

On The Ethics of Animal Research

DAVID DEGRAZIA

INTRODUCTION

Few moral issues are as polarizing as the use of nonhuman animals in biomedical research. Contrary to some at the poles, this issue is also enormously complex. Moreover, the stakes are high. From 50 to 100 million animals are involved in such experiments annually (Orlans, 1998, p. 400). And, according to many proponents of animal research, biomedical progress requires the continuation of experiments upon live animals. The purpose of this chapter is to convey some of the complexity of this important issue, sketch and evaluate leading positions, and offer several ethical and policy recommendations.

Reflection on the ethics of animal research inclines most people towards neither absolute abolitionism nor a pure *laissez-faire* approach, but to something (perhaps not well defined) in between. From such a moderate standpoint, it may seem obvious that some animal research is justified. Imagine an experiment that would cause mild pain or distress to 100 rats before they are painlessly killed, and is very likely to succeed, thereby validating a cure for a disease that currently kills tens of thousands of children every year; no scientifically promising alternative to this experiment is known. Although it may seem perfectly obvious that this experiment passes moral muster, this judgement is not self-justifying. After all, most of us would condemn an experiment that caused pain or distress – not to mention death – to human subjects *who neither consented to participate nor stood to benefit from their participation*. Yet, the rats in the imagined study neither consent nor stand to benefit. They are sacrificed for the benefit of others. The judgement that the experiment is justified while similar coercive use of humans would not be justified implies that the *moral status* of rats is, in some sense, less than that of humans.

More generally, any justification of animal research requires assumptions about moral status. Naturally, the

same is true of principled opposition to animal research, because such opposition assumes that animals' moral status is too substantial to permit their sacrifice for others' (humans' or animals') benefit. My first thesis, then, is that consideration of animals' moral status is inescapable in any responsible investigation of the ethics of animal research.

In its admirable, well-researched report, the Nuffield Council on Bioethics (NCB) disapproves:

"The debate is not best characterized in terms of the relative moral status of humans and animals but in terms of what features of humans and animals are of moral concern Once those features are identified, the question [is] how they should be taken into account in moral reasoning. Are they factors to be weighed against others, or do they function as absolute prohibitions?" (NCB, 2005, p. 57; cf. Rachels 2004).

The NCB identifies *sentience, higher cognitive capacities, the capacity to flourish, sociability, and possession of a life* as morally relevant features (NCB, 2005, p. 41).

However, this proposal is deeply problematic. First, deciding which features are morally relevant can be as controversial as debates about moral status. For example, contrary to the NCB's list, I do not believe that an amoeba's being alive is morally relevant – just as I doubt that *life per se* confers moral status. Second, even if we confidently endorsed a list of morally relevant features, as the NCB notes, we must decide how to take these features into account. If sentience is morally relevant, we must ask whether, say, rats' sentience justifies (1) an absolute prohibition against causing rats pain, (2) a presumption against causing them pain *equal* to the presumption against causing humans (unconsented) pain, or (3) a presumption against causing pain that is *weaker* than that against causing humans pain. The NCB notes that we must decide between absolute constraints and balancing considerations. But on what basis? Note that any endorsement of balancing will be unhelpful without a

specification of *how* to balance different factors. Should a rat's pain count as much as a human's pain, or less? And, if less, how much less? Answers to the questions raised in this paragraph, I suggest, are intelligible only on the basis of assumptions about animals' moral status.

Before we take up the issue of moral status, some background should be helpful.

BACKGROUND

In this chapter, 'animal research' will refer to two broad endeavours. First is animal usage in the *pursuit of original scientific knowledge*. This category divides into *basic research*, which pursues new knowledge of biological processes and functions, and *applied research*, which seeks new biological, medical or veterinary knowledge in order to promote human, animal or environmental health. Second, *testing* on animals evaluates chemicals and other products for safety.

Animal research dates back to classical Greece and Rome and, further east, to early Arabic medicine after the fall of Rome (NCB, 2005, pp. 15–29). Although little animal research was conducted in medieval Europe, animal experiments led to several important discoveries – for example, about blood circulation and the function of lungs – in the seventeenth and eighteenth centuries. The volume of animal research greatly increased in the nineteenth century. Partly in response to the pioneering experiments of François Magendie and Claude Bernard in that century, a notable antivivisection movement emerged in Britain. The 1876 (British) Cruelty to Animals Act, the world's first legislation regulating animal research, established a system requiring licences for experimentation on animals.

Despite continuing protests, animal research grew steadily for most of the twentieth century. Responding to both society's interest in animal research and its ethical concerns, British scientists William Russell and Rex Burch published in 1959 a landmark work that established the 'three Rs' – *Refinement* of techniques to reduce suffering, *Reduction* of numbers of animal subjects and *Replacement* of live animals wherever possible – as central concerns for conscientious members of the profession (Russell and Burch, 1959). Public pressure for increased regulation in Great Britain led to the 1986 Animals (Scientific Procedures) Act, which regulates the research use of all vertebrates and, by a subsequent modification, octopi. Prominent in this legislation is a requirement of harm/benefit assessments of proposed experiments.

In the United States, the (Laboratory) Animal Welfare Act became law in 1966, following widespread outrage that pet dogs were being stolen and sold to research laboratories. At first, it was primarily a pet protection bill. Subsequent amendments significantly increased the requirements for the

care and use of research animals. Although this legislation has never covered farm animals, or even rats and mice – the animals most commonly used in research – Public Health Service (PHS) policy covers all vertebrate animals in PHS-funded research. But PHS policy leaves rats and mice unprotected in privately funded research – a major gap in American regulation.

Today, member states of the European Union are legally bound by the 1986 EU Directive EEC 86/609. Among its provisions are a requirement for special authorization to conduct experiments likely to cause severe, prolonged pain in animals; requirements for breeders and suppliers; and the prohibition of animal use where a valid alternative exists. A more recent ban on the use of animals in cosmetics testing has passed and is due to take effect in 2009.

Is the policy status quo morally defensible? That depends, in significant measure, on how we should understand animals' moral status.

MORAL STATUS

A being has *moral status* if he or she is morally important in his or her own right, and not merely because how he or she is treated may affect others' interests. All *moral agents* – that is, all beings who have moral responsibilities – have moral status. Rocks do not. They have no conscious or sentient life (even potentially), so nothing we do to them can possibly matter to them. We cannot harm or benefit rocks. Similarly with cars (although what one does to a car can matter to its owner), because our treatment of a car does not matter to it and therefore does not harm or benefit it in any morally significant sense. Common sense suggests that only beings who have interests – or a welfare – have moral status. So having interests is necessary for moral status. If having interests is also sufficient for moral status, then many animals have moral status. Do they?

One historically prominent view answers negatively. According to this *no-status view*, animals' interests have no moral importance except where our treatment of animals affects human interests. That kicking a dog may upset some people, or damage an owner's property, is morally important on this view; that it hurts the dog does not directly matter. The no-status view is enormously implausible in the case of sentient animals, who have interests, and its historical prominence seems to have more to do with humans' self-interested bias and power over animals than with moral insight. Here, I quickly suggest two reasons to reject the no-status view. First, it does not adequately account for our considered judgement that cruelty to animals is wrong; an adequate account must acknowledge the moral status of cruelty's victims. Second, it has trouble explaining why it is wrong to mistreat those human beings who are sentient

yet, due to injury or genetic anomaly, lack (even potentially) advanced capacities such as moral agency and linguistic competence – capacities commonly believed to confer special moral status on human persons (DeGrazia, 1996, pp. 40–3, 54–6). Hereafter in this chapter, I will assume that (sentient) animals have at least some moral status, that how we treat them has non-derivative moral importance and that they are beings to whom moral agents can have obligations.

Among the theories ascribing moral status to animals, significant differences appear. Let us first distinguish *equal-consideration views* and *unequal-(less-than-equal-) consideration views*.

The language of 'consideration' focuses on how important, morally, animals' interests are in comparison with prudentially comparable human interests. Take for example, one's interest in not suffering (to some degree, however measured), an interest humans and animals share. How important is animal suffering (in its own right)? Equal-consideration (EC) views maintain that comparable interests have equal moral weight, regardless of the interest bearer's species. This implies that sentient beings have *equal moral status at the level of basic consideration*, but perhaps not with respect to certain interests that do not seem prudentially comparable across species. For example most commentators agree that death typically harms a person more than it harms, say, a mouse, so that their interests in staying alive are not prudentially comparable (not presumptively equal) – in which case equal consideration is consistent with the judgement that killing persons is generally worse than killing mice. (For a fuller discussion of noncomparable interests, see DeGrazia, 1996, ch. 8). Unequal-consideration (UC) views hold that animals' interests have some (non-derivative) moral importance but less than what persons' comparable interests have – implying that animals have moral status, but less than persons.

The major representatives of EC views are *utilitarianism* and *animal rights theories*. Utilitarianism grants sentient beings equal consideration by counting everyone's comparable interests equally in its directive to maximize utility or net welfare (Singer, 1990 although here he stresses equal consideration more than utilitarianism). Animal rights theories afford stronger protection for the vital interests of humans and certain animals (those claimed to have rights), generally resisting appeals to utility as a justification for sacrificing those interests. In this chapter I use the term *animal rights views* somewhat narrowly to refer to views in which rights generally trump appeals to utility (Regan, 1983; Pluhar, 1995). Some use the term more broadly to refer to all equal-consideration views or even all views granting moral status to animals.

UC theories have received less attention in the literature than EC views and the no-status view. One UC theory is the *two-tier theory*, according to which persons or humans deserve full, equal consideration whereas other sentient

beings deserve some nontrivial, but less-than-equal, consideration (Warren, 1997; McMahan, ch. 3). Another UC theory is a *sliding-scale model* of moral status, according to which sentient beings deserve consideration in proportion to their level of cognitive, emotional and social complexity. (I describe this model, without endorsing it, in DeGrazia 1996, ch. 3) This model is likely to stipulate that beyond some threshold of complexity such as personhood, one deserves full consideration – consistent with two-tier theories and the considered judgement that all persons deserve equal consideration.

Each theory of moral status just sketched is, unlike the no-status view, a serious contender. Each is supported by substantial arguments and each faces important challenges. In this chapter, I assume that both EC and UC theories are fairly reasonable and will not attempt to adjudicate between them. Before exploring the implications of these theories, let us examine the possible benefits and harms associated with animal research.

THE ISSUE OF BENEFITS

Proponents of animal research stress its benefits, which accrue mostly to humans but also to animals. The claim of benefits extends to the use of animals in basic research, in modelling diseases and developing therapeutic interventions, in pharmaceutical research and development, and in toxicity testing. Now, in the case of many advances in biomedicine and veterinary science, animal research has certainly been part of the pathway to progress. But it does not logically follow that animal research was necessary for such progress. There may be multiple paths to a particular goal. In justifying animal research, we tend to focus on the path actually taken; relatively little attention (and even less funding) has been given to other possible paths. This raises the issue of alternatives to animal research.

Some critics of animal research hold that it impedes biomedical progress. They doubt that nonhuman animals are reliable models for human beings. Obviously, mice, rats and dogs are not the same as humans. And surely the methodological difficulties of extrapolating data from nonhuman subjects to the human situation are substantial. It is probably fair to assert that animal models can be misleading, with serious consequences. Some critics argue, for example, that reliance on animal models delayed the development of an effective polio vaccine for many years (LaFollette and Shanks, 1996, ch. 8). And critics often cite the disaster involving thalidomide, which was licensed following animal research for use by pregnant women (a group on which the drug was not tested) as a treatment for morning sickness, leading to the birth of thousands of children with major limb deformities.

Nevertheless, it seems reasonable to assume that, due to many continuities and similarities across species, well-chosen animal models often furnish valuable data on the road to biomedical advances. But what if there are other, non-animal roads to progress? It would greatly vitiate the moral case for animal research if the latter were unnecessary. So how extensive are the benefits that *only* animal research can provide?

Confronting this complex issue requires comparing (1) progress that results, or has resulted, from use of animal subjects with (2) progress that could result, or could have resulted, from optimal non-animal methods. But progress of type (2) is hypothetical because investments in the study of alternatives pale in comparison with investments in animal research. So, we must speculate to estimate the value of (2). Yet, unless proponents of animal research can compare the values of (1) and (2) rather persuasively – as seems doubtful – then, although they can assert that animal research has yielded benefits, they are in no position to say that it was *necessary* for those benefits.

We must also remember that particular benefits from animal studies are only *possible and hoped for*, whereas the harms to animals are typically immediate and certain. (Countless animal studies harm animals without producing benefits.) Any honest cost/benefit analysis must multiply the value of hoped-for benefits by the (<1) probability of achieving them, before considering the predictable costs and harms. This often overlooked fact is critical not only to utilitarianism but also to all positions that regard costs and benefits as relevant to the justification of animal research. In light of both (1) the need to factor in likelihood of success in any honest cost/benefit analysis and (2) the issue of non-animal alternatives, the value of animal research would seem to be less than what proponents typically claim.

Yet its value may sometimes be sufficient to justify the associated costs and harms. Perhaps an animal experiment is the only possible way to achieve some important benefit – such as knowledge about a new veterinary technique's viability. Or perhaps non-animal means to some human benefit would be so costly or harmful to humans as to be unacceptable. (In principle, we *could* always use human subjects to learn about human biology, effective therapies and toxicity, but doing so might require coercion of human subjects or unacceptable risks to them.) Suppose we assume that animals can be useful models in pursuit of some substantial benefit *and* that no non-animal alternative is both scientifically viable and morally acceptable. Does this justify animal research? Not necessarily, for we must also consider harms and costs.

HARMS AND COSTS

In addressing harms and costs associated with animal research, we are likely to think first of harms caused in

experimental procedures. These harms range from none (e.g. in simply observing animals) to severe (e.g. in prolonged deprivation of food, water or sleep; force-feeding a substance until subjects die; induction of cancer tumours; brain damage). Intermediate cases include the taking of frequent blood samples, holding an animal in restraints in an inhalation chamber and performing a caesarean section on a pregnant animal.

Additional sources of harm for animal subjects include the following:

- *Acquisition* – usually through breeding but sometimes through the capture of wild animals;
- *Transportation to the research facility*;
- *Housing conditions*, which typically confine animals to small spaces, often without enrichment or access to conspecifics;
- *Handling* of animal subjects, sometimes including the use of restraints; and
- *Death* – if continued life for the animal subject would be worth living.

In cost/benefit assessments, harms count as 'costs'. Of course, so do costs in the ordinary sense. Government-funded research uses taxpayers' money. Research funded by for-profit companies – say, in product testing – uses stockholders' money.

Where non-animal research methods are employed, harms to animal subjects are avoided whereas financial costs are not. Wherever animal methods are not replaced, the other two Rs, reduction and refinement, loom large. Harms and costs are minimized by using the smallest possible number of animals consistent with scientific objectives. Refinements, meanwhile, involve fine-tuning experimental conditions and procedures in light of a sensitive appreciation of animal subjects' needs. Providing an instructive illustration of the latter, the NCB offers this list of rats' and mice's husbandry needs: housing in stable, compatible groups; enough space for exercise and normal social behaviour; a solid floor with a wood-shaving substrate; sufficient height for rearing; nesting material; material to gnaw; and refuges (NCB, 2005, p. 211).

With the benefits, harms and costs associated with animal research in view, let us return to theories of moral status and explore their ethical implications.

SOME DIFFERING IMPLICATIONS

The animal rights approach has almost no interest in cost/benefit considerations because it opposes harming some individuals (without their valid consent) for others' benefit. Although this approach might seem to preclude animal research, it does

not. For it can consistently permit (1) research that does not harm its subjects at all and (2) research that promotes animal subjects' best interests – therapeutic veterinary research. Moreover, insofar as current policy permits *minimal-risk* research on human children, who cannot consent in the relevant sense, an animal rights theory might permit this third category as well. But it would preclude the vast majority of animal experiments currently conducted. It would also reject the hypothetical experiment described earlier in this chapter despite its extraordinarily favourable benefit/cost ratio.

The other EC view, utilitarianism, would embrace the hypothetical experiment because its expected utility is higher than that of any known alternative. Utilitarianism would also justify some animal research conducted today. Even more-than-minimal-risk, non-therapeutic research is acceptable on this view so long as the expected benefits – factoring in the likelihood of achieving them and giving animals' interests equal weight to humans' comparable interests – outweigh the total costs, and no alternative offers a better benefit/cost ratio. Then again, utilitarianism's commitment to equal consideration entails that rather little animal research is justified. Meanwhile, utilitarians must grapple with the fact that their theory seems open, in principle, to the coercive use of human subjects in some circumstances.

Compared with utilitarianism, UC theories will be considerably more welcoming of animal research because they grant animals' interests (e.g. avoiding suffering) less weight than comparable human interests. The main difference between the two-tier theory and the sliding-scale model, both UC views, is this: the former would give all sentient nonhuman animals' interests the same weight, whereas the latter would give their interests more weight if the animals in question are more complex. But, more importantly, no UC theory will be *laissez-faire* about animal research. Recognizing that animals have moral status and that they are not mere tools for research, UC views would likely reject a great deal of current research. Examples include frivolous experiments lacking real benefits (e.g. the infamous cat sex experiments (Wade, 1976)), research offering non-essential benefits (e.g. testing new cosmetics), research causing excessive harm (e.g. Harry Harlow's maternal deprivation studies on monkeys (Harlow and Zimmerman, 1959)) and experiments that are clearly replaceable (cosmetics testing in general). UC views would also seek to minimize the harms associated with acquisition, transport, handling, housing and experimental procedures. The challenges of accommodating the needs of animal subjects' might lead such views to ban or severely limit the use of certain 'higher' mammals, such as primates, whose social and psychological needs are especially hard to meet.

These implications of EC and UC theories motivate another thesis: no reasonable view of animals' moral status can

justify the full extent of animal research conducted today. Moreover, all reasonable views would permit some animal research, though animal rights theories would permit precious little. But our discussion of the theories' implications has tacitly assumed that there are no viable alternatives to animal research. Is that so?

WHAT ABOUT ALTERNATIVES?

Although the term 'alternatives' is often used to refer to the replacement of live animal use with non-animal techniques, the term is sometimes used more broadly to refer to the other Rs as well: *reduction* in the number of animals used to that needed for scientific validity and *refinement* of techniques to minimize suffering. It is difficult to imagine morally serious opposition to reduction and refinement, so let's focus on replacement.

Replacement alternatives can be either 'complete' or 'incomplete'. Complete replacements use no animal-derived materials. Examples include mathematical and computer modelling studies of biological processes, predictions based on chemical properties of molecules, analyses of epidemiological data, research on human cell or tissue cultures, and studies directly involving human volunteers. Incomplete replacements use some biological materials derived from living or humanely killed animals – for example, cell or tissue cultures from a small number of sacrificed animals – or use animals thought to be insentient such as horseshoe crabs or insects.

The alternatives movement has made considerable progress in recent years (Stephens, Goldberg and Rowan, 2001). With respect to replacements, the most progress has been made in the area of testing. Since the late 1990s several alternatives have achieved regulatory acceptance and widespread adoption. Examples include an *in vitro* test for phototoxicity and Corrositex, a kind of synthetic skin, to test skin corrosivity. Providing an indication of progress, the Netherlands and Great Britain have stopped using animals for testing cosmetics – and the European Union has banned cosmetics testing with effect from 2009 (NCB, 2005, p. 235).

Although alternatives, including replacements, have made significant inroads in testing, one might doubt the feasibility of replacing animals in original biological research. Nevertheless, there have been advances in this area as well. For example, an *in vitro* method has proven to be a viable substitute for mouse-based methods of producing monoclonal antibodies. Sometimes computer modelling is effective in simulating biological systems. Meanwhile, some progress has involved and will continue to involve the use of human beings. Volunteers sometimes participate in physiological studies or in testing diagnostic techniques. Epidemiological studies can help identify

factors contributing to particular diseases. Human tissue and cell cultures (e.g. tumour cell lines, neuronal cell culture lines) represent an important growth area. Though often overlooked, the use of new imaging technology – such as PET scans and magnetic resonance imaging – permits study of the live human brain without invasive procedures on people or animals. Finally, the use of stem cells derived from embryos or, less controversially, from adults has enormous research promise.

Inasmuch as regulatory and financial support for alternatives to animal research is in its infancy, it is very difficult to predict how far, scientifically, alternatives can lead. What is clear is that heavy investment in and development of alternatives should be a very high priority on any reasonable view of animals' moral status.

SOME SUGGESTIONS

The ethics of animal research is enormously complex. Even if we settled the hard factual issues (e.g. the validity of animal models, the prospects for alternatives, the sentience or insentience of particular animals) and conceptual issues (e.g. how to evaluate the harm of death in the case of animals), the issue of moral status would remain. I have discussed representatives of both EC and UC views not out of politeness to representatives of different views; I honestly find all of these views reasonable. Even if one theory is the most reasonable, several others are within reason and none is an obvious winner.

Although this plurality of reasonable views impedes the quest for a detailed ethics of animal research, it does not prevent us from identifying points of overlapping consensus or palatable compromises where consensus is unavailable. In this spirit, I close with several policy suggestions:

1. *There should be a massive public investment in alternatives research.* Inasmuch as animals have moral status, they cannot be regarded – merely or even primarily – as tools for human use. On any reasonable view, there must be a presumption against animal research. And, at this time, we know relatively little about the full promise of alternatives. (Apparently, the NCB shares the spirit of my suggestion: 'The Working Party therefore agrees that there is a moral imperative to develop as a priority scientifically rigorous and validated alternative methods for those areas in which Replacements do not currently exist' (NCB, 2005, p. XIX).)
2. *Animal experiments should not be permitted where viable replacement alternatives are known to exist.*
3. *Where animal research is permitted, housing conditions must meet the basic needs – physical, psychological and social – of animal subjects.* Barren housing is a source

of major harm to research animals. Although meeting the basic needs of animal subjects is costly, nothing less is appropriate for beings with moral status. Presumably, this requirement will be considerably easier to satisfy in the case of rodents, the animals most commonly used in research, than in the case of 'higher' mammals, especially primates.

4. *Wild animals should never be captured for laboratory research.* Breeding avoids the harms associated with forcing an animal to transition from one form of life to a radically different sort of existence.
5. *Great apes should not be used in research unless their participation is voluntary and/or compatible with the best interests of individual research subjects.* Some great apes currently live in captivity. If all their basic needs are met – which is far from easy to ensure – they may be appropriately used in two circumstances: (1) where they freely choose to participate (e.g. by accepting an 'invitation' to take part in language-learning exercises and not resisting continued participation) and (2) where there is no other known means to help them (therapeutic veterinary research). As I have argued elsewhere, the cognitive, emotional and social complexity of great apes suggests that they are 'borderline persons' who deserve protections comparable with those afforded to humans of uncertain personhood (DeGrazia, 2005). (The same is true for dolphins. But as it appears impossible to meet their basic needs while they are held captive, I reject any research on dolphins that maintains them in captivity longer than necessary to benefit the dolphin subjects themselves.)
6. *Toxicity testing on live animals should be banned.* We have made much progress in developing alternatives to animal testing. With a massive public investment in alternatives, progress should accelerate. Although some representatives of business may chafe at this suggested ban, their priority – maximizing profits – is less important than minimizing harm to beings with moral status.
7. *Public funding for animal research that aims at original scientific knowledge, both basic and applied, should be reduced to some relatively small fraction – say, 10% – of current levels.* That seems a reasonable compromise between EC views, which would justify little animal research, and UC views, which would preserve considerably more of the status quo. This requirement would strongly encourage consideration of alternatives and greatly reduce harm to animal subjects while protecting the very best, most important animal research. The money saved here could more than pay for the massive increase in public funding for alternatives research recommended above.

REFERENCES

- DeGrazia D. *Taking Animals Seriously: Mental Life and Moral Status*. Cambridge: Cambridge University Press, 1996.
- DeGrazia D. On the question of personhood beyond *Homo sapiens*. In: Singer P, ed. *In Defense of Animals*, 2nd edition. Oxford: Blackwell, 2005; pp. 40–53.
- Harlow H, Zimmerman R. Affectional responses in the infant monkey. *Science* 1959; **130**: 421–432.
- LaFollette H, Shanks N. *Brute Science*. London: Routledge, 1996.
- McMahan J. *The Ethics of Killing*. Oxford: Oxford University Press, 2002.
- NCB. *The Ethics of Research Involving Animals*, London: 2005.
- Orlans B. History and ethical regulation of animal experimentation: an international perspective. In: Kuhse H, Singer P, eds. *A Companion to Bioethics*. Oxford: Blackwell, 1998; pp. 399–410.
- Pluhar E. *Beyond Prejudice*. Durham, NC: Duke University Press, 1995.
- Rachels J. Drawing lines. In: Sunstein C, Nussbaum M, eds. *Animal Rights*. Oxford: Oxford University Press, 2004; pp. 162–74.
- Regan T. *The Case for Animal Rights*. Berkeley CA: University of California Press, 1983.
- Russel W, Burch R. *The Principles of Humane Experimental Technique*. London: Methuen, 1959.
- Singer P. *Animal Liberation*, 2nd edition. New York: New York Review, 1990.
- Stephens M, Goldberg A, Rowan A. The first forty years of the alternatives approach. In: Salem D, Rowan A, eds. *The State of the Animals 2001*. Washington, DC: Humane Society Press, 2001; pp. 121–135.
- Wade N. Animal rights: NIH cat sex study brings grief to New York museum. *Science* 1976; **194**: 162–167.
- Warren MA. *Moral Status*. Oxford: Oxford University Press, 1997.