Reaction against vivisection for research reached its height in the last two decades of the 19th century and the first two of the 20th, and a resurgence began in the 1960s. Antivivisectionism was and is related, in part, to emphasis on humanitarian sentiments. Two humanitarian physicians defended vivisection as essential. Dr. Arthur Conan Doyle in 1886 justified the killing of rabbits to relieve human suffering from hydrophobia. In 1910, he objected to the antihuman campaign of the antivivisectionists. Dr. William Osier reacted similarly to the threat to vivisection. He gave emphatic evidence to investigative committees in the United States in 1900 and in Britain in 1907. Osier also performed vivisection. His experimentation included studies of pig typhoid and tapeworm cysts in pigs and of the fate of India ink injected into the lungs of kittens. Osier and Conan Doyle were but two of the many prominent physicians who helped stem the tide of antivivisection legislation near the turn of the century. A review of the elements that fostered antivivisectionism in the society of their time is relevant in understanding and reacting to similar sentiments in the present era.

The word "vivisection" has an obvious meaning: the cutting into of a living body. The dictionary provides a more specific definition: "the practice of subjecting living animals to cutting operations, esp. in order to advance physiological and pathological knowledge." Common usage has now expanded the term to include all experimentation, surgical or nonsurgical, on animals. Before the 19th century, vivisection was not unusual. For example, Erasistratus, an anatomist in Alexandria in the 3rd century B.C., is considered the first experimental physiologist because of his study of the functions of the nervous system and heart in living bodies, including those of humans. Galen, the greatest physiologist of ancient Greece, operated on mammals, including primates, to determine the results of a surgical procedure such as severing the spinal cord.

The seminal figure for modern physiology, however, was William Harvey, who in the 17th century wrote that "special care must be taken that you know things well, and have investigated them through frequent dissections of animals."

ANTIVIVISECTION

Reactions against research on living animals became quite evident during the latter part of the 18th century and gained momentum during the latter part of the 19th century. Some reactions were even somewhat vicious (Fig. 1). Such a movement cannot be understood in vacuo, so to speak, but necessitates knowledge of the society in which it manifested.

The antivivisection movement had its roots in several characteristics of British society during the 18th and 19th centuries. Cruelty to animals in general was widespread. In 1750, this treatment was effectively satirized by Hogarth in his engraving that depicted various types of torture to animals. Illustrated are releasing a cat with artificial wings to make it fly, watching two suspended cats clawing at each other in fright, burning out the eye of a captive bird, plunging an arrow into the anus of a dog, tying a bone to a dog's tail, setting a dog upon a cat, and aiming a stick to throw at a cock. Bullbaiting and cockfighting were popular sports. Such senseless cruelty to animals eventually disturbed sensibilities to such an extent that the reaction was against any manipulation, including vivisection. The 18th century also saw the development of evangelism, humanitarianism, and romanticism, including the cult of the pet with its sentimental anthropomorphism. Some persons believed that materialism was leading to the affliction of pain on defenseless creatures that have feelings, consciousness, and even souls.

The Victorian era was characterized by an abhorrence of biologic reality and of the physical self of humans, and vivisection seemed to emphasize these lower aspects of
the human race. Vivisection also was part of the rapid rise of science in the 19th century, a rise that threatened long-standing institutions such as the church, conflicted with established ways of thinking, and tampered with the order of things.

Antiscientism focused on several major developments in this period. Best known are the violent tirades against Darwin and Huxley for their advocacy of the evolutionary theory and against the use of anesthesia to relieve the pain of childbirth, a practice that seemed a direct confrontation of the biblical dictum resulting from Eve’s disobedience. Not as well known, but closely related to the antivivisection movement itself, was the extensive opposition to Jenner’s development of the smallpox vaccination. Some of this opposition was related to the imagined effects of Jenner’s cowpox, as caricatured by Gillray in his engraving “Cow Pock,” which included bovine features and excrescences. Reactions against smallpox vaccination, as against vivisection, were due more to fundamental and pervasive elements in Victorian society than to any fear of acquiring brutish features. Indeed, many persons who opposed vaccination were also antivivisectionists.

Vivisection in the 19th century was related primarily to the search for physiologic knowledge. In Britain, the development of physiology was considerably behind that in Europe proper, being hampered by several constraints that were more prominent in Britain. Traditional medicine was conservative and clinically oriented. Sir Charles Bell, a leading anatomist and physiologist of the times, explained function on the basis of anatomic studies. In 1811, his bias against vivisection led him to conclude that the anterior spinal roots subserve voluntary behavior and the posterior ones subserve involuntary behavior. Bell considered the motives for animal experimentation to be egotism and self-aggrandizement.

The lack of anesthesia before the mid-19th century was less of a deterrent to the sensibilities of other Europeans than to those of the English. Magendie of France, for example, concluded correctly in 1822 that the anterior spinal roots are motor and that the posterior ones are sensory. He demonstrated this finding by vivisection on a litter of eight puppies, but only by the infliction of considerable pain.

Relatively early in the 19th century, a strong movement against cruelty to animals began to take an organized form in Britain. In 1822, Martin’s Act, which outlawed cruelty to large domestic animals, was passed by Parliament. In 1824, the Royal Society for the Prevention of Cruelty to Animals was formed. Because of these characteristics of Victorian society, it is not surprising that British physiology lagged behind that of the rest of Europe. The second and third quarters of the century saw the development of strong support both against and for vivisection. The opponents included literary figures, such as Tennyson, Browning, Carlyle, and Ruskin, and especially Queen Victoria. The proponents included prominent figures in the scientific world, such as Darwin, Huxley, Burdon Sanderson, and Joseph Lister. One example of the effect of the strong opposition to vivisection in Britain was Lister’s need to go to Paris to conduct experiments with sutures in living animals.

In 1874, an event occurred that greatly strengthened the forces against vivisection. At the annual meeting of the British Medical Association, a French experimentalist named Eugene Magnan injected absinthe into two dogs to induce epilepsy. The audience objected to the cruelty of the unnecessary experiment. A protestor cut the restraints of one dog, which staggered about. Two county magistrates were summoned, and the session was disrupted.
This unfortunate incident, which was widely publicized, further inflamed antivivisection feeling. It was a stimulus for the formation, by Frances Power Cobbe in 1875, of the Victoria Street Society for the Protection of Animals Liable to Vivisection. This group advocated abolition of all vivisection, whereas the Royal Society for the Prevention of Cruelty to Animals did not oppose vivisection under anesthesia.

The intensity of the furor led to the establishment in 1875 of a Royal Commission "on the practice of subjecting live animals to experiments for scientific purposes." The resulting Cruelty to Animals Act of 1876 was actually a compromise. Experimentation on living vertebrates required the following measures by law:

1. Endorsement by a scientific or medical body and by a professor
2. Application to the Home Secretary
3. Performance in a place that was registered and open to inspection
4. Yearly renewal of license
5. Performance only for the advancement of physiologic knowledge and the saving of life
6. Special permission for experiments conducted without anesthesia or for demonstrations

The fine was £50 for the first offense and £100 for subsequent ones. As might be predicted, the abolitionists were unhappy with the act.

The number of vivisections had reached 7,500 by the turn of the century and more than 6 million by 1980. A strong force countering the abolitionists was the formation in 1882 of the Association for the Advancement of Medicine by Research. This association was composed of prominent physicians and citizens.

One way to obtain a better appreciation of the emotions involved in the antivivisection movement is to leave the realm of facts and figures. An example of a particularly effective opponent of vivisection was George Bernard Shaw, who, in fact, railed against many of the activities of the medical establishment. In the lengthy introduction to his play of 1913, *The Doctor's Dilemma*, he suggests that motives for the performance of vivisection by doctors include cruelty for its own sake, the need for a livelihood, and curiosity. "The men whose business it was to discover new clinical methods were coarsening and stupefying themselves with the sensual villainess and cutthroat's casuistries of vivisection."

A less vitriolic, but as negative, opinion was given by Robert Knox, the Edinburgh anatomist who was so motivated in teaching by dissection of corpses that he accepted without question bodies sold by the infamous murderers Burke and Hare. I have, all my life, had a natural horror for experiments made on living animals, nor has more matured reason altered...the belief that for the most part they are wholly unnecessary, and therefore highly to be reprobated. His basic scientific premise was that of many of his era, that is, "Physiologic knowledge can be derived from morphologic appearance." Such a dedication to the antivivisection position was undoubtedly also emotional, being influenced by Knox's express love for animals, as it was for many others.

**SIR ARTHUR CONAN DOYLE AND VIVISECTION**

Another mode in which the emotional aspects of the vivisection controversy surfaced was that of direct confrontation. An example is provided by the report in the *Portsmouth Times* of Apr. 17, 1886, of a public meeting in support of kindness to animals. The speaker, a minister, denounced Pasteur's torturing of thousands of "poor dumb creatures in order to save us from hydrophobia." Two physicians in the audience objected. Dr. Conan Doyle (Fig. 2) upheld the need to kill rabbits in order to relieve human suffering. He also objected to the lecture on medical science by a clergyman. Dr. Clare-

![Fig. 2. Arthur Conan Doyle (circa 1895). (Courtesy of the Wellcome Institute, London.)](image-url)
mont gave a biblical source for the use of animals to relieve human suffering and emphasized the medical importance of vivisection. The lecturer did not reply specifically to these arguments.

Letters to the editor columns in the press were one of the battlefields for the vivisection controversy. The London Daily Express of Oct. 29, 1910, contained a letter from A. Wall, honorary treasurer of the London Anti-vivisection Society. He stated that there was not an atom of evidence that any lives had been "saved by the torture of rabbits or guinea pigs." In quick response, on Nov. 1 that newspaper published a letter from Arthur Conan Doyle. He referred to the positive statistics in the population of a district of India who were inoculated against plague, such prevention having been developed in animals. In his characteristic rhetoric, he also referred to "the anti-human campaign with which Mr. Wall is associated."

Conan Doyle also made references to vivisection, in the sense of any experimentation on animals, in several of his writings. His master detective, Sherlock Holmes, investigated the death of Drebber in A Study in Scarlet, published in 1887, a year after the confrontation with the clergyman. Holmes gave a pill found in the suspect's room to a dog. "It gave a convulsive shiver in every limb, and lay as rigid and lifeless as if it had been struck by lightning." Holmes's conclusion was that Drebber had been killed by an alkaloid arrow poison.

In this episode, Conan Doyle felt the need to justify the implicit cruelty of such an act by describing the dog as a poor little terrier in chronic pain. He also referred to a concern for cruelty to animals by Pheneas, the spirit guide for his family's seances. "Animals will be saved from all future suffering and when the spirit first touches the earth that particular suffering will at once be eliminated."

More directly related to experimentation was Conan Doyle's reaction to the research activities of one of his medical school teachers at the University of Edinburgh. His autobiography, published 43 years after his graduation, contains a criticism of William Rutherford, professor of the Institutes of Medicine.

He was, I fear, a rather ruthless vivisector, and although I have always recognized that a minimum of painless vivisection is necessary, and far more justifiable than the eating of meat as a food, I am glad that the law was made more stringent so as to restrain such men as he.

Such an orientation is characteristic of the more conservative approach to vivisection—a compromise between the desire to help humanity through science and the psychologic revulsion against inflicting pain on living creatures.

SIR WILLIAM OSLER AND VIVISECTION

Another physician, more famous for medical than literary activities, was also involved in the vivisection controversy. The first indication of William Osler's awareness of the controversy was recorded while he was enrolled in graduate studies in London in 1872. On the propriety of using the lower animals for the purpose of experimentation Dr. Sanderson said 1st, we are at liberty to use them on the same grounds as we do for food; 2nd for scientific investigation are justified in giving pain; 3rd for mere demonstration we are not justified in giving pain.

Burdon Sanderson was one of the more vocal opponents to legislative restrictions on vivisection.

More direct involvement on the part of Osler, but still relatively passive, was the signing in 1896 of a resolution protesting proposed antivivisection legislation. A year...
later, in a presentation on cretinism and its treatment, he gave credit to animal experimentation. That I am able to show you such marvellous transformations, such undreamt-of transfigurations, is a direct triumph of vivisection, and no friend of animals. ... will consider the knowledge dearly bought, though at the sacrifice of hundreds of dogs and rabbits.

Osler provided additional opposition to legislation against vivisection in the United States by testifying at a public hearing of a Senate committee. He considered such regulations "a piece of unnecessary legislation." Thus, Osler played an important supportive role in defeating antivivisection laws in the United States. He was also involved in the British controversy while Regius Professor of Medicine at Oxford. In testimony to the Royal Commission on Vivisection in 1907, he emphasized that the cure for cretinism by thyroid extract and the prevention of several diseases were made possible mainly by animal experimentation.

Osler further extolled the value of vivisection to humanity in a lengthy letter to the London Times on March 15, 1909. He concluded an extensive review of the contribution by Italians to the prevention of malaria with the following:

And let us not forget that humanity owes this triumph to the men who introduced experimentation into medicine, to the Harveys, the Hunters, the Magendies, and the Claude Bernardsthe arch-vivisectors whom it has become fashionable to abuse!—and who have thus enabled us to wring from nature what Harvey calls "her closet-secrets."

This is an excellent example of the union of Osler’s historical knowledge with his writing skills for a cause.

William Osler was to enter into the breach once more, this time in opposition to the "Dogs’ Protection Bill" introduced into Parliament in March 1919, the last year of his life. The specific restrictions were considered by the medical profession to be a major menace to medical progress, so much so that William Osler made a resolution on the subject at a scientific meeting of the British Medical Association.

The prohibition of experiments upon dogs would. . . have the deplorable result of hampering the progress of medicine and of rendering Britain alone, among the civilized nations of the world, unable to contribute to progress in a department of medical research in which it has hitherto played a distinguished part.

Osler’s involvement helped to rally the British medical profession against such a restriction on research. The results were amendments to soften the bill. The final victory was passage in Parliament of an amendment, proposed by Sir Watson Cheyne, that the House decline to proceed further with the measure.

William Osler’s involvement with vivisection differed from that of Conan Doyle in that he also actively engaged in research using animals. He published accounts of several such investigations. The first is found in a review "On the Pathology of Miner’s Lung" in the Canada Medical and Surgical Journal in 1875. Our interest in Osler’s review on miner’s lung is the description of his experiments conducted on kittens. The objective was "to show the remarkable aptitude of cells to take up granules of various sorts, and, also, to demonstrate the rapidity with which the lymphatic glands are affected."

In one experiment, Osler injected India ink into an axilla of one kitten and the thorax of another. The kittens were killed within 2 to 3 days. Gross and microscopic studies revealed India ink in leukocytes, lymphatic vessels, and lymphatic glands. Osler concluded that extraneous materials, such as India ink and carbon, are quickly rendered harmless by becoming "fixed in cells" and then are carried to lymphatic glands.

Osler did not perform the first animal experiments related to anthracosis. In 1862, Villaret exposed rabbits to inhalation of carbon. In 1867, Knauff exposed dogs to inhalation of both carbon and ultramarine blue. The objectives of these two investigators nevertheless were different from those of Osler. Villaret and Knauff were concerned with proof that carbon in the air could reach the pulmonary parenchyma, whereas Osler’s interest was in the body’s cellular defense mechanism against irritating material. His experiments are important because they were reported in 1875, 8 years before Metchnikoff’s first report on phagocytosis was delivered at the Odessa Congress in 1883.

William Osler’s purpose in performing a second animal research project was to clarify knowledge of the so-called pig typhoid. In 1878, many opinions were held about its nature, including similarities to anthrax, typhoid fever, and dysentery. He inoculated four sows, each with a different substance from diseased animals. Included were materials from an ecchymotic skin lesion, from an intestinal plaque, from caseous bronchi, and from diseased glands. To a fifth animal he fed minced intestinal plaques.

Detailed clinical observations were made on the sows daily. All became diseased. A high fever developed in the four inoculated ones, and three had diarrhea; all four died within 18 to 25 days. The condition of the one fed the plaques was similar, but it lived for 31 days, after which it was bled to death. In each instance, Osler performed a complete postmortem examination, including both gross and microscopic studies. He also examined the bodies of 19 pigs that had died in an epidemic of the disease.

The major findings were soft plaques and ulcers of the digestive tract and bronchopneumonia with a caseous
material in the bronchi. Osler concluded that pig typhoid was a distinct entity that was related to dysenteric disease in humans but with the additional involvement of skin and lungs. His description and the location of the intestinal lesions certainly suggest an infective disease similar to human dysentery. Pig typhoid is now known as swine fever or hog cholera, and it is caused by a virus.  

The third animal experiment was performed in collaboration with A. W. Clement, then a student in the Montreal Veterinarian College and later president of the American Veterinarian Medical Association. Osler held an appointment as instructor in this college. The object of their experiment was to determine why cattle infested with the common tapeworm (*Taenia saginata*) seldom seemed to have larvae in the muscles. They fed 50 segments of the worm to a calf and studied the animal both clinically and pathologically. After having a fever for 51 days, the calf was killed.

Postmortem examination revealed numerous encysted larvae 3 to 6 mm long in the lungs, heart, kidneys, tongue, and muscles. Clement and Osler concluded that larvae are frequently present but are often overlooked by meat inspectors because of their smallness and only mild opaqueness. Directly related to this study of parasitic disease in animals is the massive study by Osler and Clement of 1,000 hogs for *Trichinella spiralis*, *Cysticercus cellulose*, and *Echinococcus* (Fig. 4). Osler has been called the “Father of Comparative Pathology in Canada” on the basis of such fundamental and extensive research.

These three instances of oslerian vivisection are of interest because each made an important contribution: one to our knowledge of pulmonary phagocytosis, one to our understanding of a swine disease, and one to the prevention of human infestation with tapeworms. These studies were conducted in Montreal, where antivivisection reaction was not strong. Even in Britain, though, few comments would have been made on experimenting on pigs and cattle. The British would have voiced some objection, however, to the use of kittens, such sentiments prevailing for animals used as pets or for recreation but not as food.

**PRESENT-DAY ANTIVIVISECTION MOVEMENTS**

This overview of the history of vivisection and opposition to it in the 19th century provides some useful insights for our day. Emotion obviously often overshadowed reason in the debate between those for and those against vivisection in Britain. The situation was no different in the United States, where a bill preventing cruelty to animals in general was passed by Congress in 1871. Here, antivivisection support was not so great as it was in Britain. The movement resulted in legislation relating to the care of laboratory animals but not to vivisection. Perhaps this outcome was the result of the different societal characteristics between a country steeped in centuries of history, tradition, and formality and one not yet emerged from the frontier way of life.

The past has direct relevance for the present because antivivisection activity has again increased, more strongly (as before) in Britain than in the United States. For example, a bill for the protection of animals (scientific purposes) was introduced in the British House of Commons several years ago. Sponsored by the Royal Society for the Prevention of Cruelty to Animals, this bill precluded the use of animals in experiments except to relieve suffering or to prolong life in humans and animals. In the United States, the antivivisection sentiment is now even stronger than it was in the last century. In De-
As recently as late March 1983, 47 amendments to the opposition by the chairman of the Labor and Human Resources Committee, it did not reach the Senate floor. As recently as late March 1983, amendments to the proposed legislation were approved that would require that the National Institutes of Health develop a plan to reduce the number of animals and the stress to animals used in research.

As in the past, antivivisection is associated with a general antiscience trend, including opposition to vaccination, fluoridation, and scientifically established treatments. The arguments against vivisection today are basically the same as those of a century ago, but with a few additional ones based on new technology and modern consumer products.48

1. The LD_{50} (median lethal dose) determined by exposing animals to various substances is not valid because it does not give a direct indication of acute, short-term toxicity.
2. Species react differently to substances.
3. Dissections of animals are performed by schoolchildren who are untrained and who may become indifferent to suffering.
4. Many animals are used for nonmedical purposes (for example, testing the toxicity of consumer products, such as cosmetics).
5. The price paid for dogs to be used for experimentation is high enough that pets are often stolen for such purposes; there are “children and old age pensioners whose pets disappear in the night.”
6. Alternatives to the use of animals in biologic research now exist (for example, computer research, experiments on bacteria, and exposure of tissue cultures to substances). A bill before Congress in 1981 was based on this argument; it would have banned surgical experiments on living animals.49

The modern antivivisectionists argue that the use of living animals is no longer necessary in research but is continued because of tradition, secrecy, bureaucratic lethargy, and profit making. Countering these arguments are those who see vivisection as essential.50 They point out that alternatives have serious limitations; for example, tissue cultures cannot detect the poisonous actions of curare and strychnine. They point out, furthermore, that antivivisectionists do not object to animals being slaughtered for food or furs. Antivivisectionists are selective in their concern for animals, worrying most about dogs and cats, although at present only about 0.6% of all experiments use these two species.51 Thus, antivivisectionists are inconsistent. They would not refuse a life-saving drug that was developed and tested with the use of dogs—for example, insulin, which was discovered by Banting and Best. The provivisectionists further claim that public demand for improved medical care and the testing for safety of new substances has led to a greater use of animals in research.52 Testing for the safety of commercial products (for example, cosmetics, food additives, and detergents) accounts for about 60% of animals used in research today.53

DISCUSSION
Arguments about vivisection voiced 150 years ago continue today, albeit cloaked in new verbiage. Common societal elements in these two eras are protraditionalism and antiscientism. Antivivisection sentiment apparently is caused not only by cruelty to animals but also by tensions related to the place of science and medicine in society.

The very core of the vivisection controversy was expressed by Gallistel49 in a recent publication. “One should urge the abandonment of animal research in part or in toto only if one believes that the moral value attached to the avoidance of animal suffering is greater than the moral value attached to the enrichment of human understanding and the alleviation of human suffering.”

On a more pragmatic basis, to quote from a letter by Conan Doyle on vaccination, “The interests at stake are so vital that an enormous responsibility rests with the men whose notion of progress is to revert to the condition of things which existed in the dark ages before the dawn of medical science.”54 The basic question, then, is whether the ends (knowledge gained by vivisection) justify the means (inflicting suffering on animals). According to Visscher,55 “The truism that the ends do not justify the means involves very complex moral questions and is not a self-evident principle with universal applicability.”

Finally, before anyone embarks on research involving animals, five fundamental questions should be asked.56

1. Is the animal the best experimental system for the problem?
2. Must the animal be conscious at any time during the experiment?
3. Can pain or discomfort associated with the experiment be lessened or eliminated?
4. Can the number of animals used be reduced?
5. Is the problem worth solving anyhow?

Vivisectionists need to justify their experiments, and antivivisectionists need to justify their opposition.57 The issue in part is moral. “The use of animals in research


cember 1982, a hearing was held by the House of Representatives Subcommittee on Health and the Environment on a bill entitled “The Humane Treatment and Development of Substitutes for Animals in Research.” Because of opposition by the chairman of the Labor and Human Resources Committee, it did not reach the Senate floor.
ultimately comes down to whether the benefits and knowledge gained by experimentation justify the taking of animal life or the infliction of pain. 28 Conan Doyle and William Osler were both staunch defenders of vivisection (the latter was also a vivisectionist), and both were moral, sensitive, and humane physicians.

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