Introduction

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THE PUBLICATION of a volume on livestock economies and veterinary medicine is perhaps particularly timely at the beginning of the twenty-first century, given that the interest of the urban population in animal health and welfare, at least in the West, has probably never been greater. Popular movements reflect a widespread concern about such things as animal rights, experimentation, hunting, industrial-style food production, and the threat of species extinction through exploitation and environmental change. Furthermore, certain events over the last twenty years have highlighted problems of animal diseases and their control. Foot-and-mouth disease was epizootic in Great Britain and the Netherlands during 2001, and apocalyptic images of slaughter and cremation were broadcast across the media, with considerable emotional impact. They seemed to negate modern science, with its vaccines and therapeutics, harking back to a more primitive age.

During the early 1990s, the fact that dangerous diseases may pass between animals and humans was again brought to the public consciousness by the discovery of a link between bovine spongiform encephalopathy (BSE or mad cow disease) and Creutzfeldt-Jakob disease (CJD). Presently,

veterinary and medical authorities in Europe and elsewhere are concerned with the dangers posed by avian influenza, which emerged in Southeast Asia and appears to be moving westward. The disease threatens the poultry industry, but more important, from the point of view of those not involved in that economic sector, is the fear that the virus will mutate to become transmissible between humans. Fevered comparisons have been drawn in the media with the deadly "Spanish flu" epidemic of the late 1910s. While such developments offer considerable scope for sensationalist reporting, they are obviously of great importance to contemporary societies. They also raise questions about how livestock diseases have been managed in different social, political, and economic contexts.

The historical literature on the management and control of livestock diseases has, to date, largely been restricted to studies with a national or local focus. Much of what has been written so far about veterinary medicine and veterinary interventions has referred to western Europe, the United States, and South Africa, where historians have been particularly interested in examining the late nineteenth-century professionalizaton of veterinary science within the context of expanding state bureaucracies.[1] In addition, for Great Britain and the United States, there have been articles on public health issues, especially bovine tuberculosis and tapeworm infestation, which can be transmitted to humans through contaminated milk and meat, respectively. Beginning in the late nineteenth century, both governments introduced regulations dealing with food production and processing.[2] Historians have also taken an interest in contemporary diseases such as BSE and foot-and-mouth,[3] as well as infections that have historically caused devastating losses, most notably the cattle diseases contagious bovine pleuropneumonia and rinderpest.[4] In addition, there are studies linking the history of animal diseases and their control to environmental history. In the West, older ideas that livestock diseases were caused by "miasmas" or unhealthy vapors pervaded well into the twentieth century and were not automatically superseded by the reductionist germ theories of the late nineteenth century.[5] In some regions, biting arthropods such as ticks and tsetse flies transmitted specific diseases, suggesting the importance of environmental factors in their epidemiology and control. Scientists and indigenous pastoralists knew that, in some cases, wild animals played a role in the maintenance of infection, while certain plant species were toxic to domestic animals.[6] This emphasis on the ecology of disease is particularly a feature of studies on Africa, where trypanosomosis (spread by tsetse flies) has been such an important determinant of pastoral production and practices.[7]

While the historiography of veterinary medicine and animal diseases has grown considerably in recent years, relevant studies are, given the im-

portance of the topic, still relatively few. This book is intended to assemble accounts from different parts of the world, thus providing a starting point for further comparative inquiry. Broadly speaking, four interrelated themes emerge from these chapters. Several chapters deal with the institutionalization of veterinary medicine and the role veterinary institutions came to play in state building and regulation in both metropolitan and colonial settings (in particular, those by Peter Koolmees, Ann Greene, Abigail Woods, Dominik Hünniger, Martine Barwegen, Daniel Doeppers, Rita Pemberton, Robert John Perrins, Saverio Krätli, and David Anderson). From the nineteenth century on, the professionalization of veterinary medicine was supported by improvements in the understanding of disease etiologies and the efficacy of treatments. Second, the expansion of global trade and of European colonialism was a means of disseminating Old-World pathogens to different parts of the globe, causing major cattle epizootics around the world during the second half of the nineteenth century. Rinderpest was a major problem, as the chapters by Barwegen and Doeppers reveal. Governments had little choice but to respond, so the epizootics of the late nineteenth century were an important stimulus for the establishment of state veterinary services outside Europe and America. A third theme concerns other consequences of the transfer of domestic animals and commercial pastoralism to unfamiliar environments, where livestock became susceptible to new sources of infections, such as scab and footrot in sheep, dealt with here in the Australasian context by John Fisher and Robert Peden, respectively. This gave rise to different forms of scientific study, as did exposure to tropical diseases, which contributed to the development of tropical veterinary medicine, and studies into diseases such as surra (a form of trypanosomosis) in horses and camels, which is explored here in William Clarence-Smith's chapter. Finally, several presentations illustrate the close relationship between colonialism and veterinary medicine. In some colonies, veterinary medicine was used by the state to foster the development of settler economies, and veterinary administrations became an important component of state bureaucracies (see the chapters by Fisher, Perrins, Peden, and Anderson). In colonies of conquest, however, veterinary medicine emerges as a means by which colonial administrators sought to exert control over indigenous populations, sometimes with damaging consequences for local pastoral economies. This was evident in the cases of Kenya and Niger, covered by Lotte Hughes, Saverio Krätli, and David Anderson. The book is roughly organized around these themes, though there are, of course, many overlaps.

Turning to the first of the four themes, the professionalization of veterinary medicine, Joanna Swabe has demonstrated how the nineteenth

century, particularly the latter part, was a key period for the rise of the modern veterinary regime, that is, "the social practices and institutionalized behaviours that have emerged in response to the problem of maintaining animal resources and protecting human health and economy."[8] During the mid-1860s, the rinderpest epizootic in western Europe caused considerable damage among cattle in Great Britain and the Netherlands, though it was contained by more efficient systems of control in France. Rinderpest revealed the vulnerability of animal economies to infection carried through trade and the fragility of food supplies in an era of industrialization and urbanization. The control and prevention of contagious animal diseases increasingly became a priority of the state and a state function, as veterinary officials were incorporated into government bureaucracies. In Europe, strategies for containing diseases were internationalized through veterinary conferences beginning in the 1860s. Attempts to coordinate disease control across international boundaries culminated in the establishment of the Office Internationale des Épizooties in 1924, in response to the spread of foot-and-mouth disease in Europe. The increasing authority of the veterinary regime was underpinned by the professionalization of veterinary medicine, as educational standards for professional membership based on courses offered in veterinary schools were established in various countries in Europe, the United States, and South Africa.[9]

If the Americas were spared the major Old-World epizootic of the late nineteenth century—rinderpest—similar developments in veterinary medicine occurred there as administrators sought to harness science to agricultural development. In the United States, the founding of agricultural experiment stations following the 1887 Hatch Act was part of this expanding bureaucratic process.[10] A new form of applied science, economic entomology, emerged from the experiment stations where entomologists tried to eliminate pests that harmed the economy by conveying diseases. This included research into ticks, which, as many American stockowners suspected and scientists in the early 1890s proved, transmitted the cattle disease known as Texas fever (*Babesia bigemina* and *Babesia bovis*).[11] This discovery paved the way for investigations into tropical animal diseases in many parts of the world.[12] The late nineteenth century saw the establishment of state veterinary departments in British colonies, including India, South Africa, Australia, and the West Indies. Given the economic importance of pastoralism and the relative underdevelopment of the state in many colonies, the evidence suggests that while colonial veterinary services might have been initially small and frequently ineffective, they nevertheless constituted a significant part of the state-building process.

The emergence of veterinary bureaucracies during the late nineteenth century was a response to official attempts to increase the efficiency of states' administrations and facilitate economic development in order to enhance their international influence and power. In this cultural environment, supporters of the scientific enterprise developed their own rhetoric of modernity and progress. The terminology might have varied from place to place, but the American mantra of "national efficiency" advocated by scientific, economic, and conservationist lobbyists during the Progressive Era of the early twentieth century—and the concurrent ideology of constructive imperialism proposed by the British colonial secretary Joseph Chamberlain (1895–1903)—resonated with wider political ideas about development in the West, as well as in the European and Japanese settler colonies.[13]

From the late nineteenth century, various aspects of the veterinary regime were supported by increasingly sophisticated understandings of disease etiologies based on germ theory and the so-called laboratory revolution in medicine. During much of the nineteenth century, states sought to contain disease through a mixture of regulations such as quarantines to prevent the importation of sick and infectious livestock from abroad, as well as internal restrictions on stock movements and compulsory slaughter-out policies. The structures needed to enforce such measures, even at a local level, required an expansion in official personnel and increasingly, with the development of microbiological sciences, investment in immunological research as well as the creation of field veterinary departments. From the early 1880s, significant discoveries in human and animal medicine, emanating from the Louis Pasteur Institute in Paris and Robert Koch's Institut für Infectionskrankheiten in Berlin, offered new opportunities for disease control, which helped to validate the role veterinary science could play in ameliorating pastoral production.[14] Working in competition with each other, teams of scientists from both institutions began to release specific prophylactics and therapies for several diseases including anthrax, rabies, and tetanus. The search for specific preventatives accelerated in subsequent decades so that vaccines against an increasing range of animal diseases became available by the mid-twentieth century. Nevertheless, continuity with the earlier period needs to be emphasized. Stockowners practiced prophylactic inoculation before the laboratory revolution. More significantly, the older methods of control and prophylaxis—namely, import controls, quarantines, and slaughter—remain key elements of veterinary public policy right up to the present day.

Veterinary regulations and public policy are important themes in this collection, and several chapters throw further light on these issues. Peter

Koolmees takes a long-term view in his exploration of responses to epizootic diseases in the Netherlands since the eighteenth century. He demonstrates that while public responses have changed greatly in recent years, there have been strong continuities in preventive policy with a much earlier period. At the beginning of the twenty-first century, the veterinary administration continues to rely on the slaughter of infected animals as an essential preventive measure. He suggests, however, that public opinion, marked by a growing concern about the welfare of animals, may render the use of such methods increasingly difficult or unfeasible. In contrast, Dominik Hünniger analyzes administrative efforts to control epizootic disease in eighteenth-century Schleswig-Holstein. Again, he points to the importance of quarantine, slaughter, and the control of trade as the principal methods adopted by governments and draws links with the methods used to control plague in humans. Hünniger shows that the regulation of animal diseases was an important means through which the state asserted its authority and was part of the process of state formation in the preindustrial period. Several chapters deal with the establishment of veterinary regimes in the colonies. These too are concerned with the ways in which governments tried to extend their authority through the regulation of animal disease in pursuit of economic development.

Ann Greene switches our attention from epizootic disease and agricultural development in rural areas to the urban environment through an examination of the relationship between veterinarians and their most important patient, the horse, in Pennsylvania during the late nineteenth and early twentieth centuries. Toward the end of the nineteenth century, an increasingly science-based university education enabled veterinarians to attain a professional identity that allowed them slowly but surely to discard the disparaging title of "horse doctor" or "cow leech," since their university training set them apart from those who administered "folk" cures. When the importance of the horse, which fueled the Industrial Revolution and powered transport, declined from the 1920s, the veterinary profession retained its position in towns and cities. Greene's chapter illustrates the changing role of veterinarians in urban areas during the twentieth century. The route to attaining a professional identity and an indispensable role in society was, however, by no means an uninterrupted progress. As Michael Worboys has pointed out, the long-term prospects of the average practitioner in Great Britain during the nineteenth and early twentieth centuries were not promising.[15] Government appointments were few, and the major source of income, the treatment of horses, was set to decline in the face of the automobile. In addition, in the United States and parts of Europe, many

stockowners remained skeptical well into the twentieth century about the benefits of veterinary science. In her chapter, Abigail Woods argues that in Great Britain, farmers were generally reluctant to call upon the services of a veterinary surgeon unless the situation was desperate. It was only during World War II, when, in an attempt to increase livestock yields, the British government sponsored research into artificial insemination to breed larger and more productive beasts, that more and more farmers felt that veterinary science had something new and worthwhile to offer them in terms of enhancing their profits.

In some parts of the world, the institutionalization and spread of Western biomedicine and veterinary controls came not in the face of economic opportunities but in response to devastating epizootics. In recent times, the second half of the nineteenth century might be regarded with some justification as a period of panzootic disease. At midcentury, contagious bovine pleuropneumonia, an insidious disease that could assume an "occult" form, spread through trade from mainland Europe to Great Britain, North America, southern Africa, Australia, and elsewhere. It became a preoccupation of embryonic veterinary services in many parts of the world. In South Africa, this disease was known as lungsickness and was closely associated with the Xhosa cattle-killing movement, which had devastating social consequences.[16] Later, rinderpest, a deadly cattle disease that had reached western Europe from central Asia during an earlier period, spread, again through trade, to India, parts of Southeast Asia, and even to Africa.

To understand the spread of diseases such as rinderpest, epidemiological factors need to be located within a broader historical and geographical context. The nineteenth century witnessed an exponential increase in trade in livestock and animal products. In the European colonies, settlers in Australia, New Zealand, and South Africa introduced Merino sheep in order to provide wool for an expanding textile market in the northern hemisphere. Colonists in these countries, as well as in Southeast Asia and the Philippines also imported cattle to feed a growing population that was becoming increasingly urbanized. Trade in livestock also enabled diseases to spread within continents, a notable example being the southward introduction of the tick-borne cattle infection East Coast fever, which entered Southern Rhodesia (now Zimbabwe) and South Africa from East Africa in 1901.[17] Unused to exposure to pathogens from outside, indigenous livestock in the importing country were particularly prone to unfamiliar infections. In Asia and Africa, colonial warfare facilitated disease transfers as the horses and oxen that accompanied foreign armies spread alien infections and contracted and disseminated more localized maladies over a wider

area. It was Italian military operations in the Horn of Africa that led to the introduction of rinderpest to East Africa from India in 1887. From there, it gradually spread throughout the continent during the 1890s, obliterating herds and in some places causing famine among communities dependent on cattle. The timing of these African outbreaks coincided with rinderpest epizootics in parts of Southeast Asia, placing it on the scale of an international panzootic. "Ecological imperialism," to use Alfred Crosby's phrase, was more than the westward transferral of germs from western Europe to the Americas.[18] Ultimately, this process became global as commercial and military networks expanded. Thus, the dispersal of different diseases did not necessarily follow a linear projection from a western metropole to the colonized states. The movement of animals within continents and between different colonial states numerically extended the centers of infection for particular diseases throughout the world.

Of all the epizootics, rinderpest has received the most attention from historians, particularly of southern Africa, who have been concerned with the way in which the epizootic threw into sharp relief political and social tensions during a period of colonial conquest and nascent industrialization.[19] While Clive Spinage's book on the subject has sketched out the trajectory of rinderpest throughout the world,[20] the chapters here by Dominik Hünniger, Dan Doeppers, and Martine Barwegen provide a welcome addition to this literature with their accounts of responses to this disease in specific locales. They enable at least the beginning of a comparative analysis of reactions to rinderpest in different societies and in different time periods. Hünniger describes attempts by the authorities to control rinderpest in eighteenth-century Schleswig-Holstein as disaster management. He shows how trade embargoes and quarantines became the mainstay of preventive policy and how these could adversely affect particular social groups, as the control of animal diseases became an important way in which the state exerted and extended its authority. Doeppers and Barwegen focus, respectively, on the late nineteenth-century rinderpest epizootics in the colonies of the Philippines and Java. Again, commerce was central to the spread of disease and, as in Great Britain, India, and southern Africa, rinderpest was a powerful stimulus for the establishment and consolidation of veterinary services. Doeppers's chapter corresponds with a period of technological advance in rinderpest prophylaxis, and he shows that if government responses were initially faltering and inadequate, they were eventually replaced by more effective policies in which vaccination played an essential part. Barwegen, on the other hand, argues that veterinary policies could be misconceived and damaging, an imposition of metropolitan methods

on indigenous people under a colonial regime that ignored popular beliefs and practices. Her chapter questions a too-ready acceptance of progress in the control of animal diseases during the early twentieth century.

If imperial expansion was accompanied by the transfer of pathogens to and between the colonies, the empire was certainly capable of fighting back. Colonial farmers and others, who depended one way or another on their animals, became increasingly aware that unfamiliar environments presented unfamiliar stock diseases. Ecological limitations, therefore, hampered pastoral production and became strong impetuses for scientific investigation. As in human tropical diseases, of which malaria provided a prime example, livestock infections that were attributable to biting arthropods, infectious game, or toxic flora were intimately connected with the environment, and from the late 1890s on, their study assumed an interdisciplinary character. However, whereas (at least in the British context) "tropical human medicine" became institutionalized in the metropole at the London and Liverpool Schools of Tropical Medicine, scientists of tropical animal diseases tended to pursue their studies primarily in the colonies where the infections arose.[21] Military veterinarians were, perhaps, the pioneers of these studies, one example being the British bacteriologist David Bruce. While working in northern Zululand (South Africa) during the mid-1890s, Bruce discovered that nagana (bovine trypanosomosis) was caused by a protozoan (a trypanosome) found in the blood of game and spread to cattle and horses by the bite of the tsetse fly.[22] In the French Empire, too, as Diana K. Davis has shown, some of the earliest research into animal vaccines occurred in the colonies, with the first trials of anthrax and sheep pox inoculations taking place in Algeria in the late nineteenth and early twentieth centuries.[23] To consolidate and expand this knowledge, research institutes appeared in South America, the United States, India, and various European colonies in Africa from the late nineteenth century. Scientists generated important knowledge about diseases, and their work provides an example of a field in which colonial science ran ahead of the European metropolis.[24]

One aspect of this expansion in veterinary knowledge about diseases of the tropics is illustrated by William Clarence-Smith, whose chapter usefully corrects the assumption that trypanosomosis was purely an African disease. He shows that surra, a form of trypanosomosis that affects horses and camels, was a scourge of the Asian continent. As in the case of nagana, it was a military veterinary surgeon, Griffiths Evans, who first demonstrated a connection between a species of trypanosome and this disease in 1880. His discovery was important not only because it helped people to understand how surra spread but also because it showed that Paris and Berlin

were not the only centers of groundbreaking biomedical research at that time. Evans did not discover the species of fly that conveyed the disease, nor did he develop a prophylactic; but his work was nonetheless important for the expansion of veterinary medical knowledge as it encouraged further research into protozoan diseases, which ultimately revealed that flies, as well as ticks, were capable of conveying fatal infections to livestock.

A further question relating to disease and environment concerns the impact of colonial administration and Westernized veterinary regimes upon local or indigenous knowledge and practices of disease control. In many colonies, blood-sucking arthropods played an important part in the transmission of disease. Creatures such as tsetse flies and ticks were highly visible, and the evidence suggests that indigenous peoples, and indeed colonial farmers, were often aware of their connection with disease, irrespective of germ theory and other developments in Western science. They were accordingly able to develop strategies to prevent or control infections. Accounts by earlier travelers, as well as modern studies by scientists and historians, indicate that in precolonial Africa, for example, local pastoralists learned to manage their environment and avoid areas that they knew, through observation and experience, were occupied by tsetse belts or seasonally prone to tick infestation.[25] The arrival of colonial armies and settlers, however, disrupted this process, and Africans lost control not only of their land but also of their ability to manage the disease environment.

Lotte Hughes's contribution to this book looks at African approaches to the environment and explores how the Purko Maasai recollect their experiences of being ousted from the Kenyan highlands to make way for white settlers in the opening years of the twentieth century. In retrospect, they associate the consequences of eviction with longer-term problems in protecting their cattle from diseases such as nagana and East Coast fever. In Kenya, as in many other African countries, the presence of wildlife constituted another ecological factor in producing disease. For a range of cultural and economic reasons, colonial and postcolonial governments established game reserves, many of which were unfenced and bordered grazing lands.[26] Nagana, malignant catarrhal fever, and rabies are just some of the diseases that are carried by a variety of game and threaten livestock.

For Kenya and other European colonies, a notable topic was the importance of livestock economies and the development of veterinary science. This doubtless reflects the position of the colonies in the overall imperial scheme as providers of primary products. As might be expected, the story that emerges differs to some extent between colonies in which indigenous pastoralism continued to dominate in the face of relatively small numbers of

colonizing farmers and the colonies of settlement to which European farmers immigrated in large numbers. In parts of East Africa, for example, colonial administrators sought to transform indigenous pastoralism into commercial production and to promote settler farming but were faced by a range of diseases, many of which were spread by ticks. The colonial authorities tried to control these through restrictions on stock movement and compulsory insecticidal dipping. In the French colonies, French veterinarians had long been involved in trying to improve the rangeland through planned farming, as French veterinary education emphasized the importance of the environment in promoting animal health and counteracting disease.[27]

In parts of Africa, especially in the literature covering the British colonies, initiatives such as compulsory dipping and intervention in pastoral land management were frequently unpopular because they undermined customary animal husbandry and represented unwelcome incursions by an alien state into the lives of nomadic pastoralists. In the 1930s, animosity intensified in Kenya and South Africa as veterinary and soil scientists became preoccupied with the issue of erosion, which they ascribed to overgrazing, and they introduced measures to force Africans to reduce their herds. In the wider context, the impact of the American Dust Bowl had a significant influence on agricultural scientists in many parts of the world as fears of desertification and the eventual collapse of rural economies began to take hold. Attention to the carrying capacity of the land became the scientific watchword for sustainable development during the 1930s and 1940s, and destocking by persuasion or force was politically imposed in many parts of colonial Africa.[28] This resonates with themes in the history of medicine, science, and technology in the colonies more generally. If Daniel Headrick has interpreted various innovations in science and medicine as "tools of empire" that enabled colonists to conquer indigenous populations and overcome hostile environmental conditions,[29] historians have more recently been concerned with the ways in which Western medicine assisted colonial administrations in extending social control over the colonized, as science underpinned militaristic public health policies and sanitary measures.[30]

David Anderson develops some of these ideas in a chapter set, like that of Lotte Hughes, in colonial Kenya. He describes the unequal distribution of veterinary services between settler farmers and indigenous pastoralists and shows how veterinary interventions among Africans were aimed at protecting European-owned cattle from disease through the imposition of disruptive and damaging quarantines. He reminds us that veterinary medicine was by no means for the benefit of all, by illuminating how veterinary policy was skewed toward the aim of obtaining supplies for an embryonic

meat-packing industry. He outlines the tensions these policies engendered and provides a critique of the myth of the "economic irrationality" of pastoral producers. From a West African perspective, Saverio Krätli examines French interventions in cattle production in colonial Niger. During the 1930s, the colonial authorities tried to transform nomadic pastoralists into sedentary farmers. A key element of their strategy was to introduce and breed cattle that could produce milk for urban markets. Krätli analyzes cultural contestations surrounding the "ideal" breed type, showing how WoDaaBe nomads, living in the precarious arid environment of the Sahel, strove to retain their Bororo cattle, which were adapted to withstand drought and seasonal shortages of grazing, thus illuminating scientific and popular practices in cattle breeding. As in many European colonies, the practice of veterinary medicine was as much about reordering indigenous society as it was about controlling disease.

Robert Perrins's chapter provides a welcome addition because it extends the scope of the collection beyond the Western world and the European colonies. His examination of the development of veterinary medicine by the Japanese in Manchuria introduces a new political and geographical dimension. In Manchuria, the development of veterinary services, as well as bacteriological institutions to investigate a number of local diseases, was viewed by the authorities as essential for Japanese settlement in northern China. The emphasis on creating and improving a settler economy, as opposed to prioritizing that of the indigenous people, mirrored similar episodes in some of the European colonies. Further extending the geographic scope of this volume, Rita Pemberton paints a more positive picture of the rise of state veterinary services in Trinidad and Tobago. She demonstrates how the threat of zoonoses was an important motivation for veterinary development. Nevertheless, British efforts to advance the livestock sector in Trinidad and Tobago were a response to the declining profits that European planters accrued from sugar production and were thus aimed at the ruling colonial elite.

In the European colonies, as well as countries in Europe and North America, the rise of the veterinary regime was not welcomed by all, and the same was true in the colonies of settlement. Recent studies on southern Africa have shown that the imposition of veterinary regulations was politically controversial, producing conflict between modernizing, "progressive" producers and subsistence farmers. Commercial agriculturists, as well as subsistence pastoralists who practiced transhumance to optimize grazing, often resented local quarantines and stock regulations if these meant that they could not transport their animals to market or move their livestock

seasonally to desirable pastures.[31] The chapters by John Fisher and Robert Peden, set in late nineteenth-century Australasia, provide a useful counterpoint to the southern African case. Here the emphasis is on settler farmers, rather than veterinary practitioners and institutions. Fisher shows how wool producers in Australia, linked to metropolitan markets through the export trade, became increasingly concerned with scab in sheep. This condition arose from the gnawing of the acari mite and could result in considerable damage to the fleece. During the mid-nineteenth century, it was farmers, rather than the state, who experimented with dips and through their agricultural boards introduced local regulations that led to the eradication of the disease through regular insecticidal dipping. Fisher thus illustrates how veterinary science was part of a broader, progressive agenda set by colonial farmers, rather than necessarily being an imposition of officialdom.

In a chapter that provides thematic parallels, Robert Peden shows how New Zealand sheep farmers used selective breeding to eliminate a disease known as footrot. The standard wool-producing sheep, the Merino, was very susceptible under local conditions, and breeders responded by developing the Corriedale variety that was more tolerant of damp grazing lands. In contrast to Krätli's study of Niger, farmers rather than veterinarians took the lead in these breeding experiments. A comparison with South Africa, where progress along these lines took much longer, suggests that the possibilities for disease control were restricted not only by environmental contingency or limitations in scientific knowledge; local political, economic, social, and cultural factors have also played a role and have historically contributed to a variety of opportunities and outcomes in the management of livestock diseases.

Thus, overall, the historical presentations in this book focus primarily on the political economy of certain livestock diseases as well as on environmental issues pertaining to animal health. A subject that historians have been slower to respond to, however, is the epistemology of science itself. In fact, discussions about developments in veterinary science have largely remained a monopoly of practicing scientists, and only the laboratory revolution of the late nineteenth century, along with its political and social impacts, has engaged widespread attention from historians.[32] In general, the chapters here show how science was adopted by farmers and states as a tool of development, but little has been written about how the scientific knowledge that they used had been acquired or constructed. Yet the potential for developing this theme is considerable. The editors of this book have recently looked at the history of the Onderstepoort Veterinary Laboratories in South Africa, concentrating specifically on the type of

science carried out at that institute, not just in the context of the political and economic agendas that underpinned veterinary research but also the actual work scientists themselves carried out in the laboratory and the field.[33] They have explored developments in microbiology and the discovery of vaccines, the ecology and control of arthropod borne diseases, and the dangers of plant poisonings, thereby giving scientists direct agency in the construction of veterinary knowledge. Similar studies are appearing for other institutions such as the Animal Research Station in Cambridge (U.K.).[34] The nature and evolution of veterinary science as a discipline, as well as further examinations of specific infections and ecologies of disease, in the format of either individual monographs or comparative studies, proffer exciting topics for further research by environmental and scientific historians alike.

Notes

1. For example, Iain Pattison, *The British Veterinary Profession, 1791–1948* (London: J. A. Allen, 1983); John Fisher, "Not Quite a Profession: The Aspirations of Veterinary Surgeons in England in the Mid-Nineteenth Century," *Historical Research* 66, no. 161 (1993): 284–302; Joanna Swabe, *Animals, Disease and Human Society: Human-Animal Relations and the Rise of Veterinary Medicine* (London: Routledge, 1999); Daniel Gilfoyle, "Veterinary Science and Public Policy at the Cape, 1877–1910" (DPhil thesis, University of Oxford, 2002); Susan Jones, *Valuing Animals: Veterinarians and Their Patients in Modern America* (Baltimore, MD: Johns Hopkins University Press, 2003).

2. Anne Hardy, "Professional Advantage and Public Health: British Veterinarians and State Veterinary Services, 1865–1939," *Twentieth Century History* 14, no. 1 (2003): 1–23; idem, "Pioneers in the Victorian Provinces: Veterinarians, Public Health and Urban Animal Economy," *Urban History* 29, no. 3 (2002): 372–87; Keir Waddington, "'Unfit for Human Consumption': Tuberculosis and the Problem of Infected Meat in Late Victorian Britain," *Bulletin of the History of Medicine* 77, no. 3 (2003): 636–61; idem, "To Stamp Out 'So Terrible a Malady': Bovine Tuberculosis and Tuberculin Testing in Britain 1890–1939," *Medical History* 48, no. 1 (2004): 29–48.

3. John Fisher, "Cattle Plagues Past and Present: The Mystery of Mad Cow Disease," *Journal of Contemporary History* 33, no. 2 (1998): 215–28; Abigail Woods, "The Construction of an Animal Plague: Foot and Mouth Disease in Nineteenth-Century Britain," *Social History of Medicine* 17, no. 1 (2004): 23–39; idem, "'Flames and Fear on the Farms': Controlling Foot and Mouth Disease in Britain, 1892–2001," *Historical Research* 77, no. 198 (2004): 520–42; idem, *A Manufactured Plague: The History of Foot and Mouth Disease in Britain* (London: Earthscan, 2004).

4. John Fisher "A Pandemic (Panzootic) of Pleuropneumonia, 1840–1860," *Historia Medicinae Veterinariae* 11, no. 1 (1986): 26–32; idem, "To Kill or Not to Kill: The Eradication of Contagious Bovine Pleuro-pneumonia in Western Europe," *Medical History* 47, no. 3 (2003): 314–31. On rinderpest, see, for example, Michael Worboys, "Germ Theories and British Veterinary Medicine, 1860–1890," *Medical History* 35, no. 3 (1991): 308–27; idem, "Veterinary Medicine, the Cattle Plague and Contagion, 1865–1890," in *Spreading Germs: Disease Theories and Medical Practice in Britain, 1865–1900* (Cambridge: Cambridge University Press, 2000), 43–72; C. Huygelen, "The Immunization of Cattle against Rinderpest in Eighteenth-Century Europe," *Medical History* 41, no. 2 (1997): 182–96. For rinderpest in South Africa, see Charles van Onselen, "Reactions to Rinderpest in Southern Africa, 1896–97," *Journal of African History* 13, no. 3 (1972): 473–88; Pule Phoofolo, "Epidemics and Revolutions: The Rinderpest Epizootic in Late Nineteenth-Century Southern Africa," *Past and Present* no. 138 (February 1993): 112–43; and Daniel Gilfoyle, "Veterinary Research and the African Rinderpest Epizootic: The Cape Colony, 1896–98," *Journal of Southern African Studies* 29, no. 1 (2003): 133–54.

5. Andrew Cunningham and Perry Williams, eds., *The Laboratory Revolution in Medicine* (Oxford: Oxford University Press, 1992); Worboys, *Spreading Germs.*

6. Karen Brown, "Poisonous Plants, Pastoral Knowledge and Perceptions of Environmental Change in South Africa, c. 1880–1940," *Environment and History* 13, no. 3 (2007): 307–32.

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31. For South African examples, see Mordechai Tamarkin, "Flock and Volk: Ecology, Culture, Identity and Politics among Cape Afrikaner Stock Farmers in the Late Nineteenth Century" (paper presented at the conference "African Environments, Past and Present," Oxford, July 1999); William Beinart, *The Rise of Conservation in South Africa: Settlers, Livestock and the Environment, 1770–1950* (Oxford: Oxford University Press, 2003).

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33. For an overview, see Brown, "Tropical Medicine and Animal Diseases."

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