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Current Comments®

Animal Experimentation—When Do the Ends Justify the Means?

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In 1977, I became involved in the animal experimentation controversy[1] when Nicholas Wade, then a reporter for *Science*, used *Science Citation Index*® data to assess the impact of some research that had been questioned in the press.[2] Antivivisectionists accused a scientist at the American Museum of Natural History of mutilating cats for trivial scientific gain. His experiments involved removing endocrine glands, sectioning nerves, and ablating brain tissues of domestic cats and observing their subsequent sexual behavior. Our own citation analysis showed that the literature reporting that work was reasonably well cited, and therefore had some impact upon the research community.[1] But although citation analysis can help us to evaluate the impact of basic research, it cannot, alas, answer moral or ethical questions, whether on animal experimentation or other issues.

There's no question that experiments with animals have greatly advanced the frontiers of medicine over the years. For example, the discovery of insulin, which has proved so beneficial to diabetics, was accomplished in part through experiments on dogs.[3] Advances in the treatment of pediatric vision disorders resulted from Hubel and Wiesel's experiments with monkeys and cats.[4] A recent paper by Neal E. Miller, Rockefeller University, New York, describes how experiments with animals led to the development of new drugs for the treatment of mental illness.[5] And this listing is by no means exhaustive.

Nevertheless, medical researchers today find their work threatened by an "animal rights" movement, which seeks to curtail the use of animals in research. Some of the observations by animal rightists are outlined by prominent activist Peter Singer in his book, *Animal Liberation*. Singer suggests that most animal experiments are unnecessary.[6] He and other activists assert that animal lab work often replicates already documented experiments, is not innovative enough to merit publication, could be replaced by alternative methods, is performed for trivial purposes, or is inappropriate because the results cannot be translated to humans. Moreover, these activists claim that some experiments and tests are unnecessarily cruel, causing animals great pain and suffering for little scientific gain. They add that facilities used may not be adequate for the proper care of the animals, and that scientists have little regard for the animals they use.[7]

To refute such charges and promote the scientific community's point of view, the National Society for Medical Research (NSMR, 1029 Vermont Avenue, NW, Suite 700, Washington, DC 20005) was founded in 1946.[8] More recently, scientists established the Association for Biomedical Research (ABR, 400-2 Totten Pond Road, Suite 200, Waltham, Massachusetts 02154) in 1979. Both groups promote freedom for researchers to use laboratory animals without excessively restrictive regulations. To this end, they monitor pending legislation

concerning laboratory animals in the US, and lobby on behalf of the scientific community's viewpoint. Membership in NSMR consists of research institutions and concerned individuals, while membership in ABR is limited to institutions. More will be said about these organizations later in this essay.

The problem addressed by both sides in the controversy is not trivial. It is difficult to accurately determine how many animals are used in scientific research around the world, but one estimate puts the figure at about 250 million each year.[9] In the US alone, according to the National Institutes of Health (NIH), about 20 million animals per year are acquired by various research institutions for scientific studies. This includes about 18,500,000 rodents, 400,000 rabbits, 240,000 cats and dogs, 450,000 birds, and 30,000 primates.[10] These animals are used in basic research; applied biomedical research; the development of drugs; and the testing of consumer goods for toxicity, safety, irritation, mutations, cancer, or birth defects. In addition, animals are the subjects of psychological experiments and are also used in medical and veterinary schools to demonstrate diseases or for surgery practice.

The ethics of humankind's treatment of animals has been the subject of discussion throughout the ages. Philosophers, scholars, and scientists—among them Aristotle, René Descartes, Voltaire, Immanuel Kant, Thomas Aquinas, and Charles Darwin—grappled with such moral and ethical questions as: Do animals have rights? How do humans differ from other animals? Do animals possess language, rational thinking, or self-consciousness? Do animals feel pain or suffer? Essays by these venerable scholars have been compiled into a book edited by Tom Regan, North Carolina State University, Raleigh, and Singer.[11] More will be said about these questions later in this essay.

Real public debate over animal experiments did not surface until the seventeenth and eighteenth centuries, when European scientists began performing surgery to advance their knowledge of physiology.[12,13] Samuel Johnson summed up the public outcry when he wrote:

> I know not that by living dissections any discovery has been made by which a single malady is more easily cured. And if knowledge of physiology has been somewhat increased, he surely buys knowledge dear...at the expense of his humanity.[11]

In 1871, the British Association for the Advancement of Science issued guidelines stating, among other things, that anesthesia would be used wherever possible during animal experiments. This self-regulation mollified the critics until 1873, when a manual was published describing experiments for the laboratory. The manual neglected to mention that anesthesia should be used, and public furor ignited once again.[12,13] By 1876, animal welfare groups had pressured the British Parliament into passing the Cruelty to Animals Act. The law required experimenters to be licensed by the Home Secretary. Many kinds of animal experiments required special certification. However, by 1884 responsibility for licensing recommendations was placed in the hands of a scientific body, the Association for the Advancement of Medicine by Research, and licenses were subsequently issued in large numbers.[12,13]

In the US, Henry Bergh founded the American Association for the Prevention of Cruelty to Animals in 1866.[13] In 1883, the first antivivisectionist society was established in Philadelphia. Animal welfare proponents concentrated their efforts on state legislatures where, thanks to scientific lobbying, restrictive bills consistently failed to pass. In the first decade of this century, the Ameri-

can Medical Association developed a voluntary code regulating laboratory experimentation.[13] In 1966, the US Congress passed the Animal Welfare Act. Amended in 1970, the act regulates laboratory animal use by licensing research facilities and establishing minimum standards for the care of experimental animals.

Today, animal rights organizations continue to lobby for stronger measures. At least 400 different animal rights organizations now exist in the US, each with different concerns. Some oppose all animal experimentation, while others are interested solely in the protection of household pets. Still others target specific procedures as objectionable and attempt to change them.

Recently, debate has focused sharply on two standard tests used extensively by industry—the Draize test for eye irritation and the lethal dose 50 percent (LD_{50}) test for toxicity. Both of these procedures use large numbers of laboratory animals.

The Draize test measures the extent of injury a substance may cause to the eyes. It was developed in 1944 in response to the Federal Drug and Cosmetic Act of 1938.[14] This act requires that cosmetics be free of substances which might injure the user. Rabbits are the subjects of the Draize test. One-tenth of a milliliter of a substance is instilled in the conjunctival sac of the rabbit's eye. The eyelids are held together for one second. The rabbit is then released and examined periodically thereafter.[15] Although the law does not specifically require the Draize test for new cosmetics, the test is nevertheless routinely performed. This is because the law *does* require cosmetic manufacturers to label their products as "untested" if the Draize test, or some other approved assay, is not performed.

Animal welfare groups object to the Draize test on a number of grounds. Andrew N. Rowan, Tufts School of Veterinary Medicine, Boston, Massachusetts, asserts that the differences in physiology between the rabbit eye and the human eye render test results invalid. Other critics of the test charge that the scale used to judge irritation is subjective and the results are open to interpretation.[16,17] Still others make the arguable point that cosmetics are too frivolous to justify subjecting animals to pain.

Another testing procedure found objectionable by critics is the LD_{50} test, which measures toxicity—the degree to which substances are poisonous. LD_{50} is the amount of a substance required to kill half the test animals within 14 days. The American biometrician Chester I. Bliss is sometimes credited with standardizing the test in its present form while a student at University College London in 1935.[18]

Critics of the LD_{50} note that a hundred animals may be used each time a substance is tested, of which half will die. Since the test measures acute toxicity only, and cannot predict the long-term effects of small doses, it may not apply to drugs taken over a long period of time. Further, hundreds of variables affect the outcome of the test, including the sex, age, and health of the animals—and even the lab's caging practices. Finally, according to Rowan, the test does not indicate the cause of death, "which sometimes, in the case of a relatively benign substance like distilled water, results merely from the sheer bulk of the dose."[19]

In the US, LD_{50} has been used extensively in the pharmaceutical industry where it is generally believed that the test is mandated by federal law. However, at a recent Food and Drug Administration (FDA) meeting there was considerable confusion on the matter.[20] Industry and animal rights groups were both represented. Both were under the impression that the LD_{50} test is required by the FDA. FDA officials denied this, however, and asserted that other tests may comply with regulations.[20] In this

connection, the scientific community's efforts to reduce the number of animals used in the Draize and LD_{50} tests are relevant.

A major criticism of animal experiments is that they don't always apply to humans. One relevant controversy concerns Depo-Provera, an injected contraceptive. Depo-Provera is used in 82 countries to control population growth and is approved by the World Health Organization. In the US, however, it may be prescribed only as a treatment for inoperable endometrial cancer. Proponents of the drug say that it is safe, and they point to the experience of thousands of women who have already taken it.[21] Opponents point to animal studies, which show the development of tumors and other abnormalities.

Beagles were used to test the drug as a contraceptive. Many of them developed breast tumors. But researchers now believe that the healthy beagle's breast may contain a reservoir of microscopic tumors. Over a long period of time, these tumors can grow and become malignant if stimulated by progesterone, an ingredient of Depo-Provera.[21] Humans do not exhibit this trait, and in fact dogs are no longer used to test contraceptive hormone preparations in the US.

When results from a ten-year study of rhesus monkeys were released, two out of 52 animals had developed endometrial cancer after receiving Depo-Provera.[22] This was surprising, since the drug is used to treat this disease. Nevertheless, the drug's proponents assert that the onset of endometrial cancer in monkeys differs from that in humans, and that the drug is safe and effective.[23]

Animal rightists sometimes cite the thalidomide case as one in which the results of animal studies did not apply to humans. Thalidomide, of course, is the tranquilizer which resulted in thousands of birth deformities before its removal from the market. There's a popular misconception that thalidomide had been extensively tested, and its teratogenic effects went undetected.[9] (p. 103) The sad truth is that the manufacturer of the drug performed no tests at all on pregnant animals.[24] Numerous tests of the drug on animals, after it had already been taken by thousands of pregnant women, clearly demonstrated the drug's teratogenicity. Some animal rightists would have us eliminate such testing.

Another focus of debate over the validity of animal studies is the recent saccharin controversy.[25] Studies on rats sufficed to convince the FDA that saccharin may cause cancer in humans. But critics charged that a person would have to drink about 800 12-oz. bottles of diet soda daily to consume the equivalent amount administered to the test rats. Toxicological testing routinely relies on giving large doses to small groups of animals. Scientists reason that if large doses cause tumors in a significant number of animals during their short lifetimes, a small dose administered over a longer period can cause tumors in some people.[25]

Some of the more emotional rhetoric from animal rights activists concerns the treatment of laboratory animals. In 1981, Edward Taub, Institute for Behavioral Research, Silver Spring, Maryland, was prosecuted for the alleged mistreatment of the primates in his laboratory.[26] Photographs offered at his trial showed animals with mutilated limbs and open wounds.

Taub was investigating how monkeys cope with the loss of sensation when their forelimb sensory nerves are severed. His work would presumably be used to develop better rehabilitation techniques for human stroke victims. One consequence of Taub's research was that the monkeys inflicted wounds on themselves. Although Taub was recently exonerated of all charges,[27] his case served to focus public attention on laboratory conditions.

Scientists are often criticized for not trying alternatives to animal research. One reason they don't may be inade-

quate training in the alternative design of experiments. Biologists, for example, may not know which problems are good candidates for nonanimal experiments.[28] Bernard Dixon notes that researchers stick with established techniques. Doctoral students must be sure that the methods they use are sanctioned by advisers. Thus, an adviser must be familiar with the approach being tried. This works against using novel experimental methods.[29]

In response to pressures exerted by animal rights activists, the scientific community is looking for ways to alleviate animal suffering. Many universities, including Tufts, Medical College of Pennsylvania, Johns Hopkins, and Rockefeller, have established research programs to study alternatives to animal testing.[30] The Johns Hopkins Center for Alternatives to Animal Testing was established with a $1 million grant from the Cosmetics, Toiletry and Fragrances Association and $300,000 from Bristol-Myers. A $750,000 grant from Revlon, Inc., the cosmetics firm, supports the quest for alternatives to animal research at Rockefeller University's Laboratory Animal Research Center.

The Rockefeller scientists are working toward creating a replacement for the Draize test. Their efforts involve the development of cell culture assays that mimic the complexities of the living animal. According to Ellen Borenfreund, Rockefeller University, the assays have several requirements: they must be easy to standardize so that reproducibility among laboratories is assured, and "they must be capable of detecting toxicity over a large spectrum of chemically differing toxicants and target tissues."[31] The reproducibility of assays is a difficult problem. Two different types of cell cultures are used in this kind of research—cell lines and primary cultures.[31] Cell lines isolated from tumors can be maintained over generations and exchanged between laboratories. However, they may not have the specific metabolic systems needed to develop accurate assays. Primary cell cultures are isolated directly from living animals. They can be maintained for only a few days, but do retain most complex metabolic activity. Rockefeller scientists are working on both types of cultures in their search for alternatives.[32]

One approach under study is based on a characteristic of inflammatory response—macrophages, cells that engulf and consume foreign material, migrate to areas of injury. This migration can be measured *in vitro* in a specially designed chamber. D.M. Stark, Laboratory Animal Research Center, Rockefeller University, is studying how cultured macrophages react to fluids from cell cultures which have been exposed to various irritants. Ideally, the migratory response toward these culture fluids can be correlated with the already established *in vivo* response.[32]

Another approach involves the development of a preliminary screening test for irritants. Borenfreund exposed five different cell lines to a group of about 40 potentially toxic agents. Her results correlated well with already published Draize data, but the test might be difficult to standardize. Her colleague, J. Walberg, uses another approach.[33] He collects cells shed in the washing of eyes from rabbits exposed to various alcohols of known irritancy. The cells are recovered by centrifugation, counted, fixed, stained, and examined by microscope. Again, results were found to parallel the Draize test. In this case, although animals were still used, a standard could be developed eliminating the need for repeated testing, thus reducing the number of rabbits exposed.[33]

Several researchers have recently published methods for reducing the number of animals used in the LD_{50} test. E. Schütz and H. Fuchs, Hoerst Company, Frankfurt, Federal Republic of Germany, found that three male animals per dose were all that are needed to determine toxicity rather than the five ani-

mals of each sex now used.[34] H. Müller and H.-P. Kley, Byk Gulden Lomberg Co., Konstanz, Federal Republic of Germany, assert, "A 50-75 percent reduction of expenditure in animal material is possible in most LD_{50} determinations."[35] Other researchers are pursuing cell culture alternatives to the LD_{50}.

Culture assays have already proved a successful alternative to some types of animal testing. The Ames test is one well-known example.[36] This test is an unobtrusive alternative to direct exposure. Bacteria in an extract of rat liver are exposed to potential carcinogens. These bacteria cannot make a certain amino acid, histidine. If, after exposure, histidine is detected, it is assumed that the chemical under study affected the DNA and caused the change. It therefore could cause changes in living things. The Ames test has been discussed in a previous essay.[37]

In addition to cell culture alternatives, scientists are working on replacement techniques that rely on computer modeling. Corwin Hansch, Pomona College, California, uses "quantitative structure activity relation analysis," a method that makes preliminary estimations of the toxicity or efficacy of compounds. Hansch converts structural characteristics into numbers allowing for more precision than do pictures of molecules. Comparison of the numbers can tell researchers which differences between two compounds are significant.[28]

To efficiently use this technique, a large data base containing the chemical structures of known molecules is required. For example, the National Cancer Institute uses structure activity analysis to find new antitumor drugs. All new reported compounds are compared with the structures of 55,000 known compounds. Any compound with an unusual structure is analyzed chemically. If accepted as a potential new drug, it is tested on cancerous mice. This eliminates about half of the new compounds before they have to be tested on mice.[30] In a recent article, Nancy L. Geller, Memorial Sloan-Kettering Cancer Center, New York, notes that statistical methods can minimize the number of animals needed by contributing to the adequate design of experiments.[38]

A recent article in *Chemical & Engineering News*[39] reviewed many alternatives to animal research. Many of the scientists quoted in this article express optimism that the number of animals used in research can be significantly reduced. They are not, however, sanguine about the chances of replacing animal experiments entirely. Their sentiments are echoed by NSMR. Testifying on behalf of the society before a committee of the US House of Representatives, S.M. Wolff, Tufts University School of Medicine, pointed out that the word "alternative" is really a misnomer describing adjunct methodologies to be used side by side with traditional animal testing, not replacing it entirely.[40]

Thus, the new techniques will still leave us with the ethical question of whether we have the right to use animals for experiments at all. A related and more profound question is whether or not animals possess "consciousness" in the sense that humans do. Does human consciousness differ from that of animals in kind, or only in degree? Donald R. Griffin, Rockefeller University, an ethologist, examines these questions in his 1981 book, *The Question of Animal Awareness*.[41]

Griffin begins by summing up the prevailing scientific orthodoxy regarding animal consciousness: "The current scientific *Zeitgeist* almost totally avoids consideration of mental experience in other species, while restricting attention to overt and observable behavior and physiological mechanisms."[41] (p. 1) Throughout the book, Griffin cites a huge body of literature which reflects the assumption that nonhuman animals, with the possible exception of the great apes, are incapable of any thought

or behavior which has not been genetically programmed.

Griffin does not share this assumption, although he does not argue the opposite view. He merely demonstrates that experimental evidence gives us no reason to assume that evolutionary development is anything but a continuum. According to Griffin, a view of the animal kingdom which has humankind somehow qualitatively detached from other species is not necessarily supported by the evidence.[41]

Griffin examines those human attributes alleged by philosophers and scientists to set the human species apart from all others. These include symbolic communication, self-awareness, anticipation of future events, and so on. Griffin shows that experimental evidence either suggests that even such "lower" species as honeybees possess some or many of these attributes or that no conclusions about the presence or absence of these attributes can be drawn.[41]

Nowhere in his book does Griffin address the implications of his work on the ethics of using animals in scientific research. Still, one wonders if an animal's possession of awareness would endow it with "rights" which exempt it from being the subject of scientific experiments.

A recent unsigned editorial in *Nature* presents a defense of the use of laboratory animals that does not depend on the question of consciousness. The anonymous author writes: "We should resist the temptation of viewing the natural world as a blissful, magical kingdom, save only for man, a clod with heavy boots trampling the flowers. The 'sentient, purposeful' creatures of the wild lead difficult, violent, parasitized and short lives. Man's exploitation of animals for his own survival is hardly a perverse departure from the natural order."[42]

The anonymous author (the Washington office of *Nature* says that editor John Maddox did not write the essay) concludes with a statement most scientists would find reasonable: "None of this implies that human beings can treat animals as they choose. Perversion—and corruption of human values—undeniably comes from pointless cruelty to animals.... But there are simply no consistent or universal principles that imbue animals with 'rights' as exercised by humans."[42]

The scientific community recognizes that it must be conscientious in providing humane care for experimental animals, or else lose public credibility. Most scientists make every reasonable effort to keep their laboratory animals comfortable and disease free. However, other motivations exist. As C.R. Coid, Clinical Research Center, Harrow, Middlesex, England, points out, "Scientists can do without the frustrations and additional costs arising from the use of animals infected with pathogens or harboring microorganisms which may interfere with experiments."[43]

Under the Animal Welfare Act, the US Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) insures that laboratories follow humane standards. This service, consisting of diligent, well-trained inspectors, has been threatened with budget cutbacks. NSMR in concert with four other scientific organizations fought to maintain APHIS intact.[44]

Responsible laboratories follow guidelines outlined in *Guide for the Care and Use of Laboratory Animals* prepared for NIH by the Institute of Laboratory Animal Resources, National Research Council.[45] The purpose of the guide is "to assist scientific institutions in using and caring for laboratory animals in ways that are judged to be professionally appropriate."[45] Topics covered are quite diverse. The guide is very specific. For example, it recommends the amount of caging space required for different animal species, exercise, etc.

By adhering to the guide's criteria, animal research facilities can be accredited by the American Association for Ac-

creditation of Laboratory Animal Care (AAALAC), 2317 Jefferson Street, Suite 135, Joliet, Illinois 60434.[46] A nonprofit corporation, the Council on Accreditation reviews applications for accreditation and conducts on-site visitor's inspections. Criteria are so stringent that relatively few—only 422—laboratories have achieved it. However, full accreditation by AAALAC is accepted by NIH as assurance that animal facilities follow Department of Health and Human Services policy on laboratory animals when evaluating research grants. The National Science Foundation, the Department of Defense, and other federal funding agencies require that grantees performing research on warm-blooded animals comply with the standards established by the Animal Welfare Act of 1966 and the NIH guide.[47]

While the scientific community accepts voluntary controls, most scientists adamantly oppose any further legislation that interferes with the design or progress of experimentation. Walter C. Randall, president, American Physiological Society, called "unfortunate" the notion that restrictive federal legislation was needed despite easily verifiable trends that marked reductions have taken place in the use of animals in research and testing.[48] In recent years, several versions of a bill designed to put more teeth into laboratory regulation have been introduced in the US Congress.[49,50] Rats and mice, exempt from regulation under the present Animal Welfare Act, would be included under most new versions. One provision directed government agencies to look for and use methods of research and testing that reduce the use of warm-blooded animals—a design scientists regard as "clumsy interference with the conduct of research."[49] In addition, animal care requirements would be made stricter.

The establishment of an "animal experiment review board" at each institution, staffed by scientists and at least one nonscientist not connected with the institution, was also proposed. Several versions called for all federally supported research facilities to be accredited by the AAALAC.[49] Universities fear that it would cost $500 million to bring all NIH supported laboratories up to AAALAC standards. An additional provision states that a 50 percent share of NIH funds now going to work involving animals be diverted to fund nonanimal substitutes, a move that could severely restrict research.[51]

As we noted earlier, scientists have also responded by establishing NSMR and ABR. In its early days, NSMR defended scientists against antivivisectionist publicity by the Hearst newspaper chain. Subsequently, through its assistance in the founding of the AAALAC, and its watch over legislation affecting scientific freedom, NSMR has effectively combated the emotional rhetoric characterizing this controversy. NSMR takes a reasoned approach. It stands for the use of nonanimal methods when these have been proved effective. But it believes that these techniques will nearly always be used as *adjuncts* to animal testing. It is against restrictive legislation but for responsible laboratory animal care. In addition, NSMR documents the benefits to humankind of laboratory animal experimentation.[8]

To keep its members abreast of its activities, NSMR publishes a newsletter, the *NSMR Bulletin*, ten times a year. Recent issues analyzed the proposed legislation affecting lab animal management, announced upcoming conferences of interest, reported on the outcome of the Taub case, and followed antivivisectionist activities.[52,53]

The ABR keeps its member organizations abreast of legislative developments through two newsletters. One, *Regulatory Alert*, is published at irregular intervals, whenever new legislation is proposed in Congress. Recent issues have discussed the so-called Walgren Amendment which, if it becomes law, would give the recommendations in the NIH

guide the force of law;[54] and the recent efforts of animal rights groups to push legislation which would divert huge sums of federal research money from experiments on animals to investigations into whether those experiments actually duplicate previous work.[55]

The other ABR newsletter, *Update*, is published about twice a month. It provides follow-up information on the progress of legislation previously reported in *Regulatory Alert*. Recent *Updates* have reported on a request from several US senators to the General Accounting Office to study the enforcement of the Animal Welfare Act,[56] and the progress of a bill which would forbid the Department of Defense from using dogs and cats to train combat surgeons.[57]

Another organization, the Scientists' Center for Animal Welfare (SCAW, P.O. Box 3755, Washington, DC 20007), was established by scientists and social scientists to "provide scholarly input, collect scientific facts and make objective analysis of animal welfare issues." SCAW has sponsored its own conference on review procedures for animal experimentation.[58] One speaker at the conference, Michael W. Fox, Institute for the Study of Animal Problems, Washington, DC, has suggested that journal editors should reject papers reporting research which used inhumane methodology.[58] He suggests that journals publish guidelines for the proper use of laboratory animals. At least one journal, the *American Journal of Physiology*, does publish such guidelines.

Several journals deal with laboratory animal issues. The *Journal of Animal Science* covers animal welfare topics on occasion, as does the *Journal of the American Veterinary Medical Association*. The *Annals of the New York Academy of Sciences* recently devoted an entire issue to the role of animals in biomedical research,[59] while as far back as 1967 the *American Journal of Public Health* devoted part of an issue to the benefits of using animals in research.[60] Information on cell culture alternatives can be found throughout the biological and biomedical journal literature.

It may seem obvious to many *Current Contents*® readers that research on laboratory animals has contributed greatly to the advance of medical science and the well-being of humankind. Unfortunately, these contributions may be too obvious for our own good. Randall correctly identifies the activities of the animal rights activists as posing a major threat to the future of medical research.[61] Yet in reviewing the literature for this essay, I was surprised at how the critics of animal research dominate the popular literature on this subject. While one can find cogent defenses of animal research in the scholarly literature, it is in the political arena where the battle is being fought.

While the existence of NSMR and ABR is encouraging, what is needed is for more individual scientists to become involved in public education, lest regulations interfering with experimental design are imposed on us. It is clear that scientists can never be complacent on the issue of laboratory animals.

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