Chapter Nine

The Invention of the "Stressed Animal" and the Development of a Science of Animal Welfare, 1947–86

Robert G. W. Kirk

In Britain, as elsewhere in the 1950s, it had become "fashionable to assert" that there was "an increase in the incidence of mental disorders and that the cause of this is the increased stress of modern life." Some medical professionals feared this trend to be self-fulfilling, warning that "mental health propaganda" was "instilling a phobia for the inevitable stresses of life."[1] The language of stress was certainly ubiquitous at this time, not least within the various branches of the biomedical sciences. In the wake of Hans Selye's general adaptation syndrome, stress had quickly become a conceptual space in which the study of clinical medicine, biology, physiology, endocrinology, neurology, biochemistry, psychology, psychiatry, and behavior, among many other fields, could enter into dialogue. This is not to suggest that there was agreement on the nature of stress or even the meaning of the term. On the contrary, across these disciplines stress was invoked in different ways, according to different models. Arguably, it was the very flexibility of the concept that accounted for its prevalence.

In July 1958, for example, the Mental Health Research Fund organized a conference with the aim to "arrive at a synthesis of the concepts used in different branches of the behavioral sciences when discussing stressful effects."[2] Held at Oxford University, the conference hosted prominent participants, including the psychiatrists Aubrey Lewis, W. Linford Rees, and Martin Roth; the psychiatrist, psychoanalyst, and ethologist John Bowlby; ethologist and animal behaviorist Robert A. Hinde and Oliver L. Zangwill; the Pavlovian psychobiologist Howard S. Liddell; the cyberneticians William Ross Ashby and W. Grey Walter; and Hans Selye himself. It is no coincidence that the majority of participants resist categorization within a single discipline. As the

conference progressed, the neurochemist Derek Richter noted, with increasing awe, the multiplicity of meanings that stress held across "common language," "physics," "biology," "physiology," and "psychology." Though finding a shared language had proved far from simple, participants concluded that the practice of differentiating and synthesizing understandings of stress was nonetheless productive.[3]

Bowlby, too, had sought commonalities in the differing meanings of stress employed across the diverse disciplines represented at the conference. Noting common characteristics in the different understandings of stress, he resolved that all presumed that

> an organism lives by maintaining a variety of relationships, external and internal. To define its state at any time we must define the relations which it is set to attain, maintain and escape, and the course of its current activity in regard to those relationships. In "relationships" I include those which serve both physiological needs, like the need for nutrition and psychological needs, like the need for status and success. These relations are maintained by constant activity, e.g., nutrition by an endless succession of meals, "success" by an endless series of successful performances. None can be attained once for all.

Stress discourses, then, were capable of representing the dynamic organism in all its complexity. Stress could capture relational responses to change across sites where interactions had hitherto proved difficult to integrate. Bowlby, therefore, came to believe that all applications of the term addressed the process of adapting to challenge. When challenged, organisms would change along four dimensions, physiologically, emotionally, behaviorally, and structurally. At the end of this process the organism would regain its original state or enter a new one. Change, in any or all of these dimensions, could be attributed to stress. Hence the utility of the concept as a vector of communication across disciplines. For Bowlby, stress "connotes a degree of challenge sufficient to evoke the kind of change or behaviour which interests the particular observer. Its meaning, therefore, depends not only on the 'dimension' in which he is interested but also on the threshold above which appear the kind of phenomenon which he finds interesting."[4] In other words, stress was general enough to be found anywhere yet specific enough to give structure to the chosen object of study. Above all else, then, the concept of stress was epistemologically and ontologically *relational*.

This chapter explores how stress provided a language capable of structuring dynamic and always-active relations, rendering them comprehensible and thereby opening them up to intervention and management. The argument is developed through three parts, beginning with an analysis of the introduction of Selye's concept of the general adaptation syndrome into the regulatory landscape of British animal-dependent science. Here, it is shown how ecological investigations of population decline challenged the

regulatory definition of "pain" by invoking stress as an explanatory concept. Regulatory understandings of animal pain, which were conventionally restricted to surgical interventions into the body, were subsequently widened so as to include mental suffering, a condition of possibility for the emergence of the "stressed animal."

The second section unpacks the implications of the "stressed animal" within the laboratory, showing how stress facilitated the emergence of a "science" of animal welfare. In the 1950s stress was mobilized to reveal the complex interdependencies a living organism shared with its physical and social environment. It provided a model that, by including the experimenter, placed knowing human scientist and animal object of knowledge within an interdependent relationship. Though the implications of this move took some time to become explicit, this was nonetheless the originary moment of the ethical framework known as "humane experimental technique" (or the 3Rs) which today governs animal experimentation across the developed world. Finally, the trajectory of the stressed animal is traced from the laboratory to sites of intensive (or "factory") farming. By emphasizing relationality, the conceptual landscape of stress engendered a form of reflexive thought that brought all relationships within its remit, including that between human and nonhuman animal. Consequently, this chapter argues that stress facilitated a fifth dimension of change: *that of the ethical orientation of living organisms to one another*. By rendering relationships knowable, thus manageable, stress provided a language by which traditionally moral notions such as "well-being" could be reconfigured from political philosophical rhetoric to become objects of scientific and economic knowledge materialized in physical spaces, scientific practices, and legal regulations.

The Stressed Animal and the Regulatory Landscape of British Science

The Cruelty to Animals Act (1876) established an elaborate licensing system for the regulation of animal experimentation, through which the Home Office governed animal experimentation in Britain for over a century.[5] The spirit of the act was taken to be the prevention of the infliction of unnecessary pain on animals subjected to experiment. By the mid-twentieth century Home Office inspectors had accrued extensive knowledge regarding the best practices in animal experimentation, together with a considerable body of precedent. Consequently, in most cases civil servants were capable of determining which scientific practices required licensing. Whether or not a given procedure formed an experiment, and if so whether it caused pain, could nevertheless be contentious. In the early years of the act, for example, there was considerable confusion about whether the use of animals in the

production of sera and antitoxins fell under the act. Eventually, this question was resolved by legal opinion having determined that the injecting of animals for production purposes did not fall under the act, as the practice was not an experiment (though it may cause pain). Subsequent injection of products into small mammals for the purposes of standardization, however, was judged an experiment and therefore required licensing under the act. Both practices involved similar invasive manipulations of the animal body, but it was intent as opposed to practice that determined legality.[6]

Practices thought to come under the act by some and not by others were conventionally determined in an ad hoc manner, often through consultation with a sitting Advisory Committee whose remit was to advise the Home Office on novel or complicated applications. The status of a given practice might occasionally change over time. The use of mice in the Zondek-Aschheim pregnancy test, for instance, was ruled not to fall under the provisions of the act in 1944, as it had been refined not to involve the infliction of pain and, moreover, having become established as a routine medical test was no longer thought of as an experiment.[7] Importantly, over this period, one aspect of interpretation remained consistent: pain was understood physiologically, that is, as the result of physical (generally surgical) interventions into the animal body.[8]

In day-to-day practice individual scientists were expected to recognize their experimental work as being "calculated to give pain" and thus apply for licensing under the act. In 1949, for this reason, Dennis Chitty and John Clarke applied to the Home Office for a license. In doing so they introduced the concept of stress to the regulatory landscape of British animal experimentation. Furthermore, they inadvertently challenged the long-held definition of pain as being the result of surgical interventions into the animal body. Chitty, a British-born Canadian ecologist, and Clarke, a Australian doctoral student, were members of Charles Elton's Bureau for Animal Population at the University of Oxford.[9] From the 1930s Elton and his small team of researchers had worked to establish population cycles as an economically crucial yet little-understood phenomenon. The promise of being able to predict and control periods of scarcity and abundance in wild populations of animals with economic value attracted the support of numerous parties. Imperial Chemical Industries (ICI), for instance, sponsored research into game populations. Similarly, the Universities Federation for Animal Welfare (UFAW), a self-styled "scientific" animal welfare society, supported an investigation into wild rabbit populations in the hope of demonstrating them to be detrimental to British agricultural production (as opposed to a useful source of food).[10] By pioneering new methods of conducting censuses of wild populations, such as Chitty's methods of trapping, ringing, and recapturing live mammals, the bureau had become a leading center for research into population density and mortality in natural habitats by the 1940s.[11]

The formative work of the bureau was synthesized in Elton's *Voles, Mice and Lemmings: Problems in Population Dynamics* (1942). This book established the reality of cycles in populations of small, wild mammals, as well as the economic importance of understanding such cycles and the inadequacy of current explanations for the phenomenon. Elton contended that none of the four main explanatory hypotheses—food shortage, predation, weather, and epidemic disease—adequately explained sudden population collapses.[12] This led Chitty to develop a controversial, yet latterly influential, hypothesis. He proposed that individuals born into dense populations differed congenitally from those born into growing populations. Such qualitative change, he suggested, provided a self-regulatory mechanism by which populations could control their number.[13]

This theory was first articulated in a manuscript prepared in the late 1940s and submitted to the *Journal of Animal Ecology*. Chitty explained how natural population crashes might be caused "primarily due to adverse conditions to which the parents were subjected in the previous breeding season." Despite Elton and Chitty having founded the journal in 1932 and having served as editors until 1950, the newly appointed editor rejected the paper. At best, Chitty's "vague speculation" was judged to go against the grain of ecological thinking by proposing internal as opposed to external regulatory factors for a population. At worst, it could be read to imply a form of inheritance of acquired characteristics (i.e., Lamarckism). Had it not been for the intervention of Peter Medawar, a past colleague and supporter of the work of the bureau, the paper may not have been published at all. Medawar encouraged Chitty to press on, recommending the article to the *Philosophical Transactions of the Royal Society of London*, where it was published in 1952.[14] For Chitty, this proved to be a formative experience. Subsequently, he became vehemently committed to ecology as an *experimental* science. Indeed, throughout his career he remained suspicious of ecological theories based on observation, descriptive reasoning, or mathematical modeling alone.[15] To be taken seriously, Chitty believed, a hypothesis required replicable experimental evidence.

In 1949, therefore, Chitty challenged John Clarke to provide the evidence through a series of laboratory-based experiments using the short-tailed field vole (*Microtus agretis*). Voles had long served as the favored model for population density research at Oxford because they were readily available in local woods and, anecdotally, were known to increase by dramatic proportions before suddenly disappearing. In the 1930s, Richard M. Ranson and John R. Baker had developed methods for domesticating and maintaining wild voles in the laboratory.[16] Because voles were known to fight with remarkable ferocity in threatening scenarios, fighting was chosen as the object of study. Chitty and Clarke reasoned that increased fighting within a dense population could cause physiological disturbance in pregnant animals capable of

creating abnormalities in their progeny. Such abnormalities, it was thought, could be responsible for increasing mortality over generations. But without a mechanism capable of connecting behavior at the level of the population to physiological change at the level of the individual, it was unclear how this could happen or what should be measured as evidence of the process. As ecologists, neither Chitty nor Clarke possessed the necessary pathological expertise to compare whole organisms for abnormalities. They required what Clarke later described as a "quick, uncomplicated measure of the physiological state of the animals, which would be at once meaningful."[17] Stress, as set out in Hans Selye's general adaptation syndrome, proved a perfect fit for this job. Stress not only provided a mechanism by which behavioral change in the population could be related to physiological change in the individual but also suggested an efficient biological marker for the measurement of bodily change.[18]

With an experiment planned, Chitty and Clarke applied to the Home Office for a license, including dispensation from anesthetics, as they believed their experimental design to be "calculated to give pain." They explained their desire "to keep voles under conditions likely to result in fighting for the establishment of social hierarchy" to study the "effect of social stress upon longevity and reproduction with particular reference to the adaptation syndrome (Selye)."[19] But there was no precedent for such a request because "no certificate has previously been submitted to the Secretary of State to allow such experiments to be made in this country." The Home Office was uncertain as to how to respond because "no actual operative procedure" was intended, and it was unclear how the work could be calculated to inflict pain.[20] Importantly, analogous experiments *had* been undertaken in 1930 by Francis A. E. Crew and Ljuba Mirskaia at the Animal Breeding Research Department within the University of Edinburgh. Investigating the effects of density on mouse populations, they described how "mouse differed from mouse temperamentally. . . . The males fought desperately and without respite and . . . the commonest form of injury was partial or complete castration. Such mutilated males as survived were permitted by their masters to re-enter the community. . . . Certain boxes had to be withdrawn from the experiment, for . . . the original occupants had provided a group which spent all their time killing new members and replacements. . . . These were death traps for the new-comers."[21] No license had been requested for this work. Yet there was no question of Crew and Mirskaia having been in the wrong for not having applied to the Home Office.[22] Rather, the Home Office wrote to Chitty asking why he thought a license was required for the proposed experiment.

At no point was the scientific worth of investigating correlations between population density and Selye's general adaptation syndrome questioned.

The singular difficulty, in the view of the Home Office, was how to fit Chitty's understanding of pain within current regulative practices. In a detailed explanation, Chitty described why he believed that "animals subjected to the stress of fighting" should be understood to "suffer." The proposition that "fighting upsets maternal physiology" implied that "the resulting progeny suffer permanent disability to grow and/or reproduce." In addition, there was a risk "some animals may be physically injured or killed by fighting."[23] As was customary in difficult cases, the Home Office called on the Advisory Committee on the Administration of the Cruelty to Animals Act, an expert group consisting of scientists and lawyers, to adjudicate.

All permissions to dispense with anesthesia had hitherto been accompanied by a standard limiting condition, stating that "no operative procedure more severe than simple inoculation or superficial venesection may be adopted in any of the said experiments." This clause formed part of the "pain condition," the intent of which was to ensure that no animal suffered severe pain.[24] In this case, no operative procedure was planned and so such a caveat made little sense. Moreover, it did nothing to address the possibility of "severe injuries" occurring as a consequence of fighting.[25] The Advisory Committee therefore asked Chitty how he intended to meet the "Pain Condition," to which he explained injured animals would be removed and painlessly put to death. Satisfied, the committee concluded that "the experiments were potentially valuable and no undue suffering was likely to result. In effect the experiments would reproduce conditions that occurred in nature, but whereas under natural conditions animals maimed in fighting would die a lingering and often painful death, in this case serious casualties would at once be removed and painlessly destroyed."[26] The moral deference to "nature" is itself worthy of note. However, of most significance is how stress challenged the conventional regulatory understanding of pain. In the event, the full extent of the challenge was evaded.

Chitty and Clarke were granted their license. As their proposed work would not violate the standard limiting condition, it was appended despite its irrelevance. Nonetheless, this episode marked the beginning of a major redefinition and extension of the regulatory understanding of pain. Suffering could no longer be viewed as solely deriving from physical interventions into the body. While stress-induced suffering continued to be predominantly framed in terms of physiological change, the capacity of animals to experience pain had widened far beyond physical interventions into the body. Animal sociality, for example, could now be recognized as capable of causing suffering by altering behavior and detrimentally effecting physiology. The implications of this new model of suffering was quickly mobilized and deployed by those who sought to make animal welfare a foremost concern of animal-dependent experimental science.

Materializing Well-being in the Laboratory: A Science of Animal Welfare?

In 1949 Chitty briefly toured the United States, discussing his World War II development of economic methods of pest control.[27] At Johns Hopkins, he met with Curt Richter, David E. Davis, John B. Calhoun, and John J. Christian, all of whom were undertaking analogous work on population density with a view to controlling rat infestation in Baltimore.[28] In quite distinctive ways the Baltimore group was investigating relations between population density, environment, behavior, and stress.[29] Richter, for example, was investigating how the stress of domestication might alter laboratory rats through a process he thought may "parallel the development of man in society."[30] Though Chitty must have discussed their mutual interests, he failed to make explicit connections between his encounters in Baltimore and his vole work at Oxford. In 1950, when Christian published a paper that effectively preempted his and Clarke's investigation, Chitty was "temporally devastated."[31] It was not in Baltimore, therefore, that Chitty was introduced to the work of Selye but rather at a meeting of the Society for Experimental Biology that Chitty attended on his return to the United Kingdom.

At this meeting Michael Robin Alexander Chance suggested that Selye's ideas "might provide the theoretical framework" for Chitty's "otherwise bald and unconvincing narrative" regarding the regulation of populations.[32] Chance was a zoologically trained pharmacologist, who had worked in industry (Glaxo Laboratories, 1938–46) before joining the University of Birmingham as lecturer in pharmacology (1946–82). His real interest, however, was the new behavioral science of ethology, which is conventionally understood to have methodologically prioritized the relationship between environment and behavior, emphasizing the study of animals in nature as opposed to in the laboratory.[33] Chance, however, applied ethology to the study of domesticated laboratory animals. Reasoning that the "natural" environment of laboratory animals was, in fact, the laboratory, Chance deployed ethological techniques to identify the "normal" species-specific behavior of common laboratory animals (so as to render them more reliable experimental tools).[34] He was among the first to demonstrate that social behavior could alter physiological reactions to pharmaceutical drugs, a discovery that had crucial implications for experimental design and later directly informed experimental studies of stress.[35] For Chance, ethology provided a means to capture the complexity of living organisms within their environment. Ethological techniques could chart interactions between the wider physical and social environment on the one hand and individual physiology, emotion, and behavior on the other. Structural changes in the individual body could thereby be related to behavioral changes in the population. Stress, therefore, was a useful conceptual resource for ethological studies, as

it provided a theoretical framework to relate phenomena across psychosomatic and psychosocial territories.

This conceptual orientation, which was shared by many who were influenced by ethology and psychosomatic approaches in the 1950s, situated the knowing subject within the environment of, and therefore in relation to, the object of (or means to) knowledge. Consequently, it encouraged reflective thought. One example of this trend was a tendency toward explicit consideration of the methodological difficulties in the production of objective knowledge. Chance, for example, developed a course for medical students titled "How to Observe," consisting of practical exercises in behavioral observation of laboratory animals. The intention was to demonstrate to students that what they *looked for* in a given situation often had little to do with what they *looked at*.[36] Placing the knowing subject in relation to the object of knowledge also accentuated the subjective relations between the two. Accordingly, in his work Chance emphasized how researchers, animal caretakers, and animal technicians formed part of the social environment for laboratory animals. From this perspective humans were understood as agents in the psychosomatic and psychosocial processes that shaped the animals.[37] This view had clear implications for experimental design—psychosocial spaces now had to be controlled if verifiable experimental knowledge was to be produced. Moreover, this approach also opened up the relationship between experimental scientist and laboratory animal as a new territory for ethical intervention, within which the well-being of laboratory animals came to the fore.

In the 1950s, Chance's studies of laboratory animal well-being were supported by the Universities Federation for Animal Welfare (UFAW) as part of a wider research program to develop "humane experimental technique." UFAW was unique among animal advocacy groups in that it sought to recruit the intellectual elite to develop a "science" of animal welfare.[38] Rather than appealing to popular politics, UFAW worked with scientists and veterinarians in an attempt to pragmatically "reduce the sum total of pain and fear inflicted on animals by man."[39] From the 1940s UFAW had considerable success appropriating a then prevalent concern over the reliability of experimental animals as a means to turn scientific attention to questions of animal welfare.[40] By arguing that the welfare of laboratory animals was the starting point in the production of standardized, and thus reliable, laboratory animals, UFAW encouraged the consideration of laboratory animal well-being as a key methodological concern in the design of experiments. UFAW funded Chance's research, for instance, as his ethological studies were thought to demonstrate "the importance of a happy home life (cage design, nature, and number of companions) in producing uniform results in test animals."[41] In this way, animal well-being was reconfigured and transitioned, moving from a language dominated by moral rhetoric into a new form of

specialist expertise grounded in pragmatic science. Within this logic, ethical concern became scientific necessity.

The UFAW Handbook on the Care and Management of Laboratory Animals (1947) did much to establish the new science of laboratory animal welfare (as well as UFAW's credibility within scientific circles). It was the first general handbook providing standard methods of animal care for all the major laboratory animal species. Animal-dependent experimental scientists responded positively to the *Handbook*, one reviewer describing it as "a very practical blend of economics and humanitarianism . . . indispensable to all concerned in any way with the production and use of animals in laboratories."[42] The style of the *Handbook* was strongly practical, providing standard species-specific approaches to animal housing, breeding, feeding, handling, and general husbandry. Yet emphasis was also placed on the sometime subjective and always relational aspects of *working with animals*. For example, the *Handbook* described how "animals may suffer acutely from boredom, and they certainly need exercise, companionship and opportunity for play." As little was known about these needs, much more had to be learned about the "psychological conditions that make for a happy and contented stock."[43] Consequently, UFAW focused a good deal of attention and financial support on such research.[44] Within this work the concept of stress came to play an important role.

In 1954, UFAW funded a new research project intended to develop humane approaches to experimental science. Peter Medawar was appointed to guide the work, chairing UFAW's Scientific Advisory Committee, which also included William Lane-Petter, then head of the Medical Research Council's Laboratory Animals Bureau. Medawar enthusiastically supported what he saw as "research on methods of research," providing space in his laboratory at University College London (UCL) for two researchers, William Moy Stratton Russell and Rex Burch.[45] Russell took the lead in shaping the conceptual development of what became *The Principles of Humane Experimental Technique* (1959).[46] Russell had recently completed a D.Phil at the Department of Zoology at Oxford. While there he had become enamored by ethology, the principles of which he synthesized with cybernetics and systems theory to form what he termed a "psychosomatic" approach to animals. His aim was to develop an approach to laboratory animals about the principle of "*mens sana in corpore sano* [a healthy mind in a healthy body]." What became "humane experimental technique" emphasized that the experimenter would not "get one without the other."[47]

Drawing directly on the work of Chitty and Clarke, Russell presented his psychosomatic approach as a refinement of stress research.[48] It was "regrettable alike on humane and scientific grounds that so large a proportion of the study of psychosomatics in animals has so far been carried out with the bludgeon of 'stress' of the more severe kinds." Russell went on to explain

that "everything about the rich physiological network suggests the possibility of much more refined effects of behavioural upon internal states." Here again, stress provided a theoretical approach capable of integrating physiological, psychological, and behavioral change across the levels of individual and population. Russell believed that domesticated animals appeared less able to cope with stress because of the restraints placed on their range of responses by the controlled environments in which they lived. "Conflict states never persist in nature," Russell claimed, because "while lower animals have no direct control over their moods, automatic mechanisms ensure that distressing ones do not persist." However, this "natural sequence is disturbed in captive and domesticated animals."[49] Consequently, those who worked with laboratory animals were under a moral obligation to ensure environments met the welfare needs of animals, either by allowing automatic mechanisms to operate as in nature or by compensating in some way if they could not. The physical environment, thereby, became a site mapped and shaped by ethical considerations.

To understand the "refined effects" of psychosomatic interactions, Russell made "distress" (as opposed to stress) the central concept and object of humane experimental technique. Distress gave notions of "humane" and "inhumane" a practical meaning embedded in quantifiable properties. It was defined as a state that "if protracted, would lead to the stress syndrome." Humane experimental technique demanded not only the removal of negative scenarios but the provision of positive ones. Science was expected to "aim at well-being rather than the absence of distress."[50] The laboratory animal was portrayed as existing on a scale with one end being "distress" and the other "well-being." Russell outlined various promising lines that might provide criteria to quantify distress. Again, stress was the model. The advancement and refinement of endocrinology, for example, promised a reliable approach to the biological measurement of distress. Following the work of Chitty, the measurement of breeding productivity could also serve as a general indicator of well-being, with any decline indicating an increase in distress. Finally, albeit a somewhat subjective indicator, "the animal's behaviour *toward the experimenter*" was suggested as an "extremely pertinent and valuable criteria" of laboratory animal well-being.[51] Within humane experimental technique, well-being became a variable within a new science of animal welfare, which served to reconfigure moral values from political-cum-philosophical concepts to quantifiable material states.

Today, codified as the "3Rs" or the refinement, reduction, and replacement of animals in experimental science, humane experimental technique provides the ethical framework governing animal experimentation in the developed world. Yet few have read *The Principles of Humane Experimental Technique*. Unlike the *UFAW Handbook*, it was poorly received and quickly dropped out of print.[52] The conventional history assumes the 3Rs to have

been ignored until they were "rediscovered" in the late 1980s. However, alongside the wider work of UFAW and others, the *Principles* formed an important contribution to the reimagining of the laboratory animal. No longer could animals be approached as mere tools. Not only had recognition of their experiential capacities broadened, but it had vastly escalated in practical as well as ethical importance.

Moreover, animal well-being was gradually reconfigured from a political-cum-philosophical ideal to a set of practices grounded in the material cultures of science. The concept of stress was a critical mechanism within this transformation. In the work of Russell, for instance, stress helped to imbue laboratory animals with mentality, and thus the capacity for mental suffering, recognition of which was cast as simultaneously having ethical significance and scientific consequence (as mental suffering brought physiological change, it had to be controlled to produce replicable experimental results). This new, largely materialized approach to, and understanding of, animal well-being went on to inform the development of "laboratory animal science," the growth of the laboratory animal industry, and the professionalization of the role of animal attendants and technicians in the post–World War II period. Accordingly, laboratories and animal houses were extensively redesigned to provide an environment more conducive to the laboratory animal "welfare," a process that encompassed everything from the design of cages and the development of pathogenically secure buildings to the provision of "silent" fire alarms operating at a range inaudible to common species of laboratory animals. The logic governing these transformations latterly became known as the science of animal welfare.

In this way, stress also contributed to the wider transformation of the ways in which animals were commonly understood to experience pain. The Departmental Committee on Experiments on Animals, for example, which was appointed by the Home Secretary in 1963 "to consider the present control over experiments on living animals," reported that "many scientific witnesses suggested that the concept to be controlled by the Act should be expressly expanded from 'pain' to comprise 'any interference with or departure from the animal's normal state of health or well-being,' and that this larger concept should be termed 'discomfort' or 'distress.'"

Changing understandings of the experiential capacities of animals were not solely driven by the intellectual concept of stress. Rather, they were equally a response to the experimental practices that produced such knowledge:

> Other witnesses reminded us that mental illness and neurosis are largely problems in modern civilisation, and drew attention to increasing interest in states of animal behaviour and psychological experiment designed to find forms of treatment for disordered states in human patients. . . . These

> witnesses told us that manipulation of environment was likely to be much more widely used as an experimental technique in the future, and urged that any procedure designed to produce the equivalent of stress in man should be subject to statutory control.[53]

Recognition that the environment could be used as an experimental tool to impact negatively on the physical and mental health of animals brought with it an obligation to ensure that the everyday environments experienced by animals be designed to maximize well-being. The report of the Departmental Committee recommended the expansion of the regulatory definition of pain to encompass at least three states of incrementally increasing suffering: "discomfort," "stress," and "pain." The emergence of the "stressed" animal had implications far beyond laboratory animal production, provision, use, and welfare. A key site of related transformation was the increasingly industrialized farm.

Materializing Well-Being on the Farm: An Economics of Animal Welfare?

Agriculture and industrialized farming provided a second interrelated discourse within which stress again emerged in conjunction with ethical reflections on animal well-being. For instance, the model of animal suffering developed within the laboratory sciences and expressed by the Departmental Committee on Experiments on Animals directly influenced the report of the concurrent Technical Committee to Enquire into the Welfare of Animals Kept under Intensive Livestock Husbandry Systems.[54] The latter formed a response to Ruth Harrison's *Animal Machines* (1964), an "exposé" that drew on the language of stress to represent modern methods of industrial farming as inherently "cruel."[55] Harrison, like Russell, emphasized relationships, in her case that between stockmen, livestock, and the environment. She lamented that within industrial factory farming, "the domesticated animal is very dependent on those who look after it. . . . In the agricultural world drugs have taken the place of stockmanship, but it is difficult to blame the stockman entirely for this. When he has vast numbers of animals to look after he cannot be expected to have the same feeling and instinct for their needs as he did with relatively few."[56]

Throughout *Animal Machines* dynamic psychosocial relations were presented as the territory through which health and welfare were determined. Improperly structured relations, whether between human and animal, or animal and animal (e.g., population densities), were described as stress situations that led to disease. Wherever possible, the concerns of industrial farmers were quoted verbatim. For instance, the words of K. M. Smith,

head of the Veterinary Division of Associated Broiler Breeders, were used to reveal the inhumane consequences of industrial broiler production: "When animals are subjected to adverse conditions a chain of events was initiated in the body, irrespective of the nature of the stress and, if this continued long, the animal developed clinical signs of disease."[57] Harrison blamed industrial practices for the increased suffering inflicted on animals by modern farms. For her, industrialized "factory farming" was incompatible with the well-being of animals because it maximized profit at their expense. Others, however, believed the two to be perfectly compatible, arguing that productivity relied on health and welfare. Here, ethology played a central role, much as it had in the laboratory, by making well-being a condition of productivity. Though agricultural discourses focused on economic as opposed to scientific productivity, in practice this reconciliatory logic again placed emphasis on a material approach to farm animal welfare.

When appointing members to the Technical Committee, the Ministry of Agriculture, Fisheries, and Food was anxious to have "someone on the Committee who is an authority on the reactions of animals to conditions that man imposes upon them" and who was also experienced in questions of "animal mentality." Initially, Phyllis Croft, a veterinarian who had investigated neurosis in farm animals, was the preferred appointee. She was recommended as "a world authority on consciousness in lower animals."[58] Working with Grey Walter at the Burden Neurological Research Institute, and later with Derek Richter at the Neuropsychiatric Research Centre (at the Whitchurch Hospital in Cardiff), Croft, with support from UFAW, had also studied the effects of electrocution, electric stunning, and electric anesthesia on animals. Her work on the electrical activity of the heart as a measure of consciousness and sensibility to pain directly informed the development of humane experimental technique.[59] However, her association with UFAW made it "doubtful farming circles would regard her as an independent member."[60] Consequently, the Cambridge ethologist William H. Thorpe was selected in her place. Thorpe was highly successful in convincing the committee that stress, encompassing mental stress, was incompatible with both the welfare of farm animals and their overall economic productivity. In a detailed analysis titled "The Assessment of Pain and Distress in Animals," included as an appendix to the committee's report, Thorpe explained the experiential capacities of agricultural animals and the utility of ethology for gauging suffering. In doing so, he drew widely on work funded by UFAW, for instance, citing John R. Baker (on *The Scientific Basis of Kindness to Animals*) and referring to Lord Russell Brain's address to a UFAW symposium on "The Assessment of Pain in Man and Animals."[61] Brain's reasoning so swayed the committee that it was quoted verbatim to justify their acceptance that "animals can experience emotions such as rage, fear, apprehension, frustration and pleasure, though they do display different degrees

and types of intelligence which may affect the reaction to particular stress-causing circumstances."[62]

Through his experience chairing the Technical Committee, Francis W. Rogers Brambell, a veterinarian by training, became a leading proponent of ethology's potential to provide a scientific approach to animal welfare. He believed ethology opened a window into "the feelings of animals . . . derived from their structure and functions and also from their behaviour." Echoing Russell, Brambell also identified a moral obligation toward animals as a condition of their domestication. Placing animals "wholly and continuously under human control," he argued, would "markedly increase the responsibility of those who use them towards the animals in their charge."[63] In practice, this translated into a series of detailed species-specific recommendations specifying the types of environments and, crucially, population densities, thought to be concordant with maximizing animal welfare.

Animal well-being was elided with efficiencies of livestock production, for example, through the widespread assumption that stress impaired breeding and growth rates. The report described how "cattle of all ages kept indoors become very accustomed to their immediate environment and routine and that a change, even to another house, unsettles them and tends to set up a temporary state of stress which is reflected for a week or two by decreased growth."[64] This was a highly instrumental form of animal ethics; the provision of adequate environments was driven as much by the desire to maximize animal productivity as to preserve animal well-being, so much so that the committee entertained the idea of breeding animals better suited to economically designed environments as opposed to altering industrialized farms to suit the needs of existing animals. The geneticist, Kenneth Mather, for example, assured the committee "it was possible deliberately to breed birds with temperaments or mental attributes suitable to specialised types of keeping." Evidently, by this point, the category of "mental stress" had become broadly accepted, although there was little consensus on "how important a part of the animal's existence this represented."[65] In its conclusion, the *Report of the Technical Committee* made clear that animal welfare, grounded in scientific information on the behavioral needs of domestic animals, "could be of great economic value to the industry."[66]

By the late 1960s the stressed animal had become prominent across veterinary literature. In 1967, for instance, the *Veterinary Record* published an extensive review of research on the effects of domestication on behavior and health, which explained how "overcrowding in many species . . . acts as an adrenal stress and may cause sudden death (Selye's syndrome)."[67] The work of John B. Calhoun, Heini Hediger, Konrad Lorenz, Curt Richter, and William H. Thorpe, among other ethologists, was deployed to argue that the "relationship between social stress and the incidence of certain mental disorders in humans" should now be extended (or returned) to the study

of domesticated animals. Problems such as cannibalism in poultry would then be reimagined as forms of "paraneurosis" caused by social stress.[68] Elsewhere, stress-related research, including that by John J. Christian, David E. Davis, and Vero Copner Wynne-Edwards, was mobilized to transform veterinary responsibilities as well as knowledge and practice. "Stress manifestation . . . is a confession of failure on our part to give guidance to the animal husbandman" claimed a 1969 article in the *British Veterinary Journal*.[69] Such a conclusion was far from unique. As in human medicine a decade before, stress was becoming ubiquitous within the veterinary literature almost as though Selye was being discovered anew.

In May 1973 the Royal Society for the Prevention of Cruelty to Animals (RSPCA), in conjunction with the recently established Society for Veterinary Ethology (1966), organized a symposium to discuss growing concerns about "Stress in Farm Animals." The meeting was notable on several counts, not least that it was the first scientific meeting the RSPCA had organized in its near-150 years of existence.[70] The move to court scientific expertise was indicative of the growing influence of a new pragmatic "middle ground" within animal advocacy politics, which promised to reconcile animal suffering with utility. The landscape of the "animal question" was changing. Traditional antagonism over animal use was moving from a focus about a rhetorical dichotomy grounded in a language of moral values to a pragmatic, quantifiable science, expressed in material practices. Without literacy in the new scientific language, animal advocacy groups—even those as preeminent as the RSPCA—risked becoming sidelined. Put another way, the UFAW model of animal advocacy was quietly gaining ground where it mattered, shaping policy and practice. At a time when philosophies influenced by radicalized animal liberation and direct action were gaining widespread public attention, a pragmatic scientific approach to animal welfare appeared increasingly valuable to industries finding themselves newly under siege.

Papers presented at the 1973 meeting attempted to formulate a general concept of stress as well as find pragmatic methods of identifying, preventing, controlling, and understanding stress in domesticated animals. Several themes discussed at the Mental Health Research Fund's 1958 conference were replayed, not least the problem of the multiple meanings of stress. "Although Hans Selye gave stress its medical meaning he did not deprive the word of its broad meaning to the layman," complained one participant. Consequently "those . . . who would study stress in animals have been hampered by an inadequate vocabulary."[71] The 1973 meeting struggled to formulate a general concept of stress. Having "left the meeting with confused thoughts and suffering from mental constipation," one attendee reported that "the concept of stress seems to have taken on misleading connotations. Stress is a convenient shorthand

term which describes a number of incomprehensibles. As yet, it does not explain a mechanism."[72]

Such views, however, were held by a minority. General veterinary opinion acknowledged that the stress concept was "not, apparently, open to easy definition" yet was nonetheless highly useful (particularly when "Selye's original terminology" was remembered).[73] The vagueness of the term was understood to be productive. It allowed stress to serve as a vector by which what had been individual, ephemeral, and often subjective observations of animal ill health could be codified within a new language of disease. The stress concept allowed subjective observations to be communicated and widely understood. In this way, the "isolated point of view of a veterinary surgeon" could be translated into a new "terminology of what is all too obviously a disease syndrome." Increasing veterinary use of the stress concept "could not be otherwise," one surgeon concluded, because "all practicing veterinary surgeons know these factors exist, most of them suffer from the symptoms!"[74]

This, again, indicates how the conceptual landscape of stress encouraged reflective thought. Stress situated all living organisms, including human and animal, within interdependent relationships. Accordingly, the adoption of the language of stress was often followed by the recognition of moral and ethical obligations. Throughout the 1973 meeting, for instance, stress was understood to be a problem of veterinary health with corollary significance to animal well-being (hence the RSPCA's interest). In closing the symposium, P. L. Brown concluded that all agreed that "animal behaviour may well prove to be the best indicator that we have of the animal's wellbeing and welfare."[75] Yet, in an analogous way to how laboratory animal welfare had become amalgamated with the needs of experimental science, here farm animal well-being was equated with productive economies. If stress could explain sudden animal death in transportation, for example, it had clear economic significance in terms of preventing the loss of "product."[76] More subtly, the stress concept was increasingly employed to make animal productivity a marker of well-being. Here, the work of John J. Christian, who had shown that both growth and reproduction rates could be suppressed by stress, was invoked to establish "economic performance" as an indicator of animal well-being.[77] In this way the stress concept facilitated a rapprochement of the economic priorities of intensive farming and the welfare needs of agricultural livestock.

Reflections: The Materialization of Well-Being

The stress concept served a comparable role within laboratory animal science and factory farming, operating to reconfigure the problem of animal well-being from a political-cum philosophical critique to a set of scientifically

grounded materialized practices linking welfare to productivity. In doing so, stress transformed what had been a problematic site, that of animal suffering in the laboratory and the farm, into a newly productive space for interventions by new forms of expertise. Ethology, for instance, has developed as an applied science, a science of animal welfare. Applied ethology as expert knowledge increasingly polices a new, and latterly influential, middle ground, where rhetorical debates between animal use and animal ethics are reconciled by reforming practice to enhance productivity.

Concurrently, the stress concept has incrementally widened understandings of the experiential capacities of animals, encouraging, for instance, a wider recognition of their capacity for mental suffering. Although legislative change to place animal "distress" on a par with "pain" within the regulatory landscape of British animal experimentation was not enacted until the Animals (Scientific Procedures) Act of 1986, this understanding was nonetheless widely entrenched by the early 1960s. On the farm the legislative extension of animal suffering to include distress occurred much earlier, incorporated within the Agriculture (Miscellaneous Provisions) Act of 1968 (a direct response to the 1965 *Report of the Technical Committee*). While the credibility of Selye's general adaptation syndrome had declined within human psychiatric and medical thought by the 1980s, it remained a useful tool with which to frame and problematize human-animal relations. For instance, stress, as structured by Selye's general adaptation syndrome, was presented as a reliable indicator for measuring animal suffering by Marian Stamp Dawkins in *Animal Suffering: The Science of Animal Welfare*, published in 1980.[78]

As a concept, stress drew much of its utility from its flexibility of meaning. The multiple meanings inherent to the language of stress allowed ideas and dynamic processes that had been unhelpfully separated to be systematically and scientifically related to one another. Indeed, stress was so effective that it could act as a vector of communication across disciplines, specialisms, and even long-polarized political positions on the politics of human-animal relations.

In contrast to terms such as "psychosomatic," which instantiated through their construction the historical legacy of the separation they were intended to overcome, stress appeared to provide a scientific language capable of capturing the ethereal and subjective relational experiences that hitherto could be represented only in common language. Within animal-dependent science, stress provided a language through which laboratory animals could be situated within, and understood to interact with, the complex physical and social environment of the laboratory. Stress made the physical and social environment determining factors of the physiological state of the laboratory animal under study. Furthermore, stress relocated the human subject within that environment, making the researcher integral to, controller of, and obligated to, the laboratory animals' well-being. This logic also gave new importance to the role of animal caretakers and technicians, as well

as the work and structure of the animal house. Stress provided a language that resonated with a fundamental, yet not systematically articulated, aspect of animal experimentation: the relational, epistemological, and ontological interdependence of the knowing human and the animal object of (or means to) knowledge.[79]

Experiences previously expressed in common language could be codified within an apparently scientific language, and subjective states such as pain and suffering could now be quantified, each of which in turn allowed ethical concerns previously limited to the realm of political-cum-philosophical rhetoric to be reconfigured as material practices within, and of importance to, the experimental work of the laboratory. This accounts for how and why the language of stress proved capable of bridging the gulf between practices of animal use and moral arguments for animal well-being. Perhaps of most significance was that the invention of the stressed animal allowed the explicit recognition of the mentality of animals and their capacity for mental suffering. This, more than any other consequence, had radical implications for our understandings of, and relations to, nonhuman animals in the material cultures of the laboratory and elsewhere.

Notes

1. I. Atkin, "Stress and Mental Disorders," *Lancet* 2 (July 6, 1957): 44.

2. Special Correspondent, "Adaptation to Stress Conference of Behavioural Scientists," *British Medical Journal* 2 (August 9, 1958): 382; see also James M. Tanner, ed., *Stress and Psychiatric Disorder Proceedings of the Second Oxford Conference of the Mental Health Research Fund* (Oxford: Blackwell, 1960).

3. Derek Richter, "Current Usage of the Word 'Stress' in Different Fields," PP/BOW H 223, John Bowlby Papers, Contemporary Medical Archives Centre, Wellcome Library, London, UK (hereafter cited as PP/BOW); Special Correspondent, "Adaptation to Stress," 382.

4. John Bowlby, "Research on Stress in Relation to Mental Health and Mental Illness," PP/BOW H 223, p. 1.

5. Richard D. French, *Antivivisection and Medical Science in Victorian Society* (Princeton, NJ: Princeton University Press, 1975).

6. See E. M. Tansey, "The Wellcome Physiological Research Laboratories 1894–1904: The Home Office, Pharmaceutical Firms, and Animal Experiments," *Medical History* 33 (1989): 18–19.

7. "Pregnancy Tests Legal Opinion as to the Necessity for License," HO 45/251/45, National Archives (hereafter cited as NA), Kew. The Friedman test, which involved surgically opening rabbits to assess their suitability, was thought to cause pain but was also judged not to require a license as it was not an "experiment."

8. For an account of the transformation of pain in nineteenth-century British culture, see James Turner, *Reckoning with the Beast: Animals, Pain and Humanity in the Victorian Mind* (Baltimore: Johns Hopkins University Press, 1980).

9. Peter Crowcroft, *Elton's Ecologists* (Chicago: University of Chicago Press, 1991).

10. A. D. Middleton, "Periodic Fluctuations in British Game Populations," *Journal of Animal Ecology* 3 (1934): 231–49; Charles W. Hume, *Some Facts and Queries relating to the Wild Rabbit Problem*, UFAW Monograph 4F (London: UFAW, 1938).

11. Dennis Chitty, "A Ringing Technique for Small Mammals," *Journal of Animal Ecology* 6 (1937): 36–53.

12. Charles Elton, *Voles, Mice and Lemmings: Problems in Population Dynamics* (Oxford: Clarendon Press, 1942); Dennis Chitty, "Mortality among Voles (Microtus agrestis) at Lake Vyrnwy, Montgomeryshire in 1936–9," *Philosophical Transactions of the Royal Society of London Series B, Biological Sciences* 236 (1952): 505–52.

13. Dennis Chitty, "Population Processes in the Vole and Their Relevance to General Theory," *Canadian Journal of Zoology* 38 (1960): 99–113.

14. Chitty, "Mortality among Voles," 506.

15. Dennis Chitty, *Do Lemmings Commit Suicide?* (Oxford: Oxford University Press, 1996), 114–15.

16. The vole's comparatively recent domestication was described as an advantage because existing laboratory stocks have been living under artificial conditions for only a few generations. The usual types of laboratory rodents (white mice, rats, guinea pigs, etc.) have been domesticated for such countless generations that they have developed a number of characteristics by artificial selection. There is little possibility of such selection having had much effect on the vole stocks yet. This overcame those who argued for behavioral and physiological differences between laboratory and wild animals, such as Curt Richter, making the Oxford stock of laboratory voles a reliable model for their wild relatives in Wytham Woods. See Richard M. Ranson, "The Field Vole (Microtus) as a Laboratory Animal," *Journal of Animal Ecology* 3 (1934): 71; cf. Curt P. Richter, "Domestication of the Norway Rat and Its Implications for the Problem of Stress," in *Life Stress and Bodily Disease: Proceedings of the Association for Research in Nervous and Mental Diseases*, ed. Harold G. Wolff, Stewart G. Wolf, and Clarence C. Hare (Baltimore: Williams and Wilkins, 1950), 19–47.

17. John R. Clarke, "The General Adaptation Syndrome in the Study of Animal Populations," *British Journal for the Philosophy of Science* 3 (1953): 351.

18. For instance, Seyle's general adaptation syndrome had established the enlargement of the adrenal glands and the involution of the thymus as quantifiable reactions of an organism to stress; see Hans Seyle, *The Physiology and Pathology of Exposure to Stress: A Treatise Based on the Concepts of the General-Adaptation-Syndrome and the Diseases of Adaptation* (Montreal: Acta, 1950).

19. "Experiments on Living Animals Licence no. 11364," July 31, 1950, H0 285/13, NA, 2.

20. "Advisory Committee on the Administration of the Cruelty to Animals Act, 1876," H0 285/13, NA, 2.

21. Francis A. E. Crew and Ljuba Mirskaia, "The Effects of Density on an Adult Mouse Population," *Biologia Generalis* 7 (1931): 241–42.

22. Crew's Home Office file contains several minor infringements but shows no record of an application for the population density investigations, see file 45 24715, NA.

23. "Supplementary Statement by Applicant," n.d., H0 285/13, NA.

24. The "pain condition" was attached to all certificates in line with recommendations of the Second Royal Commission (1912). It read, "If an animal, at any time

during any of the said experiments is found to be suffering pain which is either severe or is likely to endure and if the main result of the experiment has been attained, the animal, shall forthwith be painlessly killed: if an animal at any time during any of the said experiments is found to be suffering severe pain which is likely to endure, such animal shall forthwith be painlessly killed; if an animal appears to an Inspector to be suffering considerable pain, and if such Inspector directs such animal to be destroyed, it shall forthwith be painlessly killed." See "Advisory Committee on the Administration of the Cruelty to Animals Act, 1976," H0 285/13, NA, 2.

25. "Advisory Committee on the Administration of the Cruelty to Animals Act, 1986," H0 285/13, NA, 3.

26. "Advisory Committee on the Administration of the Cruelty to Animals Act, 1876: Note of a Meeting held at the Home Office, 11th October 1950," HO 285/13, NA, 1.

27. This work revealed how little was known about common vermin, how inefficient the current methods of trapping and poisoning were, and how quickly practices could be improved when properly studied, demonstrating the economic utility of applied population density research. See Dennis Chitty, ed., *Control of Rats and Mice* (Oxford: Clarendon, 1954).

28. David E. Davis, "Early Behavioral Research on Populations," *American Zoologist* 27 (1987): 827.

29. For the Baltimore Rodent Ecology Project, see Edmund Ramsden, "Rats, Stress and the City: Rodent Models and Built Environments," *History of the Human Sciences*, 25 (2012): 123–47; for Calhoun's later work on population density, see Edmund Ramsden, "From Rodent Utopia to Urban Hell: Population, Pathology, and the Crowded Rats of NIMH," *Isis* 102 (2011): 659–88.

30. Richter, "Domestication," 44.

31. Crowcroft, *Elton's Ecologists*, 83; John J Christian "The Adreno-Pituitary System and Population Cycles in Mammals," *Journal of Mammalogy* 31 (1950): 247–59.

32. Chance, quoted in Chitty, *Lemmings*, 99.

33. Many ethologists, famously Lorenz, believed that domestication corrupted behavioral patterns. See Richard W. Burkhardt Jr., *Patterns of Behaviour: Konrad Lorenz, Niko Tinbergen, and the Founding of Ethology* (Chicago: University of Chicago Press, 2005).

34. Robert 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 (2009): 513–36.

35. Michael Robin Alexander Chance, "Aggregation as a Factor Influencing the Toxicity of Sympathomimetic Amines in Mice," *Journal of Pharmacology and Experimental Therapeutics* 87 (1946): 214–19. For relevance to stress, see David A. Hamburg, "Crowding, Stranger Contact, and Aggressive Behaviour," in *The Psychosocial Environment and Psychosomatic Diseases*, vol. 1 of *Society, Stress and Disease*, ed. Lennart Levi (London: Oxford University Press, 1971), 209–18.

36. Michael Robin Alexander Chance and D. A. Humphries, "Medical Student's Powers of Observation," *British Journal of Medical Education* 1 (1967): 141–34.

37. Michael Robin Alexander Chance, "The Contribution of Environment to Uniformity," in *Collected Papers: Laboratory Animals Bureau* 6 (1957): 59–73.

38. Charles W. Hume, "Science and Animal Welfare," *Animals' Friend* 45 (1939): 110–12.

39. UFAW, "The Aims and Methods of UFAW," *24th Annual Report*, September 30, 1950, 2.

40. Robert G. W. Kirk, "'Wanted: Standard Guinea Pigs': Standardization and the Experimental Animal Market in Britain, ca. 1919–1947," *Studies in the History and Philosophy of the Biological and Biomedical Sciences* 39 (2008): 280–91.

41. UFAW, "Laboratory Animals," *31st Annual Report*, June 30, 1957, 4.

42. Alfred L. Bacharach, "Laboratory Animals: The UFAW Handbook on the Care and Management of Laboratory Animals," *British Medical Journal* 2 (1949): 20–21.

43. Charles W. Hume, "Law and Practice: The Rights of Laboratory Animals," in *The UFAW Handbook on the Care and Management of Laboratory Animals*, ed. Alastair N. Worden (London: UFAW, 1947), 19.

44. "UFAW," *Lancet* 2 (1958): 632.

45. Peter B. Medawar, foreword to *Humane Technique in the Laboratory*, vol. 6 of *Laboratory Animals Bureau Collected Papers* (London: HMSO, 1957), 5. This period overlapped with the most significant decade of Medawar's scientific career, during which he consolidated the work on acquired immunological tolerance that won him the 1960 Nobel Prize.

46. Burch, a microbiologist, acted primarily as a data gatherer, touring British laboratories in an effort to understand current practice and needs. He left the project early to take up a job in industry.

47. William M. S. Russell and Rex L. Burch, *The Principles of Humane Experimental Technique* (London: Methuen, 1959), 13.

48. Russell may have encountered Chitty and Clarke at Oxford. Medawar, as noted, certainly knew of their research. He also served as the external examiner of Clarke's D.Phil thesis (Niko Tinbergen, the renowned ethologist, was the internal).

49. Russell and Burch, *Principles of Humane Technique*, 12, 22.

50. Ibid., 24, 23.

51. This suggestion was made by William Lane-Petter; see Russell and Burch, *Principles of Humane Technique*, 28; italics in the original.

52. "Review: The Principles of Experimental Technique," *Lancet* 1 (1959): 34.

53. Sydney Littlewood (chair), *Report of the Departmental Committee on Experiments on Animals* (London: HMSO, 1965), 56, 57.

54. The Departmental Committee on Experimental Animals' statement on "pain" was quoted in full as an appendix; see W. Rogers Brambell (chair), *Report of the Technical Committee to Enquire into the Welfare of Animals kept under Intensive Livestock Husbandry Systems* (London: HMSO, 1965), 80–81.

55. For the antecedents of factory farming, see Abigail Woods, "Rethinking the History of Modern Agriculture: British Pig Production, c. 1910–65," *20th Century British History* 23 (2012): 165–91.

56. Ruth Harrison, *Animal Machines* (London: Stuart, 1964), 151.

57. Ibid., 19.

58. Phyllis G. Croft, "Some Observations on Neurosis in Farm Animals," *Journal of Mental Sciences* 97 (1951): 584–88; "Cruelty Committee," April 23, 1964, MAF 121/267, NA. At this time, a full decade before Donald Griffin's controversial argument for animal mentality as an object of ethological study, to be an authority on animal consciousness was a dubious accolade within most scientific circles.

59. Phyllis G. Croft, "The Criteria for Humane Technique," in *Humane Technique*, 19–22; Russell and Burch, *Principles of Humane Technique*, 26.

60. "Cruelty Committee."

61. Lord Russell Brain, "Presidential Address," in *The Assessment of Pain in Man and Animals, Proceedings of an International Symposium held under the Auspices of UFAW, 26th–28th July 1961*, ed. C. A. Keele and Robert Smith (London: E & S Livingstone, 1962), 3–11.

62. Brambell, *Report*, 71–79, 10; John R. Baker *The Scientific Basis of Kindness to Animals* (London: UFAW, 1948). Baker, as noted, began his career working with Elton on voles.

63. Brambell, *Report*, 9, 15.

64. Ibid. 40.

65. Kenneth Mather, "Committee of Enquiry into Intensive Livestock Husbandry Systems, Minutes of Meeting held at 2PM on the 3rd December 1964," MAF 121/267, NA, 1.

66. Brambell, *Report*, 10.

67. Michael W. Fox, "Influence of Domestication upon Behaviour of Animals," *Veterinary Record* 80 (1967): 699. Fox, a British veterinarian and ethologist, was active in promoting laboratory animal welfare during the 1970s before associating himself with American radical animal advocacy groups, such as the Humane Society, in the 1980s.

68. W. Ferguson, "The Role of Stress in Epidimiology," *British Veterinary Journal* 125 (1969): 253–54.

69. T. K. Ewer, "The Assessment of Stress in Farm Animals," *British Veterinary Journal* 124 (1969): 249.

70. John Napier, "Introductory Address: Society for Veterinary Ethology Proceedings of Joint Symposium with the Royal Society for the Prevention of Cruelty to Animals," *British Veterinary Journal* 130 (1974): 85–86.

71. A. F. Fraser, "Ethostasis: A Concept of Restricted Behaviour as a Stressor in Animal Husbandry," *British Veterinary Journal* 130 (1974): 91–92.

72. J. R. Bareham, "The Concept of Stress," *Veterinary Record* 92 (June 23, 1973): 682–83.

73. Roger Ewbank, "Use and Abuse of the Term 'Stress' in Husbandry and Welfare," *Veterinary Record* 92 (June 30, 1973): 709–10.

74. E. M. Pittaway, "The Concept of Stress," *Veterinary Record* 93 (July 21, 1973): 88.

75. P. L. Brown, "Summary: The Synthesis of the Stress Entity," *British Veterinary Journal* 130 (1974): 95.

76. T. N. Allsup, "Welfare Problems Associated with Transport," *British Veterinary Journal* 130 (1974): 92.

77. M. J. Bryant, "The Social Environment: Behaviour and Stress in Housed Livestock," *Veterinary Record* 90 (1972): 355.

78. Marian Stamp Dawkins, *Animal Suffering: The Science of Animal Welfare* (London: Chapman and Hall, 1980), esp. 56–68. Dawkins, an Oxford-trained ethologist, was a student of Tinbergen in the generation following William M. S. Russell.

79. Cf. the notion of "becoming with," in Vinciane Despret, "The Body We Care For: Figures of Anthropo-zoo-genesis," *Body and Society* 10 (2004): 111–34.