Transversal
International Journal for the Historiography of Science

Transversal: International Journal for the Historiography of Science, 2024 (17): 1-9
ISSN 2526-2270
Belo Horizonte – MG / Brazil

Special Issue
History and Philosophy of Science in the Belle Époque

The Development of Experimental Physiology: The Laboratory and Vivisection in Victorian England

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Abstract:
In the mid-19th century, experimental physiology emerged as an important field of research, coinciding with the flourishing of various other scientific disciplines. The experimental approach in physiology involved vivisection, which led to an increase in the number of experiments performed on living animals. The growing interest in this discipline had consequences not only within the scientific community but also in society. Through a historical study of this period, the specificities of the development of physiology in Britain – where ethical opposition to experiments was most pronounced – will be described. This aims to highlight two key consequences: the perception of the physiological laboratory as a modern and specialized environment for science and the need for regulation of the use of living animals for scientific purposes during the period.

Keywords: Anti-vivisection movements; Experimental physiology; Physiological laboratory; Victorian era; Vivisection

Received: August 17, 2024. Reviewed: December 10, 2024. Accepted: December 11, 2024.
DOI: http://dx.doi.org/10.24117/2526-2270.2024.i17.06

Introduction

The 19th century was a fertile period for the development of new research methods. Within the field of Medicine, there was significant advancement in physiology as an autonomous discipline. The experimental method for conducting scientific research also advanced, spurred by the increasing popularity of empirical studies.

This article will discuss how physiology developed through the experimental method in 19th-century Britain. It will explore the unique characteristics of the discipline in this context, including its relatively slow development as compared to Germany and France, as well as the intense ethical debate surrounding the experimental method involving vivisection

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of animals. Furthermore, the article will present the groups of scientists involved in the controversy and the arguments for and against the use of animals in scientific research.

The article aims to address two central aspects of the debates surrounding vivisection in the Victorian era. It seeks to examine the consequences of physiology's development as an independent field of study. In doing so, it will also highlight the pivotal role of the laboratory in these studies and the outcomes of the controversy in shaping legislation to regulate experiments on living animals for scientific purposes in the United Kingdom.

During this period, the term "vivisection" gained prominence in the fields of biology and medicine and even entered popular usage. The term "vivisection" is a compound derived from the Latin words *vivus* (alive) and *sectio* (cut), which literally means "cutting living bodies" (Rupke 1987, 14). Despite its origin in the act of cutting a living animal, according to its original Latin meaning, the term was broadly used in the United Kingdom to refer to various forms of animal experimentation (Etherington 1842, 1). By the mid-19th century, "vivisection" had become a widely recognized term, encompassing all types of experiments on animals, including the application of chemical agents, physical stimulation, and the inoculation of microorganisms, not necessarily involving surgical procedures (Rupke 1987, 14). For this reason, in this text, the term "vivisection" will also be used in its broader sense, encompassing any experiments conducted on living animals.

Vivisection worked as a systematic tool for confirming or refuting hypotheses about physiological functions. Experimentation was a valid scientific method for testing theories and served as a foundation for future hypotheses. Thus, vivisection was not necessarily an end in itself but rather part of an active, interventionist, and empirical approach to study bodily functions (French 1975, 39). Physiological research aimed to understand the functioning of the human body. Moreover, vivisection became a key method in biomedical research, contributing to studies of diseases and the search for their cures.

The general justification for conducting such experiments was that understanding the biological functions of other animals would provide insights into human biology, thereby enabling science to generate knowledge that could improve human life. This knowledge could prove beneficial either for understanding the organism or for therapeutic purposes. In any case, nearly all scientific research involving animals operated on the premise that most discoveries would, in some way, benefit humanity (Mayer 2008, 400).

The Development of Experimental Physiology and Vivisection

The history of physiology is closely tied to the history of anatomy, and for a long time, physiology was regarded merely as a branch of anatomy (Sharpey-Schafer 1932, 781). Early knowledge about the functioning of organisms was rooted in anatomical studies of the body. According to Charles Singer (1957), dispersed knowledge of anatomy existed since the dawn of humanity, but he considers the scientific study of the discipline to have begun with the ancient Greeks.

Physiological and anatomical studies were conducted with the help of living animals. Numerous pieces of evidence point to experiments with animals being conducted in Antiquity (Atalić 2012, 401). The earliest records of anatomical descriptions using animals date back to Alcmaeon of Croton around 500 BCE (Rupke 1987, 15). During that time, Alcmaeon "began to construct a positive basis for medical science by the practice of dissection of animals" (Singer 1957, 9).

Thus, since Antiquity, animals have been used in studies related to anatomy, physiology, and medicine. However, live animal studies were sporadic, conducted by a few individuals and in limited numbers. Only in the 19th century did the number of animal experiments increase significantly, coinciding with the development of physiology. In this context, the field was dominated by the experimental methodology, which primarily involved vivisection. In the 19th century, organized investigation and systematic use of the

experimental method led to a dramatic rise in the number of experiments conducted on animals and the number of scientists practicing them (Sharpey-Schafer 1932, 781).

By the first half of the 19th century, the use of live animal experiments was already well-established in France and Germany as a valid research method, including the creation of chairs in experimental physiology at various universities in these countries (Bending 2000, 117). In Britain, however, the discipline of physiology developed at a comparatively slower pace (French 1975, 36). British modern physiology only became established around 1870. This slower development can be attributed to factors such as the lack of scientific education, funding, and research materials, as well as the limited prestige that physiological research held in the country. Another major factor was the reluctance of physicians and surgeons to recognize physiology as a distinct field of study separate from anatomy (French 1971, 30). French notes that "the development of modern physiology in Britain during the nineteenth century cannot thus be separated from progressive reform of medical education in the latter part of the period" (French 1971, 31).

At the beginning of the century, experimental research received little institutional support. Most professors were practicing physicians who needed to supplement their incomes, and students were not required to engage in laboratory practices or activities. The majority of medical schools in the 19th century lacked the funds to invest in extensive laboratory equipment and instruments (Butler 1988, 474). Consequently, one factor contributing to the slower development of the discipline compared to continental countries was the financial investment in research and the necessary instruments. Building well-equipped physiological laboratories was expensive, and in England there was little interest in creating them due to the lack of immediate benefits from the research (Geison 1978, 42). However, this interest gradually changed.

Knowledge acquired in Germany and France during the 1840s and 1850s began to spread to Britain during the 1860s and 1870s, mainly through students who had studied in those countries. British medical students who gained postgraduate experience on the continent returned to Britain with new practices and teaching models in physiology (French 1971, 32). Some studied in France, particularly under Claude Bernard, such as J. S. Burdon-Sanderson, F. W. Pavy, and W. Rutherford, while many others studied in Germany, under Carl Ludwig, including E. A. Schafer, W. H. Gaskell, A. D. Waller, V. Horsley, T. Lauder Brunton, E. Ray Lankester, and W. Stirling. These practitioners became significant figures in the British scientific context in the following years, transforming the discipline into an independent field acquiring leadership by the century's end (French 1975, 42).

The gradual British interest in physiology can be traced back to the establishment of its teaching in universities. William Sharpey (1802-1880) was appointed lecturer in anatomy and general physiology at University College London in 1836 (Sharpey-Schafer 1927, 1). Sharpey's initial lectures as a professor focused on anatomy, but over the years, he dedicated himself to deepening the teaching of physiology. Sharpey did not teach experimental physiology, as no British institution did at the time (Geison 1978, 31). However, in 1867, he recommended Michael Foster for the position of professor of practical physiology. Foster became one of the most recognized professors in the discipline and introduced experimental teaching in the field. He organized a practical physiology course in a small room, which became the institution's first physiological laboratory (Sharpey-Schafer 1927, 2).

Following the development of physiology at University College London, other British universities began to establish similar departments. In 1870, Foster was invited to occupy the inaugural Chair of Physiology at Trinity College, University of Cambridge. Foster greatly influenced Cambridge, holding the position until his retirement in 1903. Under his leadership, Cambridge's School of Physiology became the center of physiological research in England and gained international recognition for its contributions (Geison 1978, 5).

The vacancy left at University College for the position of professor of practical physiology and histology was filled by John Burdon-Sanderson in 1870. The following year,

he also became director at the Brown Institution. In 1871, Edward Schafer, who would later adopt the name Sharpey-Schafer, was appointed assistant professor of physiology under Burdon-Sanderson. These appointments had an immediate impact on institutions and the development of physiology in Britain (French 1975, 42). By the end of the century, other professors also began adopting experimental methods, and original research became increasingly common.

The Debate on Vivisection

The expansion of the number of experiments conducted on living animals raised questions about the nature and purpose of these experiments, both within the scientific community and in society at large. Questions about the ethics of the experiments, the necessity of vivisection, and the need for regulations on who and how these experiments could be performed were common in Britain from the mid-19th century onwards.

The existence of experiments on animals became publicly known through reports in popular magazines and specialized journals. Additionally, public demonstrations of experiments increased, mainly for educational purposes, in university courses or medical congresses. With this knowledge, the public began to question the legitimacy of experimental practices, accusing scientists of cruelty to animals.

Two main events are often cited as causing significant discomfort among the British population and contributing to the onset of the debate: the publication of the *Handbook for the Physiological Laboratory* in 1873 and a letter written by George Hoggan (1837-1891), published in the *Morning Post* in 1875, detailing experiments on dogs in a French laboratory led by Claude Bernard. The initial focus of protests against vivisection centered on the publication of the *Handbook for the Physiological Laboratory* (Romano 2002, 149). This book was edited by Burdon-Sanderson and written in collaboration with three colleagues: Michael Foster, lecturer in physiology at Cambridge; bacteriologist Emanuel Klein; and physician and pharmacologist Thomas Lauder Brunton (Richards 1986, 33).

The book was the first guide to the practice of experimental physiology published in England, but despite its scientific success, it was overshadowed by the uproar it caused among opponents of vivisection, as it described practices, including painful experiments conducted by Sanderson and Klein. One of the criticisms was that the book never mentioned the use of anesthetics. Furthermore, the book had an educational aspect, as it was introduced as a guide for beginners, focusing on the practical applications of physiology through experimentation (Burdon-Sanderson 1884 [1873], vii). The authors were later summoned to testify before the 1876 Commission, which will be discussed later, due to the controversial nature of the book.

Another event linked to the beginning of the protests was the annual meeting of the British Medical Association held in August 1874 in the city of Norwich, England (French 1975, 55). The meeting caused controversy for including a demonstration of experiments on living animals. On that occasion, the French experimentalist Eugene Magnan was invited to present a lecture on the physiological effects of alcohol. After his lecture, Magnan performed an experimental demonstration by inducing epilepsy in a dog with an intravenous injection of absinthe (Feller 2009, 266). Magnan was accused of cruelty to the animal, and a formal lawsuit was filed against him. However, there was no legislation at the time regulating animal experimentation, so the lawsuit failed due to lack of legal support (Ritvo 1987, 160). Nevertheless, the case brought visibility to the issue of vivisection and raised questions about such demonstrations.

In the 19th century, Victorian society underwent cultural changes, becoming more concerned with issues considered humanitarian. The flourishing of this reformist environment led society to also consider the status of animals (Turner 1980, 36). The problem of pain became a central issue in the Victorian ethos (Carvalho and Waizbort 2010, 587). The

pain inflicted on non-human animals was at the heart of the vivisection debate in late 19th-century Britain. With the belief that animals also feel pain, just like humans, one of the main demands of the anti-cruelty movements was to prevent any suffering or pain from being caused during experiments.

One of the contributions to the change in the perception of the sensation of pain was the creation of anesthetics. Anesthetics were first developed in the 1840s, and with the existence of a means to eliminate pain, the idea that pain should and could be avoided became more prominent in social imagination. As such, anesthetics contributed to the conduction of experiments on animals. Most physiologists agreed that anesthetics removed any sensation of pain, and that this would eliminate any objections to conducting experiments (Boddice 2016, 88).

The use of anesthetics allowed for better control of variables and more precise observation by eliminating animal pain during experimental procedures. Likewise, anesthesia made possible procedures that would not be viable due to surgical conditions and the physiological consequences of pain (French 1975, 40). Since anesthetics were thought to prevent the animal from feeling pain, physiologists believed that their widespread use would end concerns about animal suffering, and they would be able to pursue their scientific goals without hindrance. However, knowledge about anesthetics was still not very sophisticated at the time, so one could not be sure that animals did not experience some kind of pain even with the use of anesthetics, as their use might not have been efficient (Richards 1986, 134).

The new way of viewing animals as beings capable of suffering and, under certain circumstances, in need of protection, reflected changes in the British legal system. The first law aimed at preventing cruelty to animals was enacted in 1822 by the UK Parliament under the title *Cruel and Improper Treatment of Cattle Act*. It was also known as *Martin's Act*, after its proposer, Irish politician Richard Martin, a member of Parliament, who had significant support from the clergy and the teaching community in London (Turner 1980, 39). Martin's Act prohibited acts of cruelty to cattle owned by individuals. Before this legislation, it was already prohibited to cause harm to cattle belonging to others, which was equivalent to criminal damage (Bates 2017, 16). No other type of harm to domestic animals of other species, such as dogs and cats, was mentioned in the law. Additionally, the law did not address the issue of vivisection, which would only happen in 1876.

The strongest opposition to vivisection came from organized movements aimed at preventing such experiments. During the 19th century, the first organizations against animal cruelty emerged. In 1824, the *Society for the Prevention of Cruelty to Animals* was founded, which would later become the *Royal Society for the Prevention of Cruelty to Animals* (RSPCA), when it received royal patronage from Queen Victoria. This was the first society in the world focused on animal welfare. Initially, the organization's function was to perform volunteer work by making reports and gathering evidence for cases under Martin's Act (Bates 2017, 16).

Societies against vivisection emerged from the 1870s in England. In 1875, the *Victoria Street Society for the Protection of Animals Liable to Vivisection* (which would later become the *National Antivivisectionist Society* or NAVS) was founded by Irish journalist and activist Frances Power Cobbe, along with English doctor George Hoggan (Atalić 2012, 409). In the following years, more societies against vivisection and animal cruelty were established, such as the *London Antivivisection Society* (founded on June 10, 1876) and the *International Association for the Total Suppression of Vivisection* (founded on June 21, 1876). Similarly, across Europe and the United States, animal protection societies were formed inspired by the British model (Kete 2002, 25).

These societies were the main source of opposition to vivisection. Through them, meetings were organized to discuss the topic, where lectures were held, pamphlets and journals were created to inform the general public about the experiments, and petitions and protests were organized. The societies also lobbied to push for the regulation or abolition of

the experiments. The members of these societies were the ones who reported cruelty to animals and mobilized in general for the end of these experiments.

The pressure from societies against vivisection led to changes in Victorian society. The mobilization aimed at regulating experiments on living animals, with some groups seeking the abolition of vivisection. This mobilization initiated the investigation process and the eventual law that would regulate experiments. In late 1874, Cobbe, the main leader of the anti-vivisection movement, wrote a memorandum circulating in London requesting that the *Royal Society for the Prevention of Cruelty to Animals* (RSPCA) mobilize to restrict experiments on living animals. The petition was submitted with over 600 signatures in January 1875 (Cobbe 1889, 214). The petition was then sent to Lord Hartismere, whose real name was John Henniker-Major, a British conservative politician in the House of Lords. Lord Hartismere drafted the document to become a bill to regulate vivisection and presented it to Parliament on May 4, 1875 (Parliamentary Papers 1876, 336).

Concerned about the impact that the petition might have, pro-vivisection individuals also gathered to deliver a proposed bill. Also, in early 1875, John Burdon-Sanderson, Darwin, and Huxley met to prepare the guidelines for this document (French 1975, 70-71). Burdon-Sanderson was responsible for circulating a petition among physiologists, anatomists, and physicians in London, Oxford, Cambridge, and Edinburgh. The goal was to draft a new bill that would protect both medical practice and animal welfare (French 1975, 75).

This resulted in the formation of the *Royal Commission* in 1876 to investigate the issue. The Commission included physiologists and other experts who heard testimonies from 53 individuals. The public debates regarding the necessity, morality, and regulation of experiments led to the establishment of the *Cruelty to Animals Act* of 1876, the first legislation in the world to regulate animal experimentation. The law established procedures for regulating animal experiments, requiring licenses for experiments, mandated the use of anesthetics when possible, and prohibited experiments for educational demonstrations.

However, critics argued that the law, instead of effectively reducing vivisection, legalized it, allowing experiments to continue with some restrictions (Cobbe 1889, 215). The Act remained in effect until 1986, when it was replaced by the *Animals (Scientific Procedures) Act*. However, the effects of the 1876 Act were considerable. It legalized vivisection under state control, allowing the practice to expand, while satisfying societal demands for humane treatment.

The Physiological Laboratory

Physiology presented itself as a frontier in the specialization of medical science in the 19th century. The practices within the laboratory and the experimental method separated this field from other sciences. Fields like botany and astronomy were often explored by people who were not specialists at the time. Since physiology required specific instruments and claimed the research space within a laboratory, it appeared to be farther removed from the amateur scientist and generated the consequent specialization of the physiologist. This separation made physiology seem modern and innovative (Hamilton 2010, 71).

For the physiologist, the laboratory was the representation of the idea of science as highly specialized, requiring specific equipment and instruments that could not be understood by common or popular knowledge. In this way, the laboratory also represented a boundary between science and popular knowledge. The lay or non-scientific public could only support the research with public funds, not truly understanding what occurred in the pursuit of scientific knowledge (Hamilton 2010, 72). In this context, Cobbe criticized the research conducted by Emanuel Klein (1844-1925), asserting that as a public servant, Klein's use of public funds for experiments involving unnecessary animal suffering would likely not be agreed upon by the general population (Hamilton 2010, 75).

From this perspective, the laboratory can be considered as the representation of the space for controversy regarding the use of animals for scientific research. The symbolic meaning of the laboratory to physiologists and to opponents of vivisection were completely different. For physiologists, the laboratory was the space for medical and scientific progress, providing advancement for the well-being of humanity. For opponents of vivisection, "the laboratory was nothing but a glorified torture chamber" (Boddice 2016, 75).

A common image at the time was that it was necessary to enter the laboratory to reveal the cruelties being carried out by scientists. Some anti-vivisection pamphlets metaphorically evoked the image of bringing light into dark places (Kean 1998, 103). A recurring representation in pamphlets was that of animals tied to the operating table. These images sought to represent the public's interest in making visible what science was hiding, with the aim of ending the brutality of the experiments. As if, by making visible what they perceived as cruel acts, there would be a change in attitude among the practitioners of science.

The laboratory door created a certain opposition between two different views on what was appropriate in physiological research. These differences primarily concerned the object of scientific study and the methods used to conduct it. Physiologists embraced a methodologically autonomous science, free from the interference of social values. On the other hand, there was a perspective that incorporates such values as legitimate factors within the scientific domain. The public, represented by the anti-vivisection societies, sought to change the scientific methods of the time through the symbolic act of entering the laboratory. Meanwhile, scientists sought to maintain the boundary of the laboratory. Scientists criticized the opponents of vivisection, arguing that they had no right to speak on the issue of experiments due to their limited perspective on the subject (Mayer 2008, 403). According to them, vivisection as a scientific method was authorized to be discussed and judged only by specialists in this method, the scientists themselves.

The debate showed two opposing views on how science should be conducted. The anti-vivisection side believed in science that included ethical values, asserting that the ethical conduct of scientific practices should extend to both humans and non-human animals. On the other side, supporters of vivisection considered that good scientific practice should aim for the well-being of humans, even if some animal suffering occurred in the process.

The questioning of experiments revolved around specific topics. The pain caused during experiments was the main point of debate for anti-vivisection movements. Inflicting pain on animals was considered cruelty by many, and so, at the beginning of the movement, there was a demand that anesthesia be applied to all procedures involving animals. However, the ability to feel pain and the degree of sensitivity of the animals used were not agreed upon among scientists.

The number of animals used in research was also criticized, as many experiments involved a large number of animals. Similarly, an excessive number of animals was used to replicate experiments whose results were already known. The justification and purpose of the experiments were equally debated, as many experiments appeared to lack a clear goal. The demonstration of experiments for educational purposes and the hands-on experience in educational institutions was, at the same time, a delicate matter, as there was no consensus even among physiology professors on the necessity for students to perform operations. An important point in the controversy was the question of cruelty and how experiments on live animals might make people more cruel. Therefore, the main arguments against vivisection were that experiments on live animals were both useless and immoral (Rupke 1987, 194).

These arguments were debated during meetings of the royal commission and various scientific congresses, and other meetings that took place during the period. However, accusations of the uselessness and immorality of the experiments did not lead to their abolition. Nevertheless, the United Kingdom became a pioneer in regulating the use of live

animals for scientific purposes, making the country one of the places with the strictest and most transparent laws on the topic in the 20th and 21st centuries, compared to other regions.

Final Considerations

The flourishing of modern science during the 19th century also manifested in studies of physiology. In Great Britain, specialization in the physiology began around 1870, and by the turn of the century the country became a leader in the research of the field. However, this field was permeated by ethical discussions involving its research subject, live animals, and the practice of vivisection. The controversy was not limited to the scientific community but expanded to Victorian society.

Concerns about the pain caused to animals during experiments and the lack of a clear purpose for the procedures were sources of discord on the issue. Despite all the criticisms, experiments were permitted by law, promoting the continued use of the experimental method, which would only increase in the following years. The use of live animals in scientific procedures became commonplace from that point onward. In this way, the work of physiologists was protected by legislation, despite opposition.

The societies that emerged during the Victorian era against vivisection can be considered the beginning of the organized movement against animal cruelty that would be consolidated in the following years. Some of these societies still exist today and continue to advocate against animal experimentation.

Here, we aimed to show the consequences of the development of physiology in British territory, pointing to the symbolic environment of the laboratory and the main topics of discord. Additionally, we considered the legislative consequences of the development of this scientific field to be important. It is possible to conduct a study that demonstrates the other cultural aspects were involved in the flourishing of science in that context. Furthermore, other countries that contributed to the studies of experimental physiology could be studied in relation to the internal disputes that occurred. Although the opposition movement in Great Britain was the largest against vivisection, similar movements emerged in various countries.

References

Atalić, B. 2012. "Historical development and ethical considerations of vivisectionist and antivivisectionist movement". *JAHR – European Journal of Bioethics* 3: 399-414.

Bates, A. W. H. 2017. *Anti-Vivisection and the Profession of Medicine in Britain. A Social History*. London: Palgrave Macmillan.

Bending, L. 2000. *The Representation of Bodily Pain in Late Nineteenth-century English Culture*. Oxford: Clarendon Press.

Boddice, R. 2016. *The Science of Sympathy. Morality, Evolution, and Victorian Civilization*. Champaign: University of Illinois Press.

Burdon-Sanderson, J., ed. 1884 [1873]. *Handbook for the Physiological Laboratory*. Philadelphia: P. Blakiston, Son & Co.

Butler, S. V. F. 1988. "Centers and peripheries. The development of British physiology, 1870-1914". *Journal of the History of Biology* 21: 473-500.

Carvalho, A. L. L. and R. Waizbort. 2010. "A dor além dos confins do homem. Aproximações preliminares ao debate entre Frances Power Cobbe e os darwinistas a respeito da vivissecção na Inglaterra vitoriana (1863-1904)". *História, Ciências, Saúde – Manguinhos* 17: 577-605.

Cobbe, F. P. 1889. *The Modern Rack*. London: Swan Sonnenschein & Co.

Etherington, G. F. 1842. *Vivisection Investigated and Vindicated*. Edinburgh: Rickard.

Feller, D. A. 2009. "Dog fight. Darwin as animal advocate in the antivivisection controversy of 1875". *Studies in History and Philosophy of Biological and Biomedical Sciences 40*: 265-271.

French, R. D. 1971. "Some problems and sources in the foundations of modern physiology in Great Britain". *History of Science 10*: 28-55.

French, R. D. 1975. *Antivivisection and Medical Science in Victorian Society*. Princeton: Princeton University Press.

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

Hamilton, S. 2010. "Reading and the popular critique of science in the Victorian anti-vivisection press. Frances Power Cobbe's writing for the Victoria Street Society". *Victorian Review 36*: 66-79.

Kean, H. 1998. *Animal Rights. Political and social change in Britain since 1800*. London: Reaktion Books.

Kete, K. 2002. "Animals and ideology. The politics of animal protection in Europe". In *Representing Animals*, edited by N. Rothfels: 19-34. Bloomington: Indiana University Press.

Mayer, J. 2008. "The expression of the emotions in man and laboratory animals". *Victorian Studies 50*: 399-417.

Parliamentary Papers. 1876. *Report of the Royal Commission on the Practice of Subjecting Live Animals to Experiments for Scientific Purposes. With Minutes of Evidence and Appendix*. London: House of Commons Parliamentary Papers.

Richards, S. 1986. "Drawing the life-blood of physiology. Vivisection and the physiologists' dilemma, 1870-1900". *Annals of Science 43*: 27-56.

Ritvo, H. 1987. *The Animal Estate. The English and Other Creatures in the Victorian Age*. Cambridge: Harvard University Press.

Romano, T. M. 2002. *Making Medicine Scientific. John Burdon Sanderson and the Culture of Victorian Science*. Baltimore: Johns Hopkins University Press.

Rupke, N. A., ed. 1987. *Vivisection in Historical Perspective*. London: Croom Helm.

Sharpey-Schafer, E. 1927. "History of the Physiological Society, 1876-1926". *Journal of Physiology 64* (3): 1-76.

Sharpey-Schafer, E. 1932. "History of physiology in Great Britain during the last hundred years". *British Medical Journal 2* (3747): 781-783.

Singer, C. 1957. *A Short History of Anatomy from the Greeks to Harvey*. New York: Dover.

Turner, J. 1980. *Reckoning with the Beast. Animals, Pain and Humanity in the Victorian Mind*. Baltimore: Johns Hopkins University Press.