Arresting Contagion:

Science, Policy, and Animal Health in the United States

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Chapter Outline

Chapter 1
Introduction

After a long battle, victory. In October 2011, the United Nations' Food and Agricultural Organization announced the global eradication of rinderpest, the most feared of all livestock diseases.[1] Such a feat had been accomplished only once before, with the conquest of smallpox celebrated in 1980. Rinderpest is a highly contagious viral disease that over the millennia has devastated cattle, water buffalo, sheep, goats, and other animals. It repeatedly battered Europe, likely killing over 200 million cattle in outbreaks in the eighteenth century. The re-appearance of the "cattle plague" in Britain in 1865 spawned that nation's first systematic policies against animal diseases. The epizootic hit the horn of Africa in 1888 and spread south to the Cape Colony by 1896, contributing to one of the worst famines in that continent's history. Rinderpest was not to be trifled with. During World War II, a joint U.S. and Canadian bio-warfare team selected rinderpest as its weapon of choice. In a secret laboratory on a St. Lawrence River island, scientists worked with the live virus to build offensive and defensive capabilities.[2]

Rinderpest played a vital role in the birth of federal livestock disease policy. Out of fear of this plague, Congress temporarily prohibited the importation of cattle in December 1865. In early 1866, amidst rumors that the contagion had jumped the Atlantic, the Senate directed Commissioner of Agriculture Isaac Newton to investigate. He determined that the reports were unfounded, but called for new laws to contain and destroy infected cattle within a "military cordon" should the disease ever strike.[3] Newton also recommended strengthening import controls and establishing quarantine stations. The danger of rinderpest subsided in Europe, and Congress did not enact Newton's bolder proposals.[4] However, other livestock diseases did leap the nation's ocean defenses. These, along with the spread of diseases already enzootic in parts of the United States, created serious health threats.

Many of our readers have likely never heard of rinderpest. The great cattle plague and the other scourges that ravished livestock a century ago have passed from memory. Animal diseases still register in the public consciousness today, albeit more weakly, in

the form of mad cow disease and other emerging risks. This book investigates the largely untold history of government interventions to combat livestock infections and contagions in the United States.[5] Congress empowered a new agency in 1884 to fight livestock diseases. This move predated what is commonly considered the first significant federal thrust into economic regulation and predated any sustained federal push to directly improve human health. The agency made spectacular advances in both science and public policy. Indeed, it is credited with creating the template for regional disease eradication which would be used around the world in fighting rinderpest and other animal and human diseases. The book shows how this agency evolved to overcome great obstacles, including scientific ignorance, rampant disease denialism, constitutional impediments, knotty jurisdictional conflicts, and strong grassroots resistance. Its successes have led later generations to take these accomplishments for granted and to forget the scientific challenges and political struggles along the way. Our story highlights the interactions of science and policy to solve serious problems.

Boundaries and Contagions

Throughout the nineteenth century, the animal disease environment was growing worse in the United States. Many states responded by enacting livestock sanitary laws. But infectious and contagious diseases paid no heed to state boundaries. In response to livestock health threats, individual states often blocked interstate commerce.[6] This invariably incited charges that states were using health concerns as a ruse to protect their own producers from legitimate competition. Such charges were at times justifiable, but producers and their elected representatives in infected areas were also often in a state of denial. While the states bickered amongst themselves, many European nations restricted imports of American livestock and livestock products. Clean states could not differentiate their products from those of infected states in international markets, so all suffered. For these and other reasons, state governments proved ineffective in the battle to control livestock contagions.

The increased threats, coupled with the failure of state actions, led many to demand federal intervention. At the same time, a small cadre of scientists defined the problem and created blueprints for action. Step by step, Congress created an increasingly

powerful national animal health bureaucracy, complete with authority to impose domestic and international quarantines and conduct eradication campaigns within states. The federal courts gradually upheld Congress' assertions of power over what had been the exclusive domain of the states. This was a highly contentious process that repeatedly pitted powerful ideological, regional, and economic interests against one another. These battles over livestock health helped redefine the American federalism and shape economic regulation in the United States. Scientists, who directed the new institutions, would have a major impact on enhancing agricultural productivity nationally and globally.

One Health

Much more than output on the farm was at stake. Approximately seven-tenths of all infectious diseases of humans are shared by other vertebrate animals. These shared and transmissible diseases—zoonoses—include anthrax, brucellosis, cholera, Ebola, influenza, malaria, mad cow disease, plague, rabies, Salmonellosis, trichinosis, tuberculosis, yellow fever, and hundreds of other killers.[7] Humans contract many zoonoses solely from other animal species. The most effective method to combat many zoonoses is to introduce more hygienic processing and distribution systems for animals and animal products, and to treat or cull the diseased animals. For these reasons, livestock sanitation policies, including those aimed at improving milk and meat hygiene, had a significant impact on human health. Animal health policies contributed to preventing illnesses that otherwise would have killed hundreds of thousands of Americans in the first half of the twentieth century. In addition, there was a close synergy between advances in animal and human medicine. Many scientific breakthroughs came out of a research process that transcended existing disciplinary boundaries.

Animal health policies face different constraints from those governing humans—one deals with property rights while the other deals with civil liberties. Most people care more about their own health than that of their animals; most think that a human's life is more valuable than an animal's life. For these reasons, one might predict that human health would have advanced faster than animal health. However, the reverse has often

been the case. Indeed, as advocates of child health legislation repeatedly lamented in early twentieth century, the federal government invested more to reduce the mortality of young livestock than of human babies.[8] Law and custom long prohibited using human cadavers to conduct medical training and research, and thus much of what physicians learned about human physiology was based on animal models. In addition, it was easier to control livestock diseases because authorities could test and quarantine animals more indiscriminately, slaughter sick and suspect animals, and even depopulate entire districts. But all such actions required a legal system that permitted the interruption of commerce, the confiscation of dangerous goods, and at times the payment of compensation. It also required leaders with a will to act. Studying changes in animal disease regimes sheds light on health policy more generally. Unencumbered by the same ethical constraints, the links between science, policy, and results are often sharper for livestock than for human diseases.

Societies confront fundamental problems with respect to health. Contagious diseases create externalities that are often hard to address without collective action. The presence of a contagion is against the common interest. Arresting contagions is a public good. While individuals have incentives to protect themselves and their loved ones, the incentives to privately invest to protect strangers are weak. The result is an under-investment in precautions against the spread of contagions. The same logic applies to states vis-à-vis other states. In many institutional settings, a livestock owner has an incentive to conceal diseased animals in the hope that they might recover to sell or butcher them rather than see them condemned. In regions where a contagion was prevalent, the prospect of re-infection reduced the incentives for individuals to invest in cleaning up their own herds. Unless one's neighbors cooperated, such investments would likely be wasted.

In the past, decentralized efforts almost always proved ineffective. Those seeking to address contagions turned to government, which could exercise police power. There are economies of scale and scope in disease control. It is generally more efficient to police one large all-encompassing border (be it a county, state, nation, or continent) than for each political entity within the larger area to regulate its own frontier. Solving coordination problems proved difficult everywhere, so it is all the more remarkable that

the United States, with its cultural traditions of voluntarism, localism, and pluralism, was a successful pioneer.

Building a Federal Bureaucracy: Science and Policy

By 1900, the United States had emerged as a world leader in controlling contagious animal diseases, even though the nation was a laggard in human medicine and the biological sciences more generally. The principal organization that led the fight against livestock diseases was the Bureau of Animal Industry (BAI), which was created within the United States Department of Agriculture (USDA) in 1884. For its first two decades the BAI was energetically directed by the veterinary scientist Daniel E. Salmon. By the early 1940s, the BAI had led campaigns that eradicated seven major animal diseases from the United States: contagious bovine pleuropneumonia (1892), fowl plague (1929), foot-and-mouth disease (1929), glanders (1934), bovine tuberculosis (1940), dourine fever (1942), and Texas fever (1943). Its eradication campaigns were complex large-scale experiments in social engineering. The scientists who led the global smallpox eradication program acknowledged this precedent when they noted that the BAI's campaign against contagious bovine pleuropneumonia (CBPP) was the world's "first planned programme whose stated objective was eradication."[9]

The BAI represented an important institutional innovation. As the first federal agency created with an explicit scientific research mission, the BAI became a leader in transferring scientific knowledge from Europe to the United States and in generating original research aimed at understanding and solving animal disease problems. It established the "first significant microbiological laboratory in the United States in 1884"—several years before the founding of a hygienic laboratory by the predecessor to the National Institutes of Health (NIH).[10] Among the early BAI breakthroughs were the discovery of the *Salmonella* bacterium (named after Daniel Salmon), the typing of distinct tuberculosis bacteria, and the first proof that an arthropod vector—in this case a tick—transmitted a microorganism that caused an infectious disease—Texas fever. This discovery sped advances in the understanding of other vector-borne diseases, including malaria, yellow fever, typhus, and African sleeping sickness. Other early breakthroughs include the development of practical methods to

eradicate ticks, the discovery that hog cholera was caused by a filterable virus, and the identification of the hookworm parasite afflicting the people of the South. BAI scientists made numerous other advances in bacteriology, virology, immunology, parasitology, and other emerging disciplines.

The BAI's public policy innovations rivaled the importance of its research contributions. The science underlying the BAI's triumphs was readily available to animal health officials in other countries, but few nations equaled the United States in converting science into the public policies needed to control diseases. Changes in legal interpretations and in administrative capabilities accompanied scientific progress as officials learned how to create effective institutions. Disease control campaigns required building social capital: they demanded creating coordinated surveillance systems dependent on farmers and local veterinarians to ring the alarm, gaining the trust and cooperation of state and local officials and farmers, educating stock owners about new and often alien scientific ideas, implementing incentive-compatible compensation schemes, organizing rural plebiscites, and much more. In designing programs, one size did not fit all; it took considerable trial and error to tailor policies to meet the specific threats of different diseases and ensure that they would work in the field.

The constitutional necessity to gain state support led to novel cooperative agreements that redefined the frontiers of American federalism by transferring power from the states to the national government. These changes occurred earlier in animal health than in many other policy arenas. The BAI could deploy trained experts to hot spots and intervene with near-dictatorial power to nip problems in the bud. This policy of concentrating authority was dubbed the "one man principle." The agency's quarantine system repeatedly blocked the entry of diseases into the United States. The United States and Canada both eventually adopted an "island-nation" mentality similar to that developed earlier in Britain. It was wiser to invest in eradicating existing diseases and to prevent their re-introduction than to employ more lax policies and coexist with diseases, as was long done in most European countries.[11]

Origins of Economic Regulation

Our story about animal disease control and food safety is tied to a broader literature on the origins of government regulation.[12] The traditional accounts of food safety laws in the United States, relying on the muckraking exposés of Upton Sinclair, viewed the federal government's intervention as nothing less than a triumph of good over evil, with the new federal laws and regulatory agencies reining in special interests that were endangering public health. Over the past few decades, with the rise of the Chicago public choice school, this view has lost favor. In its general form, the Chicago argument is that powerful groups, pursuing a narrow interest, push for policy changes at the expense of the politically weak. Concentrated, well-organized interests generally prevail over more diffused interests. Much of the potential rent is dissipated in the political struggle. In some cases, these changes might result in gains to society as a whole, but such an outcome is unlikely. According to the now popular interpretation, rent-seeking special interests vied for government protection to limit competition. Public interests played little or no role either in explaining the origins of the food safety and livestock sanitary legislation or in determining the *ex post* effects of the legislation.

Starting from a different perspective, we know that contagious human diseases were rampant in the past. We know that human life expectancy has increased sharply in the United States since 1850. We know that a major cause was the fall in infectious disease mortality, which began long before the commercial appearance of sulfa drugs in the 1930s and of antibiotics in the 1940s. The advance of knowledge about how diseases spread; public health investments in cleaner water and better waste disposal, and mandatory vaccination were all among a longer list of the reasons for the decline in human diseases. Here we argue that enlightened public policies also helped control animal diseases. In addition, the improvement in the animal health and the control of zoonotic diseases played important roles in improving human health. Our account challenges the public choice perspective, which treats virtually all claims of dangerous infectious animal diseases as shams--as pretexts for protectionism, anti-competitive legislation, and expanding bureaucracies. The only parasites recognized on this subject are redistributive politicians and their backers. The public choice literature echoes the denials about the dangers of animal contagions and charges of rent-seeking made by past opponents of reform. Those past critics could at least claim that the germ theory of

disease was something new and unproven; no more. The residents of rich counties are largely protected from the ravages of contagious diseases and can safely ignore their perils. This security from animal contagions is thanks largely to government-financed research, conducted by publicly-employed scientists, along with intrusive government regulations.

A glaring flaw with some of the recent economic literature is the proposed alternative to pre-emptive regulation—namely, using the tort system to recover damages from contagious diseases. Historically, the tort system provided little compensation to injured parties. The information costs of determining the individual responsible for infecting oneself or one's animals were prohibitively high. In addition, many victims could be affected by the same source, creating free rider problems in establishing damage claims. Given the contagious nature of many diseases, trying to handle problems *ex post* increased the likelihood that diseases would spread to third parties.[13] In such cases, it is more efficient to prevent damages *ex ante* via regulation than to identity the sources of harm and correct them after the fact. It is much cheaper to arrest contagions in their early stages before they spread widely.

More generally, our account paints a richer picture of the origins of federal regulation than hitherto told. The standard historical view is that the rise of Big Government was a response to the prior rise of Big Business. Big Government represented, depending on one's point of view, an attempt to either control the exercise of market power or distribute wealth.[14] This story typically begins in 1887 with the creation of the Interstate Commerce Commission (ICC), established to regulate railroads. The next steps were the passage of the Sherman Anti-Trust Act of 1890 and the Meat Inspection Act of 1891—America's first significant federal food safety legislation. This chronology misses the regulatory significance of the BAI. Created several years before the ICC, the BAI sought to solve coordination problems associated with combating infectious disease and reopening foreign markets closed on sanitary grounds. The stakes were enormous—during the late nineteenth century, the capital stock (valued at current dollars) invested in livestock and accoutrements such as fencing exceeded that invested in railroads.[15]

Contours and Themes

The expansion of federal powers to regulate disease in the late nineteenth century was a long and difficult process in which political and legal institutions haltingly responded to forces that were transforming both the domestic and international economies. The next chapter analyzes some of the key changes. The decades before the establishment of the BAI in 1884, were an era of scientific discovery which saw the growing acceptance of the germ theory of disease. A new cadre of European-trained veterinary scientists sought to transfer their knowledge into effective public policy in the United States. The chapter introduces several themes, including the interplay of science and public policy, the controversial constitutional issues at stake, the regional schisms, and the prevailing culture of denial which delayed the advent of animal disease control policies.

The BAI designed and implemented disease control and food safety policy in the United States. Its creation represented a landmark in the history of federal regulation and the rise of science policy. Chapter 3 examines the congressional debates stretching over a decade that led to the BAI's creation. This legislative history, coupled with subsequent policy initiatives, shows that the BAI Act of 1884 has a better claim to represent the birth of significant federal economic regulation than does the Interstate Commerce Act (ICA) of 1887. In addition, our analysis of the debates and voting patterns on the BAI bills sheds new light on congressional motives in passing the ICA.

Staunch opposition from southerners and northern stockyard interests significantly limited the BAI's original powers and staff. However, the need to expand the fledgling BAI's size and authority soon became evident. In the summer of 1884, CBPP erupted in the Midwest, and there would be little hope of control if it spread to the open range. By 1886, the disease threatened to infect the nation's major distribution channels. Jurisdictional disputes between Chicago, the State of Illinois, and federal officials led to paralysis. The private sector was also divided and incapacitated. Fights broke out between meat packers, urban livestock owners, stockyard interests, and others. It became clear to most that the BAI needed more powers, including the authority and wherewithal to pay indemnities to gain cooperation from stock owners and state officials. Congress would soon grant additional powers and funding. The BAI's response to the

CBPP crisis established precedents for later eradication efforts. State-federal agreements were hammered out that deputized BAI agents to exercise police powers within states. A new federalism was being born. In 1892, the Secretary of Agriculture declared CBPP eradicated from the United States. This was the first time that an established contagious disease had been eradicated on a continental scale.

This episode highlights many recurring patterns. Rifts between states disrupted trade; federal interventions generally promoted commerce. State and local officials generally lacked the scientific expertise to understand and handle the problems, and they were too beholden to local interests to make tough decisions. Contrary to popular assertions, local representatives were not more efficient managers than far away federal bureaucrats when it came to arresting livestock contagions.

Our story deals in large part with the legal changes that led to the development of a national market in the United States. Individual states frequently banned the movement of livestock from other states. An 1878 U.S. Supreme Court ruling on a Texas fever case changed the legal landscape by seriously restricting the ability of states to limit trade on health grounds. This case added to the pressure for federal intervention (Chapter 2). Gradually the courts responded to new scientific findings to allow state restrictions of southern cattle. By the late 1880s, southern cattle interests were once again bucking against myriad state prohibitions. It was in this setting that in 1889 the federal government segregated the U.S. cattle market, relegating southern stock to special pens and separate railroad cars over much of the year. These policies limited the spread of the disease to stock outside the South, but did little to improve productivity within the South. Chapter 5 analyzes the attempts to understand Texas fever and limit its spread to northern cattle.

States also erected quarantines to block the spread of many other diseases, including cattle and sheep scab, foot-and-mouth disease, hog cholera, and bovine tuberculosis (Chapters 5, 6, 7, and 10 respectively). At first, federal interventions often attempted to give more order and specificity to what otherwise were less targeted state barriers to trade. An important element in maintaining or restoring trade was convincing threatened parties that competent and independent monitors were at work. During disease outbreaks, the testaments of state and local officials and of industry executives

had no currency, but in general the assurances of top BAI and USDA leaders carried considerable weight. The BAI could offer a valuable seal of approval that the states could not.

There was a wide range of disease-control policy options, and the methods chosen typically depended on a disease's infectious characteristics and on the economic damage it might inflict. Foot-and-mouth disease (FMD) was so contagious that it called for far more draconian interventions than either CBPP or Texas fever. FMD repeatedly struck the United States; during the worst outbreak (in 1914-16), it infected cattle in 22 states and the District of Columbia. This was a potential tipping point for the livestock industry, and only "heroic" policies saved the country from the plight of nations such as Argentina where FMD became enzootic. Recurrent FMD outbreaks in the first two decades of the twentieth century revealed that efficient control of the contagion required an extensive surveillance system, a plan of action, pre-approved funding to handle emergencies, teams of trained responders, and a clearly-defined chain of command built into state-federal cooperative arrangements. When confronted with FMD, many interests that had originally opposed a powerful federal authority changed their tune. The broad support for FMD control led Congress to allocate more funding and authority to the BAI. By the mid-1910s, the institutions of disease control and eradication were maturing. Chapter 6 details this little-known story.

FMD never became enzootic in the United States, it was relatively easy to identify, it was highly contagious, and it required immediate action. This made stamping out the preferred policy. With compensation, such policies were politically acceptable to most—especially in light of the fact that trade would be cut off if the disease was not controlled. Other diseases such as hog cholera and Texas fever were initially too enigmatic and too widespread to make eradication a feasible policy option. Efforts to deal with Texas fever show the complex interactions of science and public policy. Scientific advances led to a better understanding of the disease and its mode of transmission, thus making new policies legally and politically possible. But the causality also ran in the other direction, because policy makers financed and directed the course of scientific inquiry in the hope of obtaining knowledge that would facilitate disease control.

As with CBPP, eradication of Texas fever was a contentious enterprise with opponents obstructing state and federal policies.

In bad years, hog cholera killed nearly all the swine in hard-hit regions, and over 10 percent of the total American swine population. As with Texas fever, BAI scientists made fundamental discoveries to unravel the mysteries of this disease. Chapter 7 analyzes how this quest led to important advances in immunology, along with the discoveries of the *Salmonella* bacterium and the hog cholera virus. These advances depended on European ideas, techniques, and equipment, but were also in part a product of mission-directed BAI research projects. The march of science was marked by missteps and vitriolic disputes among researchers. This was especially evident in the case of hog cholera. Such divisions in scientific opinion often delayed public policy.

The public policy story of hog cholera ranges over a broad front dealing with the discoveries by BAI scientists, the emergence and regulation of the new biologics industry, and the transfer of scientific advances to the farm. Hog cholera represents a case where policy makers long opted against collective action. Individual farmers and their private veterinarians could limit the disease's impact with a succession of vaccines—all of which created serious negative externalities.

The next three chapters deal directly with the links between animal and human health. Once again we see the interactions of science and public policy, the effects of widespread denialism, the crushing impacts of disease threats on domestic and international trade, the failures of state and local interventions, and the eventual successes of new federal regulations. Trichinosis outbreaks caused panic in Europe in the mid-nineteenth century (Chapter 8). When American pork products were implicated, most European nations rapidly erected import barriers, igniting a two-decade long trade war. In this case most Americans, including the leaders of the BAI, cried foul. Much later, researchers at the USDA and what would become the National Institutes of Health discovered the ugly truth—trichinosis among Americans was much more prevalent than earlier claimed, and the curing methods employed by American packers were far from failsafe. We next reexamine the political economy of early meat inspection legislation. Deniers, including meat packers, many congressmen, and more recently public choice

scholars, have all claimed that there were no significant health problems and no need for federal meat inspection. They were all wrong. Chapters 8 and 9 make our case.

In the late nineteenth century, milk was the conduit for scores of deadly diseases. By 1940, milk hygiene was roughly on par with the product sold in the twenty first century. Chapter 10 begins the discussion of why and how this change occurred, with an emphasis on the efforts to understand and control the spread of BTB in cattle and humans. Circa 1900, BTB was likely killing about 10,000 Americans a year. In this age of discovery and control, scientists working for the BAI and state universities made key advances in both understanding and detecting the disease. However, the diagnostic test was controversial; many farmers thought that the procedure spread the disease, caused abortions in cows, and harmed humans. They cited Robert Koch's position in a raging dispute with other researchers over the dangers of BTB to humans. The great Koch was proved wrong, but his discredited ideas lingered for decades. State and local efforts to control BTB increased after 1900. These had the unintended consequence of encouraging farmers to sell their suspect and infected animals. Middlemen facilitated this nefarious trade. One prominent Chicago-area cattle dealer, James Dorsey, knowingly shipped diseased cattle that infected at least 10,000 dairy herds in the United States, Canada, and Mexico. His actions exposed tens of thousands of families to tuberculosis. This case exposed the flaws of relying on the tort system to control the problem and proved a catalyst for stronger government intervention. By 1914, at least a dozen states had closed their borders to Illinois livestock. Federal intervention helped reopen trade.

For CBPP and FMD, eradication came with the initial federal attempts to control eruptions. But for many other diseases, eradication could only be entertained after firmer scientific and political foundations were established. In the case of Texas fever, the age of federal eradication policy began in 1906 (Chapter 11). Texas fever eradication was a part of a broader movement. At this time, livestock in roughly three-fourths of the territory of the United States was under federal lockdown to prevent the spread of parasitic diseases. Hostilities festered, and violence was common; opponents murdered agents and dynamited facilities.

The history of these campaigns shows how strongly held views about states' rights changed with economic conditions. Once an area was cleansed, its leaders

generally became defenders of federal intervention because they did not want their constituents' farms reinfected. This political dynamic was a common feature of most control and eradication programs. For this reason, the BAI often started programs with velvet gloves and became more authoritarian as political support increased. This was certainly the case with BTB eradication (Chapter 12), which began in 1919. The BTB campaign was the BAI's most ambitious and controversial endeavor, and it involved what was likely the most extensive use of police power in the peacetime history of the United States. Success required developing and adjusting incentive programs to gain farmer cooperation. By 1940, this program and parallel programs of mandatory pasteurization were preventing roughly 25,000 deaths a year in the United States from BTB infections.[16]

BTB eradication also paid huge dividends by increasing agricultural productivity. This was true for other programs. In every case for which we could assemble data, our conservative estimates of the benefits to the agricultural sector of disease eradication exceeded the costs by at least ten-to-one. As with BTB, the spillovers to human health and to advancing science added significantly to the net benefits.

The age of hog cholera eradication only began in earnest in 1961, when the federal government abandoned its policy of coexisting with the disease. A prolonged quarantine and slaughter campaign achieved success by 1977. Chapter 13 tells this story. Changes in the disease environment mandated the new policy. The threat from two new diseases dramatically increased the risks of misidentifying diseases in the early stages of a contagion, which could have had catastrophic consequences. Suddenly powerful producer interests, who had previously opposed stringent measures, now lobbied for eradication. This required mandating changes to long-standing feeding practices, which had the additional benefit of significantly reducing the incidence of trichinosis. We close in Chapter 14 by providing perspective on past achievements in light of current challenges.

In our account, there were distributional fights with winners and losers—this is true of almost any important technological and institutional change. But the overwhelming message is a story of progress. We chronicle large-scale government interventions that successfully eliminated major diseases and created models later used

worldwide. We focus on a handful of the policies to combat some of the most important diseases. There were many other problems that we do not touch on; their inclusion would reinforce our message.

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[1] World Organization for Animal Health (OIE), *Bulletin* No. 2011-2, pp. 1-10; *New York Times*, 28 June 2011, p. D1.

[2] Alan L. Olmstead, "The First Line of Defense," *Journal of Economic History* 69, no. 2 (June 2009), pp. 329-30 and Clive A. Spinage, *Cattle Plague: A History* (Kluwer Academic: New York, 2003).

[3] Rinderpest could and did jump oceans. It entered Brazil in 1920 and Australia in 1923, but in both instances it was caught early and stamped out.

[4] US Senate Misc. Doc. 98, 39th Cong., 1st Sess., "Letter of the Commissioner of Agriculture…." Isaac Newton letter dated April 17, 1866, p. 21; *New York Times,* 15 July 1866, p. 4; Houck, *Bureau*, p. 125; Vivian D. Wiser, "Protecting American Agriculture: Inspection and Quarantine of Imported Plants and Animals," Agricultural Economic Report No. 266, Economic Research Service, USDA, July 1974, pp. 1-58.

[5] An infectious disease is a class of clinical illnesses resulting from a pathogen residing in a host. Infectious pathogens include some bacteria, viruses, fungi, protozoa, multicellular parasites, and aberrant proteins dubbed prions. These pathogens are the source of disease epidemics (in humans) and epizootics (in other animals). Transmission of these pathogens can occur in many ways including direct contact, ingesting contaminated products, contact with contaminated body fluids, contact with contaminated inanimate objects, inhalation, or by the bite of an infected vector. Today, infectious diseases are synonymous with transmissible diseases and communicable diseases. Contagious diseases are a subset of infectious diseases which are highly infective or easily transmitted from one host to another by contact with the sick host, with its secretions, or by inhalation. Diseases transmitted by vectors such as mosquitos are infectious but not contagious. Our usage of these terms may, in places, stray from strict conformity with these definitions.

[6] When others states and foreign nations conditioned market access on meeting sanitary standards, they added to the incentives to combat diseases, offsetting in part the underinvestment in measures to prevent the spread of contagions. An opposing consequence was to increase incentives to conceal and deny disease problems.

[7] Calvin W. Schwabe, *Veterinary Medicine and Human Health*, 3rd ed. (Baltimore, MD: Williams & Wilkins, 1984), pp. 16, 194–251; and Steele, *CRC Handbook.* A. Merianos, "Surveillance and Response to Disease Emergence," *Current Topics in Microbiology and Immunology* 315 (2007), pp. 477-509; L. H. Taylor, S. M. Lathan, and M. J. Woolhouse, "Risk Factors for Human Disease Emergence," *Philosophical Transaction: Biological Science* 356 (2001), pp. 983-89.

[8] *New York Times*, 4 April 1909, pp. SM10; *Washington Post*, 17 April 1914, p. 4.

[9] Frank Fenner, Donald A. Henderson, Isao Arita, Zdeněk Ježek, and Ivan D. Ladnyi, *Small Pox and Its Eradication* (Geneva: World Health Organization, 1988), p. 372.

[10] Schwabe, *Veterinary Medicine*, p. 188; A. Hunter Dupree, *Science in the Federal Government: A History of Policies and Activities to 1940* (Cambridge: Harvard Univ. Press, 1957), pp. 158-66.

[11] Peter K. Olitsky, Jacob Traum, and Harry W. Schoening, *Report of the Foot-and-Mouth-Disease Commission*, USDA *Technical Bulletin* no. 76 (Washington: GPO, 1928), pp. 15-16, 30; United Kingdom, Minister of Agriculture, Fisheries, and Food, *Animal Health, A Centenary, 1865-1965: A Century of Endeavor to Control Diseases of Animals* (London: Her Majesty's Stationery Office, 1965), pp. 125-263.

[12] Edward L. Glaeser and Andrei Shleifer, "The Rise of the Regulatory State," *Journal of Economic Literature* 41, no. 2 (June 2003), pp. 401-2; and Gary D. Libecap, "The Rise of the Chicago Packers and the Origins of Meat Inspection and Antitrust," *Economic Inquiry* 30 (April 1992), pp. 242-62.

[13] Information problems associated with contagious diseases make a Coasian solution infeasible.

[14] Price V. Fishback, et al., *Government and the American Economy: A New History* (Chicago, IL: Univ. of Chicago Press, 2007).

[15] Robert E. Gallman papers, Capital Stock Estimates, Current Value, Tables B-4, B-9, H-6.

[16] Our estimate of human deaths rests on the growth in the population and the spread of BTB in cattle. See Chapter 12.

Chapter 14

The Mirror of the Past

On 19 April 2012, the Animal and Food Safety Laboratory at the University of California, Davis notified the U.S. Animal and Plant Health Inspection Service (APHIS) of suspicious test results for a sample of the brain stem of a slaughtered dairy cow. Using the Bovine Spongiform Encephalopathy (BSE) surveillance system, the sample was traced back via an ear-tag identification number to a central California rendering facility where additional biological material was collected. On 24 April, the USDA confirmed the fourth case of Mad Cow disease in the United States.[1]

BSE is a communicable disease capable of destroying the central nervous system of its victims. It is related to scrapie in sheep and to Creutzfeldt-Jakob Disease (CJD) in humans. BSE was first recognized in cattle in Britain in 1986; by 1993, over one-half of the country's dairy herds were implicated. Authorities denied the disease posed any risks, but many in the public remained wary. The leap of the disease to humans was first announced on 21 March 1996, when 10 cases of variant CJD were reported in Britain. Widespread panic ensued, consumers boycotted British beef, and other countries banned its importation. As of 2012, 226 people had died in the United Kingdom of variant CJD. Authorities discovered more than 180,000 infected cattle and slaughtered roughly 4.4 million to stamp out the disease. Restoring consumer confidence was a costly enterprise.[2]

The origin of the disease is mysterious. It is suspected to have jumped species as a result of adding scrapie-contaminated sheep meat-and-bone-meal to protein supplements fed to cattle. Such a feeding practices were not new, but small changes in the rendering process may have had unexpected consequences. In the early 1980s, high petroleum prices led renderers to economize on the use of solvents in the tallow extraction process, which, it is thought, allowed the infectious agent to jump to cattle. The epizootic was possibly amplified by feeding affected bovine meat-and-bone-meal to calves.[3] If so, seemingly small changes in production practices had large and unintended consequences. The spread of many other diseases has been linked to feeding practices. In the California BSE case, trace-back procedures did not identify such sources. Mad cow disease represents a recent example of new (or variants of) diseases jumping species to

infect humans. Mad cow, Avian Influenza, SARS, and other threats remind us of how vulnerable we are to threats in a constantly evolving biological environment. Although imperfect, the institutions and policies to research, monitor, and control these problems are in place.

Arresting Contagion chronicles the origins and development of infrastructure of animal disease control and food safety in the United States. The developments described in these pages were made possible by farsighted leaders who perceived the threats that diseases posed to animal and human health, and designed bold and pragmatic policies to promote effective collective action. These social engineers launched large-scale interventions that successfully eliminated numerous major diseases and created models for eradication campaigns later used world-wide. Indeed, before the widespread application of modern pharmaceuticals, they wiped out from the United States contagious bovine pleuropneumonia (1892), fowl plague (1929), foot-and-mouth disease (1929), glanders (1934), bovine tuberculosis (1940), dourine fever (1942), and Texas fever (1943). More was to come. They sometimes overcame what appeared to be hopelessly difficult challenges. These leaders built *de novo* institutions and protocols to deal with many issues that scientists and policymakers confront today. Many lessons were learned:

- Early detection and rapid respond were crucial to success.
- Laws and procedures needed to be in place before a crisis hit—although a crisis unleashed demands for real action, it was hard to draft effective policies in the midst of an emergency.
- The cost of competing policy options had to be weighed against the expected benefits, but root-cause solutions such as eradication and stringent border control were especially desirable for contagions.
- The tort system failed to provide efficient signals to control the spread of infectious and contagious diseases; regulation aimed at prevention was more efficient than trying to assess damages *ex post*.
- The problems of different diseases were interrelated; as were their solutions.
- It is a given that some interested parties will deny the existence of a problem and some will oppose the solutions—strategies to deal with denialists and opponents depended on many variables—one size did not fit all.

- Compensation policies also had to be tailored to the threat and designed to limit moral hazard problems; without compensation, farmers were more likely to conceal sick animals.
- Setting such policies was a trial-and-error process. Policies needed to be recalibrated as conditions changed.
- Policies had to survive in the court of public opinion—policymakers had to be able to clearly explain a given threat and their actions.
- Gaining public support often required waiting for scientific advances to clarify problems—in this way, science often drove policy; but policy also drove science in a mission-oriented research structure.
- Local authorities and industry insiders often were too closely tied to affected parties or lacked sufficient expertise to act effectively—their "expert judgment" was often myopic and ill-informed.
- Although the federal government could take the lead, it needed state and local cooperation. This was a problem when state and local officials lacked authority or opposed federal policies.
- The alternative to federal intervention was not *laissez faire*; states could and did shut down both intra- and interstate trade—federal regulations provided coordination.
- It was necessary to distinguish between legitimate disease concerns and attempts to promote hysteria to limit competition—the conflicts between efficiency and rent-seeking were to be expected.
- Particularly dangerous contagions called for draconian measures that required the aggressive use of police powers at many levels.

Our account is both specific and historical, but the nature of the problems and of the lessons learned has a general contemporary relevance. *Arresting Contagion* describes a dangerous and untidy world. Problems which emerged in one locale could affect the nation and the world. In addition to these negative spillovers, there were also large positive externalities. New knowledge developed for one purpose had wide-ranging implications for other problems; scientific ideas and technologies built upon previous discoveries and spread rapidly. The new

ideas were for the most part public goods, and they often emerged from public institutions. Political and social innovations were also available to all, but they spread much more slowly.

In this world, scientists and policymakers identified problems, which if left unchecked would have led to bad (less efficient) outcomes. The scientists specified the underlying causal mechanisms, developed new methods of discovery, and proposed novel root-cause solutions that included preventive methods and cures. Lives were often in the balance. The proposed solutions generally demanded collective action rather than individual choices and called for creating new centralized political institutions. There were no road maps for the large-scale interventions and no guarantees of success. Such solutions mandated pre-emptive regulation, transcended established jurisdictional boundaries, and required outside enforcement and verification. Continuous monitoring and the empowerment of experts were essential. The costs imposed were immediate, targeted, and concrete; the promised benefits were often far off, diffused, and uncertain. Many, including many of those harmed by the policies and others who opposed the growth of Big Government, opposed change. Sometimes the most aggressive resistance was outside the normal political arena. In addition, denialism was rampant. This took several forms: the problems did not exist; if they did, they were not important; if they were, they were beyond cure; and even if cures were possible, they were worse than the afflictions.

The scientific process was filled with controversies, which initially provided grounds for opponents of change. With further advances in knowledge, these grounds shrunk, yet many denialists clung to their increasingly discredited claims. The press often failed to distinguish the views of quacks from those of eminent scientists. Opponents often blocked funding for scientific research. Recurrent crises demonstrated the growing threats and mobilized support for change. Distributional questions often dominated public discussions. Implementing pragmatic solutions required a trial-and-error process to ascertain appropriate combinations of carrots and sticks. Under some circumstances, planners compensated those suffering losses. This bought more support but also encouraged strategic resistance, as many held out for a better deal. There was also concern that power, once bestowed, would be misused for unintended purposes; the centralization of power was indeed a slippery slope. Many opponents of change advocated going slow, letting scientific and technological knowledge progress, and waiting to address the problem when easier solutions became available. This was a balancing act because delay and inaction

allowed problems to grow worse. Education programs targeted key audiences, success bred success, and social capital was built. Coalitions dissolved, breaking political log jams and helping to overcome the inertia that inhibited action. The first step was often the hardest. Once seemingly intolerable constitutional violations became a part of the new social contract; in time, few (mostly those who had forgotten the past) wanted to return to the old ways. The enduring and familiar nature of these issues makes the achievements of the past even more remarkable and all the more relevant for today.

[1] The USDA was reorganized many times. APHIS now performs many of the BAI's former functions. US APHIS, "Summary Report: California Bovine Spongiform Encephalopathy Case Investigation," July 2012, http://www.aphis.usda.gov/animal_health/animal_diseases/bse/downloads/BSE_Summary_Report.pdf, accessed 15 Nov. 2012.

[2] http://vla.defra.gov.uk/science/docs/sci_tse_stats_gboverview.pdf, accessed 15 Nov. 2012; http://www.guardian.co.uk/uk/2012/apr/25/mad-cow-disease-british-crisis, accessed 15 Nov. 2012; http://www.accessexcellence.org/WN/NM/madcow96.php, accessed 15 Nov. 2012; http://www.telegraph.co.uk/news/uknews/1371964/The-recipe-for-disaster-that-killed-80-and-left-a-5bn-bill.htm, accessed 15 Nov. 2012.

[3] http://www.accessexcellence.org/WN/NM/madcow96.php, accessed 15 Nov. 2012.