its love of what is ugly, and natural enthralment by the abominable.
>
> [...]
>
> But the *deliberate* blasphemy of science, the assertion of its own virtue and dignity against the always implied, and often asserted, vileness of all men and –

> Gods, – heretofore, is the most wonderful phenomenon, so far as I can read or perceive, that hitherto has arisen in the always marvellous course of the world's mental history.
>
> (pp. 72-73)

Here Ruskin outlines a direct opposition between science and art, ugliness and beauty, sinfulness and worship. But science's greatest blasphemy is the fact that it sets itself up as an alternative authority to God.

Ruskin's Authorities

Ruskin's use of Scripture and his apocalyptic style in *Storm Cloud* chimes with Collingwood's description of his preacher-like lecturing style. His objections to scientific naturalism centred on the fact that he believed it was decentring the authority of God. As he got older, Ruskin's attitude towards modern and professional science became increasingly hostile.[91] It represented unwanted change, pollution, and the destruction of the natural world and, as I have shown, Darwinian evolutionary ideas (which suggested that beauty has a purpose in sexual selection, and is not simply present for its own sake) challenged Ruskin's beliefs in the aesthetics of nature. The speed at which science was changing appeared to be violently ripping God out of a position of authority, replacing Him with flux; where did absolute authority lie? Dinah Birch suggests that a loss of religious certainty, along with the death of Ruskin's father in 1864, had led him to doubt the absolute truths he had written about up until that point.[92] I suggest that the debate and uncertainty created by Darwin and other scientific naturalists turned this doubt into a crisis of authority. Ruskin's social activities meant that he would inevitably come into contact with

[91] See Burd, and Frost's response, 'The Everyday Marvels of Rust and Moss'; also Francis O'Gorman, '"The Eagle and the Whale?": John Ruskin's Argument with John Tyndall', in *Time and Tide: Ruskin and Science*, ed. by Michael Wheeler (London: Pilkington Press, 1996), pp. 45-64.

[92] Dinah Birch, 'The Ethics of the Dust: Ruskin's Authorities', *Prose Studies*, 12 (1989), 147-158 (p. 148).

leading scientists (such as Huxley at the Metaphysical Society) and his distaste for their science was expressed in personal attacks.[93]

From the lecture platform, Ruskin deployed multiple strategies for challenging scientific authority. To return to 'The Work of Iron': Ruskin concludes this lecture by turning away from his discussion of the aesthetics of rusted iron (important because it represented the beauty of God's work expressed in a natural process), to its role in social policy. Three iron objects are considered: the plough, the fetter, and the sword. The fetter, literally as iron chains, performs a necessary social role, Ruskin argues. But it is what the iron fetter metaphorically represents which he sees as most important for social harmony: 'wise laws and just restraints are to a noble nation not chains, but chain mail – strength and defence, though something of an incumbrance [*sic*]' (p. 132). 'Restraint' is more 'honourable to man' than 'Liberty'; this is not the kind of restraint promoted by scientific naturalists in their journey towards mechanical objectivity, however. Ruskin did believe that there were truths which ought to be accepted as such without question. The limitations and indeed contradictions of this ideal, that the strength of social chains can be a positive thing, but that the iron must also be allowed to rust, becomes apparent when the iron begins to break down chemically. The disconnection between the 'ochreous dust' celebrated for its beauty, and the strength of the iron fetters, highlights the disconnection in Ruskin's thought. That the iron oxide will not give up its oxygen means that it will remain a beautiful but (if we were to make chains from it) brittle and useless substance. The writer seems to be saying that we should strive to be able to see beauty in nature; but to allow natural change in the iron will ultimately liberate us from the chains that are necessary for our happiness.

[93] Ruskin was present at Huxley's reading of his paper, 'Has a Frog a Soul; and of What Nature is That Soul, Supposing it to Exist?', at the Metaphysical Society, 11 November 1870. Huxley's paper was shockingly materialist. In a paper to the Society five years later, '(*Theorem*): Social Policy Must Be Based on the Scientific Principle of Natural Selection', Ruskin criticized Huxley's defence of automatism in 'On the Hypothesis that Animals are Automata', although the scientist was not present at this reading. *The Papers of the Metaphysical Society 1869-1880*, 3 vols, ed. by Catherine Marshall et al (Oxford: Oxford University Press, 2015), I, pp. 174-184, 294-303.

The fetters metaphor in 'The Work of Iron' draws attention to the trope of enslavement more generally across Ruskin's works. His attitude towards slavery is, again, difficult to pin down. On several occasions in *Time and Tide* Ruskin contrasts attitudes towards the slave trade with workers' conditions in Britain. He criticizes the slave *trade*, but not slavery itself. On working-class education he exclaims: '[w]hat is the use of arguing so pertinaceously that a black's skull will hold as much as a white's, when you are declaring in the same breath that a white's skull must not hold as much as it can, or it will be the worse for him? It does not appear to me at all a profound state of slavery to be whipped into doing a piece of low work that I don't like; but it is a very profound state of slavery to be kept, myself, low in the forehead, that I may not dislike low work'.[94] Importantly for Ruskin 'low work' is not slavery; in his lecture 'Work', delivered at the Working Men's Institute in Camberwell, 24 January 1865, he argues that '[t]here is rough work to be done, and rough men must do it; there is gentle work to be done, and gentlemen must do it'.[95] All labour is necessary. What Ruskin sees as true slavery is being forced to perform 'low work' but not to be given the education to understand that it is 'low'. In making this argument Ruskin, directly or indirectly, positions slavery as less serious than educational equality. This, and his defence of General Eyre, casts a graver shadow over his use of the fetters metaphor in 'The Work of Iron'. Arguing that some chains are for the good of the enchained can easily be read literally.

By promoting deference to authority in this way, Ruskin was attempting to explain how the acceptance of absolute authority can bring stability. One of the reasons that Ruskin found modern science so unsavoury was that after Darwin new and chaotic paradigms began to appear. Tyndall and Darwin, notes O'Gorman, worked in fields in which 'flux, uncertainty,

[94] Letter XVII of *Time and Tide*, Ruskin, *Library Edition*, XVII (1905), pp. 402-404 (p. 403). See also Letter XXIII, pp. 436-445 (p. 438), in which Ruskin declares that 'though a fearless defender of some forms of slavery, I am no defender of the slave *trade*.' Ruskin also compared the treatment of Eyre with that of the working classes by the British legal system in a speech for the Eyre Defence Fund in 1866, report reproduced as 'A Speech in London (1866)', Ruskin, *Library Edition*, XVIII, pp. 552-554.

[95] John Ruskin, 'Work', in *The Crown of Wild Olive*, Ruskin, *Library Edition*, XVIII (1905), pp. 369-533, pp. 401-432 (p. 417).

ceaseless change' were ever present.[96] Scientific naturalists worked towards truth, knowing that they would never quite reach it. This, Ruskin found anathema; he saw truth as absolute. How could these men claim the authority to speak for science when they had destroyed the one absolute truth in nature, and had replaced it with a new paradigm that actually celebrated, and indeed could not exist without, uncertainty and constant revolution? The most common way in which Ruskin's opposition to this new world view was manifested was in animosity towards scientific naturalists themselves. Tyndall bore the brunt of this ire; Paul Sawyer has rightly pointed out that 'if Tyndall did not exist, Ruskin would have had to invent him; and in large part he did'.[97]

Deucalion, a series of lectures and essays on geology which was published in serial form (from 1875) and never completed, was one of three science textbooks Ruskin produced in the final decades of his publicly active career. Along with *Proserpina* on botany, and *Love's Meinie* on ornithology, *Deucalion* was intended to form the basis of science teaching at Ruskin's St George Schools (a scheme which was never realized). As the writer observed of his text, *Deucalion* is a 'fragmentary collection of former work, now patched and darned into serviceableness'.[98] A miscellany of lectures interspersed with related essays, the work finds coherence not just in the topic of geology, but in the writer's continuing hostility towards scientific naturalists, especially Tyndall. In 'Of Ice-Cream', based on lectures delivered at the London Institution and Oxford in 1875, Ruskin accuses Tyndall of wrongly assuming that results from experiments and demonstrations on a small scale, will hold true on a larger scale. After creating a miniature snow-topped mountain out of flour, Ruskin points out that the equivalent full-sized mountain would be capped with snow six miles deep:

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[96] O'Gorman (1996), p. 46.

[97] Paul L. Sawyer, 'Ruskin and Tyndall: The Poetry of Matter and the Poetry of Spirit', in *Victorian Science and Victorian Values: Literary Perspectives*, ed. by James Paradis and Thomas Postlewait (New Brunswick, NJ: Rutgers University Press, 1986), pp. 217-246 (p. 232).

[98] Ruskin, 'The Three Aeras', *Deucalion*, pp. 114-123 (p. 123).

> But you will say, the scale is so different, you can't reason from the thing on that scale. A most true objection. You cannot; and therefore I beg you, in like manner, not to suppose that Professor Tyndall's experiments on "a straight prism of ice, four inches long, an inch wide, and a little more than an inch in depth," are conclusive as to the modes of glacial motion.[99]

Tyndall had proposed a theory of glacial movement based on Faraday's idea of regelation, whereby two pieces of ice melt upon touching each other, then re-freeze. This was in contrast to James Forbes's theory that ice should be treated in the same way as other solids or liquids, and that it had viscous properties which allowed glaciers to move. Ruskin read Tyndall's *Glaciers of the Alps* and immediately took issue with the physicist's theory. Even before the *Deucalion* lecture Ruskin condemned the style of *Glaciers* in Letter 34 of *Fors Clavigera*, 'La Douce Dame', October 1873.[100] Ruskin wrote that Tyndall had not discovered anything new (p. 637), and that surely he could not deny the viscosity of ice. His sharpest criticism was reserved for Tyndall's narrative style. When the physicist remarks, in classic Tyndallian style, that he would love to take his audience up to the glaciers, but must settle for an imaginative excursion instead, Ruskin responds that '[i]t is, at all events, written for entirely ignorant people – and entirely idle ones, who cannot be got to read without being coaxed and flattered into the unusual exertion' (p. 636). He believes that Tyndall can only retain his audience's interest by resorting to fantastical narratives and by calling his audience courageous even though they have only imaginatively scaled the mountain. Tyndall's is a false authority; the tactic of persuading his audience through flattery is underhand, and his fictionalized excursion up the mountain is inadequate as scientific proof.

These two examples: the small scale demonstration that does not hold true for the larger, and the narrative strategy of asking the audience to imagine the mountain, are cited by Ruskin to challenge the key pillars of the scientific naturalists' claims to authority in lectures. If scientists claim that seeing is believing, but their demonstrations are false, and that imagination is a key element of scientific discovery, but those imaginative excursions are mere flattery, how can

[99] Ruskin, 'Of Ice-Cream', *Deucalion*, pp. 124-136 (p. 130).
[100] John Ruskin, *Fors Clavigera*, Ruskin, *Library Edition*, XXVII, pp. 624-643.

they be said to be speaking for scientific truth? By attacking the techniques by which scientific naturalists communicate their work, Ruskin attempted to demonstrate how the objective act of seeing, was inadequate.

Conclusion

This chapter has illustrated two ways in which the methods and theories of scientific naturalism were received by non-experts. In the speeches in which Kingsley and Ruskin responded to science, they borrowed rhetorical strategies from science lectures in order to support or dispute that science. Kingsley, like several Anglican clergymen, saw little in evolution and developments in geology to undermine his faith. To be scientifically curious was to celebrate God's work and, in some circumstances, the failure to put scientific knowledge to good use constituted a sin. As every member of society had the capability to appreciate nature, and as amateur science was a wholesome and healthy recreation, Kingsley presented individual enquiry and learning as an overwhelmingly positive and democratic idea. 'To those who believe in God, and try to see all things in God, the most minute phenomenon cannot be secular' (*Town Geology*, p. 22). He picked up the scientific naturalist line that doctrine ought not to be trusted until it can be tested, and encouraged his audiences to test nature for themselves. The community of professional scientists should be looked upon as guides, not absolute authorities.

Ruskin, in contrast, feared that scientific naturalism was stripping the world of confirmed truths. Like Kingsley, Ruskin believed that absolute truth could only be found in God. Whereas the clergyman had adopted the ideas and language of modern science and written them in to natural theology, however, Ruskin tried to do the opposite, launching personal attacks on Tyndall from the lecture podium and in print (the very opposite of Kingsley, who considered Huxley a friend). He believed that statements ought to be taken as truth when delivered by an authority. One can sense frustration on Ruskin's part as modern scientists came increasingly to lay emphasis on individual observation as the source of scientific truth.

Unfortunately for these scientists, scientific naturalism was not the kind of authority of which Ruskin approved. Perhaps this is because it was an epistemology that was in opposition with and at the same time dangerously close to his own. Both were acutely concerned with vision and truth, and both believed that hard work and self-restraint were the best ways to achieve it. Scientific naturalists urged people to be sceptical of what they were told or what they read, until they could be confident that their own observations of nature were as accurate and detached as possible. Ruskin, likewise, taught that the artist must be sceptical at first of what he sees; only through patient and repeated observation combined with the exercise of the imagination, can they ascertain the truth. Whereas a scientific naturalist will come close to truth without ever reaching it, the artist *can* be certain of religious truth. Finally, for both parties the imagination was fundamental. Whereas scientific naturalists had to navigate the tricky contradiction between mechanical objectivity and the necessary actions of the fallible human observer, for Ruskin the combination of imagination and observation posed no problem. In fact, the imagination was fundamental if Ruskin's trinity of objective observation, aesthetic experience, and understanding of God was to be complete.

Chapter 5

Science Lectures in Nineteenth-Century Manchester: Constructing Civic Identity and Class in the Industrial City

The economic power of nineteenth-century Manchester was undoubtedly a product of the sciences. Developments in physics and chemistry transformed textile weaving, dyeing, printing and bleaching. Biology informed the sanitary knowledge that was the key to workers' health and so to a healthy economy. On a practical level, engineers implemented large-scale sanitary works. The scientific education of the working classes was seen – by many of the industrial middle and upper classes that ultimately benefited from their labour – as an economic necessity. Industrialists such as the Gregs at Quarry Bank Mill, believed that the benefit of educating their workers was two-fold: primarily, an understanding of the science behind the operations they were carrying out would ultimately make them better at their job. Secondly, it would contribute to their moral and spiritual wellbeing.[1]

So far this thesis has dealt with the following issues: performance and personality as factors which affect whether a scientific statement is deemed to be true; the expression of masculinity in the self-presentation of scientific naturalists; the differing epistemologies of religion and aesthetics, and their co-existence or conflict with scientific naturalism; and the vital role that print played in the transmission of live performance. In this final chapter I consider how several of these factors were played out within a dynamic lecture network, using the city of Manchester as a case study. The public performances discussed in previous chapters have been

[1] Mary B. Rose, *The Gregs at Quarry Bank Mill: The Rise and Decline of a Family Firm, 1750-1914* (Cambridge: Cambridge University Press, 1986), p. 104; Steven Shapin and Barry Barnes, 'Science, Nature and Control: Interpreting Mechanics' Institutes', *Social Studies of Science*, 7 (February 1977), 31-74 (pp. 35, 39).

scattered throughout Britain, mostly England. Many were concentrated in London. Here, I will examine how scientific performances were staged in a specific locality, consider the reasons for their staging, and, most importantly, how the instruments of local and national publication affected their scientific message. Manchester is a useful case study because, as it experienced rapid industrialization thanks to scientific and technological advancements, it was also still working out its relationship to science. Should it privilege theoretical or practical science? Which groups of the population ought to have access to scientific knowledge? In focusing on a single city it is also possible to ascertain patterns of power, with the same individuals involved in the organization of different science lectures. I ask the following questions: were science lectures used as a way to negotiate relationships across and between classes within the city, and if so, how, and why? What role did scientific spaces play in Manchester's internal class politics? Coming from outside and looking in, what did London-based scientific naturalists have to gain by lecturing in a provincial city? This chapter will seek to answer these questions through analysis of three examples of scientific speech: the BAAS visit to Manchester in 1861; the published series, *Manchester Science Lectures for the People* (1866-1880); and the *Manchester Health Lectures for the People*, staged by the Manchester and Salford Sanitary Association (published from 1875).

The Cultural Landscape of Nineteenth-Century Manchester

The Manchester middle classes had enjoyed the benefits of scientific association since the end of the eighteenth century. Such institutions as the Manchester Athenaeum (founded 1835), the Royal Manchester Institution (1823), the Natural History Society (1821), and the Botanical

Society (1827),[2] gave middle-class members access to the sciences and arts, through libraries, lectures and soirées. The Gaskells, for example, attended lectures by Dickens, Ruskin, and Thackeray.[3] William Gaskell, who also attended the BAAS meetings, was a member of the Manchester Literary and Philosophical Society (founded 1781) and the Portico Library (1806).[4] Unitarians, like the Gaskells, dominated middle-class culture and politics in the city. In part, this dominance was shaped through public good works which were founded on Unitarian liberal attitudes towards education.[5] When the Manchester Mechanics' Institution was founded in 1824, half of the twenty-two founding committee members were Unitarian.[6] William Gaskell gave classes on English poetry to working men at the Mechanics' Institution, and was active in the Manchester and Salford Sanitary Association (founded 1852), whose work will be discussed later in this chapter.[7] John Ashton Nicholls (1823-1859), a cotton manufacturer who knew William through the Unitarian Cross Street Chapel, was one of the directors of, and lecturer for, the Ancoats Lyceum (founded 1838), a working-class educational society which catered for those who could not afford the Mechanics' Institution subscription fee. Nicholls maintained, unlike many middle-class directors of such institutions, that the workers should, as much as possible, take charge of the running of the Lyceum. When financial difficulties hit in 1849, he wrote to

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[2] For more on scientific societies in Manchester see Michael E. Rose, 'Culture, Philanthropy and the Manchester Middle Classes', in *City, Class and Culture: Studies of Social Policy and Cultural Production in Victorian Manchester*, ed. by Alan J. Kidd and K. W. Roberts (Manchester: Manchester University Press, 1985), pp. 103-117; Robert Kargon, *Science in Victorian Manchester: Enterprise and Expertise* (Manchester: Manchester University Press, 1977); R. D. Bud, 'The Royal Manchester Institution', in *Artisan to Graduate: Essays to Commemorate the Foundation in 1824 of the Manchester Mechanics' Institution*, ed. by D. S. L. Cardwell (Manchester: Manchester University Press, 1974), pp. 119-133; Chris E. Makepeace, *Science and Technology in Manchester: Two Hundred Years of the Lit and Phil* (Manchester: Manchester Literary and Philosophical Publications, 1984).

[3] Barbara Brill, *William Gaskell, 1805-1884* (Manchester: Manchester Literary and Philosophical Publications, 1984), p. 90.

[4] Elizabeth Gaskell wrote to Marianne, 'My dear! your poor Papa lives in dread of that British Association, in W. Week! If he does *not* go to London it will be because he's frightened away by it. Speechmaking, public-meetings and such noisy obtrusive ways of "doing good" are his dislike, as you know', 13 May 1852, Letter 123, *The Letters of Mrs Gaskell*, ed. by J. A. V. Chapple and Arthur Pollard (Manchester: Manchester University Press, 1966), pp. 187-188. The Gaskells also became friends with the engineer William Fairbairn (who plays a role later in this chapter); both he and William were members of the Lit and Phil. Elizabeth thanked Fairbairn for his critique of *North and South* in a letter of summer 1855, Letter 249, Chapple and Pollard (eds.), pp. 352-353.

[5] Jenny Uglow, *Elizabeth Gaskell: A Habit of Stories* (London: Faber and Faber, 1999), pp. 87-146.

[6] John Seed, 'Unitarianism, Political Economy and the Antinomies of Liberal Culture in Manchester, 1830-50', *Social History*, 7 (January 1982), 1-25 (p. 5).

[7] Brill, pp. 76, 108.

fellow director F. Richmond, that '[w]e must depend on the elaboration of those principles on which the Lyceum was originally founded, and I should rather wish to see the working classes themselves making the requisite exertions, than have it done for them'.[8]

Historians have debated the complex motivations behind middle-class philanthropic work in industrial cities. Simon Gunn has convincingly argued that the relationships established in the 'town council, church and chapel, philanthropic and voluntary association' gave the urban middle classes 'the sense of a collective identity'; it was the relationship that the middle classes had *with each other* which was most important in the strengthening and maintenance of economic, political and social authority.[9] In addition, John Seed has pointed out that the middle-class investment in the artistic and scientific education of the working classes was in part financially motivated. Seed provides the example of John Nasmyth, 'an engineering employer in Manchester, [who] told the Select Committee on Arts and Manufactures in 1836 that efficiency and economy in machinery generally coincided with beauty of design. Exposure to art would develop taste in the mechanic and would thus enhance his design skills'.[10]

We have in the words of Nasmyth and Nicholl the foundations of the archetypal "Manchester Man": the worker, who takes the helping hand offered by his philanthropic social betters, follows a path of self-improvement, and returns to bestow charity on the next generation.[11] Central to this image is the industrial application of art and science. A fictional example of Nasmyth's cultured worker is Jabez Clegg, the protagonist of Isabella Banks's 1876 novel, *The Manchester Man*. Set in the first quarter of the nineteenth century, the novel follows Jabez from his rescue as a baby caught in the flood currents of the River Irk, to education at

[8] Letter to F. Richmond, 20 May 1849, *In Memoriam. A Selection of the Letters of the Late John Ashton Nicholls, F.R.A.S., &c.*, Edited by His Mother (Manchester: Printed for Private Circulation Only, 1862), pp. 13-16, p. 14.
[9] Simon Gunn, 'The "Failure" of the Victorian Middle Class: A Critique', in *The Culture of Capital: Art, Power and the Nineteenth-Century Middle Class*, ed. by Janet Wolff and John Seed (Manchester: Manchester University Press, 1988), pp. 17-43 (p. 32).
[10] John Seed, '"Commerce and the Liberal Arts": The Political Economy of Art in Manchester, 1775-1860', in Wolff and Seed (eds.), pp. 45-81 (p. 70).
[11] A common image in fact and fiction. See Peter Shapely, 'Charity, Status and Leadership: Charitable Image and the Manchester Man', *Journal of Social History*, 32 (Autumn 1998), 157-177.

Chethams College and his subsequent apprenticeship to a small-ware manufacturer, and finally to his adulthood as a successful businessman. When Jabez's master, Mr Ashton, discovers that his apprentice has an eye for design, he encourages those artistic talents.[12] Further, Jabez's honesty and hard work are rewarded, particularly when they yield industrial gains. Ashton insists to Jabez that 'if you work extra hours, apprentice or no apprentice, you must have extra pay' (p. 106). The fairness of the master inculcates in his worker the same sense of justice, illustrated by the novel's conclusion: Jabez becomes a patron of art, and one of the first directors of the Manchester Mechanics' Institution (p. 310).

Banks (1821-1897) spent her early years in Manchester and had attended lectures at the Manchester Athenaeum. Her journalist husband, George Banks, delivered lectures to mechanics' institutions around Yorkshire.[13] *The Manchester Man* was written in the 1870s but looks back on a Manchester that was familiar to Banks, to the early days of working-class education movements. As such it keeps alive the sense of progress and stability envisioned by earlier educational reformers such as Henry Brougham.[14] Jabez's patronage keeps the cogs of the city well oiled; workers can become educated and follow the same route up the social ladder as Jabez himself, but there will always be a fresh stream of workers to take their place.

Similarly, Geraldine Jewsbury's 1851 novel *Marian Withers*, originally serialized in the *Manchester Times and Examiner*, depicts the relationship between a self-educated factory owner and his workers. *Marian Withers* offers a vivid depiction of Manchester and Cheshire around the time of the first Reform Act, exploring themes of unemployment, working conditions in mills, sanitary problems in city centre slums, middle-class philanthropy and working-class education.

[12] 'Since the discovery of his faculty for design, much of his time had been occupied at a desk with pencils and colours, making patterns for the wood-turner, the mould-coverer, the tassel-maker, the fringe-weaver [...]', Mrs Linnaeus Banks, *The Manchester Man* (Didsbury, Manchester: E. J. Morten, 1973), p. 105.

[13] E. L. Burney, *Mrs G. Linnaeus Banks* (Didsbury, Manchester: E. J. Morten, 1969). Isabella was a member of the Cooper Street Mechanics' Institution in Manchester and visited their exhibitions, p. 20. She refers to mechanics' institutions again in her Yorkshire novels *Wooers and Winners* and *The Slowly Grinding Mills*, Burney, p. 81, and in *Wooers* the working-class character Caleb Booth is a collector of natural history specimens. On Isabella's attendance at the Athenaeum see Burney, pp. 29-30; for George's lectures see p. 76.

[14] Henry Brougham, *Practical Observations Upon the Education of the People, Addressed to the Working Classes and Their Employers* (London: Richard Taylor, 1825).

These themes are foregrounded by the main plot which focuses on Marian, the daughter of John Withers.[15] John is a symbol of self-improvement. As an apprentice he is taught to write by his philanthropic boss, before turning to mechanics. Withers's inventions streamline textile machinery and allow him to rise to the position of mill owner. He is convinced that greater mechanical efficiency frees, rather than enslaves, his workers:

> "I hope [...] to see the day when machinery will be brought to such perfection that it will do all the drudgery of work that is not fit for human beings, and thus the workman will only need to give the intellect. The more a machine can be made to do, the more the character and position of the workman is raised [...] Improvement in machinery will not only lighten labour, but shorten the hours of work, and the people will have time to improve themselves, and become something better than drudges [...]"[16]

Jewsbury provides a counterargument to Withers's idealism in the third person narrator's comment that now (in 1851), 'the machine does everything, and the man has only to wait upon it' (I, p. 26). Man is now servant to machine, as in the case of 'the miserable-looking children at the "devil"' (I, p. 45), a spinning barrel, with teeth which break up raw cotton when it first enters the mill, and which frequently snags the small hands that operate it. Nevertheless, it seems that Withers achieves his ambition. Through the help of the Broughamite Mr Cunningham, Withers establishes a Lyceum with a library, containing books, periodicals, and London and provincial newspapers, and a classroom with 'a competent schoolmaster'. Cunningham donates 'a small telescope and a microscope; and the wonders these instruments displayed gave a great impulse to the desire for knowledge in the hearts of these rude and savage men'. The motivation behind the Lyceum is the encouragement of 'enlightened ideas of self-control and self-government' (III, p. 240). The observation of the natural world is directly linked to a thirst for self-improvement.

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[15] Jewsbury (1812-1880) was herself the daughter of cotton manufacturer Thomas Jewsbury. Her family moved to Manchester in 1818; Jewsbury remained there until 1854 when she moved to Chelsea. Joanne Wilkes, 'Jewsbury, Geraldine Endsor (1812-1880)', *ODNB* [accessed 23.09.16].

[16] Geraldine Jewsbury, *Marian Withers*, 3 vols (London: Colburn and Co., 1851), II, p. 46.

There were real-life Jabez Cleggs and John Withers, working men who had advanced socially, and returned their thanks through philanthropic acts.[17] Conversely, there are also literary depictions of men who remained in the working classes and fervently pursued science. Job Legh in Gaskell's *Mary Barton* (1848) is one of the most well known examples.[18] In 'Eawr Folk' the artisan poet Edwin Waugh describes the scientific interests of his family members:

> Er Johny gi's his mind to books;
> Er Abram studies plants, –
> He caps the dule for moss an' ferns
> An' groin polyants;
> For aught abeawt mechanickin',
> Er Ned's the very lad;
> My uncle Jame roots i' th' stars,
> Enough to drive him mad.[19]

Waugh's verse attests to the range of sciences in which working-class amateurs were interested, from botany, to mechanics, to astronomy.[20] It also shows that self-education took the form of both practical science and the study of books; if they could afford the membership fee, workers had access to the libraries and reading rooms of mechanics' institutions.

[17] One David Morris, F.A.S., gave a lecture to the Warrington Mechanics' Institution entitled 'Lancashire Poets and Poetry'. After the discourse, it was reported that Morris told the story of 'a poor boy returning from a runaway excursion to sea'. Anxious that his mother would not accept him, the boy was comforted by a 'clean respectable old woman' in Warrington; rather than chastise him, she told him to return home, where indeed he was welcomed by his mother. 'From that day, he became a better and wiser lad. He joined a class in the Manchester Mechanics' Institution, and worked his way up till he became a director'. The man later returned to Warrington, hoping to find the old woman. 'But as he could not return the kindness to her, his heart told him he should return what little kindness he could to the people of Warrington, for her dear sake; and that poor lad of 33 years since had given them the lecture that night on the Poets and Poetry of his native county'. David Morris, 'Lancashire Poets and Poetry', *Pitman's Popular Lecturer and Reader*, 8 n.s. (1863), 274-282 (pp. 281-282). It is important to recognise, particularly in light of the lecture he had just delivered, that Morris may well have been casting his own story according to the "self-help" ideology of the period.

[18] Legh is an avid entomologist. Gaskell famously describes 'a class of men in Manchester, unknown even to many of the inhabitants, and whose existence will probably be doubted by many, who yet may claim kindred with all the noble names that science recognises', *Mary Barton*, ed. by Shirley Foster (Oxford: Oxford University Press, 2008), p. 37. See pp. 37-39 for descriptions of mathematician weavers, botanists and entomologists. See also, Terry Wyke, 'The Culture of Self Improvement: Real People in *Mary Barton*', *Gaskell Society Journal*, 13 (1999), 85-103.

[19] Edwin Waugh, 'Eawr Folk', reprinted as Appendix 17 in Patrick Joyce, *Visions of the People: Industrial England and the Question of Class 1848-1918* (Cambridge: Cambridge University Press, 1991), pp. 393-394.

[20] This chapter, however, concentrates on the organization of science lectures by the middle classes. Anne Secord has written extensively on self-organized working-class science and artisan naturalists: 'Science in the Pub: Artisan Botanists in Early Nineteenth-Century Lancashire', *History of Science*, 32 (1994), 269-315; 'Corresponding Interests: Artisans and Gentlemen in Nineteenth-Century Natural History', *British Journal for the History of Science*, 27 (1994), 383-408; 'Elizabeth Gaskell and the Artisan Naturalists of Manchester', *Gaskell Society Journal*, 19 (2005), 34-51.

It is important to note that the emergence of working-class institutions converged with the increasing availability of cheap print. The repeal of the Stamp Act in 1855 and the abolition of paper duty in 1861 meant that printed news became more affordable. This had a particular impact in the regions: local newspapers became increasingly available and readers had access to recent local – rather than delayed London – news. On 21 March 1876 the printer and stationer Abel Heywood, addressing the Manchester Literary Club, noted that, while two decades earlier the circulation of Manchester newspapers was non-existent, there was now an average circulation of 73,000-75,000 Manchester morning papers, and 45,000-50,000 evening papers.[21] By July 1855 the price of the *Manchester Guardian* had been reduced from 7*d* to 2*d*.[22] Newspapers and journals emerged with a distinctly local flavour, and regional publishing houses became more powerful. In the second half of the nineteenth century Manchester enjoyed a print culture which simultaneously consolidated its identity as a practical, industrious northern powerhouse, and spread its image beyond the boundaries of the city. Furthermore, as such texts circulated amongst the population of Manchester they may have helped *to create* a distinct Mancunian character, as much as to record it.[23] Overall, Manchester in the second half of the nineteenth century was negotiating between older notions of philanthropy, and newer ideas of working-class enfranchisement and better access to education. Thus, novels like *The Manchester Man* and *Marian*

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[21] Abel Heywood, 'Newspapers and Periodicals: Their Circulation in Manchester', read 21 March 1876, *Papers of the Manchester Literary Club* (Manchester: Printed for the Club by A. Ireland & Co., Pall Mall, 1876), II, pp. 39-58 (p. 40).

[22] David Ayerst, *Guardian: Biography of a Newspaper* (London: Collins, 1971), pp. 28, 119. At 7*d* the *Guardian* was a weekly paper, then twice weekly, before becoming daily at 2*d*.

[23] On the Manchester press and book trade see: Michael Powell and Terry Wyke, 'Manchester Men and Manchester Magazines: Publishing Periodicals in the Provinces in the Nineteenth Century', in *Periodicals and Publishers: The Newspaper and Journal Trade 1750-1914*, ed. by John Hinks et al (New Castle: Oak Knoll Press, 2009), pp. 161-183; John Turner, 'Book Publishing from the English Provinces in the Late Nineteenth Century: A Report on Work in Progress', in *The Mighty Engine: The Printing Press and Its Impact*, ed. by Peter Isaac and Barry McKay (Winchester: St Paul's Bibliographies, 2000), pp. 185-196; Powell and Wyke, 'Penny Capitalism in the Manchester Book Trade: The Case of James Weatherley', in *The Reach of Print: Making, Selling and Using Books*, ed. by Isaac and McKay (Winchester: St Paul's Bibliographies, 1998), pp. 135-156; Brenda Scragg, 'Some Sources for Manchester Printing in the Nineteenth Century', in *Images and Texts: Their Production and Distribution in the Eighteenth and Nineteenth Centuries*, ed. by Isaac and McKay (Winchester: St Paul's Bibliographies, 1997), pp. 113-120. On the cultural impact of the local press see: Margaret Beetham, 'Ben Brierley's Journal', *Manchester Regional History Review*, 17 (2006), 73-83; B. E. Maidment, 'Class and Cultural Production in the Industrial City: Poetry in Victorian Manchester', in Kidd and Roberts (eds.), pp. 148-166; Margaret Beetham, '"Healthy Reading": The Periodical Press in Late Victorian Manchester', in Kidd and Roberts (eds.), pp. 167-192.

Withers looked back to a period in which the middle classes had a clearly delineated role (real or imagined) in the education of the working classes. At the same time, the authority to practice and to speak for science, and the right to have access to it, was being re-negotiated. In this climate, the scientific speech or lecture could have an immediate impact.

'Weather beautiful; time, 10.50': the British Association at Manchester, 1861

The rapid architectural development of Manchester city centre during the 1850s and 1860s had a significant influence on the way in which the city was perceived from the outside.[24] The vast warehouses which climbed into the Manchester skyline were an unmistakeable announcement of economic dominance. Spatial changes also affected the ways in which different classes within the city perceived their relationship with each other. Slum clearance, street widening, and improvements to the sewerage system, were visible testaments to engineering and practical science. While these schemes were ostensibly for the benefit of all citizens, they ultimately favoured the middle classes. Manchester was evolving from a city which embodied both material productivity (and the inevitable waste consequent upon that productivity), into a space in which the gains of industry could be enjoyed by the few. Monetary wealth was exchanged for cultural riches. The visibly cleaner public spaces which emerged from this tidy-up, presented an apparently morally cleaner aspect too. Gone (at least from view) was the squalor which was often attributed to, or seen as the cause of, working-class vice. Simultaneously, as Simon Gunn points out, this period witnessed the movement of middle-class culture away from a private sphere towards the 'outdoors, as in the case of promenades and civic processions, or in settings, like the concert hall or the giant exhibitions of art and industry, where events could be presented as

[24] Title quotation from 'Telegraphic Soirée at Manchester', *The Times*, Tuesday 10 September 1861, p. 10.

spectacle'.[25] Within these spaces, the shared, ritualized appreciation of objects of art and science, worked to consolidate middle-class power. And in the nineteenth century, nowhere was the ritual of meeting, exchange and display more important to the cohesion of a particular social group, than in the British Association for the Advancement of Science. Sandwiched between the controversial events in Oxford and Cambridge, the BAAS meeting at Manchester in September 1861 buzzed with talk of du Chaillu and his gorillas.[26] But of greater relevance to the current chapter are its entertainments, soirées and excursions. It was here that the convergence of science and middle-class cultures was displayed.

When the BAAS met in Manchester, they found a city built to enable and to best display the social rituals so important to the smooth running of the society. They also found that Manchester was a useful symbol for everything that the BAAS stood for scientifically. Spaces built specifically for the dissemination of science, such as the Manchester Mechanics' Institution, or for training in empirical science, like Owens College, were opened up to the Association.[27] Further, the BAAS could reciprocate the benefits bestowed upon them by this city of science: by bringing internationally renowned scientific delegates to what was, still, a provincial city, it also brought Manchester's scientific achievements to the attention of the world's press.

All of the BAAS's major soirées, exhibitions, and opening and closing meetings were held in the Free Trade Hall, a vast building on Peter Street which could accommodate up to 4,000 people. The city's ultimate symbol of civic pride and unity, the building in which the Association gathered in 1861 had been erected on the site of an earlier, timber meeting hall,

[25] Simon Gunn, *The Public Culture of the Victorian Middle Class: Ritual and Authority and the English Industrial City 1840-1914* (Manchester: Manchester University Press, 2000), p. 29.

[26] Owen delivered a paper, 'On Some Objects of Natural History from the Collection of *M. Du Chaillu*', and a letter was read from J. E. Gray disputing the placing of gunshot wounds in the specimens used by Owen, *Report of the Thirty-First Meeting of the British Association for the Advancement of Science; Held at Manchester in September 1861* (London: John Murray, 1862), pp. 144-145, 155-156.

[27] The Mechanics' Institution was used by Section E (Geography and Ethnology). A letter from a BAAS local secretary, R. W. Warbishire, asking whether the BAAS could use rooms at the Institution, reveals that the Association hoped to be accommodated free of charge. Warbishire writes that the BAAS 'have no doubt but that the Members of your Institution will be glad in this way to do their part in the public hospitalities of Manchester to the chief Scientific Congress of the World', playing on notions of civic duty. Quoted at the Monthly Board Meeting of the Manchester Mechanics' Institution, 7 February 1861, Manchester, University of Manchester, Archive of the Manchester Mechanics' Institution, Manchester Mechanics' Institution Minute Book 1858-1863, GB 133 MMI/1/6.

known as the Pavilion, which had been built to stage the meetings and speeches of the Anti-Corn Law League in 1839.[28] The Pavilion was designed for partisan public speech, for rousing oratory and rallying cries for political action. In 1842 it made way for another building, named the 'Free Trade Hall'; while this title retained an echo of former activism, after the repeal of the Corn Laws in 1846, the new building had a far more varied purpose. Like the Pavilion it had a large platform for speeches, but also included a sound reflector so that speakers could be heard throughout the hall.[29] Societies such as the Athenaeum and the Mechanics' Institution hired the hall for large meetings, and musical events were also staged there. This building was pulled down to make way for yet another 'Free Trade Hall', opened in 1856. This time it was clear that its primary purpose was as a civic space, to be enjoyed by a wide range of societies. The Pavilion had had a 'gas-lit display above the speakers' platform that spelt out the single word "Justice"',[30] whereas the interior of the new hall contained only 'the civic arms of Manchester and Salford'.[31] The outside of the building displayed sculptures by John Thomas, who had also designed those on the outside of the Houses of Parliament. They represented Free Trade, Europe, Asia, Africa, America, Arts, Manufactures, Agriculture, and Commerce.[32] As such, when the BAAS met in what was the third incarnation of a hall on the Peter Street site (and importantly also on what was the site of the Peterloo Massacre), they spoke in a space which had a rich history of public speech, but which was also now very much a symbol of non-radical, middle-class civic unity.

For the BAAS meeting, the Hall's interior was transformed into a site of scientific display. The *Manchester Times* devoted an entire supplement to the meeting, in which it textually recreated the inside of the 'completely metamorphosed' hall. It is worth quoting a substantial part of its panoramic description to gauge its effect:

[28] For a thorough history of the Free Trade Hall see Terry Wyke, *A Hall for All Seasons: A History of the Free Trade Hall* ([Manchester]: Charles Hallé Foundation, 1996).
[29] Ibid., p. 14.
[30] Ibid., p. 10.
[31] Ibid., p. 37.
[32] Ibid., p. 35.

> The walls on the ground floor have been hung with crimson cloth and covered with diagrams, and a table for mechanical models runs round the wall, excepting the end opposite the orchestra, where are glass cases intended to contain specimens of Indian manufacture [...] glass cases, contain objects illustrating the various sections [...] From the orchestra on the right and left are flights of steps [...] which lead to the gallery, the baluster posts bearing specimens of folio-cultural plants in pots [...] A tall flowering plant is placed between the pillars all round the gallery wall. In the gallery facing the orchestra is a circular screen; on the concave hang three pictures, the centre one being Maclise's "Trial by Touch", and on each side a landscape, by Linton. The convex of this screen is a table, on which are arranged a valuable series of photographs of the late solar eclipse, taken in Spain by Mr. Warren De la Rue.[33]

The large amount of detail in this description suggests an attempt to recreate the scene for the reader, to help them as far as possible to imagine that they are BAAS members entering the hall for the first time. At the same time, the hall is pictured as unpeopled, as though the reader is getting an uninhibited glimpse of the space before it is filled with crowds. The text also reveals more in one paragraph, than what a viewer might see in a single glance: objects at opposite ends of the gallery, paintings and photographs on the front *and* back of a screen. The crimson hangings frame the stately arrangement of 'table and three antique carved chairs' positioned on the orchestra stage like thrones, set for the parliament of science. Touches of the natural world are artificially arranged, tamed into decoration. Snippets from each section, alongside manufactures from the Commonwealth, are displayed together to form a united vision of contemporary science, the convergence of national and international interests. Finally, the screen on which hang examples of creative industry – of human interpretations of nature – bears on its opposite side scientific photographs, mechanical reproductions. Two sides of the same coin, this very deliberate display marries art with technology and science, to argue that they are equal aspects of human ingenuity.

The models and specimens on display in Manchester were there to represent the practical applications of science. Between the Oxford and Cambridge meetings, Manchester stood out in radical industrial and modern contrast to those medieval, genteel cities. One

[33] 'The British Association', *Manchester Times*, Saturday 7 September 1861, n.p.

reporter for the *Glasgow Herald* romanticized these distinctions when he compared the 'narrow and inky Irwell' to the Cherwell and Isis, 'literary Dons' with 'merchant princes', and the 'monastic institutions' of Oxford with the 'palatial character' of Manchester's warehouses. Manchester is new, its reputation about to be made, while Oxford resonates with the 'whisper[ed] [...] names of departed sons of genius'.[34] This emphasis on the modern and practical uses of science was embodied by the BAAS president for that year, the engineer William Fairbairn – who, coincidentally, was the engineer called upon to check the structural safety of the Pavilion (the original hall of 1839). The enormous timber structure was built in just eleven days, and Fairbairn had his workmen jump up and down in the gallery to test its strength.[35] In his presidential address Fairbairn called for a return to what he saw as the BAAS's original purpose: to improve standards of living through the application of theoretical science to invention and manufacture. He, and the city, were a conscious choice: 'my election was intended', Fairbairn stated, 'as a compliment to practical science, and to this great and influential metropolis of manufacture, where those who cultivate the theory of science may witness, on its grandest scale, its application to the industrial arts'.[36] His speech ranged across all of the sciences represented by the BAAS, but his focus was on mechanical science. Fairbairn painted a picture of progress and constantly emphasized a sense of wonder at the rapidity of mechanical advancement. He stressed the material benefits for the worker, insisting that the steam engine 'has given to the poor man, in all countries in which it exists, a degree of comfort and independence, and a participation in intellectual culture unknown before its introduction'.[37] According to Fairbairn, then, John Withers's vision of the freed worker had become a reality.

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[34] 'British Association at Manchester', *Glasgow Herald*, Friday 6 September 1861, n.p.
[35] Wyke, *A Hall for All Seasons*, p. 11.
[36] 'Address by William Fairbairn, Esq., LL.D., C.E., F.R.S.', *Report of the Thirty-First Meeting*, pp. lii-lxvii (p. lxvii).
[37] Ibid., p. lx.

For some, Fairbairn's address was mere 'sentence-turning', and was 'a great deal too long'.[38] For others, it was delivered 'lucidly' with the 'charm of self-possession'.[39] With the hall packed with upwards of 2,500 people, however, it was reported that 'the crowd was so great, and the movement through the large Free Trade Hall was so continuous, that only a few of the audience could catch a single word of what was said'.[40] It was fortunate, then, that Fairbairn's speech was printed as a pamphlet by the *Guardian* and distributed almost immediately after it had been spoken.[41]

It was also in the vast Free Trade Hall that communication of a different kind took place. As Samuel Alberti has pointed out, nineteenth-century scientific conversaziones helped to consolidate middle-class identity by publicly enacting shared cultural interests.[42] As well as a Microscopical Soirée, and an exhibition by the local Field Naturalists' Society, a Telegraph Soirée took place on the evening of Saturday 7 September.[43] At 8pm messages were sent throughout Europe (a working cable had been laid under the English Channel in 1851). The *Times* described the soirée:

> Messages were sent through the Electric and International Telegraph Company's wires by Varley's instruments [...] to [...] many [...] distant places on the Continent, and there was also a communication with Balmoral. At 8.30 p.m. the Prince Consort telegraphed from that place the following message to the President:- "Has the meeting of the British Association at Manchester been successful?" A satisfactory answer was instantly sent. At 8.45 p.m. a message was sent to St. Petersburg, asking the state of the weather. The answer was,

[38] 'The British Association at Manchester', *Preston Guardian*, Saturday 7 September 1861, n.p.
[39] 'Meeting of the British Association at Manchester', *Illustrated London News*, Saturday 14 September 1861, p. 263.
[40] 'British Association at Manchester', *Glasgow Herald*, Tuesday 10 September 1861, n.p.
[41] William Fairbairn, 'Address', (Manchester: Printed at the *Guardian* Steam Printing Office, Cross Street, 1862).
[42] Samuel J. M. M. Alberti, 'Conversaziones and the Experience of Science in Victorian England', *Journal of Victorian Culture*, 8 (2003), 208-230 (p. 216).
[43] For information on the development of telegraphy at this time, its global impact, and its relationship with other scientific developments, see: Roland Wenzlhuemer, *Connecting the Nineteenth-Century World: The Telegraph and Globalization* (Cambridge: Cambridge University Press, 2013); Duncan S. A. Bell, 'Dissolving Distance: Technology, Space, and Empire in British Political Thought, 1770-1900', *Journal of Modern History*, 77 (September 2005), 523-562; Bruce J. Hunt, 'Doing Science in a Global Empire: Cable Telegraphy and Electrical Physics in Victorian Britain', in Lightman (ed.), *Victorian Science in Context*, pp. 312-333; Iwan Rhys Morus, '"The Nervous System of Britain": Space, Time and the Electric Telegraph in the Victorian Age', *British Journal for the History of Science*, 33 (December 2000), 455-475; Roger Neil Barton, 'New Media: The Birth of Telegraphic News in Britain 1847-68', *Media History*, 16 (2010), 379-406.

> "Weather beautiful; time, 10.50." The audience were equally surprised and delighted with these realizations of the rapidity of the telegraph.[44]

Following these polite exchanges, a lecture was given on the history of the telegraph to the present, and on the new printing telegraph, which printed or embossed the dots and lines onto paper.[45] William Fothergill Cooke and Charles Wheatstone had patented the electric telegraph instrument in 1837. Mancunians would have been familiar with this technology and its commercial uses for well over a decade before the BAAS soirée, as the Electric Telegraph Company telegraph office had opened at Manchester's Royal Exchange in 1847. It was vital for the rapid communication of business information from and across the city, and therefore an essential and established component of Manchester's economic success. In staging the technology as part of a soirée, the Association was presenting itself as a nexus connecting British economic power, science, and the traditional seat of political power, with Balmoral, symbolically, at the heart of the Empire. The audience would not just have seen the apparatus being used; they would also have heard it. As the sound of the telegraph resonated around the hall, the audience would have been reminded of the speeches they had heard there that week. This performance glossed over the fact that there had been a failed attempt to lay a cable under the Atlantic in 1858, after which, 'British engineers and scientists began to push for the adoption of a uniform standard to which all resistance measurements could be compared'.[46] It was actually at the Manchester meeting in 1861 that the BAAS set up a Committee on Electrical Standards to address this problem, and at the Telegraph Soirée a specimen of the failed 1858 cable was one of the 140 items on display.[47] Further, another report of the soirée noted that after the successful messages to Balmoral and St Petersburg, a storm caused 'currents of atmospheric electricity' to pass through the wire, leading to the 'abandonment of the intention to extend the circuit to

[44] 'Telegraphic Soirée at Manchester', *The Times*, p. 10.
[45] Mr. Grove's lecture is briefly described in 'The British Association', *York Herald*, Saturday 14 September 1861, p. 11.
[46] Hunt, p. 324.
[47] *Catalogue of Apparatus, &c., in Telegraph Exhibition* Oxford, Bodleian Library, Papers of the BAAS, Dep BAAS 147, p. 5.

Taganrog'.[48] These numerous failures contradict the image of success that the BAAS portrayed to the public, but they might also have enhanced their reputation, as stated in their title, for the advancement of science. Showing failures alongside successes demonstrated the society's commitment to continuous improvement.

As well as gathering to hear papers and attend soirées, BAAS members went on numerous excursions to local areas of scientific interest. In Manchester, these visits were almost all to industrial locations: the Manchester Waterworks reservoirs at Woodhead, the Glass and Chemical Works in St Helen's, the Great Marston Salt Mine, and the Dunkirk Coal Company's 'Astley's Deep Pits' in Dukinfield (the latter hosted experiments to determine temperature change below the earth's surface).[49] One particular excursion to the Worsley coal mines attracted the attention of a reporter from the *Dundee Courier*:

> At the bottom of the Edgefold Pit the ladies and gentlemen in picturesque costume – the gentlemen in caps which would have become a Parisian cook, and coats approximating to that of a cockney policeman, and the ladies appropriately protected from dust and damp – each bearing in their hands a Davy lamp, were shown the mysteries of mining. The seven-feet seam runs westwards upwards of 1,700 yards, or nearly a mile; but in order to obviate the necessity of travelling so long a distance, a party of colliers worked a seam in a recess midway. Sitting around in this place, on planks provided for the occasion, the scene was very interesting. The workmen plied their "picks" with vigour and energy, and undermined a large block of coal, and then using their sledge hammers to wedges at the top, brought down a huge mass with a crash which startled the novices in the art of gathering "black diamonds".[50]

The reporter brings both observers and workers into a single 'scene' of immersive theatre. Colliers are actors using prop-like picks (quotation marks point to this artificiality), while the observers are simultaneously audience and participants. The BAAS attendees wear charming costumes which allow them to play the roles of persons of a lower class. They sit in a makeshift auditorium on 'planks provided for the occasion'. There is an unsubtle hint of amusement in the reporter's tone, as the "black diamonds" fails to shroud in mystery or glamourize the dirty

[48] 'The British Association', *York Herald*, p. 11.
[49] See Fairbairn's speech, *Report of the Thirty-First Meeting*, p. lvi.
[50] 'The British Association', *Dundee Courier and Argus*, Saturday 14 September 1861, n.p.

process of extraction. The naivety of these tourists of science persistently calls into question whether they are aware of, or are willing to acknowledge, the industrial practicalities associated with their more abstract scientific work.

The meeting at Manchester celebrated and consolidated the unity of the BAAS as a genteel, and increasingly professional group. It made use of existing civic platforms, designed for display, to exhibit the international standing of British science, at the same time creating a symbiosis whereby local societies could also advertise their scientific accomplishments and civic commitment. While it was able to draw on Manchester's successes in exploiting science for industrial gains, the BAAS may, however, have neglected to recognize the dirtier, more dangerous aspects of the application of science to industrial work. The meeting of BAAS at Manchester showcased the city's scientific prowess to outsiders. In the next section I turn to a series of science lectures which, as their title suggests, were *for the people*. Originating as a solution to a particularly Mancunian crisis, however, the *Manchester Science Lectures for the People* also became a vehicle through which the city's science could be represented beyond its boundaries.

'[S]o cheap and yet so valuable a collection of thoughtful and instructive addresses': the *Manchester Science Lectures for the People* 1866-1880

Eawr pashunce and eawr fortitude, is known throo eawt the world,
Un th' banner with the word "Distress" is everywhere unfurl'd,
Let Yankees raise ther flag o' peace, un bid God speed the plough,
We'll shew um then i' England whot we larnt at th' Factory Skoo.[51]

[51] From E. Moss, 'Eawr Factory Skoo', written during the Lancashire Cotton Famine, reprinted in *Songs of the People: Lancashire Dialect Poetry of the Industrial Revolution*, ed. by Brian Hollingworth (Manchester: Manchester University Press, 1977), pp. 108-109 (p. 109).

Due to overproduction and stock-piling in the 1850s, and uncertainty over the supply of raw cotton during the American Civil War, the British textile industry experienced a period of crisis.[52] In the first half of the 1860s textile workers in the north west of England were often either unemployed or forced to take short-time work. Just three months after the BAAS had visited Manchester, the average number of working days for a Lancashire mill worker had dropped from six to four per week. A year later, one fifth of the county's population were drawing relief.[53] This period saw a surge in philanthropic activity; Relief Committees sprang up in the majority of affected towns, providing food and, frequently, educational opportunities for the unemployed.[54] During the winter of 1862 over one hundred entertainments were put on for an out of work audience in Manchester. These included musical evenings, and lectures on science and geography. Staged in disused mills, these lectures attracted an audience of over 4,000 per week.[55]

The organizer of these evenings, Henry Enfield Roscoe, Professor of Chemistry at Owens College, believed that their success might be replicated. In the winter of 1866-67, and between 1870 and 1880, a total of eleven lecture series were organized as the *Manchester Science Lectures for the People* (*MSLP*). While the example of the Relief Lectures showed that there was demand, the full motivation for staging the *MSLP* came from a combination of factors. Nationally, employers were taking an increasingly paternalistic approach to providing education and leisure facilities for their employees. A realignment was taking place of the relationship between the middle and working classes in Manchester; philanthropic activities were becoming less concerned with overt religious moralizing and more interested in improving living conditions generally.

[52] Title quotation of section III taken from review of the *Manchester Science Lectures for the People*, in *Public Opinion*, reproduced on a price list inserted into the Fourth Series of those lectures, *Science Lectures for the People, Fourth Series 1872-1873, Delivered in Hulme Town Hall, Manchester, in the Years 1872-73* (Manchester: John Heywood, 1873).
[53] D. A. Farnie, *The English Cotton Industry and the World Market 1815-1896* (Oxford: Clarendon Press, 1979), p. 146.
[54] W. O. Henderson, *The Lancashire Cotton Famine 1861-1865* (Manchester: Manchester University Press, 1969), pp. 68-76. Michael E. Rose discusses the Manchester and Salford District Provident Society (f. 1833), whose volunteers collected donations and distributed aid. Their numbers fell throughout the 1850s, but rose again during the Famine. 'Culture, Philanthropy and the Manchester Middle Classes', in Kidd and Roberts (eds.), pp. 103-117 (pp. 105-106).
[55] David Riley, 'The Manchester Science Lectures for the People, c. 1866-1879', *Bulletin of the John Rylands Library*, 85 (2003), 127-146 (p. 128). Riley's article is the only detailed study of the *MSLP* I have found.

Debates over the relative merits of applied or theoretical science as the basis of technical education were ongoing, while the failure of mechanics' institutions in achieving their original aim of providing scientific instruction was increasingly recognized. As self-supporting societies the institutions had to accept their members' demands for literary lectures, lighter readings and musical evenings.[56] At the same time there was increasing government intervention in universal education,[57] and technical education for artisans,[58] culminating in the 1870 Education Act.

Manchester was exemplary of this atmosphere. On the one hand an increasingly paternalistic relationship was affirmed by factory owners who provided libraries and lectures for their workers.[59] On the other, institutions such as Owens College, sought to provide non-applied scientific education to middle-class men.[60] Chemistry professors there, including Lyon Playfair, Edward Frankland, and (from 1857) Roscoe, were committed above all to laboratory teaching. In part this ethos was carried over into the *MSLP*; Roscoe and other *MSLP* lecturers believed that their working-class audience should be taught pure, not applied science, exemplified by their turning down a donation from the Society for the Promotion of Scientific Industry in 1873, despite financial difficulties.[61] This was because they believed that a sound theoretical knowledge

[56] Kargon notes that after 1840, more than half of the lectures at the Manchester Mechanics' Institution 'were on such subjects as poetry, travel, elocution, drama, and history', p. 24. As early as 1841 the SDUK remarked that 'the testimony is nearly uniform that, after a while, the workman ceases altogether to frequent the lecture-room', *Report of the State of Literary, Scientific, and Mechanics' Institutions in England* (London: SDUK, 1841), p. 51.
[57] Through the Newcastle Commission 1858-61 into elementary education for all classes, and Lord Cavendish's 1868 Select Committee on Scientific Instruction.
[58] In 1853 the Department of Science and Art was founded, the first time that government funds were made available for technical education. G. W. Roderick and M. D. Stephens, 'Steam Intellect Created – The Educational Roles of the Mechanics' Institutes', in Inkster (ed.), *The Steam Intellect* Societies, pp. 20-32 (p. 28).
[59] Martin Hewitt cites the Hulme Operative Institute, founded in 1845 with the support of weavers John Pooley and Co., and the Gorton Institute, founded in 1856 for the employees of the Manchester, Sheffield and Lincolnshire Railway, *The Emergence of Stability in the Industrial City: Manchester, 1832-67* (Hampshire: Scolar Press, 1996), p. 127. T. Thomas also points out that much of the political conflict of the first half of the century which led to Manchester becoming synonymous with class tensions, had been largely diffused by the third quarter, 'Representation of the Manchester Working Class in Fiction', in Kidd and Roberts (eds.), pp. 193-216 (p. 194). This suggests that the reasons for setting up working-class recreations were moving beyond simply the need to neutralize such threats.
[60] Owens became a constituent college of Victoria University, later the University of Manchester, in 1880.
[61] Riley, p. 139.

would make them better practical workmen, able to understand the processes they enacted at a fundamental level.[62]

Roscoe held a long-standing belief in the utility of lectures, and he chaired the Committee established following the 1871 BAAS meeting at Edinburgh, which aimed 'to consider and report on the best means of advancing science by Lectures'.[63] As David Riley points out, Roscoe's professional contact with such men as Huxley, Tyndall, and Alfred Russel Wallace, meant that he could secure the biggest names in science for the *MSLP*; these scientists were otherwise unlikely to speak in front of provincial groups on a regular basis.[64] Roscoe actively supported working-class education, although he held specific and arguably narrow views on what that education should be. In addition to his belief that pure over applied knowledge made for a better worker, he also believed that not all working people were capable of understanding science. In particular this was due, he argued, to inadequate teaching: in 1871 he noted that the Department of Science and Art teachers '"are, as a rule, I was going to use a strong word, exceedingly ill-educated, at any rate, that they are certainly not up to the mark of teaching science properly"'.[65] In 1868 he had told the Samuelson Committee, '"I think that the attempt to teach science completely to the working class is a mistake, but I think we should give an opportunity for the best men in the working class to rise"'.[66] While committed to establishing lectures for workers, Roscoe was adamant that they should be accompanied by classes, that the lecture itself was, as he told his audience, undertaken 'with the view of your gaining interest

[62] Robert Bud and Gerrylynn K. Roberts, *Science Versus Practice: Chemistry in Victorian Britain* (Manchester: Manchester University Press, 1984), p. 86.
[63] *Report of the Forty-First Meeting of the British Association for the Advancement of Science: Held at Edinburgh in August 1871* (London: John Murray, 1872), p. lxxiii.
[64] Riley, p. 137.
[65] Quoted in Riley, p. 132.
[66] Quoted in Kargon, p. 181.

enough in scientific matters to induce you to start to learn for yourselves, or to attend some class or other means of instruction by which you may work at the subject'.[67]

Instruction must be structured, he argued, and not given in isolation. Printed syllabuses should be provided, and lectures must be 'given in a plain, but scientific form,' 'illustrated with diagrams and experiments made on a scale such as could be seen by a large audience'.[68] Roscoe summarized this view in *Nature*, stating that:

> If such science lectures, *followed up by regular science instruction*, could be permanently established every winter, under careful and thoroughly competent teachers, in each of our great centres of industry, what invaluable results might not be accomplished! This is truly a subject worthy of the attention of some of our wealthy philanthropists, if, indeed, Government does not take the matter up. How much better would it be to devote money to the establishment of such a series of science classes, than, as is too often the custom, to employ it for building an almshouse![69]

This emphasis on the professional competence of the teachers, and the hint that their work should receive greater government recognition, chimed with the calls of other scientific naturalists to consolidate their professional positions. The comparison of an almshouse with the apparently safer investment of science classes, confirmed Roscoe's commitment to science education as civic duty, seeing scientific truth as 'lying at the foundation of our material welfare, but also of our social and moral well-being'.[70] Further, his motivations linked back to older anxieties about social unrest, the kinds of anxieties which would, in the first half of the century, have been tackled through didactic, moralizing philanthropic activities. While acknowledging the 'creditable' behaviour of unemployed operatives during the Cotton Famine, Roscoe feared 'some danger of a depression of spirits occurring, which might lead to serious results if the attention of the unemployed was not turned in some new direction'.[71] In his prefaces Roscoe depicted his

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[67] Roscoe's opening statement, 'Elementary Chemistry, Lecture I: Indestructibility of Matter and of Energy', *Science Lectures for the People. Science Lectures Delivered in Manchester, 1866-7 and 1870-1. First and Second Series* (Manchester: John Heywood, 1871), pp. 9-19 (p. 10).
[68] H. E. Roscoe, 'Lectures to Working Men', *Nature*, 1 (2 December 1869), 138.
[69] Ibid.
[70] Henry Roscoe, Preface to Second Series 1870-71, in *First and Second Series* (1871), n.p.
[71] *The Life and Experiences of Sir Henry Roscoe, D.C.L., LL.D., F.R.S., Written by Himself* (London: Macmillan and Co., 1906), p. 124.

audience as well behaved and eager to learn. By differentiating between a politically threatening unemployed rabble, and 'the best men in the working class',[72] Roscoe created his ideal audience on the page.

The first series, 1866-1867, was held at the Carpenters Hall, Brook Street, Manchester, and over 4,000 people attended the thirteen lectures. No lectures took place between 1868 and 1869, and the series resumed in 1870 and continued to be held, usually in Hulme Town Hall, until 1880. A standard ticket price was fixed at 1*d* for all eleven series, although this meant that the *MSLP* could not be self-sustaining. The average cost incurred per lecture was £20-£25, and consequently Roscoe relied on individual donations, and the sale of several hundred shilling season tickets (usually purchased by middle-class patrons).[73] Donations were even received from the speakers themselves: in his Preface to Series Six Roscoe thanks Tyndall and John Lubbock for their contributions to the fund.[74] In 1870 the entire cost was covered by T. J. P. Jodrell, and in 1871 by the London Gilchrist Trust.[75] In 1873 and again in 1875 Roscoe appealed to his audience in person and in print, joking that 'for the last seven years he had had to go to a number of his friends and ask them for help. He thought that seven years was nearly enough for that sort of thing – ("hear, hear", and laughter) – and that they ought to try something else'.[76] Roscoe argued that it was better that the lectures be subsidized in order to

[72] 'The class of persons present was chiefly that for whom the lectures were designed and the marked attention and interest invariably shown by the audiences showed how keenly they appreciated the value of the information imparted by the lecturers'. Roscoe, Preface to First Series 1866-7 in *First and Second Series* (1871), n.p.
[73] For example, 200 season tickets were sold in 1872. Riley, p. 141.
[74] Preface to the Sixth Series of *Science Lectures for the People* [...] *Delivered in the Hulme Town Hall, in the Year 1874* (Manchester: John Heywood, 1875), n.p.
[75] Henry Roscoe, 'Science Lectures for the People', *Manchester Times*, 17 August 1872, n.p. One of Roscoe's many newspaper appeals for funds.
[76] 'Science Lectures for the People', *Manchester Guardian*, 18 November 1875, p. 8. The *Guardian* reported that following W. Pengelly's lecture on 17 December 1873, Roscoe made a plea to the audience for funds, saying that even if the ticket price was increased to 1*s*, they would not be able to cover costs, 'Science Lectures for the People', *Manchester Guardian*, 18 December 1873, p. 8.

retain a low ticket price, but at the same time the only way to ensure quality lecturers was to pay them.[77]

It could be argued however, that the maintenance of a low ticket price through the contributions of powerful individuals, reinforced middle- and upper-class power over working-class attendees. Riley has observed that, because the penny ticket holders were pushed to the back of the hall, the very space of the hall itself reinforced class control.[78] As well as maintaining a physical social stratification, however, shilling season tickets also influenced what type of science was taught. In contrast to mechanics' institutions which relied on subscriptions and were therefore obliged to listen to members' demands, the *MSLP* gave the working-class audience what the middle-class organizers thought they needed. The lecturers themselves were what might be considered professional scientists – of the thirteen lecturers who performed between 1871 and 1872, eight of them were F.R.S. This suggests that the entertaining aspect of the lectures, if any, was secondary to instruction in particular types of science and scientific method: pure science and empirical method.[79]

The content of the *MSLP* was highly varied. There seems to have been no uniform way of grouping lectures (apart from the First Series), so that while some topics were treated over a period of two or more weeks by the same lecturer, others were stand-alone discourses. There was no specific focus on local subjects (although place was often evoked); aside from the frequency of lectures on coal, there was little pattern to the combination of topics across the years.[80] To take the Sixth Series (1874-75) as an example:

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[77] 'He had always gone on the principle that a man was worthy of his hire; if they had good lectures they must pay for them. (Applause.)', 'Local and District ['Science Lectures for the People']', *Manchester Times*, 20 November 1875, n.p.

[78] Riley, pp. 141-142.

[79] James Stuart wrote of the importance of avoiding mere amusement in science lectures in 'Lectures to Working Men', *Nature*, 1 (18 November 1869), 71-72 (p. 71).

[80] A brief examination of titles highlights: W. S. Jevons, 'On Coal, its Importance in Manufactures and Trade' (First Series), W. B. Dawkins, 'On Coal' (Second Series), A. H. Green, 'How Coal and the Strata in Which it is Found is Formed' (Second Series), Henry Roscoe, 'On Coal Colours' (Third Series).

1. Crystalline and Molecular Forces, John Tyndall
2. John Dalton and His Atomic Theory, Henry Roscoe
3. On the Transit of Venus, W. Huggins
4. Joseph Priestly [*sic*]: His Life and Chemical Works, T. E. Thorpe
5. The Geographical Distribution of Mammals, P. L. Sclater
6. Earthquakes and Volcanoes, W. C. Williamson
7. Modern Savages, John Lubbock
8. Palestine Exploration: The Ancient and Modern Water Supply of Jerusalem, C. W. Wilson

The Second Series (1870-1871) even included a lecture on Dickens by Professor Ward, in which the lecturer argued that literary criticism is a discipline ‘as capable of being conducted on true principles, and according to a rational method, as scientific enquiry into the wonderful phenomena of physics’.[81] Many lectures included demonstrations, and some of these were enhanced by projection equipment (Tyndall asked Roscoe, ‘[h]ave you a good large screen, or will it be necessary for me to send one down?’).[82] Others, like W. K. Clifford’s ‘Atoms’ (Fourth Series, 1872), used none of these. Attendance was varied but exhibited a declining trend throughout the 1870s; while a big name such as Tyndall attracted an audience of thousands, the average attendance for other lectures in the same series was in the hundreds.[83]

The lectures were also printed in various forms after being transcribed in shorthand by Henry Pitman.[84] Pitman’s transcriptions were published initially as uncut pamphlets, priced at 1*d* (the same as the cost of a ticket) by Manchester publishing house and wholesaler John Heywood. This firm, originally a newsagent on Deansgate from 1846, along with that established by John’s

[81] Professor Ward, ‘Charles Dickens’, Second Series 1870-71, in *First and Second Series* (1871), pp. 236-259 (p. 237). Adolphus William Ward (1837-1924) became Professor of History and English Literature at Owens College in 1866, G. P. Gooch, *rev.*, R. J. W. Evans, ‘Ward, Sir Adolphus William 1837-1924’, *ODNB* [accessed 29 September 2016].

[82] Letter from Tyndall to Roscoe, 17 October 1874, reproduced in *Life and Experiences*, pp. 130-131 (p. 131).

[83] Tyndall attracted 3,700 to his ‘Crystalline and Molecular Forces’ in 1874, while other lectures in the same year had an average attendance of 675. Preface to Sixth Series, n.p.

[84] Brother of the inventor of phonographic shorthand, Isaac Pitman. There were many journals devoted to teaching shorthand in the nineteenth century: a search for ‘shorthand’, in the *Waterloo Directory of English Newspapers and Periodicals 1800-1900* yields sixty-five results, <http://www.victorianperiodicals.com/Series2/SearchResponse_old.asp?SpecificSearch=SpecificSearch&Title=shorthand&IssuingBody=&People=&Subject=&place=&startdate=&enddate=&SpecificSubmit2=Search> [accessed 19 August 2016].

brother Abel Heywood, dominated the city's publishing and print distribution.[85] It was responsible for a large number of educational texts and such periodicals as the *Manchester Magazine*, which often printed lectures delivered at local societies.[86] Roscoe praised these cheap printed lectures for bringing 'the subjects home to a much wider circle'.[87] He also considered the printing of the lectures to be unique to Manchester: '[w]e alone adopt the plan of printing our lectures, and I consider this a most important part of our scheme for endeavouring to spread a taste for Scientific studies amongst the masses of English-speaking people'.[88] Manchester was the epicentre of scientific instruction; its printing presses spread that instruction radially outwards.

Local newspapers, such as the daily *Guardian* and weekly *Manchester Times*, enabled readers to quickly receive reports of the *MSLP*, descriptions of the attendees, the atmosphere of the lecture hall, and audience reactions. They also provide modern critics with a counterpoint to the official Pitman-transcribed version, and highlight the agency of reporters in the transmission of the lecture text. Some interesting examples are the different versions of Tyndall's 'Crystalline and Molecular Forces', delivered in the Free Trade Hall, 28 October 1874. Tyndall repeated his views on science and imagination, that '[t]he man who cannot break the bounds of experience, but holds on to the region of sensible facts, may be an excellent observer, but he is no philosopher, and can never reach those principles which bind the facts of science together'.[89] He reinforced his well known beliefs, however, by aligning the scientific work of James Prescott Joule with the political speeches of 'Cobden, and Bright, and Wilson' (p. 145). In the Heywood/Pitman version Tyndall speaks directly to the audience, calling Joule 'a townsman of your own', and asserting that 'not even the greatest of your manufacturing princes, will endure a

[85] See John Heywood in Frederic Boase, *Modern English Biography*, 6 vols (London: Frank Cass & Co., 1965), I, Col. 1458.
[86] Beetham, '"Healthy Reading"', p. 178. The *Manchester Magazine* was a middle-class publication. Other regional journals which reprinted lectures include *The Monthly Literary and Scientific Lecturer* (1850-1853) and (possibly a direct relative) Henry Pitman's *Pitman's Popular Lecturer and Reader* (1856-1864).
[87] Preface to Second Series, n.p.
[88] Preface to Ninth Series, *Science Lectures for the People. Science Lectures Delivered in Manchester 1877* (Manchester: John Heywood, 1878), n.p.
[89] John Tyndall, 'Crystalline and Molecular Forces', Sixth Series, pp. 141-151 (p. 145).

purer, a more permanent or enviable fame'. Tyndall makes the leap from political oratory to scientific practice by describing Joule's silent work undertaken 'at the same time' that '[t]he walls of this Free Trade Hall, or rather its predecessor, [...] rung with the speeches of Cobden, and Bright, and Wilson'. The *Manchester Times* makes Tyndall's 'rung with the speeches' into a more grandiose 'resounded with the eloquence'. Tyndall causes his audience to cheer and applaud the solitary 'grappling' of the scientific worker by aligning it with rousing popular and radical oratory, imbued with a local identity.[90]

The textual records of Tyndall's lecture present us with a more problematic contradiction than that of simply rhetorical embellishment. The Heywood/Pitman text refers to a demonstration intended to illustrate crystalline structure. Tyndall attempts to take 'ordinary ice' and 'pull it to pieces before [his audience's] eyes' (p. 148). The act of directing a beam through the ice is described in terms which do not suggest that the demonstration is actually taking place: 'the beam selects certain points for attack [...] The liquefied spaces are rendered visible by strong illumination, and throwing their magnified images on a screen' (pp. 148-149). The indefinite article attached to 'screen' contrasts with the more certain report of his next experiment, in 'a powerful solar microscope and an intense source of light are needed. *They are both here*', 'and *now you see* the orderly progress of the crystallisation over *the* entire screen' (my italics). Indeed, as the *Manchester Times* reported, Tyndall was unable to find a block of ice pure enough for the demonstration, and he was forced to ask his audience to take him at his word.[91] The full printed version of the lecture, therefore, avoids deixis which would give the performance temporal and spatial specificity, and uses broader language to construct a performance which could have happened, rather than reconstruct one that really did.

[90] For audience responses to Tyndall's speech see 'Professor Tyndall at the Free Trade Hall', *Manchester Times*, 31 October 1874, n.p., and '(Loud applause.)' recorded by the *Manchester Guardian* in an article of the same name, 29 October 1974, p. 8.
[91] 'Professor Tyndall at the Free Trade Hall', *Manchester Times*, 31 October 1874, n.p.

Such an addition to the text might be considered over-editing; certainly it occupies the opposite end of the spectrum from many of the *MSLP* lectures transcribed by Pitman which retain the slow, repetitive rhythm of a lecture whose pace is dictated by the success or failure of demonstrations. For example, in Roscoe's own 'The Rainbow' which opened the Fourth Series, experiments are described in square brackets. The lecturer's verbal mannerisms, his 'very well's, 'so's, and 'now's are retained, as are his repetitious descriptions of experiments as he filled time while they were being set up:

> I have at the other end of the hall placed a convex mirror, and I have here the power of throwing a parallel beam of electric light on to that mirror. There you see we have our beam, and there are the beautiful carbon points which give the light. Now, Mr. Harrison, be so kind as to bring the image of these carbon points on to our mirror down below, and then Mr. Heywood will arrange the focus, and then I will show you that we can get, as we did before, a little bulb exploded by this reflection of the chemically active rays. Thus, then, you see that the chemically active rays obey the same laws which the visible light rays obey. Now Mr. Heywood will place the bulb in the focus, and then, as soon as Mr. Harrison brings his points together, we shall have a sharp explosion. [The explosion followed instantly.][92]

These circuitous, rambling descriptions fill the silences in the hall, and their reproduction here expresses some of the performance anxieties Roscoe would later write about in his memoirs. 'The lecturer', he wrote, 'has to assume a confident air, and yet he cannot be certain that at the last moment he will be able to perform what he has promised'.[93] While the seeming lack of editorial control provides the modern bibliographer or critic with a glimpse into the real-time staging of the lecture, the overall editorial inconsistencies of the *MSLP* threatened to jeopardize their function as post-performance textbooks. One reviewer of the first six series in *Nature* wryly alluded to some of Pitman's literal transcriptions (he 'had evidently done his work faithfully'), and suggested that a permanent 'responsible editor' be employed to render the texts more consistent: '[r]eading one of Dr. Carpenter's lectures, for example, there is a continual reference

[92] Henry Roscoe, 'The Rainbow', *Science Lectures for the People, Fourth Series 1872-1873.* Pagination restarts at the beginning of each lecture, p. 13.
[93] Roscoe, *Life and Experiences*, p. 169.

to diagrams and maps which, though present to the audience, are not so to the reader'.[94] Such tension is exploded in comic relief when Pitman interjects: '[The explosion followed instantly]'.

The casual reviewer might have been frustrated by these inconsistencies, but they are more serious if the *MSLP* are to be treated as genuinely useful textbooks. In addition to selling pamphlet versions at 1*d* (except for the Eighth Series which sold at 6*d* for three lectures), John Heywood sold whole lecture series bound in stiff paper covers, priced between 9*d* and 1*s*. The complete Eighth Series was not available from Heywood and was instead published by Macmillan.[95] Series were also sold together, cloth-bound, for between 2*s* 6*d* and 3*s* 6*d*. The 9*d*-1*s* editions often had brightly coloured illustrated covers which depicted a scientific figure who featured prominently in that series. Michael Faraday is depicted on the cover of the Fourth Series (it featured a lecture by J. H. Gladstone on 'The Life of Faraday'). The decision to place the portrait of someone so renowned for their lecturing, on the front cover, stressed the quality of the lectures within (fig. 25). Other portraits included Huxley (Sixth Series), William Harvey (Tenth Series), and Henry Cavendish (Seventh Series).

Both the single and double series editions contain advertising for John Heywood's other educational publications, confirming that the firm were marketing the *MSLP* as elementary science textbooks. Included in the Fourth Series are adverts for textbooks on the 'Extra Specific Subjects of Examination for Elementary Schools, under the New Educational Code', 'John Heywood's Manchester Readers' (primers in the three R's), and various history, geography and science textbooks that meet exam requirements. The Tenth Series shilling edition advertises *Health Lectures for the People* delivered and published by the Manchester and Salford Sanitary Association – all available for 1*s* each. The *MSLP* were part of a print market which advertised its local nature, both within the text (as references to the spaces of speech), and in their paratexts – delivery in Hulme Town Hall, publication by Manchester's most powerful publisher, and

[94] W. F. B., 'The Manchester Science Lectures', *Nature*, 13 (2 December 1875) 82-83 (p. 83).
[95] *Manchester Science Lectures for the People* Eighth Series 1876-7, (London: Macmillan and Co., 1877). Like Heywood, Macmillan included advertisements for their own science primers in this edition.

affinities with other local society lectures. But they simultaneously maintained that they could stand for standardized national education, their importance stretching beyond Manchester. As publication moved from pamphlet, to paperback, to double-series clothbound volume, markers of original performance were erased; the phrase '[Reported by Henry Pitman]', dates and places, even names of speakers, were lost, making the *MSLP* more text than performance.

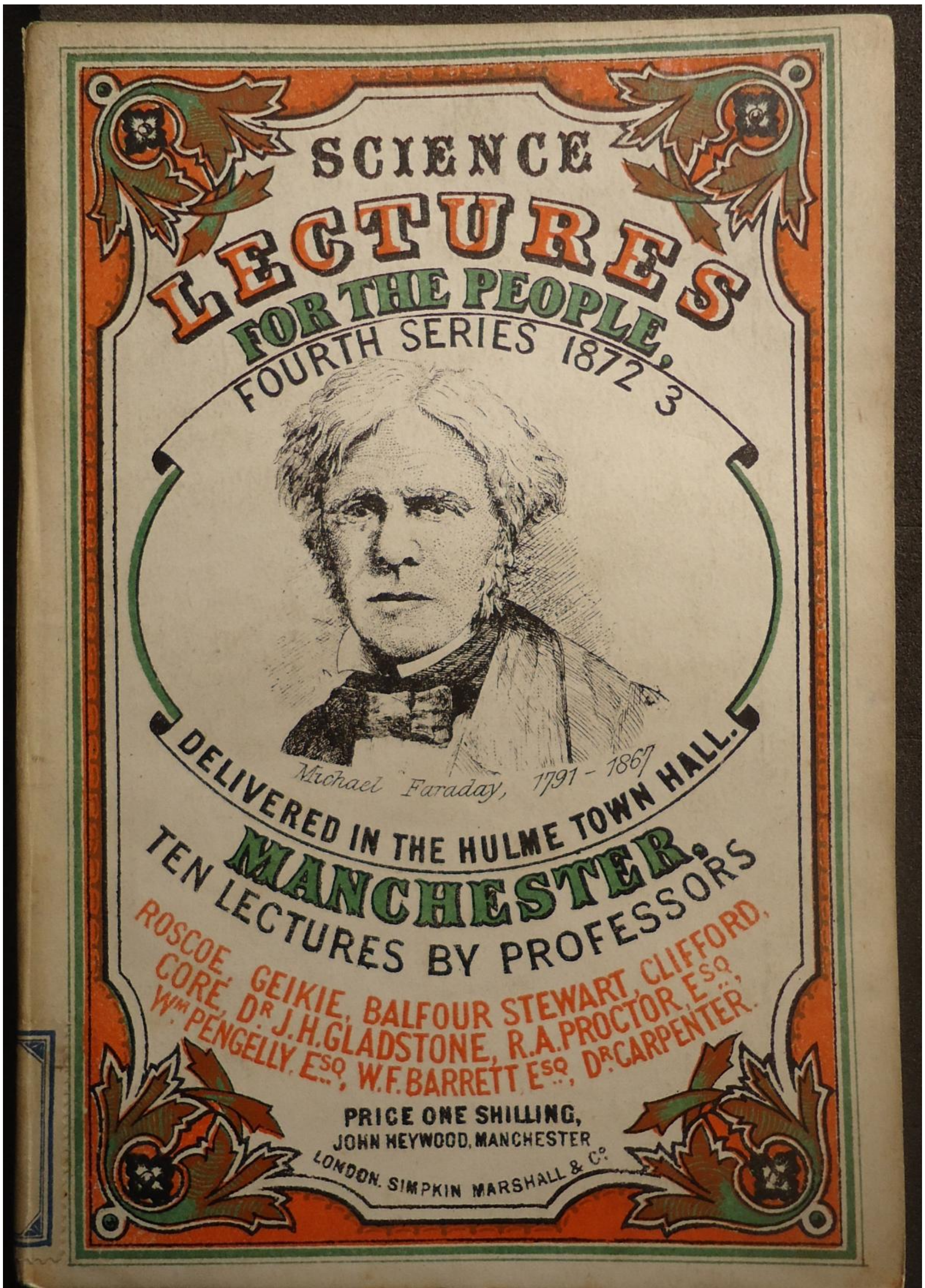

Fig. 25.

The organizers of the *MSLP* had struggled to fund their endeavour from the beginning. At a meeting held at Owens College on 18 December 1879, Roscoe submitted a report showing that, while from 1876 to 1878 the average attendance had been 728, during the current series it was only 210. It was decided that the lectures be 'discontinued for the present, in consequence of the flagging interest shown by the non-attendance of those for whose special benefit these lectures were originally instituted'.[96] One reason for the decline in attendance may have been improvements in government-backed education provision; another might have been the increased availability of texts such as the *MSLP*. Due to the deliberate policy of not having the lectures self-supporting, the people for whom they were supposedly designed had no say in their educational content. It is therefore difficult to judge their success in terms of attendance. However, as Riley correctly asserts, the *MSLP* was 'the perfect platform for scientists to expound their researches to large audiences'.[97] Roscoe was hugely successful in attracting research scientists to speak on a regional platform (even by the ailing Tenth Series he had secured as a speaker Alfred Russel Wallace), and the wider readership of the printed *MSLP* gave these scientists an even bigger audience.

The *MSLP* brought well-known scientists to the city as well as showcasing home-grown talent. In the next section I turn to a society which had been staging lectures for over a decade before the first *MSLP* series, and whose only ambition was to generate change within Manchester and Salford.

[96] 'Abandonment of the Science Lectures for the People', *Manchester Times*, 20 December 1879, n.p.
[97] Riley, p. 137.

Sanitary Science: The 'Sword of Knowledge'

In *Marian Withers*, John and his sister Alice are rescued from poverty by the kindly Mrs Fenwick, who sends the children to a workhouse at which they are educated before being apprenticed.[98] Fenwick's actions set in motion John's journey to becoming a self-made, Manchester Man. They also illustrate a central theme of the novel: that the living and working conditions of workers, and their access to education, are closely linked to their spiritual and moral wellbeing. In the representation of the slum in which John and Alice live, Jewsbury makes a direct link between a misunderstanding (or apathy) towards dirt and disease, and immorality. The 'loathsome sights and intolerable stench', the 'refuse, slops, and filth thrown from the houses and cellars' breed 'thieves, wretched women, ruffians, the offscouring of the worst class' (I, p. 8). In contrast is Mr Wilcox, John's fellow mill owner, who devises plans for a wash house for his workers, convinced that 'when a man is dirty, he will do actions he would be ashamed to do if he were clean' (I, p. 246) and that 'dirt makes a man brutal' (II, p. 50). Jewsbury's novel represents middle-class philanthropy of different kinds: the personal and feminine charity of reaching out to individuals, and larger schemes through which the male industrialist implements change in his whole workforce. Both share a belief in the connection between insanitary living and immorality, akin to that held by Charles Kingsley and explored in *The Water-Babies*. In Manchester during the nineteenth century, this concern with sanitation – and either a middle-class misperception of the working classes, or a confusion between correlation and causation – preoccupied the upper and middle classes. The collectivization of the wealthier Manchester inhabitants into various sanitary associations was a way for them to co-ordinate genuinely good work. As will be discussed, the rapid industrialization of the city was not matched immediately by improved infrastructure to

[98] Title quotation from John Nicholls, F.R.A.S., *Public Health in Reference to the Physical and Moral Conditions of the People: A Lecture Delivered in the Large Room of the Young Men's Christian Association, On the Evening of the 25th January 1855* (Manchester: Published by Request, Johnson and Rawson Printers, 1855), p. 15.

cope with an increasing population and industrial pollution. The rectification of this was seen by many as a necessary civic and moral duty. Another outcome of this collectivization was the fact that the upper and middle classes were able to consolidate their economic and political powers, by taking actions which benefited both the workers and their own economic interests. This last section turns to the work of the Manchester and Salford Sanitary Association (MSSA) and its long-running series, the *Manchester Health Lectures for the People*. Roscoe was an honorary committee member of the MSSA; his participation across Manchester institutions – educational, philanthropic, industrial – illustrates the interconnectedness of the city's middle-class power groups.

As a professor at Owens College, and later as a Member of Parliament, Roscoe held considerable power in science and government.[99] He had reformed the ailing college and established a strong academic foundation for the already powerful field of chemistry in the city.[100] The science dominated Manchester industry as a vital part of printing, dyeing and other aspects of textile manufacture. In particular, as Christopher Hamlin points out, 'chemists were beneficiaries of an ethos which equated success in the free market with innovation, and innovation with comprehension in the possibilities of science'.[101] Roscoe was no exception, and was closely connected to Manchester industry. His attitude towards public health, therefore, favoured the alteration of individual habits over large-scale government or industry-led change, exemplified in a report on industrial water pollution in 1892, in which Roscoe stated that it would be impossible to force manufacturers to change their habits because they operated on too large a scale.[102] His

[99] After his appointment at Owens in 1857, Roscoe helped to professionalize the kinds of scientific education available there: new science degrees were introduced in 1858, and he helped to forge links with local industry. See Janet Wolff, 'Calico Connections: Science, Manufacture and Culture in Mid Nineteenth-Century Manchester', in *Culture in Manchester: Institutions and Urban Change Since 1850*, ed. by Wolff and Mike Savage (Manchester: Manchester University Press, 2013), pp. 11-32 (pp. 16-17). He was elected Liberal MP for South Manchester, 1885-1895. See Robert H. Kargon, 'Roscoe, Sir Henry Enfield (1833-1915)', *ODNB* [accessed 21 August 2016].

[100] See Kargon, pp. 153-181.

[101] Introduction to Roscoe's *Preliminary Report* on industrial water pollution to the Mersey and Irwell Joint Board (1892), reproduced in *Sanitary Reform in the Provinces*, ed. by Christopher Hamlin, *Sanitary Reform in Victorian Britain*, 6 vols (London: Pickering & Chatto, 2012), II, pp. 463-470 (p. 464).

[102] Ibid.

involvement with the MSSA is better understood in this context: it was an association which wanted to improve public health in conjunction with large-scale government works in sewerage, water and housing, but which focused on change at an individual level. In part, this emphasis should be seen as a response to the collision between market forces specific to Manchester. The wealth of the city relied of the health of its people, but, if improvement could be effected at an individual level, rather than legislating against the actions of large chemical companies, such companies were absolved of financial responsibility.

The activities of the MSSA were, therefore, motivated by multiple, sometimes contradictory ideas. Like many contemporary sanitary associations (such as those discussed in chapter three), the MSSA organized home visits, lectures, and the distribution of free tracts which emphasized physical cleanliness as a moral act. It insisted on its voluntary status and appeared to disassociate itself from government sanitary work.[103] Like other voluntary associations it strove to understand the physiology and chemistry behind epidemics, and it exercised that peculiarly Victorian obsession with statistics (gathering weekly mortality rates from 1860 onwards).[104]

The MSSA therefore trod a line between scientific intellectualism and practical application. It shared with the Manchester Statistical Society (founded 1833) the belief that statistics 'could be used to neutralise potential conflict and heal the fissures in society which rapid urban and industrial growth had revealed'.[105] In the first half of the century, the population of

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[103] For example, Henry Simpson M. D., physician at the Manchester Royal Infirmary, emphasized the fact that members were *not* associated with government work (such as Medical Officers); the MSSA was 'composed of a number of gentlemen who are endeavouring to improve the health of these two great adjoining towns. They are not connected with the authorities of these towns, but are a band of volunteers, who have for many years sought information on all matters connected with the public health; and who have done what they could, by the means of the press and by such lectures as that which it is my privilege to give this evening, to spread among the people some knowledge of things useful to them in relation to their own individual health, and to that of their families'. 'The Health of the Household', *Health Lectures for the People. Delivered in Manchester 1875-6, 1876-7, 1877-8* (Manchester: Published by the Authority of the Manchester and Salford Sanitary Association, John Heywood, 1878), pp. 7-24 (p. 7).

[104] Rose, p. 107.

[105] Ibid. The Manchester Statistical Society collected a wide range of data on both sanitation and working-class education. See for example Tables 13-15, on the cost of paving streets and laying sewers in Manchester, *Transactions of the Manchester Statistical Society, Session 1861-62* (Manchester: Cave and Sever, 1862), pp. 24-25.

Manchester and Salford had more than quadrupled, increasing from 90,000 to 400,000. When the Chadwick Report revealed in 1842 that the average age of death for a Manchester mechanic or labourer was less than half that of someone of the same class living in Rutlandshire, no one could ignore this statistical evidence.[106] By the 1850s and 1860s, therefore, such groups as the MSSA were an outlet through which the upper and middle classes could express both their scientific interests and fulfil their philanthropic obligations. In his lecture 'Seeds of Disease', Arthur Ransome, Professor of Sanitary Science at Owens College, stressed the importance of this practice of data collection. In contrast to the Corporation's Health Officers who enforced public health laws, members of the MSSA gathered 'weekly reports on the health of the town'.[107] Microscopes had given them proof that the 'disease-entity' was 'spread by means of seeds or germs', and Ransome praised the work of Pasteur, Snow and Lister (p. 26). He then called for the collection of statistics on sanitation as detailed as those collected by meteorologists: '[h]ow important would it be', he stated, 'if we could obtain similar records of epidemics, and if these tornadoes of disease could be brought within our knowledge at least as plainly as atmospheric disturbance' (p. 35). Like extreme weather, epidemics as acts of God might be brought under control through abstract numerical analysis. The mid-Victorian obsession with statistics was brought to bear on the sickness of the national body.

Following the patterns discussed in chapter three, the lectures and speeches of the MSSA may be divided into two groups. On the one hand, speeches addressed to its (middle-class) membership, or potential members, were quick to recount the history and work of the society in a way which emphasized its inclusivity. On the other hand lectures to working-class audiences linked, tonally, with free hygiene tracts. These focused on popular and straightforward

[106] Kargon, pp. 109-110. In Manchester the average age of death for a mechanic was seventeen; in Rutlandshire it was thirty-eight.

[107] Arthur Ransome, 'Seeds of Disease', *Health Lectures* (1878), pp. 21-38 (p. 23). Government Medical Officers of Health were introduced by the 1872 Public Health Act, working alongside sanitary inspectors (a position which had been made compulsory by the 1848 Public Health Act). See Tom Crook, 'Sanitary Inspection and the Public Sphere in Late Victorian and Edwardian Britain: A Case Study in Liberal Governance', *Social History*, 32 (November 2007), 369-393 (p. 372). Crook also notes that '[b]y the 1890s, Manchester's Corporation was employing some twenty-eight sanitary inspectors to patrol the city's residential districts', p. 373.

physiology, rather than statistics, and adopted a heavily moralistic tone; the Association itself was depicted as a paternal group of guardians who had achieved comfort not through chance, but by following the laws of health. John Nicholls's 1855 address to the MSSA, *Public Health Considered in Reference to the Physical and Moral Conditions of the People*, is an example of the former.[108] As discussed earlier in this chapter, Nicholls's was a minority voice in calling for working-class educational institutions to be governed by the workers themselves. But in his 1855 lecture Nicholls maintained that there is a difference between how members of the lower classes learn compared to their social betters, and that the upper and middle classes should be mindful of this when lecturing. This is demonstrated through what Nicholls says his own discourse is not. His is not a densely illustrated lecture because he is concerned with a subject which is not one that he can 'relieve by any of those means of illustration, which speak so powerfully to the minds of more uneducated audiences' (p. 1). His aim is to define the 'duties' that befall members of such 'a great community', and more specifically outlines the role of the MSSA as:

> having for its direct object, the diffusion among the masses of our population not merely of an acquaintance with the laws of public health, – *that* we might understand, – but absolutely doing the work of teaching and persuading the people, that it is not good to dwell in damp and ill-ventilated abodes – that cleanliness is really a virtue, bringing its own reward – and that habits of regularity and temperance conduce to the longevity of the human race.
>
> (p. 2)

According to Nicholls, those who enjoy 'the advantages of better education and greater information' have an obligation to aid the 'labouring classes' (p. 33) through lectures, tract distribution and house visits (p. 4). The suggestion here is that sanitary living is a matter of choice, that it is merely through ignorance that workers live in 'damp and ill-ventilated conditions'. This positioning of the working classes in relation to an enlightened middle-class teacher is akin to that found in Catherine Buckton's accounts of her conversations with lecture attendees. Nicholls also endorses the authority of science when he praises the lectures of

[108] Nicholls, *Public Health in Reference to the Physical and Moral Conditions of the People*, p. 15.

'[m]edical men' who put into 'simple language and persuasive tones, the experience which has cost them so much labour, time, and thought, to acquire' (p. 6). The pursuit of medical knowledge is here described in the same terms as the ascetic endeavours of scientific naturalists such as Tyndall and Huxley. It is clear that doctors, in popularizing modern medical views on disease and sanitation, were attempting to make genuine improvements; but we can also see that their 'persuasive tones' were used to argue for the authority of those modern methods.

Nicholls speaks metaphorically in order to rouse his audience; in particular, militaristic language is used to turn the MSSA's work into a scientific crusade. Modern science and medicine are weapons in their attack on the 'serried bands of almost hopeless ignorance and indifference': 'we must cleave the closed ranks with the sword of knowledge and truth', Nicholls asserts, 'and not content ourselves with cutting off a few stragglers here and there' (p. 15). There is the implication here that ignorance of the laws of health is the true evil; as in Kingsley's lectures and sermons on cholera, the suggestion is that the MSSA needs to be evangelical in spreading sanitary knowledge, as the only way to overcome this misery. At the same time, 'closed ranks' equates with closed minds, and sanitary reformers must approach their task if not with the physical force, then certainly the relentlessness, of an army in battle. Further metaphors of growth and ripening, enforced by repetition, illustrate the MSSA's focus on the individual. When discussing the importance of clean skin, Nicholls argues that '[a]s families consist of individuals, and communities of families, it is very apparent that such neglect, if it become the rule, must soon tell upon large masses of the people' (p. 8). The 'seed [is] sown' for a 'deadly epidemic'. The metaphor of nation as body is in this case closer to reality, in that the literal neglect of the body by one individual can have a deadly effect on the whole. The 'seed' of disease is a common image, although Nicholls would have at this time been relying on pre-germ theory ideas of disease. We can see in the idea that a single seed might grow to monstrous proportions and pose a threat to the whole population, the anxieties around mutation, difference, and disease, expressed by

Kingsley and Spencer. They threaten the stability of the social order, hence the importance of MSSA members working to eradicate them.

In contrast to the types of address to MSSA members, which the Nicholls example demonstrates, the systematic organization of annual lecture series by the MSSA, reveals a more ambiguous aim in terms of target audience. The Association had staged lectures since its foundation in 1852, but it was not until the 1875-76 season that it began to publish addresses as part of an ongoing series. These *Manchester Health Lectures for the People* (*HLP*) were apparently (taking into consideration the fact that in the *MSLP* 'for the People' meant "for the working classes"), aimed at a working audience. Overall, these lectures tend to avoid the patronizing tone of some of the Association's tracts, sold by the hundred to philanthropic home visitors for broadcast distribution.[109] But they were considered to be far-reaching in scope, with the aim 'to educate the mass of the people with regard to sanitary laws',[110] and to 'present [sanitary science] in a form that will be easily understood by the unlearned'.[111] Equally, when the lecture was transferred into print, the society visualized a passive audience, uneducated but eager to learn. As the chairman of the MSSA, Daniel Noble, wrote in his preface to the 1878-79 series, 'experience shows that all merely oral lessons are soon forgotten, unless they are reverted to and thought over at leisure'.[112] This 'compact volume' served as an educational aid for those who were ignorant of the laws of health. Further, while the series was not delivered from one fixed location until 1882, the printed lectures give no indication of the place or time of original delivery,

[109] One particular MSSA series from the 1890s consisted of two-to-six page pamphlets, sold for 2*s* 6*d* per hundred, or 2*s* to subscribers. They carried such teaching as: '[y]ou must admit that, in general, the wealthier classes pay far greater attention than you do to *personal cleanliness*. Why is it that they do so? Mainly, because they know that it conduces in a high degree to *health*, *comfort*, and *respectability*', 'Facts About Health Worth Recollecting', *Manchester and Salford Sanitary Association Tract Series* No. 3 n.d., 2pp. (p. 1). Again, such texts implied that the reader carried personal responsibility for their state of living, and they could, like the 'wealthier classes', make a choice to change.

[110] John Haddon, 'Health, and How to Preserve It', *Health Lectures for the People. Health Lectures Delivered in Manchester, 1875-76, 1876-77, 1877-78* (Manchester: John Heywood, 1878), pp. 25-44 (p. 25).

[111] Arthur Ransome, Preface to *Health Lectures for the People. Health Lectures Delivered in Manchester, 1880-81* (Manchester: John Heywood, 1881), n.p.

[112] Daniel Noble, Preface to *Health Lectures for the People. Health Lectures Delivered in Manchester, 1878-79* (Manchester: John Heywood, 1879), n.p.

thereby detaching them from a specific performance, and allowing them to be read, repeatedly, as tracts.[113]

Such didactic imperatives are reinforced by analysis of the *HLP*'s bibliographic features. Like the *MSLP* they were printed by John Heywood. Pamphlets sold for 1*d* and around 1*s* for editions in a yellow card-bound series, and were also available in attractive red and gold cloth bindings. The covers of the shilling editions were illustrated with images depicting 'Cleanliness', 'Good Food', 'Healthy Homes', and 'Pure Air', announcing the Association's values, and ensuring that the volumes were part of an attractive set (fig. 26). They included adverts for the *MSLP* series, as well as Heywood's Primers, announcing their position in a market of educational texts, and reinforcing their local identity. Images depicting women carrying out household duties, and a family sitting around the table, are in visual proximity to the coats of arms of Manchester and Salford, making a direct association between cleanliness, wholesome family life, and civic pride. To follow the laws of health, is a civic duty.

Lectures on 'Cleanliness' included 'A Healthy Skin' (1877-78), and 'Water: Its Work of Purification' (1879-80). 'Good Food' was discussed in 'Indigestion' (1875-76), 'Alcohol and Its Hereditary Effects' and 'Choice of Food' (both 1879-80), and 'Food and Bodily Energy' (1880-81). Advice for maintaining a 'Healthy Home' and 'Pure Air' included 'The Ventilation of Houses' and 'Personal and Household Arrangements in Relation to Health' (both 1879-80). Some, such as that by John Angell, Senior Science Master at Manchester Grammar School, and H. V. Tomkins M.D., included demonstrations which would not have been out of place at the RI.[114] Such topics are comparable with many sanitary lectures at this time, like those performed

[113] It was not until Ransome's 'Some Dangers Connected with Dwellings, and How to Avoid Them', that the lectures were fixed at the Peter Street YMCA. See 'Popular Health Lectures', *Manchester Guardian*, 23 November 1882, p. 8.

[114] In the 1879-80 series Angell performed multiple demonstrations, such as exploding gunpowder to show combustion, and, like Buckton, wrote 'oxygen' and 'carbonic acid' 'on the blackboard in specially large letters', John Angell, 'Personal and Household Arrangements in Relation to Health. Including Hints with Respect to the Use of Gas, Gas-Stoves, and of Modern Wall-Papers', in *Health Lectures for the People* [...] *1879-80* (1880), pp. 13-43 (pp. 15, 20). To demonstrate muscular contraction Tomkins passed a current through muscle from a frog's leg, H. V.

by Buckton and others. The *HLP* are therefore typical of the lecture output of Victorian sanitary reformers.

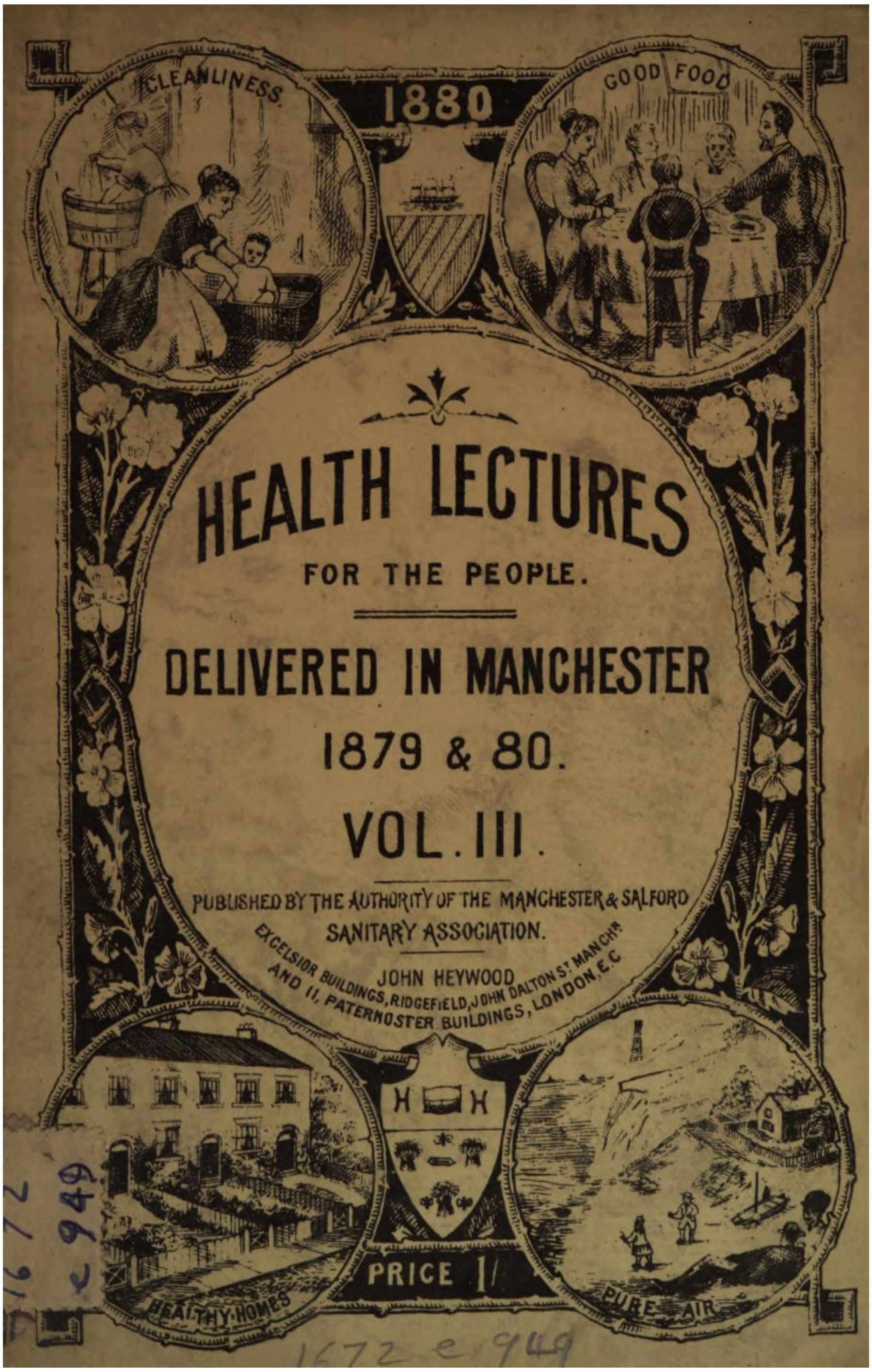

Fig. 26.[115]

Tomkins, 'Working', *Health Lectures for the People. Health Lectures Delivered in Manchester, 1882-83-1883-84, Sixth and Seventh Series* (Manchester: John Heywood, 1885), pp. 33-48 (p.37).

[115] Image sourced from the Google Books and Oxford Bodleian Libraries Scanning Project.

As I discussed in chapter three, lecturers like Buckton reinforced the validity of their practical suggestions by making references to medical authorities. The *HLP* are no exception to this, but where Buckton presented herself as a translator of physiological knowledge who, because female, knew how to make it practicable, these MSSA lectures were led by the medical authorities themselves. To take the first ten years of published series (1875-76 to 1884-85) as a representative sample: seventy-two lectures in total were published, delivered by thirty-nine different speakers. As none of these speakers are referred to using a female title (which was the norm when a speaker was a woman), we can assume that they were all men. Almost every lecturer is referred to using his qualifications, or official position in medical or sanitary work, thereby advertising an institutional or educational type of expertise. Out of these thirty-nine, one lecture is printed without the name of the speaker, while nineteen appear with the letters 'M.D.'. Of the other nineteen named speakers, the vast majority are listed as having PhDs, are physicians or surgeons at local hospitals, lecturers at Owens College, local Medical Officers, or sanitary engineers. That such a conscious effort is made to define the speakers in terms of medical or sanitary expertise – while even the dates and places of delivery of the lectures are not recorded – suggests that the MSSA wanted to promote a particular kind of knowledge. That knowledge was acquired through institutionalised medical training, commitment to empirical method, and the systematic collection of numerical data.

Through this we can see some of the contradictions that sit at the heart, not just of the MSSA's motivations, but at those of other Victorian sanitary associations. While insisting that they are volunteers, striving to change living conditions at an individual level, the *HLP* lecturers are, at the same time, part of an institutional structure with close ties to government and industry.

Further, in order to attain this credibility, the MSSA call for the support not of the working classes as a whole, but of a specific group of artisans whom they deem to be respectable.

One striking example of this is in John Haddon's lecture from the 1876-77 series, 'Health, and How to Preserve It'. Haddon uses the first and second person to establish a direct relationship with his audience and, while he claims that '[w]hat I have got to say is to the busy working classes [...] amongst whom the death rate is highest' (p. 25), the audience he actually constructs is the "deserving" section of this class. On the one hand, Haddon occasionally falls into a patronizing tone – accusing his audience of frittering away their wages on 'quack medicines, and injurious drinks' (p. 35), and telling them that the dead skin they find in their socks quickly becomes 'the most disgusting and poisonous filth' (p. 33). But because his hearers have chosen to attend a sanitary lecture at all, they are distinguished from an even lower class of men: '[*t*]*hey* have lost the better part of their nature. *They* have no love either for God or their fellow-men, and have lost even their own self-respect' (p. 26).

The MSSA claim that the *HLP* were established with this intention all along: to aid the 'unlearned', but willing to learn, members of the working classes. But in 1881 the Association took 'a new point of departure, with the view of making [the lectures] more directly useful to the working classes, to whose benefit they have, from the first, been devoted'.[116] After their 'mid-day meal, in the spacious rooms provided for them by their employers', 'many intelligent artisans' sat down to hear the lectures in the 1881-82 series. This might show the MSSA reaching out directly to the working classes, but it also suggests that lectures before 1882 did not attract the intended audience. Further, it is not clear whether the Association repeated this action. For example, just a few years later the lectures were 'delivered at the Manchester Technical School' on 'the subject of House Construction' and not in places of work.[117] While it is recorded that the audiences consisted of 'architects, plumbers, and men engaged practically in the various branches of the building trade', and so it is reasonable to assume that this was the artisan audience the

[116] Preface to *Health Lectures for the People. Health Lectures Delivered in Manchester, Fifth Series – 1881-82* (Manchester: John Heywood, 1883), n.p.
[117] Arthur Ransome, Preface to *Health Lectures for the People. Health Lectures Delivered in Manchester, 1884-85, Eighth Series* (Manchester: John Heywood, 1885), n.p.

MSSA claimed to want to reach, the printed version tells a different story. Ransome also addresses the volume to 'the householder', asserting that it 'will supply a means of testing and checking the various operations of workpeople employed about his house'. This volume of the *HLP* was directed at artisans, but it performed a dual purpose as a reference work for their employers, who could check the standard of their work.

In his prefaces to the *MSLP* Roscoe included the number of attendees in order to emphasize the success of the series and thereby gain financial support. In contrast, the printed *HLP* lectures lacked any reference to original delivery, even though their educational aims are made clear. It is likely that this is because the MSSA funded their lectures through membership fees. Indeed, in the paratexts to the *HLP* there is the sense that organizers were speaking over the working classes, whom they sought to educate, to an upper- or middle-class reader who might be persuaded to lend financial support. The *HLP* included a list of committee and honorary committee members for that year, presenting in print a unified group of upper- and middle-class patrons. In this sense the texts were less directed at a working-class readership, and more aimed at consolidating the unity of a specific, powerful group. Further, each volume included the Objects of the Association, and details of how to become a member, strengthening that identity through increased membership. Instead of political association, the Lit and Phil, or the dissenting church, the MSSA provided a way for these classes to strengthen their authority through their relationship with each other.

Conclusion

Public speech in nineteenth-century Manchester emerged from an earlier tradition of radical politics, liberal attitudes towards education, and a growing industrial middle class which wanted to display public unity. By the second half of the century, therefore, popular science lectures carried an educational purpose in the tradition of mechanics' institutions, but they were also used to strengthen the authority of those who staged them. Through the *MSLP* and the *HLP* the upper and middle classes attempted to diffuse potential political agitation through scientific instruction, and to maintain the health of the working population. For the latter, lecture texts also constructed a community of philanthropists who viewed the city in terms of statistical returns. During this period, however, with increasing government provisions for education and public health, the role of such philanthropists became more complex. Societies repositioned themselves around new state-controlled improvements, rather than implement the improvements themselves. Where statutes provided for large-scale sanitary engineering works, for example, local organizations built on a tradition of home visits and brought the teaching of personal cleanliness to individual homes.

Central to the construction of these scientific identities was print. When the BAAS visited Manchester, newspaper reports of scientific speeches and the locations in which they were delivered, spread multiple versions of the city and how it presented itself, to a national audience. Each of the events discussed in this chapter has illustrated how depictions of scientific practice – as a profession, as self-improvement, as sanitary reform – were affected by who was doing the speaking, writing, and reading. The *HLP*, for example, apparently spoke to working-class readers willing to apply sanitary science to their daily lives in order to make moral improvements. At the same time, by including the names of the Manchester elite who had made the lectures possible (and at the same time effacing their working-class audience), the texts displayed evidence of a political and social amity, which might have been just as valuable to those individuals as the educational reforms they also supported. As the example of Roscoe demonstrates, the landscape of scientific speech in Manchester was sculpted by those whose ambition it was to gain authority for modern, professional science.

Conclusion

In Britain during the second half of the nineteenth century, the lecture platform was adopted by almost every interest group to further their own agendas. However, as this thesis has shown, the lecture genre served a specific purpose in the consolidation of the authority of scientific naturalism. The combination of speech, with the performance of demonstrations or an emphasis on the visual through lecture slides – the fundamental elements that constitute the lecture form – made it an ideal vehicle in which to demonstrate the value of empirical methods. By focusing specifically on this aspect of popular science, it has been possible to pinpoint scientists' shifting perceptions of their audiences, as well as their professional ambitions. Reciprocally, this study has highlighted the ways in which the public, conscious self-presentation of expertise and authority, was a strategy that was not without risks. Just as the lecturer's audience was an unstable construct depending on whether they were listeners or readers, avid materialists or were sceptical about modern science, so too could the image of the lecturer change depending on how their discourse was reported. Newspaper reporters, shorthand writers, satirists, editors, even the scientists themselves, influenced how performances were presented on the page. Consequently, networks of performance and print had a significant impact on how scientific naturalism was communicated to a popular audience.

The intermediary stages in these networks, therefore, affected the success with which scientific naturalists persuaded non-experts of the veracity of empiricism. The attribution of intentionality in literary texts is a precarious business. But, as I have shown, the textual versions of scientific speeches are particularly well suited to such scrutiny precisely because their authors had this ambition. Scientific naturalists had something tangible to gain from these acts of persuasion: a revolution in the standing of science, public authority for themselves, and paid positions. Lectures enabled them to negotiate for these outcomes, using culturally familiar discourses of scientific demonstrations and wonder, political and religious speech, and an association between masculine physical strength and intellectual superiority. The historically specific print culture of the second half of the nineteenth century (expanding news and journal publication, local newspapers, and educational texts), meant that there was a specific market for a wider audience to "hear" lectures. Performances could be scrutinized, but what came under scrutiny were textual imprints of a live event, in which scientists' calls for their audience to "see for themselves" could only be fulfilled through textual proxy.

The historical specificity of the scientific naturalists' lecture performances is highlighted by the fact that broadcasting and visual technologies evolved with such rapidity at the turn of the twentieth century. Radio and film were to become significant influences on how lecturers presented their topics, and how secondary audiences experienced lectures. The BBC, founded in 1922, frequently broadcast science lectures in its early years.[1] Peter Bowler has noted that *The Listener*, the BBC's weekly magazine, which was launched in 1929, included transcripts of lectures, sometimes before they were broadcast.[2] We can see continuity between these and nineteenth-century lectures which included handouts and syllabuses that were often handed to the press in advance.

Radio carried the lecturer's voice beyond the lecture hall, thereby giving secondary recipients access to the aurality of a lecture, which prior to this period could only have been reproduced textually. The advent of radio, however, had a closer a relationship with early lantern slide shows, and, paradoxically, later nineteenth-century readers of lectures, than it did with the large public performances of scientific naturalists. These early lantern shows, because the light quality was so low, could only be shown to small audiences. This intimacy was replicated by the radio, which brought the scientific lecturer into the home. No longer sharing a public space with

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[1] Rutherford's 1923 BAAS Presidential Address was broadcast on the BBC. Lord Reith introduced "National Lectures" in 1929. Peter J. Bowler, *Science for All: The Popularization of Science in Early Twentieth-Century Britain* (Chicago: University of Chicago Press, 2009), p. 210.

[2] Ibid.

other audience members, listeners became more like readers, experiencing lectures as a solitary act. They were also like those viewers of early lantern slide shows, whose experience took place in a small, domestic setting, rather than a large public space devoted to science. This may have had an effect on the lecturer just as much as on his audience; just as they could not see him, so he could not gauge their reactions and act accordingly. The advantage of having the lecturer's actual voice reproduced, was gained only with a sacrifice. As it was for readers, so too for radio listeners, the lecture hall was an imagined space and therefore could not carry the connotations of scientific authority that spaces like the RI evoked.

During the early twentieth century, therefore, new technologies both enabled, and forced, the popular science lecture to diversify. The experience of a live lecture became both more *and* less visual, with the radio at one end of the spectrum, and the cinema at the other. The parallel development of film, science and technology has been well documented.[3] However, the specific development of scientific film and its uses for entertainment and education, is worth further attention. Particularly in medicine, film was used as a didactic lecture tool to bring students into the surgical theatre, and also allowed surgeons to observe their own actions and, therefore, make their surgical processes more efficient. The work of the surgeon Dr Eugène-Louis Doyen (1859-1916), is the most famous example of this.[4] In the largely popular arena, ethnographic film in the form of travelogues emerged as the descendant of nineteenth-century "displayed peoples", discussed in chapter two. As Alison Griffiths notes, these films were

[3] Virgilio Tosi, *Cinema Before Cinema: The Origins of Scientific Cinematography*, trans. by Sergio Angelini (London: British Universities Film & Video Council, 2005); Franz Paul Liesegang, *Dates and Sources: A Contribution to the History of the Art of Projection and to Cinematography*, trans. by Hermann Hecht (London: Magic Lantern Society of Great Britain, 1986).

[4] Tosi, pp. 165, 180; Scott Curtis, 'Dissecting the Medical Training Film', in *Beyond the Screen: Institutions, Networks and Publics of Early Cinema*, ed. by Marta Braun et al (Eastleigh: John Libbey, 2012), pp. 161-167. Doyen first had his work recorded in Paris in 1897; the films served to 'illustrate and publicise' his work, Curtis, p. 163. But he also used them to train students, and to watch himself at work: 'Doyen explains, "When I saw for the first time one of my operations reproduced on the screen, I recognised how far I fell short of my ideal. Many of the details of technique that had seemed satisfactory I now saw to be defective, and the cinematograph has thus enabled me considerably to correct and simplify, and to perfect my operative technique"', Curtis, p. 165.

accompanied by 'an interpretive agent', a lecturer who 'provided a metacommentary' to the films.[5]

In many cases, however, scientific film served a dual purpose: techniques such as microcinematography and x-ray cinematography enabled scientists to explore new territory. At the same time, the resulting films were shown to non-expert audiences as objects of wonder.[6] Scientists even entered into commercial agreements with film companies, who financed films on the condition that they could also be shown as entertainment.[7] Science films appeared as part of cinema programmes alongside newsreels and entertainment pieces, but they were also shown with lecturers who provided a commentary. The first 'systematic production of films on scientific topics for a wide audience' took place in England in 1903, when biologist F. Martin Duncan collaborated with the Charles Urban Company to produce a series of films entitled 'The Unseen World'.[8] Urban's strong belief in the utility of science lectures, not just for entertainment, but as a 'vital necessity' in institutions such as schools and hospitals, is made clear in his self-published pamphlet of 1907, *The Cinematograph in Science, Education, and Matters of State*.[9] The cinematograph was no mere 'showman's plaything', but a means of reducing the number of animals used in vivisection (p. 39), of making the dangers of bacteria apparent to sanitary inspectors (p. 43), and of teaching historical events which had been captured 'by the accurate and truthful eye of the camera' (p. 17). As Oliver Gaycken has pointed out, the presence of Duncan as a lecturer during the screening of 'The Unseen World' provided a 'link to the exhibition strategies of the lantern-

[5] Alison Griffiths, *Wondrous Difference: Cinema, Anthropology, and Turn-of-the-Century Visual Culture* (New York: Columbia University Press, 2002), p. 206.

[6] Lisa Cartwright notes that John Macintyre's x-ray cinematography of a frog's leg was first shown at a Ladies' Night of the Glasgow Philosophical Society, *Screening the Body: Tracing Medicine's Visual Culture* (Minneapolis: University of Minnesota Press, 1995), pp. 22, 130.

[7] In 1908, Pathé agreed to fund the biologist Jean Comandon's films of microbes, Hannah Landecker, 'Cellular Features: Microcinematography and Film Theory', *Critical Inquiry*, 31 (Summer 2005), 903-937 (p. 911).

[8] Oliver Gaycken, 'A Note on the National Character of Early Popular Science Films', in *Early Cinema and the National*, ed. by Richard Abel et al (Hertfordshire: John Libbey, 2008), pp. 258-267 (p. 258).

[9] Charles Urban, *The Cinematograph in Science, Education, and Matters of State* (London: Charles Urban Trading Company, 1907), p. 52.

lecture format'.[10] Film straddled entertainment and education, the cinema and the lecture hall, and, for many decades shared a bill with the lantern show. There was not a mass extinction of nineteenth-century forms of projection; rather slides continued to be used, and new media took their cues from old techniques.

It is difficult to ascertain whether film had a positive or negative impact on how empiricism was perceived by a popular audience. On the one hand, microcinematography enabled scientists to show processes that would normally be too slow or too fast to witness in a live demonstration. On the other hand, the demonstration had already taken place. The lecturer was no longer able to show his expertise and mastery over nature; he was merely a commentator. For the audience, the demonstration did not take place before their very eyes, but was a replay of events which had already happened in the laboratory. Overall, it is clear that new visual technologies slotted in with the Victorian science lecturing tradition, but that they complicated even further the relationship between the medium of the lecture, and the empirical message of the scientist.

Was there a decline in the number of popular science lectures being performed at the turn of the century? In retrospect we might answer in the affirmative if only because the nineteenth century seems to have been so defined by oratorical culture. One correspondent to *Nature* in 1920, choosing to write under the apt pseudonym 'Victorian', saw a qualitative rather than a quantitative decline:

> I am old enough to remember different times, and can recall with truth and gratitude the feeling of enthusiasm, and even of exaltation, which I had in early days on hearing or reading popular science lectures. I think of Huxley, Tyndall, Clifford, W. B. Carpenter, Lockyer, Roscoe, and some others. Science lectures then were aimed at showing how science did its work, and they brought into view something of the personality of the real scientific worker.[11]

[10] Oliver Gaycken, *Devices of Curiosity: Early Cinema and Popular Science* (Oxford: Oxford University Press, 2015), p. 24.
[11] 'Victorian', 'Popular Science', *Nature*, 104 (12 February 1920), 630.

'Victorian' distinguished between these 'real workers' and modern 'profane tickling of the groundlings'. Evidently, he believed that modern performances were just that, and lacked the scientific seriousness of a golden age of lecturing. Significantly, lectures in the past had brought into view the 'personality of the real scientific worker'; the character of the scientist, and his real or imagined presence on the stage, contributed to the authenticity of his science.

The question of whether the body of professional scientists more generally also felt that the status of the lecture and lecturer had changed, might be partially answered by a glance at a preliminary report, conducted by the BAAS in 1916, into a perceived decline in the number of public science lectures.[12] A Committee on Popular Science Lectures sent questionnaires to universities, technical colleges, associations such as the Gilchrist Trust and University Extension boards, local societies, and museums. Using the answers they received (150 responses in total), the committee compiled a twenty-six page report which was published in the Association's meeting *Report* of that year.[13] The document is unprecedented in its scope, and draws conclusions which reveal much about the ways in which professional scientists saw their roles at the beginning of the twentieth century. It collects such information as: the most popular scientific topics; whether entrance fees are charged and whether lecturers are paid; financial profits and losses; and whether lecture organizers perceived a change in the levels of public interest.

The resulting report consists of a patchwork of quotations and recommendations, in agreement and contradiction with each other. For example, Dr Fison, Secretary to the Gilchrist Trust, felt that there was a general decline in interest in science lectures among the working classes, even though the Gilchrist Lectures went from strength to strength (p. 340). This was partly, he wrote, due to the 'keen interest now taken by working-men in their trades unions and in labour problems in general', and also 'music-halls, kinema exhibitions, and football'. Fison,

[12] We should note that 45 years earlier, at the 1871 Meeting at Edinburgh, the BAAS had founded a similar committee (on which sat Roscoe, see chapter five), *Report of the Forty-First Meeting*, p. lxxiii. Like the 1916 committee, it suggested that a list of lecturers be drawn up, who were willing to tour local institutions.

[13] 'Popular Science Lectures – Interim Report of the Committee', *Report of the Eighty-Sixth Meeting of the British Association for the Advancement of Science, Newcastle-upon-Tyne, 1916* (London: John Murray, 1917), pp. 326-351.

like Roscoe fifty years earlier, clearly felt anxious that the working classes would organize themselves into a violent rabble if granted the opportunity, and, also like Roscoe, thought that a good dose of scientific instruction would pacify them. Mr G. T. Shaw, chief librarian of the Liverpool Library was proud to reply to the BAAS committee that, since the inauguration of lectures there in 1865, 2,324,090 people had attended. In contrast, Mr D. B. Morris, Town Clerk, Stirling, believed that ‘the popular lecture does not now occupy the place in public esteem which it did’ (p. 344). ‘The great popular interest which used to be taken in natural history arising out of the “evolution” controversy, and inspired also by the writings of Darwin, Wallace, Huxley, Lubbock, Kingsley, and others, has passed entirely away’. Anticipating the *Nature* correspondent’s comments, there is the sense that great men, and specific scientific subjects which piqued public interest, coincided at a particular moment, and that the scientific lectures of the past were no longer suitable.

The BAAS committee wrote that their ‘analysis of replies’ (p. 331) to the question, ‘[h]as public interest in popular science lectures increased or decreased in your district during the past ten or twenty years?’ was ‘inconclusive’. Any perception that there had been a quantitative decline may have been just that, a perception. But they did conclude that other entertainments were drawing people away from lectures (p. 350), and that in order to counter this, scientists must embrace new technologies to make their lectures as captivating as possible (and in line with this, the report even provides a list of suitable scientific films (pp. 346-349)). This was more important than ever:

> There is especial need at the present time of lectures showing the relation of science to many aspects of national life. Science and scientific method mean progress and efficiency, and the more this is recognised the greater will be the interest taken in the promotion of scientific study and investigation.
>
> (p. 349)

The war-time context of the report is apparent. The need to persuade the public of the national, practical importance of science, was so great, that the report termed it ‘propaganda work’ (p.

350). It need not be 'original investigators or distinguished professors' who did this, but merely those who were 'good speakers' with 'sufficient knowledge of the history of science and industry to show to an audience the debt which civilization owes to its scientific workers'. Such language indicates a movement away from the discoverer communicating his own research, towards a collective endeavour to persuade the public that "science" works as a single unit to promote and protect national interests. While scientific naturalists might have agreed with this aim, they had also wanted to be recognised as originators.

Popular science lectures in the form in which they appeared in the second half of the nineteenth century were a product of, and a genre which helped to form, British culture. The esteem in which oratory was held in all aspects of society was the result of the confluence of several historically specific factors: the increasing importance of transparency in parliamentary proceedings; newspaper reporting and accompanying technological advances in printing; education reform; Victorian theatricals and popular entertainments; and pulpit oratory. As an increasing number of public spaces emerged which were specifically designed for visual and aural entertainment, the figure of the lecturer – his voice, his body (and it was usually a man) – presented himself for public scrutiny. Importantly, a rapidly expanding print market allowed for this scrutiny to continue long after the lecture. The perceived connection between the external appearance of an "upright", calm speaker, and the extent to which his word should be trusted (a connection which was by no means confined to, but seems to have so dominated and in some senses defined, Victorian culture), provided scientific naturalists with the perfect justification for their popular work.

The strategies deployed by scientific naturalists to persuade the public of the national importance of science had worked both to institutionalize and professionalize scientific practice. The lecture had been an integral part of this development, but as a result the relationship between scientist and audience had changed irrevocably. In the early decades of the twentieth century, the popular science lecture became a tool with which to consolidate science's new position. New technologies increasingly let the science speak for itself, and the lecturer him- or herself acted as an enabler of that. Focus began to shift away from the figure of the lecturer, just as in wider scientific practice focus was moving towards anonymous, collective endeavour. Equally, the increasing commercial, industrial and military importance of science, which led in turn to increasing specialization, corresponded to a shifting attitude towards non-expert lecture audiences. Popular lectures moved away from discussing theories of scientific practice (what it meant to have an empirical outlook, how one might develop a better personal knowledge of science), towards emphasis of its impact on a macro level.

This shift in the utility of lectures is further concrete evidence in support of Theodore Porter's assertion that the fin de siècle witnessed 'a new phase of scientific naturalism', associated 'with technological productiveness rather than with [...] projects of enlightenment'.[14] In maintaining continuity with the nineteenth century, but simultaneously adopting new technologies and shifting the focus of its science, the popular science lecture mirrors the gradual evolution of scientific naturalism into, in the public's view, large-scale science and technology. Perhaps a precursor to twentieth-century science's 'productiveness' ethos, were such series as the *MSLP*, whose science was theoretical but whose intentions were economic. Scientific naturalism in the strictest sense was a peculiarly Victorian phenomenon, as were the public performances through which it was promoted. But the continuities, with gradual change, of the lecture form, paralleled similar developments in science, which did not simply break with its Victorian past.

[14] Theodore M. Porter, 'The Fate of Scientific Naturalism: From Public Sphere to Professional Exclusivity', in Dawson and Lightman (eds.), pp. 265-283 (p. 282).

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