

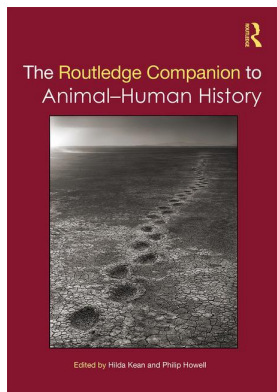
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6

THE EXPERIMENTAL ANIMAL

In search of a moral ecology of science?

Robert G.W. Kirk

We cannot properly understand animal–human history in the modern period without addressing the scientific use of animals. Animal research has been a prominent object of concern, criticism and protest within the academy and society and as such it has played a formative role in the development of the field of ‘animal’ studies. Indeed, to understand *why* a volume such as this exists one would have to consider the history of societal responses to animal research. It is in the encounter between the experimental animal and the experimenter that the boundary between animal and human has been made and remade countless times over. Why do we experiment on animals? Because animals are physiologically like humans. Why do we experiment on animals? Because animals are ethically different to humans. Animal research concerns the ongoing negotiation of similitude and difference across human and animal, always tentative and always with societal and ethical consequence. More than any other site, it is the experimental encounter where we can see situated relational interdependencies across species being negotiated and transformed with full acknowledgement of their complexity and tentative nature. As Lynda Birke, Arnold Arluke and Mike Michael have argued, ‘[a]s the laboratory animal is made and unmade, so too is the identity of the lay public’.¹ It is for this reason animal research has been and remains one of the most misunderstood, contentious and polarising of animal–human relationships. Science, in sum, has been one of the most prominent catalysts and contexts for the problematisation of animal–human relationships; yet it has equally provided many of the tools and discourses of critique through fields such as ethology and animal welfare science. To understand animal–human history we would do well to start with the role of animals in science.

The experimental animal was a condition of possibility for many fields of science, not least ‘scientific’ medicine.² Animals were the object and means of study within natural history and anatomical observation, whilst the finches, pigeons and other species that provided Charles Darwin with inspiration and evidence for the theory of evolution by natural selection clearly played a fundamental role in shaping modernity.³ Animals were fundamental to the development of the sciences of animal behaviour, ethology, primatology and related fields, all of which contribute to a

fuller understanding of animal–human history broadly conceived.⁴ The history of taxonomy, for instance, demonstrates not only the centrality of animals within nineteenth-century science but the extent to which science is enmeshed within wider societal and cultural trends.⁵ Whilst all of these areas are integral to the history of science this chapter focuses on the use of animals within a cluster of sciences which we might, at the risk of slight ahistoricism, think of as the ‘biomedical’ sciences. There are a number of overlapping reasons for this focus. Without the experimental animal, it is hard to imagine how the biomedical sciences would have come into being.⁶ Without the biomedical sciences, the modern world as we know it would not have come into being. And without the experimental use of animals within the biomedical sciences, debates about human–animal relations as well as the academic and political discourse of human–animal studies, would be very different indeed.

This chapter is structured around the conceit that social history and the history of science have approached animal research from distinct directions which, whilst productive and appropriate for their respective object of concern and audience, only provide partial accounts of the role of science as a driver of change within animal–human history. It proceeds in two substantive parts before concluding. The first part reviews how the experimental animal tends to be sublimated within social history as concern for the animal is read against wider societal themes such as class, gender, and race. In the second part, an overview of the historiography of science is presented to show how animals have been included within histories of the production of scientific knowledge in such a way that the wider societal themes fade out of analysis. Where broader social considerations are retained they rarely engage with how social values are enacted in the work of animal research. As such, both literatures address the history of animal research without necessarily bringing core moral and ethical questions to the fore of their analysis. In conclusion, it is suggested that synthesising the two by framing analysis around a ‘moral ecology of science’ would produce something greater than the sum of the parts of real value to understanding animal–human history more broadly. Moreover, such a move would align historical accounts of animals in science with the methodological, analytic and moral/ethical concerns that shape and drive scholarship from the social sciences and other fields within ‘animal studies’.

Histories of the experimental animal *as concern for the social*

Human use of nonhuman animals to understand biological life generally and human life specifically has a long history.⁷ This chapter focusses on the nineteenth and twentieth century, as animal bodies were established as a basic resource for experimental research in the then emergent life sciences during this ‘modern’ period. Broad changes in medical thinking and practice across the nineteenth century have been characterised as ‘the disappearance of the sick man from medical cosmology’ by the medical sociologist Nicholas Jewson and famously titled by Michel Foucault the ‘birth of the clinic’.⁸ These creative periodisations attempt to capture a tapestry of trends most prominent of which have been the decentring of patient experience in the diagnosis of illness and the shift toward understanding diseases as immanent entities in themselves locatable within the body.⁹ Alongside the formation of new specialisms

such as physiology and bacteriology, these trends worked to transform medicine from an art grounded in experience to a science based on experiment. Whereas the former relied on learning from lectures, texts and existing knowledge, the latter sought original knowledge through empirical observation and, crucially, experimentation. This move from valorising what *was* known to seeking what *was not* in medical thought and education formed a critical condition of possibility for the emergence of the ‘experimental’ animal.¹⁰

Early nineteenth-century post-revolutionary France, or more specifically Paris, took centre stage in the emergent new ‘experimental’ medicine.¹¹ Pioneers such as Francois Magendie (1783–1855) and his successor Claude Bernard (1813–1878) established France at the forefront of the new science of physiology, as Louis Pasteur (1822–1895) and Emile Roux (1853–1933) did with bacteriology.¹² The authority of these new sciences rested in innovative medical research practices which, in turn, relied on nonhuman animals as resources and experimental tools. By mid-century, use of animals for experimentation, or ‘vivisection’ as it was then known, was established as a ‘French’ science.¹³ Immediately, vivisection associated with a wave of radical societal transformations few of which went uncontested and none of which developed in isolation. Whilst historians of science and medicine have worked to locate ‘French’ medicine within the revolutionary politics of its time, seeking to show scientific and societal values to be deeply interwoven, it is social historians who have focussed on how moral values shaped societal responses to vivisection.¹⁴ However, social history tends to read nineteenth-century opposition to animal research, or the ‘antivivisection’ movement, as indicative of, and to some extent driven by wider (which is to say human) societal concerns.

If France was the birthplace of vivisection then Britain would appear to be the origin of political and social objections to animal research (although this may be more an effect of historiography than an accurate account of the development of antivivisection). In the British context, opposition to vivisection emerged in Britain in relation to (and subsequently became entangled with) wider concerns about animal cruelty. In February 1825, for example, the Irish parliamentarian and campaigner against animal cruelty Richard Martin (1754–1834) concluded his introduction of a bill to abolish bear-baiting to the House of Commons with reference to Magendie who he labelled a ‘disgrace to society’ for performing ‘experiments so atrocious as almost to shock belief’.¹⁵ Magendie had visited London the previous year to demonstrate his scientific work. At the time, public demonstrations of new scientific knowledge were common, serving to enhance personal standing and the authority of science more generally across society. Crowds who attended these events were drawn by a complex mixture of the desire to learn but also be entertained. This allowed reformers like Martin, who were committed to alleviating cruelty to animals, to equate vivisection with ‘cruel’ sporting practices like animal-baiting; both appeared to be exercises in animal cruelty for human pleasure. Yet, for social history, this antivivisectionist sentiment was not merely about animal cruelty. At a time when anti-French sentiment remained a powerful force in English culture, one can read Magendie and vivisection not just as symbols of brutality and perversion but as specifically a French form of post-revolutionary brutality suggestive of the generalised perversion of French culture.

By the mid to late nineteenth-century, as English protest against vivisection developed a distinctive identity within the broader animal cruelty reform movement, anti-French sentiment had become a powerful rhetorical frame for antivivisectionist discourse. The presentation of 'vivisection' as particular to French physiological science shaped early British antivivisectionist discourse in such a way that the wider political movement can and has been read as a predominantly anti-French crusade.¹⁶ Frances Power Cobbe (1822–1904), perhaps the most prominent antivivisectionist, is illustrative. Cobbe frequently characterised vivisection as a French corruption of science arguing 'as a rule that the most cultivated are the most merciful' yet in 'France, alas! It is men of science – men belonging to the learned professions – who disembowel living horses and open the brains of dogs'.¹⁷ The English medical profession was equally quick to appropriate societal aversions toward animal cruelty together with anti-French sentiment when the status of English scientific medicine was at stake. The French origins of vivisection were a much-used rhetorical resource in the long-running squabble between the English physiologist Sir Charles Bell and Magendie which was at its height between 1822 and 1842.¹⁸ This dispute revolved about who first identified and separated motor and sensory nerve roots, which was the basis for what is now recognised as the 'Bell-Magendie Law'.¹⁹ Where Magendie's claim rested on vivisection, Bell in contrast had worked with dead or at worst insensible animals. Bell presented his refusal to work with living animals as fundamental not only to his moral position as a scientist but the rigour of the scientific work itself:

After refraining long, on account of the unpleasant nature of the operation, I at last opened the spinal canal of the rabbit . . . the creature still crawled . . . I was deterred from repeating the experiment by the protracted cruelty of the dissection. I reflected that an experiment would be satisfactory if done on an animal recently knocked down and insensible; that whilst I experimented on a living animal, there might be a trembling or action excited in the muscles by touching a sensitive nerve, which motion it would be difficult to distinguish from that produced more immediately through the influence of the motor nerves.²⁰

As the dispute with Magendie developed, Bell increasingly presented himself as adhering to a deductive anatomical approach as opposed to vivisection, eventually becoming quite opposed to the notion he was an 'experimentalist' at all.²¹ Bell cultivated the notion that abhorrence toward vivisection was an English virtue which guaranteed rather than hindered the quality of the nation's science.²² Rhetorically, this allowed supporters of Bell to mobilise anti-French and antivivisectionist sentiments to belittle Magendie's claim to scientific priority.²³ Accordingly, historians have argued that anti-French sentiment was a powerful factor in shaping the development and reception of early antivivisectionism in Britain. Whilst such analysis has clear literary and cultural importance, its effect is to obscure both concern for the animal and the animal itself in favour of far more human concerns of national identity, social standing and cultural politics.

In a comparable move, social history has also shown how antivivisectionist discourse embodied wider political concerns regarding the place of women in

nineteenth-century society. In a sensitive analysis connecting Victorian (and later Edwardian) innovations in gynaecological medical practices to tropes within pornography and wider literature, Lansbury has argued that for English middle-class women 'to protest against vivisection was to challenge a world of male sexual authority and obscenity which they sensed unconsciously, even if they had no direct experience of it'.²⁴ In this way women and animals were increasingly aligned through the identification of the oppression of women in society with the vivisected animal in science. The entanglement of early antivivisectionist and feminist politics was not specific to England. Antivivisectionist protest in late-nineteenth America has similarly been characterised by social historians as a 'particularly female concern, pitting women against the exclusively male medical research establishment'.²⁵ In *fin de siècle* France, too, existing historiography would suggest that it 'was not lost on feminists that the powerlessness and suffering inflicted on animals by the experimental vivisectionist had a parallel in the way females were treated by hysteria doctors'.²⁶ Indeed, this association was so pronounced that across national contexts proponents of vivisection responded to their critics by characterising antivivisection as an irrational sentimentality common in women but unbecoming in men. Some went further still, asserting that the excessive love of animals intrinsic to antivivisection was a mental pathology. The French psychologist Pierre Janet thought antivivisectionism to be a specific form of feminine hysteria which he named 'la zoophilie' whilst the American neurologist Charles Loomis Dana claimed the same of 'zoo-phil-psychois'.²⁷ Again, these nuanced studies make important contributions to social historical understanding of gender and feminist politics. Yet, whilst it is not their intent, the consequence of bringing gender to the analytic fore is to shift attention away from the animal, which is reduced to a cypher for the expression of concerns over the gendered human. Finn's study of antivivisection and feminism in *fin de siècle* France is representative, concluding that '[i]n ridiculing the vanity of vivisectionist doctors in print, in interrupting their experiments, batting them with umbrellas and trashing their labs, French feminists were in fact striking a blow for their own gender'.²⁸

In sum, social and literary historical accounts of antivivisection tend to construe opposition to animal research as symbolic of wider, human, societal concerns such as those of nation and gender. In addition to nation and gender, the early history of animal research has been read against the values of race and changing understanding of the nature of civilisation, all ordered hierarchically within Victorian culture through the assumption that the capacity to experience pain was felt most keenly by the most evolved (and thus most 'civilised') forms of life.²⁹ Class, too, has been mobilised to explain and understand how nineteenth-century objections to animal research became entangled with movements to alleviate cruelty to animals. As Harriet Ritvo has *persuasively* argued, for Victorian culture '[c]ruelty to animals was supposed to characterise the most dangerous members of society, not those on whose responsible shoulders the social structure rested'.³⁰ In the minds of middle-class Victorians animal cruelty represented the threat of social disorder emanating from the lower classes.³¹ At a time when science was gaining ever greater social status, scientists having the prestige and social leadership associated with the clergy and clerisy, to suggest that science involved the everyday practice of animal cruelty was to reveal a threat to society itself. Accordingly, the historian Richard D. French concluded that

‘[a]ntivivisectionists foresaw the cold, barren, alienation of a future dominated by the imperatives of technique and expertise. It was not experiments on animals they were protesting, it was the shape of the century to come’.³²

It is unclear to what extent social history intends to make a hard assertion that human concerns for human values lie at the heart of opposition to animal research. Hilda Kean, for instance, in her analysis of the relationship of socialist and feminist politics to that of animal advocacy in the Edwardian period, argues that political association with human concerns does not imply a diminishment of a concern for the animal in the thought and actions of the historical actors under study.³³ Others are not so clear: perhaps because the archive is silent when asked such evaluative questions. Nevertheless, the consequence of foregrounding human cultural concerns for *historiography* is to diminish the explanatory capacity of social history to seriously interrogate how, why, and to what consequence human concern for nonhuman animals may serve as a primary motivating force of historical change. Inevitably, any discursive reduction of the animal, making it serve as a cypher for human political and societal concerns, produces what Erica Fudge has labelled histories of animals which are actually ‘histories of human attitudes toward animals’.³⁴ The question as to what extent the animal has disappeared from historiography as a result of the narrative framing of social history or because animals were never really present in the historical processes being examined all too often is left unclear. At best, we might conclude that the place of the animal within social history is sublimated toward all too human concerns (not least those of class, race and gender). As such, the narrative framing of social history renders the historical actor incapable of embodying or expressing an authentic concern for the nonhuman animal in itself. Feminist middle-class Victorian women may well have been ‘striking a blow for their gender’. Antivivisectionists of all sexes and social backgrounds may well have been ‘protesting . . . the shape of the century to come’. But such explanations say little as to how these and other historical actors related to and understood animals *as animals* and perhaps as constituent parts of ‘society’. The history of animal experimentation, as presented by social history, has struggled to engage meaningfully with the extent to which the animal may have been more than a symbol for human values and concerns. To address such a question would require the animal to be placed at the centre of the historical narrative. Moreover, it would be to make animals the analytic focus of new investigations of the social and society. Investigations orientated toward understanding how nonhuman animals have shaped human history beyond their ready representation of human concerns. Such an endeavour would imply radically rethinking the humanistic limit of our historical imagination to move toward the writing of ‘more than human histories’.³⁵ Here, approaches from the history of science may have something to offer.

Histories of the experimental animals *as concern for science*

The history of science presupposes that ‘science’ is no different from any other human activity; science forms part of human culture. As such, ‘science’ can and should be studied historically. Just as one need not be an economist to study economic history or have served in the military to understand military history one need not be

a scientist to investigate the history of science. The same methodologies and analytic approaches can be applied to the history of science as one would apply to any other field of history. Nevertheless, many historians continue to set the history of ‘science’ apart from History proper; they do so for many reasons, but two reasons in particular are of interest. First, the history of science has, historically, been more open than other historical fields to finding common cause with diverse theorists across the philosophy and sociology of science. Second, and interrelatedly, to render science open to historical study is to trouble a fundamental division of academic labour where ontology is assumed to be the province of the sciences whereas the humanities confine their interest to the vagaries of culture. Both of these characteristics are shared by – and have in many ways been inspirational to – scholars across the eclectic field of human–animal, more–than–human, and multispecies studies. Once it is recognised, as Jamie Lorimer concisely expresses the notion, that the ‘world is hybrid – neither social nor natural’, then the inclusion of animals in our historical narratives becomes not just possible but a necessity.³⁶

The historical study of science must, through its very *raison d’être*, radically depart from an understanding of science on its own terms. To recognise the historicity of scientific knowledge is to reject the claim that science as a body of knowledge has access to the uncontaminated ‘truth’ about what nature really is through virtue of a set of practices and stances situated outside of human culture.³⁷ For this reason, the history of science presupposes that scientific knowledge is embedded within and inevitably contaminated by the social and cultural contexts of its production. To claim that ‘science is social relations’, as one influential early radical science movement pioneer memorably proclaimed, or to say scientific knowledge is in some way a ‘social construction’, is far from uncontentious, as it directly challenges the authority of scientific knowledge.³⁸ This in essence was the argument at the heart of the ‘science wars’ which played out across the 1980s and 1990s.³⁹ Whilst historians of science were much less active combatants than anthropologists, sociologists and others who self-identified with the social studies of science cause, as a field its claim to historical credibility was nevertheless at stake. More pertinent to present purposes, this was the context in which a series of innovative ways of approaching and understanding science were forged, which have proved subsequently to be intellectual catalysts for scholars interested in the ‘animal question’.

One such work is Donna Haraway’s *Primate Visions*, which mobilised the history of science to intervene in and contribute to the formation of feminist science studies. *Primate Visions* presents a highly contentious but equally influential approach to understanding science encapsulated by questions such as ‘[w]hat may count as nature for late industrial people . . . For whom and at what cost . . . In what specific places, out of which intellectual histories, and with what tools is nature constructed?’⁴⁰ For Haraway, science is storytelling – a statement which contrary to how it is often understood in no way intends to demean the importance or authority of scientific knowledge. To say science is storytelling is merely to recognise that science, like all human activities, is an outcome of human creativity and thus embedded in human values and culture. Haraway meticulously reconstructs how primatology was forged in gendered, colonial, and racial contexts, all collectively shaping and driving changing understandings of ‘nature’. Each account of nature produced gave form to a specific

way of doing primatology, serving certain interests and ends over others. In Haraway's hands the history of science became a tool for political intervention, and in subsequent years her work has been recognised and deployed as such within the now burgeoning field of animal studies. Arguably, *Primate Visions* remains the most commanding exemplar of what the history of science can contribute to animal studies as an academic and political programme.⁴¹ Haraway's work remains distinctive in her elegant weaving of material and semiotic analysis to produce historically sensitive accounts of 'technoscience'.⁴²

Arguably, neither historians of science nor emergent historians of animals have fully embraced the potential of Haraway's trajectory or fully reckoned with its challenges. If we are to accept the historicity of science and the hybridity of nature and culture then it becomes impossible (or at least disingenuous) to make any unreflective or uncritical resort to 'science' as a means to ground animal advocacy politics or chart new more-than-human futures. More problematic for the historian is that to do so is to knowingly embrace ahistorical explanatory frameworks. Accordingly, historical writing should be cautious in its embracement of contemporary scientific knowledge. In their desire to find the otherwise absent animal in the archive some historians have drawn on the contemporary knowledge of animal ethology, behaviour and welfare.⁴³ To extrapolate and apply scientific knowledge in this way implies such knowledge to be a universal truth transcendent of history. As historians, however, we know better. This raises an open question as to the limits and limitations of historical practice.

A second way of thinking about and working on science which emerged from the 1980s and 1990s is the work of Bruno Latour and his followers which continues to be referred to colloquially as Actor-Network Theory (ANT).⁴⁴ Like Haraway, Latour presents a material-semiotic method which challenges simple dichotomies of human-animal, nature-culture. However, whereas Haraway retains a political and thus radical element to her work, ANT all too often falls flat in its tendency toward apolitical descriptive narrative. Within ANT all 'actors' within a 'network' are described in the same terms; thus all actors whether human or nonhuman can possess 'agency'. This suggests ANT has value for animal studies, which it does. However, ANT is severely limited in what it can do, and has been much misunderstood. One problem is derived from the name; ANT is a methodology, not a theory. As such it is incapable of explanation and so any potential for political or ethical intervention is curtailed. ANT produces description. Within ANT, for example, 'agency' has a specific meaning stripped of conscious intent. An 'actor' is merely an object that modifies another object. From the perspective of ANT everything is a potential 'actor'. The value of this approach is that it facilitated a material turn within the history of science. Yet it did so at the cost of erasing meaning and thus politics in favour of pragmatic description. Consequently, whilst ANT has encouraged historiography to include the animal within accounts of the history of science, it simultaneously, in strong contrast to Haraway, depoliticised such scholarship – rendering mute its potential to take moral, ethical or political standpoints.

One can see this effect in Robert Kohler's account of the early to mid-twentieth-century development of drosophila genetics.⁴⁵ In an attempt to distinguish his approach from predecessors both in the older 'history of ideas' tradition and

comparatively more recent ‘social constructivist’ approach, Kohler establishes that he has no interest in ‘knowledge production’.⁴⁶ Kohler framed his account as an ‘empirical’ study of ‘experimental practice’ focussed on ‘the material culture, social conventions and moral ordering of experimental production’.⁴⁷ Accordingly, he brings the animal to the fore as a means to explore the material culture of science in a direct retort to radical social constructivists (which in itself shows that the inclusion of nonhuman animals is not in itself a radical intervention). *Lords of the Fly* examines the role of the fly in shaping the scientific work of T.H. Morgan, the social organisation of his laboratory, and the moral rules governing the drosophila community. By transposing E.P. Thompson’s concept of the ‘moral economy’ to scientific practice, Kohler argues that a specific set of practices and expectations characterises the social relations of the drosophila community.⁴⁸ Moreover, he carefully shows how the biological nature of drosophila gave shape to the ‘moral economy’ of drosophila research. It was, for instance, the biological fecundity of the fly that produced a moral order characterised by a collaborative ethos, reciprocity, the free exchange of fly stocks and disclosure of experimental plans and findings. Flies reproduced at such a rate that more mutants were identified than could ever be successfully investigated by a single research group. With more work than human workers there was no impediment to sharing the tools of the trade. Research questions were owned by specific research communities, but the flies became communal property. Kohler reconstructs how these moral ‘codes’ of research conduct contributed to the drosophilists forming a distinctive communal identity. As such, the social practices of drosophila researchers owed their origin to the distinctiveness of the drosophila fly. Kohler equally demonstrates how the fly ‘impelled Morgan to abandon experimental evolution for the neo-Mendelian variety of experimental heredity’.⁴⁹ In this way drosophila ‘took over’ Morgan’s laboratory, contributing to a research trajectory within which the fly would flourish and in doing so significantly shape the development of genetic science (and by extension our understanding of the ‘human’).

In seeking to turn back the historiographic tide of sociological reductionism Kohler brought drosophila to the fore, but he framed the fly as a scientific tool which operated as something akin to a social technology. Rather than valorising the ‘agency’ of the fly (a term that Kohler actually avoids) it is the biological and material properties of drosophila which are shown to be determining factors of both scientific production and the social relations of science. In this way, Kohler is less interested in developing an ANT-like approach than he is in promoting a turn to the material culture of science which subtly reasserts the naturalistic narrative. Kohler’s message is that nature, in the form of the fly, determines knowledge production as well as the social (or ‘moral’) economy of science. In a sense, the fly was no more than a marker for a ‘nature’ which determined scientific knowledge whilst contributing to the constitution of human social and moral values, but in doing so remained outside of the same. Tellingly, Kohler shows no concern for the fly. The question as to what extent moral, social and cultural values might become embedded in the nonhuman material culture of experimental science, whether this be fly or other material tools and technologies, is left unanswered.⁵⁰ Here we can see that the history of science provides fertile ground for empirically exploring human–animal relations and is custodian of a number of approaches for capturing and reading the ‘agency’ (or contributions) of

animals to human culture. Yet, the *raison d'être* of the history of science all too often prevents such studies from exploring how moral values and ethical concerns might operate within scientific epistemology, practice and knowledge production. But this is just a fly, one might think. We ask too much. What scope is there for *including* concern for the fly within the moral economy rather than framing the fly merely as an external factor in the shaping of the moral economy of science? Perhaps more than one might think.

If one includes animal care practices within the history of scientific knowledge production (which I would argue certainly should be the case) then a different set of questions emerge which collectively present an alternative way of scientifically relating to flies. How does one accommodate, breed, feed, protect and promote the welfare of experimental animals? These and related questions were increasingly asked by scientists in the opening decades of the twentieth century, eventually catalysing the formation of a sub-field named 'laboratory animal science' tasked with finding "scientific" approaches to the health, management, care and latterly welfare of experimental animals.⁵¹ The formation of 'laboratory animal science' in the 1940s and 50s was not only a response and outcome of animal research but a conscious attempt to make a 'science' of animal care. As such, it is one of the first coherent and systematic expressions of what today we would call 'animal welfare science'. In the earliest discourse of laboratory animal science *drosophila* appear alongside other minor and major species of experimental animal. For instance, *drosophila* appear in *The UFAW Handbook on the Care and Management of Laboratory Animals* (1957) alongside guinea-pigs, mice (of various varieties), rats, voles, foxes, ferrets, minks, sheep, pigs, goats, horses, fowl, pigeons, canaries, reptiles, amphibia, cats, dogs, monkeys and primates and others, each recognised to have specific husbandry, management and care needs.⁵² The Universities Federation for Animal Welfare (UFAW) is a self-styled 'scientific' animal welfare organisation, which played an important role in developing a 'science' of animal welfare in the mid twentieth century. The *UFAW Handbook* was one of the first general textbooks addressing the practical care of laboratory animals. At the same time, it applied and promoted UFAW's distinctive view of experimental epistemology which assumed that a moral concern for the animal operated as a guarantor of the quality and reliability of scientific knowledge.⁵³ In sum, a history of the material culture of animal research could (and arguably should) include consideration of changing practices of care; from basic husbandry to the promotion of animal health and 'welfare'. Doing so would expand Kohler's use of 'moral economy' so as to include animals. Moreover, it would expand the reach of the concept in such a way that it would usefully approximate Lorraine Daston's otherwise quite distinct sense of the moral economy of science as 'a web of affect-saturated values'.⁵⁴

Kohler was far from alone amongst historians of science in bringing the experimental animal to the fore only to neglect the role of affect, care and moral values in the epistemological and material work of scientific knowledge production. A 1993 collection of themed papers, appearing in the *Journal of the History of Biology*, collectively explored the question of 'the right organism for the job' investigating to what extent an experimental system ('job') was defined and remade by the experimental organism ('tool') and vice versa. Each emphasised the human labour involved in

constructing an experimental system and experimental organism which together produced reliable, reproducible scientific knowledge.⁵⁵ A similar approach characterised *The Right Tool for the Job: At Work in Twentieth-Century Life Sciences*, within which a range of contributors sought to explore the material culture of scientific production. This volume probed the factors that made the 'right tool' for an experimental 'job' to demonstrate the situated complexity of 'rightness'. Each contribution captured the multiple practical, material, economic and social factors of 'the conditions of production' which serve as the respective conditions of possibility for situated scientific knowledge. The aim was to show how practical experimental work was 'co-constructed' with scientific theory within what the editors described as:

an ecology of knowledge . . . including an ecology of the contents of scientific knowledge, but also an ecology of the *conditions of its production* – an ecology of scientific activity/practice/work.⁵⁶

On the wave of a historiographic turn to the material culture of science which swept into the history of the life sciences in the 1990s, a number of authors brought the animal to the fore, developing and adapting methodological and analytic approaches which include the role of animals in historical accounts of scientific knowledge production. Excluded, however unconsciously, from this 'ecology' of scientific knowledge production was any productive engagement with the role of affective or moral values broad enough to include the nonhuman animal. Why? One compelling explanation emerges from the agenda behind this work. As Paolo Palladino noted at the time

problems of sociological reductionism will not be resolved by simply shifting the focus of work in the history of science away from ideas and institutions onto such organisms or any other crucial tools of scientific practice . . . to acknowledge the autonomy of technologies of production, and yet withhold critical analysis of the social relationships embedded in these technologies, amounts to an equally reductionist technological determinism.⁵⁷

The historiographic turn to material culture had, in its retort radical social construction, turned too far in favour of approaching science on its own terms. And as Daston acknowledges

[w]e are heirs to a tradition that . . . opposes facts to values . . . [e]motions may fuel scientific work by supplying motivation, values may infiltrate scientific products as ideology or sustain them as institutionalized norms, but neither emotions nor values intrude upon the core of science.⁵⁸

Accordingly, affective concern or moral values cannot be admitted a role in the ecology of scientific knowledge if one approaches science on its own terms of representation.

Historians of science attentive to the animal have, however, included other societal values within their work thereby evading (to differing extents) Palladino's

critique that a technological determinism was replacing a sociological determinist explanatory framework within studies of the material culture of science. Bonnie Tocher Clause, for instance, examined how wider social and economic trends, such as scientific management philosophy and the economics of mass-production, influenced the development of the 'Wistar Rat' (one of the first widely used 'standard' research animals).⁵⁹ Standardisation, a major theme within the history of science, is critical for the reliability of scientific knowledge as standards allow accurate communication and transmission of knowledge.⁶⁰ Standardisation of measurement, techniques and standard tools enables situated scientific work conducted in different times and places to become stabilised to such a point that agreement about experimental outcomes can occur. As such, for animals to serve as reliable 'tools' within scientific research, they too had to be standardised.⁶¹ Natural inherent variation within any population of animals for this reason posed a particular problem for the use of experimental animals. Regardless of species, from drosophila through to higher mammals, all individuals from a given population were expected to respond to the same event in the same way. Otherwise it would be equivalent to every laboratory having their own system of measurement: communication and verification of experimental results would become extremely challenging. One approach to 'standardising' experimental animals was to create populations with the same genotype. One of the earliest 'standardised' animals of this type was the 'Wistar Rat': inbred over multiple generations so as to produce genetic homogeneity. In reconstructing the history of the Wistar Rat, Clause draws affinities between science and wider social trends such as industrial production. Clause shows how the primary characteristics of the Wistar Rat, 'uniformity of product, standards of quality, and efficiency of production', were adapted from management literature inspired by Frederick W. Taylor's philosophy of 'scientific' management and applied to great effect to the production of scientific knowledge.⁶² As a result, a population of rats was fundamentally changed to become a new form of life, neither entirely natural nor a product purely of human design, appropriate to and identified by their place in scientific research.

A similar argument informs Karen Rader's account of Clarence Cook Little and the Jackson Laboratory – one of the earliest and foremost commercial producers of experimental mice. Rader elegantly examines the transformation of common mice into highly standardised experimental tools, attentive to the development of techniques of intensive inbreeding supported by industrial production and commercialisation. Rader carefully narrates historical change against the context of disciplinary formation (genetic and cancer research), transformations in the institutional and infrastructural organisation of science and its funding, as well as wider economic and social change within the USA.⁶³ Whilst Rader writes firmly within the framing of an 'ecology of knowledge', acknowledging that the 'inbred laboratory mouse began as medical and remains primarily so', she extends her reach to tentatively engage with social history and consider their 'cultural legacy'.⁶⁴ Rader, for example, explores how the case for federal support of the Jackson Laboratory was made on the grounds that mice had little societal value. Consequently, as a research tool, mice evaded antivivisectionist criticism that tended to appeal to public sentiment through a focus on 'pet' animals such as the dog. Rader charts how the ways in which society values (or fails to value) a species impacts upon what can and cannot be done to that species.⁶⁵ By revealing

how the societal niche occupied by mice was transformed into political capital and used rhetorically to gain economic support and promote scientific endeavour, Rader provides tantalising glimpses at how scientific identity may have been shaped by societal values and perceived moral consequences of animal research.⁶⁶ Nevertheless, we learn little about how such values operated on the micro level; how moral values and ethical concerns may have shaped the material culture of scientific production in everyday practice. The intrusion of wider social themes shifts the narrative focus away from the micro studies of the material culture of science. As such, the question of how affective relationships and the lived experience of working with and caring for experimental mice may have shaped the 'ecology of scientific knowledge' is left unexplored.

A slightly different though not unrelated approach to animals within the history of science explored investigates their increasing use as 'models' across the twentieth century. One motivation of such work is to realign the material production of scientific knowledge with the history of changing scientific epistemology and theories (the 'intellectual' components of science that social constructivist and material culture approaches sought to move beyond). Rachel A. Ankeny and Sabina Leonelli have argued that 'model organisms' are a distinctive category of experimental animal characterised by their explicit role to facilitate comparative modes of research. Model organisms model specific objects; serving as an epistemological and ontological bridge between research tool and object of research, animal and human. Model organisms, Ankeny and Leonelli argue, are identified through reference to their 'representational scope' (how far results from a model can be generalised) and 'representational target' (the object to be understood through use of the model).⁶⁷ When applied historically this approach interrogates the material culture of scientific production by probing the conditions of validity for a given model. Working at the intersection of the history and philosophy of science, Ankeny and Leonelli are interested in the epistemic commitments which accompany the use of model organisms; their aim is to understand the epistemological rules which govern the validity of animal research. Here, historical approaches allow Ankeny and Leonelli to demonstrate how societal structures, relations and values become entangled within the epistemological work of animal research. They show, for instance, how the construction of models for complex behavioural conditions such as alcoholism place emphasis on the situatedness of the animal, resulting in the experimental environment as much as the animal itself being standardised.⁶⁸ In a superlative series of articles exploring the work of John B. Calhoun and the pathological consequence of crowding, Edmundo Ramsden, sometime collaborator with Ankeny and Leonelli, has revealed how the epistemological demands of behavioural research necessarily expanded the vision of researchers so as include the environment as a means to control and standardise the animal body.⁶⁹ Whilst Ramsden stops short of considering the moral or ethical consequences of the wider impact of the experimental environment upon the animal, this question has increasingly been taken up by social scientists and is deserving of rigorous historical attention (a theme of my own work).⁷⁰

Why, we might ask, are sociologists of science beginning to probe the role of affect, emotion and welfare concerns within the epistemology and material practice of animal research whereas the history of science has been slow to engage with such

questions? One possibility is that historians of science all too often continue to work with a vision of science which is too close to that of science's own terms; as Daston reminds us, 'we are heirs to a tradition where facts are opposed to values' and so 'neither emotions nor values intrude upon the core of science'.⁷¹ Commonly, emotion is considered a challenge to the production of scientific knowledge as it concerns subjective states, introduced through practices and an accompanying language which places 'truth' in the eye of the individual beholder as opposed to 'objective' verifiable evidence. Historians of science tend to mirror their scientific actors predominantly because their evidence is often a representation of the ideal as opposed to a record of the actual. Sociological, anthropological and ethnographic studies of animal research have the advantage of observing science as it happens for what it is; whereas historians are confined to studying scattered remnants of representations of what science was meant to be. Where emotion appears in existing historiography on animal research it tends to be framed in such a way as to conform closely to the sciences' own terms; emotions are problematic and they are recognised only insofar as they have to be controlled and removed from the experimental encounter. The behavioural sciences, for instance, emphasise the role of the environment in shaping behaviour; thus Ramsden, in studying behavioural scientists such as Calhoun, argues that controlling the environment is important to the material production of scientific 'objectivity' (which it was). Similarly, Otniel Dror found that early twentieth-century physiologists acknowledged the emotional experience of research animals and used it as a conceptual, rhetorical, political, and practical tool in their work. Emotion, up to and including suffering, was prominent within physiological discourses because researchers recognised affective states impacted on their object of study; as Dror shows, '[p]hysiological knowledge demanded pain-free animals'.⁷² For physiologists, acknowledging and controlling animal emotion brought additional political advantages in serving as a counter to antivivisection critique. Safeguarding experimental animals by minimising exposure to suffering was not just a moral good but a scientific necessity.⁷³ In a systematic and nuanced study of the physiologist I.P. Pavlov, Daniel Todes goes further, to show how animal emotion has played a productive role in the ecology of scientific knowledge. Contrary to the strict opposition of values to facts, Todes reveals how informal acknowledgment of animal emotion provided scope for flexibility in interpreting the results of animal-based research. Within Pavlov's laboratory, animals who appeared 'happy' were considered healthy and thus 'normal', providing reliable data. However, where animals displayed unexpected results these could be discounted if their appearance was judged emotionally aberrant.⁷⁴ In this way, animal emotion played an important and productive epistemological role within the 'everyday' practice of Pavlov's science (albeit in ways that were unacknowledged in published works).⁷⁵

The history of science has developed a number of methodological and analytic approaches which include the animal within the historiography of science. However, this has been achieved without making the animal of the human-animal relationship the *object* of investigation. Historians of science remain focussed on the production of scientific knowledge; the animal enters their vision only to the extent it plays a role in the 'ecology of scientific knowledge'. Animals only *matter* in these accounts to the extent that they shape or are shaped by science. Social and culturally orientated

historians of science have been more attentive to broader political, societal, economic and cultural themes that shape the broader landscape of animal research. Susan Lederer, for example, has shown how scientific publication practices have been shaped by the culture of antivivisection as journal editors responded to public criticism of animal research by instituting policies which diminished the visibility of animals' representation in scientific papers; for instance photos were discouraged 'when the condition of the animal is unsightly'.⁷⁶ Such studies, however, in moving to the macro scale of social relations, tend to engage with cultural representations and appropriation of animals. As a result, experimental animals are displaced within these historical narratives in much the same way as they have been within social history. Ultimately, for much of the historiography of science, science remains an all-too-human activity.

**Conclusion: And say the laboratory animal responded?
A path to the moral ecology of science**

Theoretical approaches developed within animal studies and related fields suggest the animal is worthy of study in itself; this is a political as much as an intellectual standpoint. The history of science has been slow to respond to this challenge but there is no reason why the historical study of science should be an exception. On the contrary, the work of Donna Haraway is testament to the capacity of the history of science to be political. More than a testament, in asking '[w]hen we have never been human, what is to be done?' Haraway invites the history of science to take a stance.⁷⁷ What would the history of science look like if we were to take seriously an approach which framed the 'ecology of scientific knowledge' as a genuinely relational and situated process through which the human and animal were made and remade over time? There is evidence to suggest that affective, moral and ethical values shape the choice of species scientists choose to work with and in so doing change the way scientists understand their own identity as well as how society values the species under study. None other than Claude Bernard, successor to Magendie and the villain of many nineteenth-century antivivisectionist narratives, refused to work with monkeys on the apparent grounds that the species too closely resembled humanity.⁷⁸ What does this mean for how Bernard understand both humanity and the 'nonhuman' primate? We might ask the same of Bell: what was it about his encounter with experimental animals which led him to respond as he did? If the material culture of experimental practice (or 'moral economy of science') is as critical as historians of science have claimed in shaping the 'ecology of scientific knowledge', then the question of how affective, moral, and ethical values have been enacted within, and thus transformed by, animal research, becomes an urgent area of historical inquiry. This would productively align the macro-concerns of social historians with the micro-concerns of historians of science to reveal how the values of science and those of society co-develop over time; shaping and being shaped by animal research. What we begin to see here is neither a moral economy of science nor an ecology of scientific knowledge. Rather, it is the potential to develop a 'moral ecology of science'.

A moral ecology of science would be sensitive to the 'moral economy' in the sense of Kohler and that of Daston. It would include the embodied experience of

affect and emotion as well as the moral, cultural and other subjective values as situated positive components of the ecology of scientific production. Within the frame of a moral ecology of science, historical analysis would be extended to encompass questions of how the embodied emotion alongside affective, moral and other values shape and are shaped by human–animal experimental encounter which in turn drives scientific activity and knowledge production.⁷⁹ Such an approach would not only catalyse new historical questions but could serve to align approaches and concerns of the history of science with those of social history to produce more than the sum of their parts. To sketch an example, social historians have explained why dogs, cats and equines possessed privileged ethical status in late nineteenth-century discourses and regulations around animal research – because of the status these species held within everyday society.⁸⁰ We might, then, ask why, in the closing decades of the twentieth century, nonhuman primates had become the species of most concern within the discourses opposing animal research? Unlike nineteenth-century dogs, cats and equines, late twentieth-century nonhuman primates were not active visible components of everyday life in ‘modern’ urban society. So where might we find an answer? Arguably, heightened societal concerns for nonhuman primates as a species of privileged ethical value historically emerged through their use as experimental animals. It was the knowledge thereby gained of their cognitive, behavioural and social complexity which served as the conditions of possibility for social movements such as the Great Ape Project.⁸¹

From this perspective, the *raison d’être* of the use of animals within scientific research contains its own negation; species are used because of their proximity to the human. The more that proximity is experienced and understood the more difficult it becomes to sustain ethical arguments for their continued use. Evidence can be found in the 1979 report of a UK governmental inquiry into the LD50 test – a procedure which at the time had faced strong criticism from the reinvigorated animal advocacy movement. The scientific use of nonhuman-primates was not in any way related to the LD50 test and formed no part of the inquiry. Nevertheless, quite outside its remit, and responding to the testimony of scientists and technicians who worked with nonhuman primates, the report highlighted that:

primates are in terms of evolution closer to man than cats or dogs and so possibly more likely to experience pain and apprehension to the same extent as a human being. Those who have worked with them, we are told, often feel a particular affinity with and sympathy for them which they do not feel for other species.⁸²

As a result, nonhuman primates were included with the small group of highly protected species within the then regulatory framework for animal research in the UK, in essence gaining a privileged ethical position which dogs, cats, asses and mules had enjoyed since 1876. Nonhuman primates gained this status not through the imposition of social values external to science but rather through recognition of emergent relational and situated values shared by science and society.

What scientists, animal technicians and care staff had articulated in 1979 of their own accord was then a concern for the nonhuman primate. Moreover, what they

reported was a recognition of the capacity of nonhuman primates to respond as opposed to merely react to an experimental encounter. In conclusion, I would argue that one approach to the historical study of a ‘moral ecology of science’ would be to borrow and repurpose the Derridean question: and say the animal responded?⁸³ Within the history of science, how have the responses of experimental animals been productively recognised; not to close them down but to productively open them up as drivers of historical change? And to what effect? In what ways have scientists, technicians and related researchers recognised the responses of experimental animals and thereby learned to better relate responsibly toward those animals? Taking up such questions would bring the history of science into dialogue with broader work across the humanities and social sciences which seeks to understand animals generally and animal research specifically, not least the influential work of Vinciane Despret, who mobilises the history of science to make a plea to resist the removal of passion from knowledge production:

to ‘de-passion’ knowledge does not give us a more objective world, it just gives us a world ‘without us’; and therefore, without ‘them’ – lines are traced so fast. And as long as this world appears as a world ‘we don’t care for’, it also becomes an impoverished world, a world of minds without bodies, of bodies without minds, bodies without hearts, expectations, interests, a world of enthusiastic automata observing strange and mute creatures; in other words, a poorly articulated (and poorly articulating) world.⁸⁴

If further impetus was desired for understanding the history of animal research through a moral ecology of science, attentive to the productive role of affect, emotion, moral and other subjective values, then this would be it.

Notes

- 1 L. Birke, A. Arluke, and M. Michael, *The Sacrifice: How Scientific Experiments Transform Animals and People*, West Lafayette IN: Purdue University Press, 2007, 187.
- 2 A. Cunningham (ed.), *The Laboratory Revolution in Medicine*, Cambridge: Cambridge University Press, 1998.
- 3 F.J. Sulloway, ‘Darwin and his finches: the evolution of a legend’, *Journal of the History of Biology* 15, 1 (1982): 1–53; J.A. Secord, ‘Nature’s fancy: Charles Darwin and the breeding of pigeons’, *Isis* 72, 2 (1981): 162–186 (but see B. Theunissen, ‘Darwin and his pigeons: the analogy between artificial and natural selection revisited’, *Journal of the History of Biology* 45, 2 (2012): 179–212). For the role of dogs in Darwin’s thought see P. Howell, *At Home and Astray: The Domestic Dog in Victorian Britain*, Charlottesville VA: University of Virginia Press, 2015, 102–124.
- 4 A classic overview of the history of behavioural science is R. Boakes, *From Darwin to Behaviourism*, Cambridge: Cambridge University Press, 2008. For ethology see R.W. Burkhardt, *Patterns of Behavior: Konrad Lorenz, Niko Tinbergen and the Founding of Ethology*, Chicago IL: University of Chicago Press, 2005. For an insightful history of changing relations of the epistemologies of field and laboratory see R.E. Kohler, *Landscapes and Labscapes: Exploring the Lab-field Border in Biology*, Chicago IL: University of Chicago Press, 2002.

- 5 An excellent example is J.F.M. Clark, *Bugs and the Victorians*, New Haven CT: Yale University Press, 2003.
- 6 W.F. Bynum, "'C'est un malade": animal models and concepts of human diseases', *Journal of the History of Medicine and Allied Sciences* 45, 3 (1990): 397–413.
- 7 See A.H. Maehle and U. Trohler, 'Animal experimentation from antiquity to the end of the eighteenth century', in N.A. Rupke (ed.), *Vivisection in Historical Perspective*, London: Routledge, 1987, 14–47; A. Guerrini, *Experimenting with Humans and Animals: From Galen to Animal Rights*, Baltimore MD: Johns Hopkins University Press, 2003.
- 8 N.D Jewson, 'The disappearance of the sick-man from medical cosmology, 1770–1870', *Sociology* 10, 2 (1976): 225–244; M. Foucault, *The Birth of the Clinic*, London: Routledge, 1997 [originally published 1973].
- 9 Jewson and Foucault remain powerful frames for medical history in spite of their respective claims resting more on conceptual elegance than empirical evidence: see M.E. Fissell, 'The disappearance of the patient's narrative and the invention of hospital medicine', in R. French and A. Wear (eds.), *British Medicine in an Age of Reform*, London: Routledge, 1991, 91–109.
- 10 For an overview of medical history see W.F. Bynum *et al.*, *The Western Medical Tradition: 1800 to 2000*, Cambridge: Cambridge University Press, 2006.
- 11 D.B. Weiner and M.J. Sauter, 'The city of Paris and the rise of clinical medicine', *Osiris* 18, (2003): 23–42.
- 12 J.E. Lesch, *Science and Medicine in France: The Emergence of Experimental Physiology, 1790–1855*, Cambridge MA: Harvard University Press, 1984; W.F. Bynum, *Science and the Practice of Medicine in the Nineteenth Century*, Cambridge: Cambridge University Press, 1994.
- 13 Vivisection, from the Latin *vivus* (living) and *sectio* (cutting), referred literally to the cutting of living bodies. Over time, the necessity of surgery decreased dramatically across the varied scientific uses of animals. Consequently, 'vivisection' became a less useful description of scientific practice. Nevertheless, vivisection continued to be used by those opposed to animal research long after scientific discourse abandoned the term.
- 14 In an otherwise fascinating account of the way French medicine shaped and was shaped by the turbulent politics of early nineteenth-century France, Jacyna describes how a contemporary commentator acknowledged Magendie's many contributions to physiological knowledge, before noting that few liked 'this pitiless assassin of poor dogs, the only true friends we have in this world' but without examining what this might mean. See L.S. Jacyna, 'Medical science and moral science: the cultural relations of physiology in Restoration France', *History of Science* 25, 2 (1987): 111–146, 137.
- 15 Quoted in Guerrini, *Experimenting*, 70.
- 16 C.A. Recarte, 'Anti-French discourse in the nineteenth-century British antivivisection movement', *Atlantis* 36, 1 (2014): 31–49.
- 17 F.P. Cobbe, 'The rights of man and the claims of brutes', *Fraser's Magazine* 68, (1863): 586–602, reprinted in S. Hamilton (ed.), *Animal Welfare and Antivivisection 1870–1910: Nineteenth-Century Women's Mission, Volume 1: Frances Power Cobbe*, London: Routledge 2004, 1–49.
- 18 C. Berkowitz, *Charles Bell and the Anatomy of Reform*, Chicago IL: University of Chicago Press, 2015.
- 19 C. Berkowitz, 'Disputed discovery: vivisection and experiment in the 19th century', *Endeavour* 30, 3 (2006): 98–102.
- 20 C. Bell, *The Nervous System of the Human Body*, London: Henry Renshaw, 1844, 25.
- 21 G. Rice, 'The Bell-Magendie-Walker controversy', *Medical History* 31, 2 (1987): 190–200, 198, n. 32.

- 22 Subsequent British vivisectionists in contrast made a virtue of the humanitarian goals of animal research; see for instance R. Boddice, 'Vivisection Major: a Victorian gentleman scientist defends animal experimentation, 1876–1885', *Isis* 102, 2 (2011): 215–237.
- 23 See for example 'On experiments on living animals', *London Medical Gazette* 20 (1937): 804–808; P.F. Crane, *The Way In and the Way Out: Francois Magendie, Charles Bell and the Roots of the Spinal Nerves*, New York: Futura, 1974.
- 24 C. Lansbury, 'Gynaecology, pornography, and the antivivisection movement', *Victorian Studies* 28, 3 (1985): 413–437, 422. See also C. Lansbury, *The Old Brown Dog: Women, Workers, and Vivisection in Edwardian England*, Madison WI: University of Wisconsin Press, 1985.
- 25 C. Buettinger, 'Women and antivivisection in late nineteenth-century America', *Journal of Social History* 30, 4 (1997): 857–872.
- 26 M.R. Finn, 'Dogs and females: vivisection, feminists and the novelist Rachilde', *French Cultural Studies* 23, 3 (2012): 190–201, 197.
- 27 C. Buettinger, 'Antivivisection and the charge of zoophil-psychosis in the early twentieth century', *The Historian* 55, 2 (1993): 277–288.
- 28 Finn 'Dogs and females', 198.
- 29 See L. Bending, *The Representation of Bodily Pain in Late Nineteenth-Century English Culture*, Oxford: Oxford University Press, 2000.
- 30 H. Ritvo, *The Animal Estate: The English and Other Creatures in the Victorian Age*, London: Penguin, 1990, 156; H. Ritvo, *Noble Cows and Hybrid Zebras: Essays on Animals and History*, Charlottesville VA: University of Virginia Press, 2010, esp. chapter 5, 73–90.
- 31 J. Turner, *Reckoning with the Beast: Animals, Pain and Humanity in the Victorian Mind*, Baltimore MD: Johns Hopkins University Press, 1980.
- 32 R. D. French, *Antivivisection and Medical Science in Victorian Society*, Princeton NJ: Princeton University Press, 1975, 412. This remains the definitive historical study of antivivisection in the late nineteenth century.
- 33 H. Kean, 'The "smooth cool men of science": the feminist and socialist response to vivisection', *History Workshop Journal* 40 (1995): 16–38.
- 34 E. Fudge, 'A left-handed blow: writing the history of animals', in N. Rothfels (ed.), *Representing Animals*, Indianapolis IN: Indiana University Press, 2002, 3–18, 6–7.
- 35 Which is to say histories not of animals per se, not of animals in place of humans, but rather histories that recognise that the human is materially and symbolically created and sustained through its relationships with other than human historical actors.
- 36 J. Lorimer, *Wildlife in the Anthropocene: Conservation After Nature*, Minneapolis MN: University of Minnesota Press, 2015, in addition to being an excellent argument for rethinking the ontological status of 'wildlife' equally provides a lucid overview of how different and often challenging literatures can be brought together around shared themes of hybridity.
- 37 For instance, Donna Haraway characterised narratives which separate the knowing subject from the object known so as to produce 'objective' science as performing an 'illusion' akin to the 'god trick'. On this reading objectivity is rendered immanent, situated in particular practices, places and times. See D. Haraway, 'Situated knowledges: the science question in feminism and the privilege of partial perspective', *Feminist Studies* 14, 3 (1988): 575–599, 582.
- 38 R.M. Young, 'Science is social relations', *Radical Science Journal* 5, (1977): 65–129.
- 39 For a lucid overview of the core issues within this historiographic trend, together with analysis of the subsequent 'science wars' of the 1990s, see I. Hacking, *The Social Construction of What?* Cambridge MA: Harvard University Press, 1999.

- 40 D. Haraway, *Primate Visions: Gender, Race, and Nature in the World of Modern Science*, London: Routledge, 1989, 1.
- 41 In challenging simple dualisms such as nature-culture, human-animal, sex-gender, Haraway opens fertile ground for rethinking human relations to animals and remaking the world we share whilst simultaneously undermining any uncritical resort to 'science'. Some primatologists, however, reacted unfavourably to what they saw as an attack on the scientific credibility of their work, see for instance M. Cartmill, 'Review: Primate Visions: Gender, Race, and Nature in the World of Modern Science', *International Journal of Primatology* 12, 1 (1991): 67–75. Others were more favourable, see in particular S.C. Strum and L.M. Fedigan (eds.), *Primate Encounters: Models of Science, Gender and Society*, Chicago IL: University of Chicago Press, 2000.
- 42 Characteristic of Haraway's writing, 'technoscience', alongside terms such as 'naturecultures', challenges the way language reifies dichotomy. For an introduction to her thought, see D. Haraway, *The Haraway Reader*, London: Routledge, 2003.
- 43 For example E. Fudge, 'Milking other men's beasts', *History and Theory* 52, 4 (2013): 13–38; S. Nance, *Entertaining Elephants: Animal Agency and the Business of the American Circus*, Baltimore MD: Johns Hopkins University Press, 2013.
- 44 Latour has continuously fought and lost a battle to extract himself from the work which made his name, as one writing that 'there are four things that do not work with actor-network theory; the word actor, the word network, the word theory and the hyphen' (see 'On recalling ANT', *Sociological Review* 47, S1 (1999): 15–25). For a lengthy and lucid critique and re-presentation of his earlier work see B. Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory*, Oxford: Oxford University Press, 2007.
- 45 R. Kohler, *Lords of the Fly: Drosophila Genetics and the Experimental Life*, Chicago IL: University of Chicago Press, 1994.
- 46 J. Harwood, *Styles of Scientific Thought: The German Genetics Community, 1900–1933*, Chicago IL: University of Chicago Press, 1993.
- 47 Kohler, *Lords of the Fly*, 3.
- 48 E.P. Thomson used 'moral economy' to capture the normative social values which governed a local economy most famously in his example of eighteenth-century food riots. See E.P. Thompson, 'The moral economy of the English crowd in the eighteenth century', *Past and Present* 50 (1971): 76–136.
- 49 Kohler, *Lords of the Fly*, 50.
- 50 A pertinent and interesting element of Latour's thought is his challenge to the assumption that technologies belong in the realm of means whereas questions of moral value apply to ends. Thus technologies can embody moral values. See for instance B. Latour, 'Morality and technology: the end of the means', *Theory, Culture and Society* 19, 5–6 (2002): 247–260. In my own work I extend this argument to show how technologies such as the laboratory animal cage 'materialise' societal and moral values. The same could be said of the various technologies that facilitate companion animal relations (e.g. dog leads). See for example R.G.W. Kirk, 'Care in the cage: materializing moral economies of animal care in the biomedical sciences, c.1945', in K. Bjørkdahl and T. Druglitrø (eds.), *Animal Housing and Human–Animal Relations: Politics, Practices and Infrastructures*, London: Routledge, 2016, 167–184, 167–168.
- 51 R.G.W. Kirk, 'A brave new animal for a brave new world: the British Laboratory Animals Bureau and the constitution of international standards of laboratory animal production and use, circa 1947–1968', *Isis* 101, 1 (2010): 62–94.
- 52 A.N. Worden and W. Lane-Petter, *The UFAW Handbook on the Care and Management of Laboratory Animals*, London: UFAW, 1957, 859–867.

- 53 R.G.W. Kirk, 'The invention of the 'stressed animal' and the development of a science of animal welfare, 1947–86', in D. Cantor and E. Ramsden (eds.), *Stress, Shock, and Adaptation in the Twentieth Century*, Rochester NY: University of Rochester Press, 2014, 241–263.
- 54 Whereas Kohler consciously adapts his understanding of 'moral economy' from the work of E.P. Thompson, Daston, in contrast, appears to have coined the term independently – only latterly realising that her appeal 'to "economies" of affects and values has little to do with Thompson's accounts of corn markets and the tradition of "setting the price" by persuasion or riot, although it does appeal to a broader sense of "legitimizing notion": see L. Daston, 'The moral economy of science', *Osiris* 10 (1995): 2–24.
- 55 M. Lederman and R.M. Burian, 'The right organism for the job', *Journal of the History of Biology* 26 (1993): 235–367.
- 56 A.E. Clarke and J. Fujimura (eds.), *The Right Tool for the Job: At Work in Twentieth-Century Life Sciences*, Princeton NJ: Princeton University Press, 1992, 4–5.
- 57 P. Palladino, 'Review: bringing the world into the laboratory, or the (ir)resistible rise of *Drosophila-melanogaste*', *British Journal for the History of Science* 29, 2 (1996): 217–221, 221.
- 58 Daston, 'Moral economy', 3.
- 59 B.T. Clause, 'The Wistar rat as a right choice: establishing mammalian standards and the ideal of a standardized mammal', *Journal of the History of Biology* 26, 2 (1993): 329–349.
- 60 See S.L. Star and M. Lampland (eds.), *Standards and Their Stories: How Quantifying, Classifying, and Formalizing Practices Shape Everyday Life*, Ithaca NY: Cornell University Press, 2008.
- 61 C.A. Logan, 'Before there were standards: the role of test animals in the production of empirical generality in physiology', *Journal of the History of Biology* 35, 2 (2002): 329–363.
- 62 Clause, 'The Wistar rat', 348–349.
- 63 K. Rader, *Making Mice: Standardizing Animals for American Biomedical Research, 1900–1955*, Princeton NJ: Princeton University Press, 2004.
- 64 Rader, *Making Mice*, 251.
- 65 In contrast to Britain, during the period of Rader's study American animal research was loosely and diversely governed by state laws but no federal law existed to govern tensions between scientific and societal values until 1966. As enacted, the Animal Welfare Act (1966) established minimum 'standards' of care and management for animals but defined the term animal in such a way as to exclude a number of commonly used experimental animal species including mice.
- 66 Rader, *Making Mice*, 152–153.
- 67 R.A. Ankeny and S. Leonelli, 'What's so special about model organisms?' *Studies in History and Philosophy of Science Part A* 42, 2 (2011): 313–323.
- 68 S. Leonelli, R.A. Ankeny, N.C. Nelson, and E. Ramsden, 'Making organisms model human behavior: situated models in North-American alcohol research, 1950-onwards', *Science in Context* 27, 3 (2014): 485–509.
- 69 See for instance E. Ramsden, 'From rodent utopia to urban hell: population, pathology, and the crowded rats of NIMH', *Isis* 102, 4 (2011): 659–688.
- 70 See C. Friese, 'Realizing potential in translational medicine: the uncanny emergence of care as science', *Current Anthropology* 54, S7 (2013): S129–S138; N. Nelson, 'Model homes for model organisms: intersections of animal welfare and behavioral neuroscience around the environment of the laboratory mouse', *BioSocieties* 11, 1 (2016): 46–66. See R.G.W. Kirk, 'Between the clinic and the laboratory: ethology and pharmacology in the work of Michael Robin Alexander Chance, c.1946–1964', *Medical History* 53, 4 (2009): 513–536.
- 71 Daston, 'Moral economy of science', 2.
- 72 O.E. Dror, 'The affect of experiment: the turn to emotions in Anglo-American physiology, 1900–1940', *Isis* 90, 2 (1999): 205–237, 210.

- 73 Dror, 'The affect of experiment', 233–236.
- 74 D.P. Todes, *Pavlov's Physiology Factory: Experiment, Interpretation, Laboratory Enterprise*, Baltimore MD: Johns Hopkins University Press, 2002.
- 75 I have observed similar uses of anthropomorphic language and recognition of animal emotion; see for example R.G.W. Kirk, 'In dogs we trust? Intersubjectivity, response-able relations, and the making of mine detector dogs', *Journal of the History of the Behavioral Sciences* 50, 1 (2013): 1–36.
- 76 S.E. Lederer, 'Political animals: the shaping of biomedical research literature in twentieth-century America', *Isis* 83, 1 (1992): 61–79, 71.
- 77 N. Gane, 'When we have never been human, what is to be done? Interview with Donna Haraway', *Theory, Culture & Society* 23, 7–8 (2006): 135–158.
- 78 J. Schiller, 'Claude Bernard and vivisection', *Journal of the History of Medicine and Allied Sciences* 22, 3 (1967): 246–260, 255, n. 88. Bernard's view is distinctive in that the monkey was not a species that aroused particular concern within the antivivisectionist movement; the latter privileged dogs, horses and equines and cats as deserving of particular moral concern.
- 79 My own work has tentatively developed in this direction; for example Kirk, 'In dogs we trust?'.
- 80 See French, *Antivivisection*, esp. 394–395. Species also shaped the practice of Victorian animal research: see R. Boddice, 'Species of compassion: aesthetics, anaesthetics, and pain in the physiological laboratory', *19: Interdisciplinary Studies in the Long Nineteenth Century*, 15 (2012).
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