

Conclusion

The volume has aimed to break new ground in developing an animal history of medicine and a medical history of animals. Despite burgeoning interest in animal history in recent years, its scholars have seldom followed their subjects into the realms of health and medicine, while in medical history, the animal presence is largely implicit. Reduced to their diseases, bodily processes and products, animals typically provide the stage on which human history is enacted. This volume has argued instead for studying them in their own right, as subjects and shapers of medicine. As documented in our annotated bibliography (Appendix), the few scholars who have previously adopted this approach have tended to focus on the fashioning of animals into experimental subjects in laboratories. However, this volume has demonstrated that laboratory medicine was just one node in a multi-centred network of enquiry into animals and their diseases, which stretched into, and helped to fashion and connect up, domains situated at the borderlands of medicine: comparative anatomy and pathology, natural history, zoology, veterinary medicine, agriculture, nutritional science, veterinary public health, parasitology and epidemiology. In studying these networks, we have revealed what humans did to animals in their efforts to advance health and medicine, and what difference animals made to medicine through shaping its knowledge-practices, institutional settings and the lives of its investigators. The result is a richly contextualized series of case studies which not only add to our understandings of animals in medicine, but also change

our conceptions of what constituted medicine in particular times and places.

The relationships that animals forged within medicine are central to these studies. It was through such relationships that they influenced medicine and were, in turn, shaped by it. One important observation that arises in our studies is that these relationships involved *multiple species*. Generally, in medicine today, in historical writing on the subject (as summarised in our annotated bibliography), and in research outputs employing the banner of One Health (OH) (Chapter 6), interspecies relationships are portrayed in dualistic terms: a particular type of animal spreads infection to humans, or is manipulated in the laboratory to shed light on human disease. Such animals tend to be farmed livestock or laboratory rodents, and are of interest to medicine and its history because of the threats and benefits they present to human health.

Our studies have shown that this is a reductionist and anthropocentric view of medicine which fails to recognize the rich multiplicity of interspecies relationships that were forged through medical practices—not simply for the purpose of advancing human health but also to learn about relationships between species, to study the disease processes they had in common, and to advance animal health for its own sake (although here, too, humans have been the ultimate beneficiaries because healthier animals could better perform their human-designated roles). Chapters 2 and 3 have described medical interventions pursued in zoos and on Scottish hill farms for the benefit of animal, not human health, while Chapter 4 has shown how, under the post-war campaign against world hunger, such interventions were intended to benefit human and animal health simultaneously. The comparative pathology described in Chapter 2 sought similarities and differences between the diseases affecting human beings and the zoos' various vertebrates. Some investigators interpreted their findings in evolutionary terms, suggesting that disease drove, and was a product of, evolutionary differences between species. Chapter 3 described how sheep became enmeshed in relationships with ticks, bacteria, experimental animals belonging to the same and different species, and the human and animal victims of analogous diseases. Chapter 5 extended this ecological network to include tapeworms, dogs, wild carnivores and multiple types of human communities, and showed that for Calvin Schwabe, the elucidation of this network was as important a research objective as the prevention of human disease. Chapter 6 examined the somewhat uneven portrayal

of these multispecies networks in the texts and images used to illustrate and advertise OH today.

Collectively, these findings serve to expand historical understandings of the numbers and types of animal that participated in medicine. They show that the foundations—and indeed the objectives—of medicine have been more broadly zoological than historians have previously acknowledged. Furthermore, analysis of the roles that these animals have performed within medicine shows that they shaped it in previously unrecognized ways. While prevailing anthropocentric perspectives on medical history have generated insights into animals as experimental models of disease and transmitters of zoonotic infections to humans, in shifting to a more animal-centred perspective, our chapters bring to the fore a host of other animal roles: as disease victims, patients, pathological specimens, points of comparison with other species, products and shapers of their environments, suppliers of human nutrition, subjects of international health policy and commercially lucrative products of medicine (such as more productive livestock, more appealing visitor attractions in zoological gardens, dead specimens for museum display, and post-experimental sheep sold for knackers' meat).

Performed simultaneously or sequentially through animal lives and afterlives, these roles were awarded by humans and legitimated by human relationships with, and valuations of animals. They also have their own histories which merit further elucidation. As the chapters have shown, these roles opened up certain opportunities for animals to shape health and medicine. For example, as patients, pathological specimens and points of comparison, monkeys in the zoo illuminated the cause of rickets (Chapter 2); as victims of their environments and as experimental subjects, sheep influenced the geography and timing of scientific enquiry and its practices (Chapter 3); as suppliers of human nutrition, cows pushed forward the campaign against world hunger (Chapter 4); while as shapers of their environments, *E. granulosus* informed laboratory investigations into its biology and wider epidemiological movements within communities (Chapter 5). In performing their roles, animals did not only impact on the knowledge-practices of medicine but also on its social and organisational aspects. As pathological specimens, animals brought doctors into the zoo. They also advanced the career of John Bland Sutton (Chapter 2), just as the tapeworm's shaping of its environment advanced Calvin Schwabe's (Chapter 5). As victims of their environments, sheep forged diverse research networks, while as

hosts and transmitters of infection, they enabled ambitious vets to make a bid for professional recognition (Chapter 3). As sources of human health and nutrition, dairy cows brought departments of the Food and Agriculture Organization and World Health Organization into existence, and forged interdisciplinary connections that granted vets the authority to make international health policy (Chapter 4). Tracing the sequential and overlapping roles that animals held also links institutions, disclosing, for instance, that Schwabe's laboratory-based studies of *E. granulosus* fed into, but did not dominate, parallel fieldwork and epidemiological investigations, indicating not only more complex multispecies relationships but also more intricately interlaced sites and disciplinary worlds than usually feature in histories of medicine and biology.

Roles also had implications for the animals that performed them, because they affected how humans treated them. We have seen how, as patients or potential victims of disease, zoo animals, sheep and dairy cows were closely monitored and subjected to interventions such as dosing, dipping, dressings, surgical operations, special feeding or pasturing, and new housing. Pathological specimens were created through natural or deliberate deaths, post-mortem examination and sometimes the preservation of animal remains. Experimental animals had their bodily integrity disrupted, while environmental shapers had their surroundings studied and manipulated. Through the practice of medicine, therefore, animal identities, bodies, habits, environments, relationships and lived experiences were profoundly and continually altered. By attending to these processes and circumstances, we can begin to understand how animals have been changed by medicine, and how they made a difference to it, thereby elucidating their deeply intertwined histories.

Studying this process of co-constitution prompts us to rethink not only the subjects and objectives of medicine, but also how, where and by whom it was practised. In following animals through medicine, our chapters have revealed a host of spaces in which medical enquiries have taken place—not just in laboratories, but on farmland and ranches, in zoos and homes, and in the wild. The incorporation of these spaces expands the known geographies of medicine as well as the species that have participated in it. We have also highlighted the involvement of various humans who rarely feature in existing medical histories: zoological society doctors, zoo vets, keepers and superintendents in Chapter 2; the farmers, labourers, landowners, natural historians and medical experts of Chapter 3; the vets in Chapter 4 who worked to enrol animals in the

post-war international campaign against world hunger; and in Chapter 5, the dog-owning communities of Beirut, the pastoralists, ranchers and sheepherding communities of Kenya and North America, and the experts in anthropology and parasitology who studied them.

These findings show firstly, that the keepers and carers of animals were important contributors to the development of knowledge about their diseases and should therefore be incorporated into histories of animals and medicine. Secondly, that the health of animals attracted the attention of diverse scientific experts, whose engagement with them forged intersections between human medicine, veterinary medicine and biology. Chapters 2 and 3 revealed how human doctors applied medical ideas and practices to the health of zoo and agricultural animals; Chapters 4, 5 and 6 demonstrated the application of veterinary ideas and approaches to human health agendas; Chapters 2, 3 and 5 showed how the biological perspectives of comparative anatomy, zoology, botany, entomology and parasitology were brought to bear on human health, animal health and the relationships between them. While the nature of these intersections was context specific, they highlight the shared capacity of animal subjects of medicine to cut across and forge connections across disciplines. The medicine that was produced through them was not bounded by species. Indeed, some of its practitioners were outspoken in their rejection of species and disciplinary boundaries: Chapter 4's veterinary public health experts proclaimed their work as a contribution to human health and wellbeing, while for Calvin Schwabe the line between humans and non-humans was not fundamentally biological but cultural in character.

The backgrounds and positions occupied by many of the medical experts whose activities we have documented do not give an obvious indication of their interest in animal health. Similarly, the medical associations of the work performed by our experts in veterinary medicine and the natural world are not always apparent. This may explain why their activities at the borderlands of these disciplines have evaded historical detection. However, historians' traditionally anthropocentric conceptions of what constituted modern medicine are also to blame. The standard assumptions that, except in its direct bearings on human health, the health of animals was a veterinary matter and the life of animals a subject for biologists have served to obscure the actual historical relationships between veterinary medicine, biology and medicine. In showing that diseased animals featured within all three of them, we have demonstrated the need for historians to generate more empirically grounded,

historically sensitive understandings of their characteristics and boundaries. One meaningful approach to this issue is through the history of animals because, as we have shown, in attracting the attention of different types of expert, animals have helped to fashion the activities of and relationships between different fields of science and medicine.

The case studies presented here have also offered novel and important historical precedents to the current way of working known as One Health (OH), which seeks to develop integrated perspectives from across human medicine, veterinary medicine and the life sciences. Chapters have illuminated circumstances in which such integrated perspectives were developed in the past, and shown how this way of working was shaped, advanced and at times challenged by the human and animal participants, and the wider political, economic, institutional and scientific contexts. We have seen how, drawing on a longer tradition of medical involvement in animal health, the doctors who attended Britain's nineteenth-century zoos were quick to import human medical methods and concepts. However, animals did not always comply with their efforts to construct them as subjects of public health, bedside medicine and hospital medicine. Sick sheep were similarly recalcitrant pathological and experimental subjects. In studying them, the ambitious veterinarians of Chapter 3 sought to distance investigators in medicine and zoology from what had previously been a cross-cutting field of endeavour. Aided by institutional shifts in research funding and ideas of disease causation, these vets contributed to the compartmentalization of the disciplines. As a consequence, during the interwar period, the pursuit of healthy humans and healthy animals occurred largely along parallel tracks. However, as Chapter 4 revealed, the outbreak of war, and the post-war discovery of hunger and protein malnutrition, helped to break down the disciplinary compartments, and to forge new connections between healthy animals, healthy humans and their experts. This provided a fertile context for the work of parasitologist Calvin Schwabe, who crossed multiple disciplinary domains in his pursuit of the tapeworm *E. granulosus*. These findings offer a preliminary trajectory for the practice of OH from the mid-nineteenth to the late twentieth century.

It is notable that the 'OH' practices documented here do not feature in scholarly medical histories, or in the history that OH advocates have constructed for themselves. The former is primarily concerned with the uses of experimental animals in medicine, not the multispecies, multi-centred activities that we have described. The latter relies on a highly selective narrative of famous 'OH' practitioners. By contrast, with the

exception of Schwabe, whose life and work merits further scrutiny, we have elected to study, and embed within their historical contexts, the work of individuals who were more representative of their age. OH advocates also posit a mid-twentieth-century low point for OH that they attribute to reductionist tendencies that abolished earlier holistic thinking about health. The trajectory we have sketched out challenges this claim by showing how, in the context of international health, OH was actually reinvigorated in this period.

Our findings therefore suggest that in modern medicine the practice of OH is both more frequent and more significant than either historians or OH advocates have realized. This finding strengthens the case for why medical historians need to move beyond the human, to incorporate animals into their frame of reference. It also boosts the claims made by OH advocates about the historical importance of OH ways of working. At the same time, however, in revealing the historical specificity of OH, our findings challenge their conviction that it constitutes a universally applicable and self-evidently beneficial approach. We have shown that the health problem under investigation, the animals affected, the humans involved, the institutional setting, the funding regime, the intended outcomes, and the wider social, political and economic contexts may all have a bearing on whether the practice of ‘OH’ proved feasible, desirable, and capable of achieving its desired objectives. There is no universal scientific logic of OH. History shows that its merits can only be determined on a case-by-case basis, with due regard to social, political and economic circumstances.

In addition to providing precedents for the practice of OH today, the later chapters in this volume have also elucidated its historical roots as a self-conscious scientific and policy agenda. As described in Chapter 6, this movement emerged in the early twenty-first century. Partly in response to a series of emerging zoonotic disease threats, a number of research groups began to call for a reconfiguration of research, policy and clinical practice, which would break down the professional, scientific and policy silos of human health, veterinary medicine and environmental health. Such groups were often already working in this way, but with distinctively different approaches, resulting in not one OH but many. We have traced a direct connection between OH today and the post-war context of international health. As shown in Chapter 4, the realisation within this context that the health and nutrition of humans depended on the health and nutrition of animals produced new institutional settings in which new relationships were formed across human and animal

medicine. Chapter 5 shows that this context both resonated with and granted further opportunities for parasitologist Calvin Schwabe to pursue his discipline-crossing research on *E. granulosus*. This work proved crucial to his formulation of an integrated philosophy of ‘One Medicine’, which both drove and was enhanced by the twenty-first-century OH movement. Such findings reinforce the observation made above that OH—like OM before it—is not a universal good but a product of very specific historical circumstances, which this volume has gone some way to elucidate.

While the discrete case studies presented here function synergistically to shed important light on how animals and modern medicine have shaped each other, they have only begun to scratch the surface of this long neglected historical problem. In this volume we have deliberately sought the commonalities between our case studies in efforts to generate overarching insights into the integrated practice of human and animal health and its development over time and place. However, much more work remains to be done in drawing out some of the specificities: in the capacity of particular animals performing particular roles to influence the course of medicine, as practised by specific individuals working in specific institutions, countries and contexts. Further investigations will elucidate how the lives of different animals were affected by health and medicine. They will enable our preliminary trajectory of OH approaches in modern medicine to be tested and expanded, and will help to clarify the circumstances that facilitated its pursuit in certain times and places.

This is a fertile ground for enquiry, for there are many other contexts beyond those addressed here in which animals have made a difference to, and were changed by medicine. While the experimental laboratory, with its dogs and rodents, represents an obvious focus of enquiry, our case studies have revealed that it was just one of many contexts in which histories of animals and medicine were intertwined. Beyond its bounds lies a richer animal history of medicine, comprising a greater diversity of spaces, species, specialisms, modes of enquiry and human participants. We urge historians to seek out animals within the comparative fields of medicine (such as psychology, neurology, therapeutics, physiology and pathology), at the intersections of human and veterinary medicine (notably epidemiology and veterinary public health), and at the borderlands of medicine and biology (such as agriculture, nutrition science, parasitology

and biomedicine). As this volume has demonstrated, such investigations can do more than simply add animals to existing medical historical narratives. They also have the potential to reconfigure understandings of what medicine was, and therefore what medical history might become.

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