
Article:
Finn, MA and Stark, JF orcid.org/0000-0002-0638-0804 (2015) Medical science and the Cruelty to Animals Act 1876: A re-examination of anti-vivisectionism in provincial Britain. Studies in History and Philosophy of Science Part C :Studies in History and Philosophy of Biological and Biomedical Sciences, 49. pp. 12-23. ISSN 1369-8486

https://doi.org/10.1016/j.shpsc.2014.10.007

Medical Science and the Cruelty to Animals Act 1876: A Re-examination of Anti-vivisectionism in Provincial Britain

Abstract

The Cruelty to Animals Act 1876 was an important but ambiguous piece of legislation. For researchers it stymied British science, yet ensured that vivisection could continue under certain restrictions. For anti-vivisection protestors it was positive proof of the influence of their campaigns, yet overly deferent to Britain's scientific elite. In previous accounts of the Act and the rise of anti-vivisectionism, scientific medicine central to these debates has been treated as monolithic rather than a heterogeneous mix of approaches; and this has gone hand-in-hand with the marginalising of provincial practices, as scholarship has focused largely on the 'Golden Triangle' of London, Oxford and Cambridge. We look instead at provincial research: brain studies from Wakefield and anthrax investigations in Bradford. The former case elucidates a key role for specific medical science in informing the anti-vivisection movement, whilst the latter demonstrates how the Act affected the particular practices of provincial medical scientists. It will be seen, therefore, how provincial medical practices were both influential upon, and profoundly affected by, the growth of anti-vivisectionism and the passing of the Act. This paper emphasises how regional and varied medico-scientific practices were central to the story of the creation and impact of the Cruelty to Animals Act.

Keywords

Anti-vivisection; Wakefield; Bradford; asylum; anthrax; Ferrier.

Highlights

Provincial medical science influenced anti-vivisectionism in Victorian Britain;
The Cruelty to Animals Act (1876) significantly affected provincial medical research;
More attention needs to be paid to the differences between metropolitan and provincial science.

Introduction

The anti-vivisection movement in Victorian Britain had a discernable and long-lasting impact on British medical science. A dynamic exchange of influence existed between the politically-charged, social movement of anti-vivisectionism, and the scientific theories, practices and people it sought to curb. As several authors have highlighted, the movement was catholic in its affiliations, driven by a number of different factors.[1] Class divisions, xenophobia, a sentimental attachment to pets, evangelical and moral crusading, disquiet over the development of medicine down an increasingly scientific and experimental path: these and several other deeply-embedded social issues lay behind a heterogeneous movement of concerns and variously motivated individuals. Anti-vivisection sentiments did not spring from nowhere, but rather crystallized in the 1870s in reaction to professional and educational developments in British physiology and other biological disciplines that ostensibly necessitated the practice of vivisection for their increasingly experimental inquiry.

As Richard French has made clear, a long-held fear amongst campaigners that Britain would follow the barbarous route of German and French physiology was made real by John Burdon-Sanderson's 1873 *Handbook for the Physiological Laboratory*, which specified dozens of classical animal experiments to be repeated endlessly by students.[2] A barrage of petitioning and canvassing tactics followed, which saw success when the protestors forced a Royal Commission in 1875, leading, in 1876, to the Cruelty to Animals Act. Under the Act, vivisection could be conducted only for original, useful purposes, with a license from the Home Secretary. Laboratories used for such experiments needed prior approval, and animals could be kept alive, tested without anaesthetic or used for demonstration only with special dispensation from the Home Office. Amongst those who supported vivisection, it was commonly complained that British experimental medicine, already seen as backwards compared to its continental neighbours in France and Germany, was greatly hampered by the 1876 Act. British physiology had no sooner risen from its mid-century hiatus than its practitioners felt they were being hamstrung by severe experimental restrictions.[3] Anti-vivisection supporters, however, generally regarded the Act as a concession to the scientific lobby, and continued to campaign against all forms of animal testing, especially for teaching purposes. Both groups therefore regarded the Act as an unsatisfactory irritation: it was either too restrictive or too lenient.

In this paper, we return to events surrounding the 1876 Act, to further investigate some of the forces that shaped it and to question how it in turn affected medical and scientific practices in Britain. This is done through an analysis of two particular areas of medical study that became a part of the anti-vivisection debates: research into the brain, and research into anthrax. In looking at the first case – physiological brain research in the 1870s – we argue that it was not just animal experimentation but the particular theories that developed from such experimentation, and even the place in which these theories were conceived, that attracted the opprobrium of anti-vivisection campaigners and in turn influenced the creation of the 1876 Act. Then in the second case, of medical investigation conducted into anthrax between the late 1870s and the early-twentieth century, we illustrate the enormous impact that the 1876 Act had on research, and thus how, in conjunction with medico-scientific developments elsewhere, it shaped medical understanding of a much-feared illness. Considered together, these two episodes show how there existed a dynamic relationship between anti-vivisectionism and scientific theories and practices. On the one hand, the anti-vivisection movement was galvanised and inspired in response to the physiological methods and findings of individuals such as David Ferrier, the leader of experimental brain research in the period; whilst on the other, legislation regulating vivisection had a discernable and significant impact on the character and findings of local research into anthrax from the late 1870s onwards. Medical science was no monolith, but a mixture of different ideas and practices which interacted in various ways, and places, with the anti-vivisection movement.

Although these two areas of research represent endeavours in quite different fields of enquiry, they are linked not only by their relationship to the anti-vivisection movement but also by their geographical proximity, with both originating in the West Riding of Yorkshire in Northern England. The brain localization studies conducted by David Ferrier began at, and remained associated with, the West Riding Lunatic Asylum in Wakefield, whilst fifteen miles-away Bradford, an industrial town at the heart of the textile industry and already widely-known for scientific enterprise, became a centre for studies of anthrax.[4] There is some symmetry here; a pathway of cause and effect from one town to the other. The study of specific medical scientific theories which began in Wakefield shaped the creation of the

1876 Act, and the Act in turn shaped specific scientific medical theories in Bradford. However, whilst the influence of developments in Wakefield was unique, the effects in Bradford could, at least in principle, be found in towns across Britain. This paper therefore invites scholars to look with fresh eyes at the influence which the Act had outside of the metropole. Indeed, provincial medical practices in nineteenth century Britain, though the subject of some study, have been little considered in relation to the anti-vivisection movement.[5] Rather, attention has been concentrated on experimental practices in the 'Golden Triangle' of London, Oxford and Cambridge, where vivisection licences could be obtained with relative ease. Current literature shows that British medical practice and theories developed along different lines to those of Continental Europe during the nineteenth century, at least partly as a result of different relationships between provinces and metropole.[6] In this paper we refine this idea of the uniqueness of British medicine, and ground it in specific institutional practices, many of which informed, and were informed by, anti-vivisection sentiment and legislation.

From early beginnings in animal dissection in the ancient world, through to the revival of human anatomical investigations in the sixteenth century and beyond, the role of animals in producing medical knowledge has been in flux. In the nineteenth century a focus on physiological processes in action, and the advent of germ theories of disease and their claims to universality for disease causation, led to renewed interest in extrapolating from animal models to understand human physiology and pathology. Despite the increased use of animals in medical study, however, histories of medical institutions in provincial Britain in the Victorian period have tended to marginalise the importance of both vivisection as a practice and anti-vivisectionism as a movement.[7] Meanwhile accounts of dissection-based teaching in nineteenth-century Britain have principally explored the trade in bodies in order to demonstrate Victorian uneasiness with the use of such methods.[8] These studies have likewise taken the Golden Triangle as their main focus. Amongst these, Elizabeth Hurren is noteworthy in moving focus away from examining London, Oxford and Cambridge in isolation to instead consider the role of Manchester and other provincial towns in the availability and use of bodies and body parts in medical education.[9] These accounts offer important insights into the place of both provincial medical practices and attitudes towards

dissection in the nineteenth century. However, despite resonating very closely with these themes, vivisection and anti-vivisectionism are notably absent from such scholarship.

This paper therefore invites historians of science and medicine to re-examine not only the early development of the anti-vivisection movement, but also the influence which the 1876 Act had on medical science more widely, provincial or otherwise. Moving beyond the 'Golden Triangle,' it adds to previous studies of the anti-vivisection movement in Victorian Britain by, firstly, expanding upon the movement's links with debates over materialism and neurological and psychiatric practice, and secondly, by showing that outside of the circle of prestigious physiologists that are most often considered, the 1876 Act had a very real effect in changing the path of anthrax research in provincial Britain. The relationship between animals and humans in Victorian science is a source of rich material: here we seek to understand some of the problems that attended the passage of information and illness between them.[10]

David Ferrier, brain research and the background to the anti-vivisection movement

In March 1873, David Ferrier, a 26-year old physician from King's College, London visited the West Riding Lunatic Asylum in Wakefield to conduct a series of experiments on the brains of animals. His research soon led to an article, published in the asylum's own *Medical Reports*, and was to have a profound effect on medical investigations over the following thirty years.[11] Working in the asylum's pathological laboratory and utilising "a liberal supply of pigeons, fowls, guinea-pigs, rabbits, cats and dogs," Ferrier stimulated the cerebral cortex in a range of animals to produce actual bodily movement.[12] He had also been able to precisely locate where in the cortex to insert his electrodes to stimulate specific muscular action. He had, in effect, provided concrete evidence that mental functions were localized at definite sites within the brain, and could be mapped. The results spread quickly, and were widely discussed by leading figures in the scientific and lay communities, attracting both praise and criticism aplenty.[13] Spurred on by his success, Ferrier carried out more tests on dogs, jackals, cats and macaques paid for by, and operated on at, the Royal Society of London throughout 1873.[14] He also developed his experimental techniques, not only stimulating but removing ("ablating") parts of the cortex, helping to advance ideas on cortical function that would form the basis of his widely popular 1876 work, *The Functions of the Brain*.[15] For the rest of

the century, cerebral localization developed as a huge programme of research in Britain and across the world, as experimenters copied and built upon the methods of Ferrier. In doing so, they sought to contribute towards a fuller and more complete scientific understanding of mental activities (see Figure 1).

Though cerebral localization was quickly accepted by most of the scientific community, it was still a highly contentious theory, and Ferrier, as progenitor of this programme, became the focus of various criticisms.[16] Reviewers in both medical and non-medical press appreciated the novelty and value of his findings, but pointed out how much he was unable to explain and how much more remained to be done. Several eminent scientists were at odds with his work, as they remained supportive of a holistic view of the brain, not one of compartmentalised function. Édouard Brown-Séquard, international man of neurology, maintained his opposition to cerebral localization, whilst John Burdon-Sanderson – a fellow vivisector and friend who had first presented Ferrier's work to the Royal Society – devised a counter-experiment that contradicted Ferrier's theories.[17] George Henry Lewes, famous author, scientist and husband of George Eliot, was also opposed to the reductionism and "false persuasion of knowledge" which he saw in Ferrier's book. Having studied the brain in great detail himself, he was able to warn readers in 1876 that "from long occupation with his subject, Dr. Ferrier has become unable to see it in any other light than that of his own hypothesis."[18] Ferrier had waded into a debate, on the relation between mind and body, which was centuries old and which had increasingly become a subject of both popular and academic discussion through the middle decades of the nineteenth century.[19] His researches were exciting but raw, and his conclusions based on, to some, a simplistic and even dangerously reductive view of the mind. [20] As one reviewer summarised in 1879:

> Dr. Ferrier's views have met with vigorous criticism, and are at this moment undergoing a fire of argument and counter-experiments which will probably modify some parts of the great propositions which he has laid down. Such work as his is vulnerable at all points of detail if not of principle.[21]

Frances Power Cobbe and public psychological sentiment

Ferrier's work was, however, attacked on its principles too. Cerebral localization was not just reductive of empirical explanation, but reductive of the human soul. Just as phrenology's supporters in the first half of the century had been accused of propagating materialist psychology, Ferrier's "new phrenology," as it was termed by its critics, was seen by some as an attempt to remove God from the human mind. Such physiological researches fed into scientific and religious debates in Victorian Britain, and became evidence in the arguments over materialism which followed John Tyndall's 1874 Belfast Address.[22] Ferrier's investigations crossed those two constructs of modernity, science and society, and this was especially clear in his influence upon the direction of early anti-vivisection campaigners. In an 1875 article entitled "The moral aspects of vivisection," Frances Power Cobbe wrote that "[t]he common passion for science in general and for physiology in particular, and the prevalent materialistic belief that the secrets of the Mind can be best explored in matter, undoubtedly account in no small matter for the vehemence of the new pursuit of original physiological investigations."[23] Cobbe, who founded the prominent Victoria Street Society and was the single most influential figure of the anti-vivisection movement in Britain, saw experimental brain studies as unquestionably linked with materialism and a driving force behind the recent rise of animal experimentation. Cobbe's understanding is important, as it formed part of her underlying motives in the antivivisection campaigns she led in the late-nineteenth century, which in turn represented the fiercest opposition to the work of Ferrier and the cerebral localisers for around thirty years.

Earlier in the decade Cobbe had contributed two complementary articles to *Macmillan's Magazine* on the subject of psychology. In the first of these, "Unconscious Cerebration: A Psychological Study," she argued:

> should physiology establish the fact that the brain, by its automatic action, performs all the functions which we have been wont to attribute to 'Mind,' that great discovery will stand alone, and will not determine, as supposed, the further steps of the argument; namely, that our conscious selves are nothing more than the sum of the action of our brains during life, and that there is no room to hope that they may survive their dissolution.[24]

Cobbe took the idea of unconscious cerebration – then a fairly orthodox theory in British science – from the famed London zoologist W.B. Carpenter, to show that though it explained much, there was a great deal that it failed to account for.[25] In her words, "the limitations and failures of unconscious cerebration would supply us with as large a study as its marvellous powers and achievements."[26] She agreed with Carpenter on many points, but drawing on "an easy and every-day psychological study as may be verified by every reader for himself, an argument [arises] for belief in the entire *separability* [sic] of the conscious self from its thinking organ, the physical brain."[27] Her trust in the ability of ordinary people to be able to engage in true scientific thinking was central.

Cobbe's clash with the experimenters over the role of the brain can be seen in the context of the contemporary debate ongoing between Charles Darwin and Alfred Russel Wallace over the appearance of human intellect. Where Darwin took it that evolutionary theory could account for the development of the higher faculties, Wallace insisted that human intellect and morality could be accounted for only by the influence of a spiritual power.[28] In her second article on the subject, Cobbe continued this idea to show how dreams provided daily proof of an immaterial, conscious mind, separate from the brain as a "machinery of thoughts": in sleep the brain, "released from its bit and rein, plays like a colt turned to pasture."[29] Besides the metaphor of the unchained animal, apparent in both papers was an approach to psychology that was completely undermined by Ferrier and his studies of cerebral localization. Both Carpenter's 'unconscious cerebration,' and the notion that non-scientific members could contribute towards understanding of the brain, were dismissed by the new physiological studies. Ferrier demonstrated in the most macabre fashion that volitional acts were not reliant on a conscious, immaterial mind, making cats claw and macaques kick simply by stimulating a small region of the animals' cerebral hemispheres. Only empirical investigations, resting on observation and experimentation with actual brains, could contribute to this version of scientific progress. The reading public could only be passive in the uptake of knowledge, even when that knowledge challenged their personal belief in the separation of mind and brain. The public did not have to remain passive, however, with regards to the methods by which scientists produced such knowledge.

Ferrier as a symbol of fear and fiction to anti-vivisectors

Following the passage of the 1876 Act through Parliament, anti-vivisection campaigners were indignant at what they saw as a concession to the scientific lobby in allowing vivisection to continue. Thus, after two aborted attempts, they finally prosecuted an individual for breaking the laws regarding vivisection in 1881: David Ferrier. In a well-documented session of the 1881 International Medical Congress in London, Ferrier debated the theory of localization with his German holist opponent, Friedrich Goltz.[30] Both Goltz and Ferrier argued in support of their own theories of brain function, and each had a test animal to be prepared and studied as their crucial experiment: for Goltz, a dog with much of its frontal lobes removed yet which showed no loss of motor or sensory function; for Ferrier, a monkey with no voluntary control of its right-sided limbs after having had its left motor cortex removed months earlier. When both animals were dissected it was observed that the monkey's brain was as Ferrier described, but Goltz's dog had much more of its cortex intact than had been anticipated. Ferrier's monkey won the day, but around three months later he was summoned to court for operating on animals without an appropriate license. The case was soon thrown out, however, when it was revealed that Ferrier's assistant, fellow physiologist Gerald Yeo, had actually conducted all the experiments, and was in possession of a full license. Cobbe's prosecution failed, and the scientific community breathed a collective sigh of relief.

Support for Ferrier from across the country was evident in the letters received by newspapers and medical journals after the case, with *The Times* and *British Medical Journal* in particular taking allegiance with him. The day after the trial the *BMJ* led with a 3-page article espousing the benefits and necessity of Ferrier's research, whilst printing another seven pages dedicated to reporting the case in full at the back of the issue. Comparing Ferrier with Galileo, Galvani and Pasteur, they argued that in pressing charges "[i]t would hardly have been possible to select a physician whose researches have done so much as his to throw light on the nature of the most important functions of the human race, those of the brain."[31] Ferrier's defenders made reference to the possibility, or indeed the actuality, of surgery using his maps of the brain, and the untold benefits his work could have: there was no doubt in their minds as to the weight of his accomplishments.

Anti-vivisection campaigners turned to reflect on their movement, and to repeat to their audiences the potential tragedies that lurked in a country that did not seriously resist animal experimentation. The incidence of such operations would undoubtedly continue to rise, and scientists would push the boundaries of decency further, yet without contributing towards the 'progress' of society that was meant to be their aim. Indeed, in a society openly tolerant of testing on animals, surely it was only a matter of time before scientists turned to other humans as their test material? Writing in 1882, one anti-vivisection campaigner noted how:

> [t]he German physiologists ... rapturously rush to the torture-trough, and the French and Italian physiologists out-rival each other in their relations of their wanton and exultant ingenuity in producing unnatural agony and watching its helpless struggles. That these men do not immediately give themselves the greater luxury of human victims is due only to their timidity before public opinion ... Why shall not the physiologist claim the cripple, the mute, the idiot, the convict, the pauper, to enhance the "interest" of his experiments?[32]

This sentiment genuinely chimed with certain members of the public who were fearful of modern scientific medicine and the claims it made over their bodies, whether alive or dead. As French has shown, along with anti-vivisectionism, the early anti-vaccination movement and the bitter campaigns that followed the passing of the Contagious Diseases Acts were two other significant manifestations of this general concern with the creeping power of scientific and medical authority.[33] The worry of potentially being experimented upon like vivisected animals also had a resonance with criticisms of asylums in the mid-to-late nineteenth century. Asylums were remote, foreboding and obscure institutions, whose working practices were mostly misunderstood and often dreaded. Alienism – the profession of treating the insane – was as foreign to most men and women as were the grotesque experimental practices of Continental science. There was public concern at the restraint and mistreatment of asylum patients, who might be treated like brutish animals by their attendants. As the asylums grew, so did criticisms of them, particularly of the legislative power of the asylum to commit insane or even sane individuals.[34] Out of this worry came the Alleged Lunatics' Friend Society (1845-63), forerunner to the Lunacy Law Reform

Association (1873-85) – both groups whose arguments and agitations were eventually successful in leading to significant changes in English Lunacy Laws.

David Ferrier had conducted his first investigations into cerebral localization at the West Riding Lunatic Asylum, Wakefield, cementing the links between the asylum, experimentation and vivisection. With the resources and autonomy to run the asylum according to his own plan, the Medical Director at Wakefield between 1866 and 1876, James Crichton-Browne, led one of the most active schools of research in the world there into the causes and treatments of insanity. He had invited his friend Ferrier to begin his work in the asylum's laboratory, providing an opportunity that was scarcely available elsewhere at the time. Provincial county asylums, though often seen as backwaters, were home to a wealth of scientific and medical research in the nineteenth century. Indeed, after the passing of the 1876 Act, Wakefield was one of the few sites given a license to continue experiments on animals, though only on the condition "that all such experiments be limited to the administration of drugs by injection or otherwise without cutting further than may be necessary for the use of the sphygmograph under anaesthesia".[35] No more stimulation or ablation experiments were to be conducted in the asylum after 1876. Interestingly, little mention was ever made in the asylum's annual journal reports of the building of the laboratory, which Cathy Gere has speculated was a consequence of Crichton-Browne and his committee attempting to limit the damaging publicity surrounding the vivisection experiments that were conducted there.[36]

Though Ferrier and some other visiting researchers studied animals in the lab, the majority of investigations at Wakefield involved patients, whether through clinical observation, experimental trials of drugs and other therapies, or pathological dissection. Here was a medical institution not just using experimental science, but actually testing it on its fifteen hundred patients: paupers unlikely or even unable to contest their treatments.[37] Cobbe voiced a terrifying possibility: "[s]hall we have our hospitals employed in ingeniously proving Professor Ferrier's cerebral investigations and painful experiments on the brain of a dying patient who sought the shelter of that 'Good Samaritan' institution?" She was referring to an unwelcome precedent across the Atlantic, where the Ohio physician Roberts Bartholow had already replicated Ferrier's electrical stimulations on Mary Rafferty, a young cancer

patient under his care at the Medical College, evidence of which Ferrier used in support of his own claims.[38] Though he had spent only one month testing animals in Wakefield, Ferrier, cerebral localization and the asylum became conflated in anti-vivisection literature in the last quarter of the century. The concern, that patients might be treated as little more than a body of working parts for live experiments, was presented most forcefully by the anti-vivisectionists. When the 1876 Act had passed through its second reading in the commons, the MP James Maden Holt argued of Ferrier's researches:

> They manifest a refinement of cruelty which renders the operator, in my opinion, quite unfit to be trusted with the care of an animal, much less of a human being. When it comes to the knowledge of the public that these are the practices of a medical man who has free access to the lunatic asylums of the West Riding, public indignation will know no bounds.[39]

Anti-vivisectors produced pamphlets which attacked Ferrier directly, criticising his role in the 1881 trial and highlighting problems with his experimental findings. Not only were the actions of vivisection ghastly, but "the most distressing feature of these experiments is... there is no finality in them."[40] Campaigners pointed out the scientific challenges to cerebral localization, and the futility of current physiological methods in trying to solve them, as every animal was different and every experimenter understood his results differently. They referenced the pages of *Brain*, the neurological journal formed in 1878 by Ferrier and Crichton-Browne along with John Hughlings Jackson and John Charles Bucknill, where localization was under constant question and revision in continuation of work begun at Wakefield. The "cold, proud, atheistic spirit that distinguishes modern investigators" had not, and would not, succeed in localizing all mental functions.[41] The anti-vivisection movement, as Star has argued, provided the strongest opposition to the nascent doctrine of localization, and yet actually worked to unite its supporters in defence of the theory and the necessity of vivisection.[42]

Ferrier, localization and vivisection also became topics for several prominent novels of the time. In *Heart and Science* (1883), Wilkie Collins had Ferrier in mind when writing explicitly in support of the anti-vivisectionist cause. Initially published as a serialization in the

Manchester Weekly Times Supplement between July 1882 and January 1883, and then as a book in April 1883, it came in response to Ferrier's 1881 trial.[43] Collins "contrived to make use of Professor Ferrier – writing on the 'Localisation [*sic*] of Cerebral Disease,'" and sought to "drag the scientific English Savage from his shelter behind the medical interests of humanity."[44] Pedlar noted how one of the novel's key figures, Dr. Benjulia, is an eccentric scientist operating in seclusion and obscurity, carrying out tests on animals only because testing on humans was illegal. Collins' "unashamed piece of polemic" against vivisection alluded to the dehumanising effect cerebral localization had, not just on the blood-spotted experimenter, but on all humanity, whose brains became reduced by it to mere machinations.[45] H.G. Wells' *The Island of Dr. Moreau* (1896), as Otis has argued, places Ferrier as part of the theoretical background underpinning Moreau's attempts to manipulate the mental structure in animals, so as to think and communicate like humans.[46] The vivisected animals, which jabber and are kept in conditions similar to asylum patients (at least in the imagination of the public), eventually turn on Moreau. Furthermore, in *Dracula* (1897), Bram Stoker drew attention to the way modern psychology, in acquiring a more physiological basis, construed humans as automata devoid of a soul. The links to Ferrier and the institution in which he first investigated the brain were made explicit, as Dr. Seward, an asylum superintendent, writes: "Had I even the secret of one such mind – did I hold the key to the fancy of even one lunatic – I might advance my own branch of science to a pitch compared with which Burdon-Sanderson's physiology or Ferrier's brain knowledge would be as nothing."[47] Stiles has written that the "cautious, orthodox Dr. Seward represents mainstream science, with its admiration for the materialist conclusions of Ferrier and Burdon-Sanderson," indicating that whilst some were enamoured with Ferrier's breakthroughs, there was also a general feeling of disquiet towards the increasingly materialist developments of cerebral localization.[48]

From asylums to anthrax

Ferrier, the asylum at which he began his investigations, and the materialism to which his research offered support, were thus key factors which influenced the shape, scope and arguments of the anti-vivisection movement. Anti-vivisectionism was substantially influenced by Ferrier and his work, as well as the religious and moral implications of cerebral localization. Cobbe made explicit reference to Ferrier's experimental approach, and he

became one of the principal targets of the anti-vivisection literature. After the 1876 Act and Ferrier's trial in 1881, the last serious attempt by campaigners to have vivisection abolished through statute came in 1883, when objecting MPs brought the Bill for the Abolition of the Practice of Vivisection before the House of Commons. At the second reading of the Bill on 4 April, the Liberal MP Sir Robert Reid described a series of experiments on the brains of monkeys taken from the Royal Society's Croonian Lectures, given several years earlier by Professor David Ferrier.[49] "In these experiments," he declared:

> a hole was made in the top of the head of a monkey [...] hot wires were put down the hole, and these hot wires were worked about in the brain, so as to destroy this or that portion of the brain as might be desired. There are several ways of destroying the brain. Sometimes they cut away a slice of the brain with a knife. Sometimes an ingenious Professor uses a squirt to throw water in the brain and wash it away.[50]

Reid relayed the "illustrations of these horrible operations" in some detail, hoping to stimulate a sympathetic response from his fellow members. His main adversary in the House was another Liberal MP, Mr (later Sir) Lyon Playfair, Member for the University of Edinburgh. In criticising the bill and defending the 1876 Act, Playfair – a former Professor of Chemistry and member of the elite 'X-Club' – clearly had scientific prerogatives in mind: in fact, he had been largely responsible for the passing of the 1876 Act through the Commons. Ferrier had written to Playfair before the 1876 Act was passed to warn him against the sentimental proposal to exempt cats and dogs from vivisection. "The spirit of modern medicine is the endeavour by careful and exact physiological research to determine the action of drugs and place therapeutics on a scientific basis," Ferrier advised, and limiting the experimenter to working on lower animals "would be fatal to the progress of physiology and pharmacological investigation."[51]

In 1883 Playfair thus petitioned to the House not to allow any Bill to pass to "drive English physiologists to foreign countries, or to make them work secretly to evade an unjust law, and thus brand as criminals men whose whole object is to ameliorate the condition of suffering humanity."[52] Rather than appealing to their emotions, as had Reid, Playfair played to the common sense and national pride of his colleagues. In addition to the detrimental

effects on British science that abolition would have, banning vivisection would also be detrimental to the health, and the wealth of the nation. He took for one of his examples the "disease anthrax, or splenic fever", which desolated sheep flocks and had, until the recent discoveries of Louis Pasteur, killed sheep in France "to the value of 20,000,000 francs annually." "[The] sacrifice of a few mice or guinea-pigs", he thought, "would surely be justifiable in obtaining a lasting boon to humanity."[53] Moreover, as Playfair saw it, abolishing vivisection in Britain would not only be damaging to British scientific and medical practice, but it would ultimately be futile in its objectives: "[y]ou may retard, but you cannot arrest the progress of science."[54] His view held sway, as the Bill did not pass, and the 1876 Act went on to last 110 years, only being replaced in 1986 by the Animals (Scientific Procedures) Act.

Playfair referred explicitly to anthrax as a disease which had now come to occupy an important place in the vivisection debate. Louis Pasteur's recent success in producing a vaccine against anthrax in animals, argued Playfair, might be extended to protect "man against the attacks of many maladies which are produced by similar germs."[55] Two years later, a leading article in the *BMJ* likewise stated that "the prevention of anthrax, splenic fever, [and] fowl-cholera ... are the recent gifts of vivisectionists to the human race."[56] Such research had, however, been almost entirely restricted to Continental Europe, and the "gifts of vivisectionists" had emanated not from Britain, but from France.[57] British efforts to produce a vaccine against anthrax had been limited to small-scale research at the Brown Animal Sanatory Institution, where a moderately successful animal vaccine had been produced around 1880, but which was never put into mass production.[58]

In order to account, at least in part, for the differences between British and Continental research into anthrax, we now move from the physiological research of Ferrier to the biomedical work of two key figures in British anthrax research. The investigations of Bradford-based practitioners John Henry Bell and Frederick William Eurich, which were substantially influenced by vivisection regulation that restricted the level to which they were able to secure permission for, and perform, inoculation experiments. Our story shifts attention away from 'Golden Triangle' institutions which currently dominate the literature, such as the London-based Brown, and looks at how provincial anthrax research was affected

by the 1876 Act. Bradford, in the West Riding of Yorkshire, experienced by far the largest number of cases of this disease during the late-nineteenth and early-twentieth centuries.[59] The condition, originally known as 'woolsorters' disease,' emerged from the town's burgeoning wool industry, and appeared chiefly in conjunction with fleeces imported from Turkey, where anthrax was endemic. Bradford thus became an important centre for studying the disease, principally through the work of Bell and Eurich. As Bradford's most prominent anthrax investigators, Bell and Eurich offer the ideal opportunity for studying the influence of the 1876 Act on provincial research practices.[60] Whilst research into this condition in both Germany and France – largely through the work of Robert Koch and Louis Pasteur – abounded in this period, it was very different in character from that seen in Bradford.[61] We argue that the nature of research into anthrax in Bradford was to a large extent shaped by the Cruelty to Animals Act 1876 in a town whose residents were willing to tolerate and even encourage whatever methods could remove the dreaded woolsorters' disease. Indeed, episodes such as the widely-publicised and seemingly successful treatment by Pasteur of five Bradford children suffering from rabies in 1886 further softened the attitude of the townsfolk towards vivisection. Despite this, as we shall see, local researchers still found their work directed by the stipulations of the Act.

Vivisection licenses and early anthrax research

Vivisection apologists in the West Riding had defended their practices throughout the 1870s. During his Presidential address at the Leeds Medical College in 1878, Dr John Eddison, referencing the work of Ferrier, made a forceful argument "against those who poured out copious volumes of violent abuse against distinguished physiologists" as a result of their continued practice of vivisection.[62] Eddison was a passionate advocate of the practical benefits of vivisection, and had recently returned from the bacteriological laboratories of Paris. In February of the same year, he also gave crucial advice to another local medical practitioner, John Henry Bell, suggesting that there might be some link between two previously unconnected diseases: woolsorters' disease and anthrax.[63]

Woolsorters' disease – a mysterious condition affecting those in wool trade – was familiar to the Bradford public by the time the 1876 Act came into force. Bell, a well-respected local medical practitioner, was the first to investigate the disease in a systematic manner.[64] He

visited factories and spoke to workmen, attempting to re-examine what might be the cause after lime and dust had been posited as the offending substances from the 1850s.[65] When he first presented his findings to the Bradford Medico-Chirurgical Society in February 1878, Bell was of the opinion that the disease was "[s]epticaemia due to the inhalation of a septic poison, produced by decomposition of animal matter in damaged bales."[66] There was some support for his idea, and a full version of the paper appeared in the widely-circulated *Bradford Observer* the following month.

By then, however, Bell had already discussed the matter with Eddison, who advised him that there might be some link between splenic fever (anthrax) in cattle and woolsorters' disease in man. Following up this suggestion, Bell attempted to demonstrate that there was a common cause underlying these two conditions. Not holding a vivisection license, Bell was unable to conduct the necessary inoculation experiments himself. Instead he enlisted the services of Eddison, who performed the requisite investigations according to Bell's directions.[67] Whilst Bell was thus reliant on the cooperation of Eddison in carrying out some limited vivisection experiments, far more prolific was his own, factory-based work. He continued gathering information from those working in the industry, and placed particular emphasis on the site of infection in patients, their ages, the duration of illness, treatments provided and, perhaps most importantly, the occupation of the sufferers (see Figure 2).[68]

Bell was able to show that woolsorters' disease affected individuals from a far broader series of trades, including butchers, cattle-minders, plasterers and tanners. He proposed that the alternative term 'anthracaemia' should instead be used to describe the disease, in order to move away from the narrow connotations of an illness specific to woolsorting.[69] The *BMJ* was supportive of Bell's re-categorization of the disease, insisting that the use of 'woolsorters' disease' reduced wider awareness of what was a more pervasive condition than first thought.[70]

By the winter of 1879, Bell had satisfied himself that *Bacillus anthracis* was the organism which caused woolsorters' disease, and was confident enough to put forward his views in print.[71] He presented again on the topic at the Bradford Medico-Chirurgical Society the following February, where his revised theory was poorly received.[72] This meeting of the

Society was, however, instrumental in establishing amongst its members a Commission on Woolsorters' Diseases whose principal object was to identify more definitely what the cause might be.[73] The Commission met over thirty times during the following two years, and investigated a number of cases which its members encountered, but failed to find a consensus.[74]

Whilst the divisions within the Commission are interesting in and of themselves, particularly instructive for our purposes are the experimental procedures to which they adhered.[75] Although the Commission carried out animal inoculation on a number of occasions, this was actively minimised to avoid the problems associated with obtaining (and operating under) a license to practice vivisection.[76] Despite the inclusion of several detailed inoculation experiments in the Commission's final report, none of its members possessed such a license, and they were required again to seek the assistance of colleagues at the Leeds Medical College.[77] In order to circumvent these practical difficulties, the Commission also analysed blood drawn from healthy animals, a practice which did not require a license. Their hope in so doing was to demonstrate that bacilli were not present under normal circumstances, and therefore had some relationship with disease.[78] Crucially, this represented a novel approach to demonstrating a possible causal role for bacilli: rather than showing the presence of specific germs in cases of disease (the classic *modus operandi* of Koch, as evidenced by his now-famous postulates, and Pasteur), the goal was to note their absence in health. The members of the Commission were in effect reliant on a weaker form of proof than their counterparts elsewhere.

Unlike those working at the Brown Institution, therefore, members of the Commission were not able to carry out vivisection on a scale sufficient to provide them with either the opportunity to develop an attenuated vaccine or even a reliable indication as to the cause of woolsorters' disease.[79] In fact, by 1882 only five out of the Commission's twelve members, one of whom was Bell, were of the opinion that *Bacillus anthracis* was directly responsible for woolsorters' disease, despite the far more coherent national consensus which had emerged surrounding the nature of the condition.[80] Ultimately, the findings of the Commission were published "for private circulation only," distributed solely amongst members of the local medical community.[81] Whilst this may have been due in part to the

apparent failure of the Commission, the fact that a significant number of animal experiments were carried out by colleagues not directly associated with the Commission doubtless played a role in the decision to keep the details of these methods and findings out of the public domain. Indeed, although there was much press attention surrounding the establishing of these investigations in 1880, no reference was made within Bradford's two major newspapers – the *Bradford Observer* and *Bradford Daily Telegraph* – to the Commission's final report, indicating its apparent obscurity in an otherwise lively public debate.[82] Although Bell was able to satisfy himself of the causal role of *Bacillus anthracis*, he was able to inspire fewer than half of the Commission's members to agree with him. The Commission noted in its final report that:

> Messrs. and Drs. Butterfield, Bell, Rabagliati, Roberts, and Goyder, were of the opinion that the affection was internal anthrax or splenic fever, and that the cases of malignant pustule were external anthrax; and that the Materies Morbi of both, was the Bacillus Anthracis … Messers. and Drs. Burnie, Appleyard, Britton, Meade, and Ellis, were also of opinion that woolsorter's disease was internal anthrax or a form of splenic fever … but they were undecided whether the Bacillus Anthracis was the Materies Morbi of the affections, or not.[83]

Bell's colleagues did not attempt to emulate Continental approaches, and instead sought alternative methods in order to avoid practising vivisection on a large scale. Public and professional debates about the cause of anthrax and woolsorters' disease therefore persisted well into the 1880s; a lack of consensus amongst Bradford's medical community left an explanatory vacuum, which local newspapers, workers and employers attempted to fill, even after Pasteur, Koch and their adherents felt the matter had long-since been settled. Indeed, whilst Koch's posthumously-named postulates might have been the final nail in the coffin for theories of spontaneous generation as far as continental practitioners were considered, they remained a topic of considerable debate in Britain for some years afterwards.[84]

Vivisection licenses and anthrax in the early-twentieth century

Over the final two decades of the nineteenth century, Bradford employers and workers agreed on numerous local regulations to try and minimise the occurrence of anthrax in the town.[85] Concurrently, medical consensus as to the cause of the disease gradually coalesced around *Bacillus anthracis*. Although there was an increase in the awareness of both cause and possible methods of prevention, the number of cases of the disease in West Yorkshire continued to rise. It was against this background that renewed efforts to find a means of preventing the disease were instigated in the first decade of the twentieth century. At the heart of these endeavours was Bradford's other prominent anthrax investigator: Frederick William Eurich.

Eurich was an avid microscopist, having been trained in environments receptive to emerging germ theories of disease at Edinburgh and Heidelberg.[86] He held the position of city bacteriologist in Bradford from 1901, and four years later was installed as bacteriologist to the newly-formed Anthrax Investigation Board for Bradford and District. This organization, consisting of employers, workers, factory inspectors and union representatives, aimed to identify a suitable disinfectant for dangerous wools, and Eurich was appointed to this end.[87] The Board arranged for Eurich to carry out the necessary experimental work at Bradford Technical College from 1905, but conditions were so poor that he dubbed his laboratory "the rat-hole."[88]

He was further hampered by the attitudes of the Bradford Town Council's health committee towards the practice of vivisection. In his words, "the health committee would not allow its premises to be licensed for vivisection."[89] By the turn of the twentieth century, regulated vivisection had become a standard practice in both universities and emerging public health laboratories. Bradford Town Council, however, were unwilling to court controversy by endorsing vivisection, even under license, on their premises. Perhaps surprisingly, given the highly-publicized success of the rabies vaccine for a number of the Bradford townsfolk some twenty years earlier, they bluntly refused Eurich permission to seek a license for any of their premises.[90] It remains unclear why this was the case, but the energetic nonconformist tradition in the town may have had a strong influence on councillors.[91] The local Bradford press had generally been sympathetic towards the medical profession, largely dismissing the

'fanatical' arguments of anti-vivisectionists who wilfully 'refuse to accept the statements of the doctors'.[92] Yet the National Anti-vivisection Society continued to lobby councils heavily in the early twentieth century to prevent vivisection, whether licensed under the Act or not.[93] This saw the emergence of several new branches of the British Union for the Abolition of Vivisection, such as one established in Hull in 1903 with the support of both an ex-Mayor of the town and several local members of the clergy.[94] A number of prominent Bradford merchants and industrialists likewise raised very public objections to the practice of vivisection in this period. When the noted worsted spinner George Ambler died in 1905, for example, he left several thousand pounds to support Bradford's hospitals, but with the express wish that 'none of this money should be used in connection with the practice of vivisection of animals.'[95]

Whatever the rationale behind the Bradford Council's decision to deny Eurich a licence, this meant that he was unable to carry out inoculation experiments to determine whether samples of wool contained anthrax-causing bacilli; instead he developed a more reliable way of culturing the organism on agar plates. In order to prevent faster growing colonies obscuring the clusters of anthrax organisms, he injected test emulsions taken from factory dust and samples of hair and wool directly under the agar. This sub-agar technique was therefore developed out of necessity.[96] Although this allowed him to examine quantitatively the number of colonies produced by each sample, the qualitative effect was arguably of greater importance: the Anthrax Investigation Board needed to determine whether or not samples of wool had the propensity to cause disease in an individual, something best achieved in this period through inoculating test animals.[97]

Eurich's research thus moved in a different direction, and he developed an elaborate and thorough classification system of different wools, in order to demonstrate which varieties were more likely to contain anthrax bacilli.[98] He also devised a new method for determining whether disinfectant solutions could dissolve blood clots present in the wools. By creating artificial clots containing anthrax bacilli, which were then saturated with solutions, he was able to determine whether the organisms had survived.[99] The classification system served to challenge the persistent nineteenth century lay perceptions of the danger of different wools:

> Taking all in all, I [Eurich] think that East Indian goat-hair is an easy first [i.e. the most dangerous] with approximately 30 per cent. positive results, closely followed by East Indian cashmere and Egyptian wool; then follow Persian wool, East Indian wool, and mohair. In addition we must consider Syrian wool, Tunisian and Mediterranean wool, and Chinese wool and goat-hair and alpaca dangerous.[100]

Eurich was therefore able to show that, in fact, East Indian goat-hair was far more dangerous than the notorious 'Van mohair,' which had been widely implicated by workers in the nineteenth century as a cause of anthrax. Nevertheless, as he struggled to get to grips with the practical implications of his research, local workers and politicians became disenchanted with Eurich and the Board. Fred Jowett – Member of Parliament for Bradford West – was a particularly vocal critic by the end of 1910.[101] Although the Board's members offered a stubborn defence of Eurich's work, a national-level Departmental Committee of Investigation (DCI) was established by the Home Office in 1913 to focus more closely on developing an effective system of disinfection. Recognising the importance of vivisection as a means of carrying out trials, the DCI enlisted the services of Sheridan Delépine – the noted Manchester-based bacteriologist.[102] Delépine held a vivisection license, and it was to him that samples were sent by the DCI for testing. Inoculation experiments on rabbits and guinea pigs were routine for Delépine, and he "submitted all his material to the test of inoculation into guinea pigs, and, if the animals died, made post-mortem examinations of them … to ascertain the cause of death."[103] His final report demonstrated the centrality of vivisection in determining which of proposed disinfection systems was most reliable.[104] Indeed, the DCI ultimately 'attached greater weight to the result of the inoculation test, since … the death or survival of an animal has a more direct bearing on the danger of the material.'[105]

Although the DCI stated that Delépine's role was vital in "checking the results obtained by us and … criticising our experiments," in reality he played a far more central role than would otherwise have been the case had Eurich been favoured with a license to practice vivisection. The development of novel culturing techniques and wool classification by Eurich – both important tools in their own right – was contingent on the fact that he was unable to conduct inoculation experiments. Indeed, although Eurich was able to assess the presence

of *Bacillus anthracis* in a quantitative fashion, establishing the qualitative effect of this organism was beyond the scope of his research.

Similarly, John Henry Bell and his fellow members of the Commission on Woolsorters' Diseases had to contend with limited access to individuals and premises with a vivisection license. Bell himself went into factories, spoke to workers, and mapped the gross pathological progression of the disease. The work of both Bell and Eurich was therefore to a large extent shaped by the Cruelty to Animals Act 1876. This legislation did not simply regulate the practice of vivisection; it had a discernable influence on medical research into anthrax in late-nineteenth and early-twentieth century Bradford. The direction of research conducted by local medical practitioners – particularly those without strong connections to major institutions – was shaped by the Act, and their contributions to medical science were affected accordingly.

The way in which local medical practitioners carried out their research had consequence beyond the boundaries of scientific theorising and practice. John Henry Bell's failure to convince his colleagues of the causal role of *Bacillus anthracis* meant that public discussion in Bradford on the cause of anthrax and woolsorters' disease was very extensive. These widespread debates allowed interested lay groups, such as employers, workers and labour organizations the opportunity to mobilise their non-bacteriological expertise in order to influence legislation during the 1880s. In the early twentieth century, Frederick William Eurich was not able to obtain a license to practice vivisection, and so was forced to explore other avenues of research. His work led to a comprehensive, quantitative classification system for imported wools, although he was forced to seek bacteriological confirmation from the Manchester laboratory of Sheridan Delépine.

Conclusion

This paper has shown that a re-examination of Victorian vivisection can lead to new insights into the influences that drove anti-vivisection campaigns, and how the 1876 Act in turn altered scientific and medical practice. It has been the intention to demonstrate that, in addition to the many socio-political and religious influences that lay behind the rise of anti-

vivisection in Britain, scientific theories and practices – particularly in relation to study of the brain – were also significant. The work of David Ferrier was singled out by anti-vivisectionists as particularly symptomatic of an approach to scientific inquiry incongruent with civilised society; medical science could progress just as successfully without relying so heavily on vivisection. There are parallels here with the later development of the diphtheria anti-toxin, which was widely-heralded as a critical breakthrough by researchers, but dismissed by anti-vivisectionists as mere hubris.[106] Moreover, the path of provincial British medical research was significantly altered by vivisection legislation. Bradford was the leading centre for research into anthrax from the late 1870s well into the twentieth century. Here, practitioners were forced to circumvent regulation either by persuading colleagues to carry out inoculation experiments on their behalf. Further, individuals such as Bell and Eurich developed their research in new directions which did not rely on such endeavours.

The closely-related settings of Wakefield and Bradford were not entirely accidental. The former was an industrialised, provincial centre, and the presence of an asylum overseen by research-focused scientists and administrators (a combination almost unique in this period) led to practices which galvanised the anti-vivisection movement. Bradford was likewise an important industrial town; the scale of its trade in raw and processed wool was responsible for the emergence of anthrax in the town and the associated research culture. Important developments in British science happened in the growing provinces. Neither Bradford nor Wakefield was alone in their close relationship with anti-vivisection, however. To the west of the country the highly-active Manchester Anti-vivisection Society, for example, staged prominent debates and campaigned extensively during the latter decades of the nineteenth century to ensure that the issue was never far from the surface in other provincial centres, although this activity was not replicated on the same scale in either Bradford or Wakefield.[107] The campaigners were not, ultimately, successful in stopping licensed vivisection altogether, as arguments for the utility of animal experimentation in improving human health were gradually accepted by the public at large.[108] However, these two case studies show that the campaigns did have a real impact beyond merely stirring anti-scientific feelings, as the direction and content of medico-scientific research was intimately linked with, and affected by, anti-vivisection legislation and sentiment.

Previous historical studies of this period have tended to overlook the specificity of medical science for a number of related reasons. Crucially, the anti-vivisection movement has tended to be the province of historians taking a more social or cultural approach, and for whom the nuances of medical scientific research are less important than the social milieu. Moreover, even historians of science and medicine have concentrated on the professional and disciplinary aspects of the anti-vivisection debates, particularly in the 'Golden Triangle,' and have thus paid little attention to experimental and theoretical approaches which developed as a result of vivisection regulation. It is this article's contention that this reification of science and medicine is a historical artefact, resulting from the anti-vivisection literature of the period, which attempted to tarnish all of science with the same brush. Whilst the social context of the movement is, of course, an important factor in understanding how it developed, this paper has shown that specific scientific ideas and practices, emanating from provincial centres such as Wakefield, were themselves critical in informing prominent anti-vivisectionists, such as France Power Cobbe. In addition, provincial research and researchers – lacking the financial, professional, moral and legal support afforded to those in the metropoles – were more strongly subjugated by vivisection legislation. Although the research culture and outputs of major institutions remained largely unaffected, provincial medical scientists, often working in a less formalised professional context, were required to adapt their research methodologies in order to circumvent the restrictions of the Act.

Clearly the specific way in which anti-vivisectionism and the Cruelty to Animals Act 1876 interacted with brain research in Wakefield and anthrax research in Bradford is not generalizable to other provincial towns which had their own local medico-scientific institutional landscapes and socio-economic contexts. The development of these two particular programmes of research required the confluence of several factors – capable individuals, subjects for study, money, space and methods – that could perhaps only have occurred where and when they did. However, the aim here is not to highlight the unique setting of mid-Victorian West Yorkshire, but rather to return attention to the role of specific medical and scientific research in informing the anti-vivisection movement, and to contribute to the larger field of understanding how and why British science, particularly in

the provinces, followed a different path to that in Continental Europe and America during the Victorian period and beyond.

Acknowledgements

We would like to thank the many colleagues who provided valuable suggestions, particularly our two anonymous referees, Adrian Wilson and Gregory Radick. This research was supported by two AHRC Doctoral Awards held at the University of Leeds, of which one was in collaboration with the Thackray Medical Museum, Leeds.

References

Alvin, C. (2007). Dr J. H. Bell and Woolsorters' Disease. *Bradford Antiquary*, *3*, 11-26

Andrews, J. (2012). Death and the dead-house in Victorian asylums: necroscopy versus mourning at the Royal Edinburgh Asylum, c. 1832-1901. *History of Psychiatry*, *23*, 6-26

Anon. (1911). In Defence of the Anthrax Board. *Yorkshire Daily Observer*, 30 January

Anon. (1887). [Leading Article]. *Lancet*, 4 June, 1139-42

Anon. (1885). The Justification of Vivisection. *British Medical Journal*, 10 January, 80-1

Anon. (1883). The University of London and Vivisection. *Lancet*, 5 May, 795

Anon. (1881). Dr. Ferrier's localisations; for whose advantage? *British Medical Journal*, 19 November, 822-4

Anon. (1881a). Bradford Medico-Chirurgical Society. *Lancet*, 16 July, 92

Anon. (1881b). Woolsorters' Disease. *British Medical Journal*, 11 June, 927-8

Anon. (1880). Woolsorters' Disease in Bradford. *British Medical Journal*, 25 September, 512-3

Anon. (1880a). Woolsorters' Disease. *British Medical Journal*, 4 September, 397-8

Anon. (1879). Wool-sorters' Disease. *Lancet*, 20 December, 920

Anon. (1879a). Science. *Westminster Review*, *55*, 245-59

Anon. (1878). [Leading Article]. *Leeds Mercury*, 4 October

Anon. (1874). Modern Scientific Materialism. *Blackwood's Edinburgh Magazine*, *116*, 519-39

Bartlett, P. & Wright, D. (Eds.) (1999). *Outside the Walls of the Asylum: The History of Care in the Community, 1750-2000*. Linton: Athlone Press

Bell, J. (1881). Woolsorters' Disease [Letter]. *British Medical Journal*, 2 July, 29

Bell, J. (1881a). On 'Woolsorter's Disease'. *Lancet*, 12 June, 909-11

Besson, J. (1898). *Technique Microbiologique et Serotherapique*. Paris: J-B Bailliere et Fils, 1898

Bligh, M. (1960). *Dr Eurich of Bradford*. London: James Clarke & Co.

Bradford Medico-Chirurgical Society (1882), *Report of the Commission on Woolsorters' Diseases*. Bradford: Toothill

Brown, M. (2011). *Performing Medicine: Medical Culture and Identity in Provincial England, c. 1760-c.1850*. Manchester: Manchester University Press

Burdon-Sanderson, J. (1873). *Handbook for the Physiological Laboratory*. London: J. & A. Churchill

Clarke, J. (1888). *Monkeys' brains once more: Schaefer v. Ferrier*. London: Victoria Street Society United with the International Association for the Protection of Animals from Vivisection

Cobbe, F. (1875). The Moral Aspects of Vivisection. *New Quarterly Magazine*, *4*, 222-37

Cobbe, F. (1871). Dreams. *Macmillan's Magazine*, *23*, 512-23

Cobbe, F. (1870). Unconscious Cerebration. *MacMillan's Magazine*, *23*, 24-37

Collins, W. (1883). *Heart and Science: A Story of the Present Time*. London: Chatto & Windus

Codell Carter, K. (2003). *The Rise of the Causal Concepts of Disease*. Aldershot: Ashgate

Departmental Committee on Anthrax (1918). *Report of the Departmental Committee Appointed to Inquire as to Precautions for Preventing Danger of Infection by Anthrax in the Manipulation of Wool, Goat Hair, and Camel Hair*. 3 vols. London: HMSO

Eurich, F. (1926). The History of Anthrax in the Wool Industry of Bradford, and of its Control. *Lancet*, 9 January, 107-10

Eurich, F. (1912). The Cultivation of Anthrax Bacilli from Wool and Hair. *Journal of Pathology*, *17*, 249-53

Ferrier, D. (1876). *The Functions of the Brain*. London: Smith, Elder & Co.

Ferrier, D. (1873). Experimental Researches in Cerebral Physiology and Pathology. *British Medical Journal*, 26 April, 457

Ferrier, D. (1873a). Experimental Researches in Cerebral Physiology and Pathology. *West Riding Lunatic Asylum Medical Reports*, *3*, 30-96

Finger, S. (2004). *Minds Behind the Brain: a history of the pioneers and their discoveries*. New York: Oxford University Press

Geison, G. (1995). *The Private Science of Louis Pasteur*. Princeton, NJ: Princeton University Press

Geison, G. (1978). *Michael Foster and the Cambridge School of Physiology: The Scientific Enterprise in Late Victorian Society*. Princeton, NJ: Princeton University Press

Greenfield, W. (1881). Woolsorters' Disease. *Lancet*, 12 February, 276

Hadwen, W. & Eastham, T. (1907). *A Debate on: Should Vivisection be Abolished?*. London: British Union for the Abolition of Vivisection

Harris, L. & Almerigi, J. (2009). Probing the human brain with stimulating electrodes: The story of Roberts Bartholow's (1874) experiment on Mary Rafferty. *Brain and Cognition*, *70*, 92-115

Hearnshaw, L. (1964). *A Short History of British Psychology 1840-1940*. London: Methuen & Co.

Hervey, N. (1986). Advocacy or Folly: the Alleged Lunatics, Friend Society, 1845-63. *Medical History*, *30*, 245-75

Hime, T. (1886). Experimental Researches Concerning Pasteur's Prophylactic. *Lancet*, *128*, 1124-6

Hurren, E. (2012). 'Abnormalities and deformities': the dissection and interment of the insane poor, 1832–1929. *History of Psychiatry, 23*, 65-77

Hurren, E. (2012). *Dying for Victorian Medicine: English Anatomy and its Trade in the Dead Poor, c.1834-1929*. Basingstoke: Palgrave.

James, D. (1990). *Bradford*. Halifax: Ryburn

Jones, K. (1960). *Mental Health and Social Policy 1845 – 1959*. London: Routledge & Kegan Paul

Jones, S. & Teigen, P. (2008). Anthrax in Transit: Practical Experience and Intellectual Exchange. *Isis*, *99*, 455-85

Kean, H. (1995). The 'Smooth Cool Men of Science': The Feminist and Socialist Response to Vivisection. *History Workshop Journal*, *40*, 16-38

Kirk, R. (2008). 'Wanted - Standard Guinea Pigs': Standardization and the experimental animal market in Britain c.1919-1947. *Studies in History and Philosophy of Biological and Biomedical Sciences*, *39*, 280-91

Koditschek, T. (1990). *Class Formation and Urban Industrial Society: Bradford, 1750-1850*. Cambridge: Cambridge University Press

Latour, B. (1988). *The Pasteurization of France*. (trans. Sheridan, A. & Law, J.) Cambridge, MA: Harvard University Press

Lederer, S. (1992). Orphans as Guinea Pigs: American Children and Medical Experimenters, 1890-1930. In Cooter, R. (Ed.). *In the Name of the Child: Health and Welfare, 1880-1940* (pp. 96-123). Routledge: London

Lewes, G. (1876). Ferrier on the Brain. *Nature*, *15*, 73-4; 93-5

Marland, H. (1987). *Medicine and Society in Wakefield and Huddersfield 1780-1870*. Cambridge: Cambridge University Press

Mayer, J. (2008). The Expression of the Emotions in Man and Laboratory Animals. *Victorian Studies*, *50*, 399-417

McCandless, P. (1981). Liberty and Lunacy: The Victorians and Wrongful Confinement. In Scull, A (Ed.), *Madhouses, Mad-Doctors, and Madmen: The Social History of Psychiatry in the Victorian Era*. London: Athlone Press, 338-362

Menke, R. (2000). Fiction as Vivisection: G.H. Lewes and George Eliot. *English Literary History*, *67*, 617-53

Miller, I. (2009). Necessary Torture? Digestive Physiology, Vivisection, the Suffragette Movement and Responses to new forms of Clinical Practice in Britain, c.1870-1920. *Journal of the History of Medicine and Allied Sciences*, *64*, 333-72

Millett, D. (1998). Illustrating a Revolution: an unrecognized contribution to the 'golden era' of cerebral localization. *Notes and Records of the Royal Society of London*, *52*, 283-305

Mitchell, S. (2004). *Frances Power Cobbe: Victorian Feminist, Journalist, Reformer*. Charlottesville; London: University of Virginia Press

Morrell, J. (1985). Wissenschaft in Worstedopolis: Public Science in Bradford, 1800-1850. *British Journal for the History of Science*, *18*, 1-23

Otis, L. (2007). Howled out of the Country: Wilkie Collins and H. G. Wells retry David Ferrier. In Stiles, A. (Ed.), *Neurology and Literature: 1860-1920* (pp. 27-51). Basingstoke: Palgrave Macmillan

Ouida, [R.] (1882). The Future of Vivisection. *Gentleman's Magazine*, *252*, 412-23

Pasteur, L. (1880) De l'attenuation du Virus du Cholera des Poules. *Comptes Rendus de l'Academie des Sciences*, *91*, 673-80

Pedlar, V. (2003). Experimentation or Exploitation? The investigations of David Ferrier, Dr Benjulia, and Dr Seward. *Interdisciplinary Science Reviews*, *28*, 169-74

Pemberton, N. & Worboys, M. (2007). *Mad Dogs and Englishmen: Rabies in Britain, 1830-2000*. Basingstoke: Palgrave Macmillan

Pickstone, J. (1985). *Medicine and Industrial Society: A History of Hospital Development in Manchester and its Region, 1752-1946*. Manchester: Manchester University Press

Preece, J. (2003). Darwinism, Christianity, and the Great Vivisection Debate. *Journal of the History of Ideas*, *64*, 399-419

Reinarz, J. (2009). *Healthcare in Birmingham: The Birmingham Teaching Hospitals, 1779-1939*. Woodbridge: The Boydell Press

Reynolds, J. (1983). *The Great Paternalist: Titus Salt and the growth of nineteenth century Bradford*. London: Temple Smith

Richards, R.J. (1987). *Darwin and the Emergence of Evolutionary Theories of Mind and Behaviour*. Chicago & London: University of Chicago Press

Richardson, R. (1988). *Death, Dissection and the Destitute*. London & New York: Routledge & Kegan Paul

Richards, S. (1986). Drawing the life-blood of Physiology: vivisection and the physiologists' dilemma, 1870-1900. *Annals of Science*, *43*, 27-56

Rupke, N. (Ed.). *Vivisection in Historical Perspective*. London: Croom Helm

Scull, A. (1993). *The Most Solitary of Afflictions: Madness and Society in Britain 1700-1900*. New Haven & London: Yale University Press

Smith, R. (2004). The Physiology of the Will: mind, body, and psychology in the periodical press, 1855-1875. In Cantor, G. & Shuttleworth, S. (Eds.). *Science Serialized: representations of the sciences in nineteenth-century periodicals* (pp. 81-110). Cambridge, MA: MIT Press

Star, S. (1989). *Regions of the Mind: Brain Research and the Quest for Scientific Certainty*. Stanford: Stanford University Press

Stark, J. (2013). *The Making of Modern Anthrax, 1875-1920: Uniting Local, National and Global Histories of Disease*. London: Pickering & Chatto

Stark, J. (2012). Bacteriology in the Service of Sanitation: The Factory Environment and the Regulation of Industrial Anthrax in Late Victorian Britain. *Social History of Medicine*, *25*, 343-61

Stiles, A. (2006). Cerebral Automatism, the Brain, and the Soul in Bram Stoker's *Dracula*. *Journal of the History of the Neurosciences*, *15*, 131-52

Thompson, E. (1882). An Address on the Past, Present, and Future of Medicine. *British Medical Journal,* 30 September, 607-16

Tibbits, E. (1881). Woolsorters' Disease [Letter]. *British Medical Journal*, 18 June, 982

Turner, F. (1978). The Victorian Conflict between Science and Religion: A Professional Dimension. *Isis*, *69*, 356-76

Turner, J. (1980). *Reckoning with the Beast: animals, pain, and humanity in the Victorian mind*. Baltimore, MD: Johns Hopkins University Press

White, P. (2006). Sympathy under the Knife: experimentation and emotion in late Victorian medicine. In Alberti, F. (Ed.). *Medicine, Emotion and Disease, 1700-1950* (pp. 100-24). New York: Palgrave Macmillan

Woods, A. (2004). The Construction of an Animal Plague: Foot and Mouth Disease in Nineteenth-Century Britain. *Social History of Medicine*, *17*, 23-39

Worboys, M. (2004) Delépine, Auguste Sheridan (1855 – 1921). In *Oxford Dictionary of National Biography*. Oxford: Oxford University Press. http://0-www.oxforddnb.com.wam.leeds.ac.uk/view/article/57113. (Accessed 2 August 2010)

Worboys, M. (2000). *Spreading Germs: Disease Theories and Medicine Practice in Britain, 1865-1900*. Cambridge: Cambridge University Press

Young, R. (1970). *Mind, Brain and Adaptation in the Nineteenth Century: Cerebral Localization and its Biological Context from Gall to Ferrier*. Oxford: Clarendon Press

[1] The authoritative text on the antivivisection movement in Britain is: French (1975). For further perspectives on British anti-vivisectionism, see: Mayer (2008); Miller (2009); Preece (2003); Richards (1986); Rupke (1987); White (2006); Turner (1980); Kean (1995).

[2] Burdon-Sanderson (1873). Details taken from: French (1975), pp. 42-50.

[3] Geison (1978), pp. 18-23.

[4] Morrell (1985).

[5] For studies of medicine in Victorian Yorkshire see: Brown (2011); Marland (1987).

[6] For the case of bacteriology in Britain in this period, particularly in relation to continental Europe, see: Worboys (2000).

[7] See, for example: Reinarz (2009); Pickstone (1985).

[8] Richardson (1988).

[9] Hurren does include a case study on Manchester, but this is seen largely through the lens of practices in Oxbridge and London. Hurren (2012).

[10] For recent studies which have considered the relationship between human and animal health, see: Pemberton & Worboys (2007). See also: Kirk (2008); Woods (2004).

[11] Ferrier (1873a). See also: Ferrier (1873). For further information on Ferrier's work, see: Young (1970), esp. ch. 8; Millett (1998); Star (1989).

[12] Ferrier (1873a), p. 30.

[13] For more on the broader relationship between anatomists, brain science and asylums in this period, see: Hurren (2012).

[14] Ferrier's experimental notebooks from the 1870s and 1880s are held by the Royal College of Physicians. MS. 246/1-19, Ferrier, Sir David: Notebooks of experiments, Royal College of Physicians, London.

[15] Ferrier (1876). The book was so popular that an enlarged second edition, furnished with new experimental evidence, was published in 1886.

[16] Star (1989) has argued that cerebral localization was littered with weaknesses as Ferrier and his followers proposed it, yet was still widely accepted as a result of their collective work down several lines of investigation.

[17] See: Millett (1998), pp. 292-294.

[18] Lewes (1876), p. 73. For background on Lewes' views on vivisection, see: Menke (2000).

[19] See: Smith (2004); White (2006).

[20] See: Young (1970) for the most complete analysis of Ferrier's theoretical work.

[21] Anon. (1879a), p. 253.

[22] See: Hearnshaw (1964), pp. 120-131, on the links between physiology, psychology and materialism debates in the 1870s. Ferrier's work had been the most talked about item at the 1873 BAAS meeting in Bradford, the year before Tyndall's famous Belfast address to the BAAS in 1874. For background see: Turner (1978). For a critical review of materialism at the time, see: Anon (1874).

[23] Cobbe (1875), p. 228.

[24] Cobbe (1870), p. 24.

[25] Carpenter too was critical of the use of vivisection. Cobbe was a close friend of Carpenter's sister Mary, herself an active campaigner for social reform. For more on Cobbe, see: Mitchell (2004).

[26] Cobbe (1870), p. 25.

[27] Cobbe (1870), p. 24 and p. 32. French (1975) argued that Cobbe and the later anti-vivisection battles of which she was a part represented a clash between elite science and the intuitive, common sense of the lay public.

[28] For more on the debate between Darwin and Wallace, see: Richards (1987), pp. 176-184.

[29] Cobbe (1871), p. 523.

[30] See: Finger (2004), pp. 155-175; Otis (2007), pp. 27-51.

[31] Anon. (1881), p. 822.

[32] Ouida (1882), pp. 422-423.

[33] French (1975). Miller (2009) also highlights how the procedure of force-feeding was entangled with the activities of vivisectors.

[34] For background on the growth of nineteenth-century psychiatry, see: Scull (1993) and Bartlett & Wright (1999). For histories which have begun to investigate the role of medical science and bodies in asylums, see Andrews (2012), and other contributions to the same special issue of *History of Psychiatry*. On the particular issue of anti-asylum sentiment in the Victorian period, see: Jones (1960), pp. 7-28; Hervey (1986); McCandless (1981).

[35] "West Riding Lunatic Asylum Committee of Visitors Minutes," 26 April 1877, C85/1/1/3, West Yorkshire Archive Service (hereafter 'WYAS'), Wakefield.

[36] Gere, C. (2012). Personal communication regarding manuscript for forthcoming book, *Two Sovereign Masters*.

[37] Post-mortem dissections became common in Wakefield and elsewhere, though there was still strong resistance to them, as discussed by Andrews (2012), pp. 6-26.

[38] Cobbe (1875), p. 235. For Bartholow's case, see: Harris & Almerigi (2009).

[39] H.C. Deb, 9 August 1876, vol. 231, 914.

[40] Clarke (1888), pp. 2-3.

[41] Clarke (1888), pp. 6-7.

[42] Star (1989).

[43] Otis (2007) suggests that Collins and Stoker "re-tried" Ferrier through literature after the failed 1881 case.

[44] Collins (1883), ch. 32. *The Woman in White* (1860), one of Collins' earlier and more famous novels, had also presented asylums in a negative light, contributing to public distaste for such institutions.

[45] Pedlar (2003), p. 172.

[46] Otis (2007), pp. 42-47.

[47] Stoker, *Dracula*, quoted in Pedlar (2003), p. 169.

[48] Stiles (2006), p. 147.

[49] Ferrier, unusually, gave the Croonian Lecture two years running, 1874-75. It is the latter of these that is being quoted from here, though both were essentially on the same topic.

[50] H. C. Deb, 4 April 1883, vol 277, c1405.

[51] Ferrier to Playfair, 16 May 1876, Playfair Papers, 262, Imperial College Archives, London.

[52] H. C. Deb, 4 April 1883, vol. 277, c1437, 1436.

[53] H. C. Deb, 4 April 1883, vol. 277, c1435.

[54] H. C. Deb, 4 April 1883, vol. 277, c1437, 1436.

[55] H. C. Deb, 4 April 1883, vol. 277, 1435.

[56] Anon. (1885), p. 81. Edward Thompson, President of the Northern Ireland Branch of the BMA had likewise noted in 1882 that ”out of the experimental studies of anthrax has grown a knowledge of various ways in which the contagium of that dreadful disease can be greatly mitigated,” citing the work of both Pasteur and Koch. Thompson (1882), p. 608.

[57] Pasteur (1880); Latour (1988), pp. 87-90.

[58] Anon. (1883). Only 42 experiments requiring a vivisection license were conducted at the Brown Institution between October 1881 and February 1883. The *Lancet* described animals as ”large gainers by the discoveries made” through the practice of vivisection, and referring to “the solidarity of men and animals in the matter of disease.” Anon. (1887).

[59] Bradford also had a strong association with rabies in this period. See: Pemberton & Worboys (2007), pp. 115-117, 119-123, 167-169.

[60] For more on the work of Bell and other researchers of the mid- to late-nineteenth century, see: Stark (2013); Jones & Teigen (2008).

[61] Bradford’s significance is demonstrated by references in late-nineteenth century French bacteriological texts to anthrax as “*la maladie de Bradford*”. See, for example: Besson (1898). For analysis of Koch’s work on anthrax, see: Codell Carter (2003). For more on Pasteur, see: Geison (1995); Latour (1988).

[62] Anon. (1878).

[63] J. Bell (1880a), p. 911.

[64] Alvin (2007). For more details on these early investigations, see: Reynolds (1983).

[65] Bell recorded his visits to workplaces and details of individual cases. “Dr J H Bell, note-book concerning anthrax epidemic in Bradford unpaginated,” DB15/C5, WYAS, Bradford .

[66] “Bradford Medico-Chirurgical Society Minutes,” 5 February 1878, 40D89, WYAS, Bradford.

[67] Bell (1881a). Bell detailed ten cases in this paper, but did not mention in any of these whether vivisection had been used in order to show the presence of *Bacillus anthracis* or to confirm it as the cause of the disease.

[68] ”Bell Notebook”.

[69] Anon. (1880).

[70] Anon. (1880)

[71] Anon. (1879).

[72] “Bradford Medico-Chirurgical Society Minutes,” 3 February 1880, WYAS, Bradford.

[73] Anon. (1880a).

[74] Bradford Medico-Chirurgical Society (1882), p. 10.

[75]Dr Edward Tibbits was the most prominent critic of Bell. The two colleagues played out their disagreements in person and through the press. Tibbits (1881); Bell (1881).

[76] D. G[oyder], “Microscopical Examinations,” unpublished manuscript [1881].

[77] Bradford Medico-Chirurgical Society (1882).

[78] G[oyder], “Microscopical Examinations”.

[79] Greenfield (1881).

[80] Bradford Medico-Chirurgical Society (1882), p. 10. The *British Medical Journal* noted in 1881 that there could be little doubt of the role of *Bacillus anthracis* in causing the condition: Anon. (1881b).

[81] Bradford Medico-Chirurgical Society (1882), title page.

[82] Anon. (1881a).

[83] Bradford Medico-Chirurgical Society (1882), p. 10.

[84] Codell Carter (2003).

[85] Stark (2012).

[86] For a detailed biography of Eurich, see: Bligh (1960).

[87] “Anthrax Investigation Board Minutes,” 17 July 1905; 20 July 1905; 30 October 1905, WYB111/1/2/15, WYAS.

[88] “Dr F. W. Eurich’s Reminiscences,” uncatalogued, CHSTM Anthrax Archive (hereafter: CHSTM), Manchester.

[89] Eurich (1926).

[90] Bradford's energetic and enthusiastic Medical Officer of Health, Thomas Whiteside Hime, reported in 1886 that, despite the successful treatment of several Bradford children with Pasteur's rabies inoculation, there was still substantial opposition to the practice of vivisection, hindering scientific progress. See: Hime (1886).

[91] For more on the general political and social history of Bradford, see: Koditschek (1990) and James (1990).

[92] Anon., "Lord Lister on Vivisection," *Yorkshire Evening Post*, 10 October 1892, p. 2.

[93] Anon., "Public Notices," *Yorkshire Evening Post*, 13 March 1902, p. 1.

[94] Anon., "Mail Mems," *Hull Daily Mail*, 11 November 1903, p. 1.

[95] Anon., "Bequests to Charities," *Manchester Courier*, 8 April 1905, p. 7.

[96] Eurich knew "of no other organism which will grow in the depth of the agar in such a manner, that it is likely to be mistaken for that of anthrax." Eurich (1912), p. 252.

[97] "Anthrax Investigation Board Minutes," 19 February 1906; 29 March 1906; 21 May 1906, WYB111/1/2/15, WYAS, Bradford; "First Annual Report – Anthrax Investigation Board," 1906, uncatalogued, CHSTM.

[98] "Twelfth Annual Report – Anthrax Investigation Board," 1917, uncatalogued, CHSTM.

[99] "Ninth Annual Report – Anthrax Investigation Board," 1914, uncatalogued, CHSTM.

[100] Eurich (1926), p. 108.

[101] Anon., "Anthrax Research. The Work of the Investigation Board. Criticism by Mr Jowett M.P.," *Bradford Daily Telegraph*, n.d., cutting taken from: "Papers on Anthrax," University of Bradford Special Collections; Anon., "In Defence of the Anthrax Board," *Yorkshire Daily Observer*, 30 January 1911.

[102] For more on Delépine's life and work, see: Worboys (2004).

[103] Departmental Committee on Anthrax (1918), vol. I, p. 9.

[104] Departmental Committee on Anthrax (1918), vol. I, pp. 45-66.

[105] Departmental Committee on Anthrax (1918), vol. I, p. 9.

[106] Lederer (1992), p. 103.

[107] Hadwen & Eastham (1907).

[108] French (1975), pp. 288-344.