Pioneer Science and the Great Plagues

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PART I

PROLOGUE

A Science Heritage

The Puritan ship *Mayflower* landed on Cape Cod in 1620, bringing Dorking chickens, Tamworth pigs, and two dogs, an English mastiff and an English spaniel. All sturdy breeds, they had been healthy when leaving England and survived in Plymouth Colony freed from European plagues. Their risk of disease in the New World may also have been diminished by a reduction in the population density of both native humans and animals from a catastrophic plague that had swept through eastern Massachusetts the previous decade.¹

The “Indian disease” had devastated tribes prior to the *Mayflower*’s arrival; it had also killed muskrats, mink, and raccoons. Tribal members developed high fevers, headaches, and skin rashes and, near death, bleeding from the nose. Historians believed the disease to have been leptospirosis,² acquired from rats leaving the ships of previous French explorers.³ The bacteria that cause leptospirosis—spirochetes similar to those of syphilis—attack the liver, kidney, and red blood cells; harbored in the kidney tubules, they are released with urine into aquatic environments like the marshes and cranberry bogs frequented by the agrarian native tribes of eastern Massachusetts and Rhode Island. Tisquatum—called Squanto—was a native American interpreter for the Puritans; kidnapped and taken to Spain and England, he returned to find his Pawtuxet tribe no longer existed.

There was no cow on the *Mayflower*—and no cow’s milk, cheese, or butter. Three years after arrival, on September 10, 1623, the English commercial cargo ship *Anne* left the struggling Plymouth Colony with a load of clapboards and beaver hides for England. Aboard was Edward Winslow, returning to England as an agent for the colony with instructions to bring back healthy cattle. Arriving in London, Winslow purchased three red Devon heifers and one bull—all free
of rinderpest, cowpox, and other diseases that afflicted European cattle. He accompanied them home on the ship *Charity*, arriving at Plymouth in March of the next year. Short and sturdy, the red Devon was a multipurpose breed that not only provided milk and meat but could be readily trained as obedient draft oxen. In four years the colony’s herd grew to sixteen with the arrival of four black Kerry cows from England. The red Devon survived to become the draft oxen and foundation stock of New England cattle for two centuries.⁴

At the time there was no concept of a veterinarian—no science or education to support animal health care and no government agency to call or blame when disease appeared. There were homemade remedies. In the 1672 book *New England Rarities Discovered*, author John Josselyn described cranberries as “excellent against scurvy” and “also good to allay the fervor of hoof diseases.” The *Mayflower* had carried a copy of *The Surgeon’s Mate* by John Woodall, the first surgeon general of England; written at the behest of the East India Company’s navy, its only treatments were herbalism, phlebotomy, and prayer. Medicine, like governance in Plymouth Colony, adhered to biblical mandates; science was not used for analysis or logic in solving problems of health, thievery, or fornication. For animal health care in England there had been only untrained cow leeches. Control of the great animal plagues that periodically swept through the countryside was limited to feeble attempts by local agriculturalists to persuade herdsmen and drovers to segregate and remove sick and dying animals.⁵

History does not record the arrival of the horse in the early American colonies.⁶ Heavy forests made horseback travel difficult and there was less need for the horse. But in Europe horses were transportation, the means for war, and a bedrock of the economy, and it was the unschooled farrier who cared for common horses. On wealthy royal estates and in cavalry stables and equitation academies, horse masters had developed an art for the care of the lame and sick. Their diagnoses, arrived at by experience, were tainted by superstition, hindered by religious dogma, and unproven by experiment, and they were frequently wrong.

In the mid-1600s, skills of the horse master began to appear in books. The first classic, *Le parfait maréchal* (The complete horseman), was published in Paris in 1664 and appeared in German and English translations. The author, horse master Jacques Labessie de Solleysel, included a chapter on disease, complaining that in France, the veterinary art was too much in the hands of the farrier.⁷
1. THE VETERINARY SCHOOLS OF EUROPE

The Seven Years’ War from 1756 to 1763 put European states on the side of either France or Britain in a debacle that cost nearly a million lives. Horses of both sides died in catastrophic epidemics of infectious diseases. Tetanus, glanders, and rabies killed military horses and also infected and killed horsemen. Tetanus, an ever-present danger, arose from contaminated wounds. Before streets were paved and hooves protected from nails and debris by horseshoes, tetanus took a terrible toll. The painful unremitting muscle contraction of tetanus—called lockjaw in humans—led slowly and relentlessly to excruciating paralysis of muscles in the jaw, diaphragm, and rib cage. Dying was prolonged and painful. In the 1757 Battle of Prague, four thousand wounded soldiers died of tetanus and deaths in horses were correspondingly high—the astonishing losses forced cavalry horse masters to seek answers in science.

A highly infectious plague was equally catastrophic for cattle in the same century. Three devastating outbreaks of rinderpest—German for cattle plague—hit Europe in 1709–1720, 1742–1760, and 1768–1786. Affected cattle stopped eating and rapidly developed high fevers, diarrhea, and ulcers in the mouth; mortality rates were often 100 percent in newly infected herds. Losses were so great that production of milk and meat seriously declined. During the first epidemic, the public’s belief of rinderpest as divine punishment with its mandate to bear the burden was overridden by practical agriculturalists who imposed trade barriers—the rinderpest decrees—to avoid contact between local herds and caravans of cattle traveling on military sorties or on the overland oxen trade routes. Cull-and-slaughter programs were devised that proved ineffective. By the last rinderpest epidemic, both royals and politicians had taken notice of a need for veterinary science and education to combat diseases of cattle. The message had been clear: animal plagues could destroy the growing prosperity.

By the mid-1700s, France’s population and economy had doubled, and Louis XV’s finance minister had stabilized coins. Rising prices for agricultural products were highly profitable for large landowners who introduced changes from Britain—fertilizers, crop rotations, and the planting of new-world maize and potatoes. The Industrial Revolution was being fueled by trade with America and the steam engine of a Scottish engineer. With some irony, agricultural economic success brought dangers of both war and animal disease. In the countryside, the growth of livestock populations had increased the likelihood
of serious and recurring infectious diseases in cattle and sheep—anthrax, sheep pox, scabies, blackleg, and rinderpest—all diseases that could destroy food production and, along with it, the French economy. Losses from disease were forcing science into workaday animal husbandry.

As new knowledge about contagious diseases emerged, facts began to be objectively verified. In the next century, primitive scientific experimentation provided data that created experts in animal health. When the mechanical movable type printing press introduced mass communication with unrestricted circulation of information and ideas to the masses, there was a sharp increase in literacy that overwhelmed the monopoly of the learned elite, broke Latin’s status as the lingua franca, and extended into agriculture to give birth to veterinary medicine. Scientists organized academies and meetings where papers were read and from which reports were published. In the new British journal The Veterinarian, an English veterinarian reported the first subtle signs of muscle rigidity in a horse with tetanus acquired from a nail injury to the hoof while being shod by a careless farrier: “Head more elevated than usual, ears erect and pointed forward, membrana nictitans protruding in part over the eye, nose thrown out, nostrils dilated, his tail a little elevated, he straddled in his gait . . .”

The free exchange of views was a powerful stimulus to discovery, and by the end of the nineteenth century, veterinarians could explain that tetanus was caused by a bacterium. Scientists named it Clostridium tetani and discovered that it thrived in the dead tissue of wounds, releasing its toxin to spread through the body, causing lethal muscle contraction. Pioneer veterinarians were contributing to and capitalizing on the new scientific discoveries. Anti-science clerics and superstitious magicians were still forces, but education was becoming garlic to society’s anti-science vampires, who were blind to natural science—or so it seemed.

The first formal schools to educate veterinarians were established in France—one in Lyon, the other outside Paris in Alfort. Claude Bourgelat, the founder of both, was born and educated in Lyon, where he was admitted to the bar, succeeding his father, a prominent attorney, in the practice of law. Biographers write of him as a lazy youth of high intelligence and a superior and widely admired horseman. He was connected socially and as a young man was appointed écuyer (horse master) of the Academy of Equitation in Lyon in 1740.
Bourgelat’s wealth and his position as a director of the Lyon city library had given him access to books. The ancient Roman and Arabic veterinary texts, destroyed in Medieval Europe, had been rediscovered and translated into English, French, and German. Available to only the wealthy, they were sequestered in great city and personal libraries in England and France. Among the Roman works that had been translated into European languages was *Epitoma rei militaris*, a book on cavalry and military tactics written in Latin in the fourth century by the eastern Roman citizen Flavius Vegetius; George Washington owned a copy and used Vegetius’s “Let him who desires peace, prepare for war” in his first inaugural address. Vegetius wrote one other important book, *Digesta artis mulomedicinae*, a collection of equine anatomy, disease, and clinical care—and Bourgelat had a copy.

As he matured and traveled, Bourgelat gained an appreciation of biology and science. In Lyon he published a three-volume tome, *Éléments d’hippiatrique, ou, Nouveaux principes sur la connaissance et sur la médecine des chevaux* (Elements of hippiatry and new knowledge of equine medicine). Strongly advocating for veterinary education, Bourgelat operated a private school in Lyon for several years. In 1761 he was named inspector of the library of Lyon, in which role he was accused by Voltaire of preventing entry into France a consignment of books containing the historic *La tolerance*. But his connections and position among the elite horsemen were unassailable. He had furnished excellent remounts for cavalry regiments of the King and had eradicated glanders as a scourge of military horses.

Bourgelat was supported by another native of Lyon with a close relationship to its Academy of Equitation: Henri Bertin, the comptroller of finances under Louis XV. A lieutenant general of the Paris police, Bertin was a favorite of the king’s mistress Madame de Pompadour and used this influence to obtain a Royal Charter for Lyon. King Louis XV gave the new school the title of the Royal Veterinary College when it opened to students in January 1762. Two years later, using his political power to override opposition from local farriers, Bertin called Bourgelat to Paris to found the second French school, l’École Vétérinaire Nationale d’Alfort.

In the next decade the French schools prospered and were visited by influential veterinarians from other European countries who returned home to establish veterinary schools in Vienna, Copenhagen, London, Edinburgh,
Skara (Sweden), and Brussels. In Germany there were new schools in Berlin, Hannover, Munich, and Stuttgart, and Russia founded schools in Kharkov (now Ukraine), Dorpat (now Tartu, Estonia), and Kazan—all dedicated to veterinary science, some making astounding discoveries. In France, rinderpest led the government to create a third veterinary school in Toulouse directed toward diseases of cattle. The first veterinary school in the United States was a direct legacy from Toulouse; the first in Britain was from Lyon.

In England, successful farmers and “gentlemen of rank, fortune, and ingenuity” assembled in Odiham’s George Tavern on May 16, 1783, to discuss how to encourage agriculture and industry in Hampshire. Establishing the Odiham Agricultural Society, they resolved to reform farriery and animal care by establishing a school to teach veterinary science. Granville Penn, a leader of the group—and grandson of William Penn—was sent to London to seek out the immigrant Lyon veterinary school graduate Charles Benoit Vial de Saint-Bel. The expatriate Frenchman had taught in the veterinary school at Alfort but, quarreling with Bourgelat, he returned to Lyon as head of the

*The Cow-Doctor* depicts the high status of veterinarians in Europe in the mid-1880s. (Charles Cousen, English engraver, 1854; after a painting by Edmond Tschaggeny, Belgian, 1845. © Wellcome Images.)
A SCIENCE HERITAGE

Academy of Equitation and to serve as one of the horse masters of Louis XVI. Failing to be appointed at Alfort when Bourgelat died and tainted by connections to nobility—Bourgelat is alleged to have contributed to the charge that Vial was an enemy of the government—Charles Vial fled revolutionary France for England with ideas of starting his own school for veterinarians. Planning together, he and Penn established a London committee of the Odiham Agricultural Society to secure funds for a veterinary school.

Notoriety for their cause occurred in 1789 when the Western world’s most famous racehorse, a tall English thoroughbred named Eclipse, died of colic. Eclipse had dominated the racing seasons of 1769 and 1770 and stood at stud for nineteen years. To find the cause of death and to explain his extraordinary athleticism, the owners found only one qualified veterinarian for the task: Charles Vial; his autopsy of Eclipse revealed a massively enlarged heart. The publicity of Vial’s report was an important assist in the birth of a London veterinary school.

Financial support for the new London school came from livestock organizations and fifty guineas from the Duke of Northumberland. Perhaps more important, there was strong encouragement from London medical scientists, including the famed anatomist/surgeon John Hunter—he had discovered the circulation of blood in the body—and in the end, from Parliament. The veterinary school building was constructed in 1791 in Camden Town of St. Pancras Parish, close to stables that served the London transport system. The next January it opened as the Veterinary College, London, with four students studying toward a veterinary certificate. Successful in the first decade, the school was granted a Royal Charter and christened the Royal Veterinary College.

Two years later, Charles Vial was dead of glanders. He had suffered in great pain for seventeen days with boils and buboes in different parts of his body—the same massive and disseminated lymph node swellings in the horse he had treated and from which he had acquired the disease. Vial died on August 21, 1793. John Hunter also died that year; he had been the leading surgeon and medical scientist of the eighteenth century and had strongly supported the college, arranging for veterinary students to attend his medical lectures.

Losing Vial’s leadership and Hunter’s scientific support, science in the Royal Veterinary College declined, and with it the competency and luster it had accrued. Edward Coleman, its new principal, seemed to lack inquisitiveness for science and creativity, as well as enthusiasm for change. The journal The Veterinarian was founded in London in 1828; in the second volume (1829),
editors Percival and Youatt, both veterinary surgeons, condemned the weaknesses of the college in London, accusing the two faculty—Professor Coleman and his assistant—of “abuses and mismanagement” and writing that the school should “correct the existing evils, and establish our claims to respectability.” Other damning editorials soon appeared, one stating that “many valuable horses have been destroyed by the ignorance of men who have been pupils at the Royal Veterinary College for a short period.” What was needed, they said, were longer months of study, more anatomical demonstrations, and practice in techniques of surgery, laboratory work, and the forge. All agreed on the need for a committee to contact Parliament to enact a law to restrict farriers from practicing as veterinarians.

Farriers responded in the journal. An anonymous retort signed only by “A Farrier” maintained that farriers provided better horse care than that provided by the Royal Veterinary College. But farriers knew nothing of the diseases of food-producing livestock that were a major concern of educated veterinarians. There were cattle plagues other than rinderpest in the English countryside, some of them contagious to humans, making it dangerous to be a cow doctor. Diseases killing animals were not only killing farmers and veterinarians, they were being passed through meat and milk into the cities.

Raw milk, with its contaminants of disease-causing bacteria, could be hazardous, especially if it came from cows with tuberculosis. Increasing in the 1700s because human urban populations were growing, tuberculosis, known as the white plague, was killing hundreds of citizens. The disease most often insidiously attacked the lungs but could also settle in the bones, intestines, brain, or any other organ. Many cases of tuberculosis were caused not by the human bacillus but from the bovine tuberculosis bacillus, gotten through impure raw milk. In Germany one farm family, all “herculean in stature and boastful of strength and health,” had been stricken when they purchased a group of Simmental cattle, all infected with bovine tuberculosis. Within a year, the thirteen-year-old daughter and eighteen-year-old son developed pulmonary tuberculosis and died. The next year a twenty-three-year-old son died. The year after that the mother, remaining daughter, father, and finally the third son died.

Pesky skin diseases moved from cow to herdsmen and milkmaids. There were scabies parasites that crawled into the skin just where they readily jumped to humans, and ringworm that when brushed onto the arms grew in nasty inflammatory rings until treated with turpentine. And there was cowpox. Teats of milk
cows developed painful pocks that spread to the hands of milkers. Starting as small vesicles, they progressed to pustules and then to scabs that peeled away in a week or two; there was no fatality, and milkers with cowpox recovered without developing serious illness. There was even an old wives’ tale that cowpox was beneficial—milkers having had cowpox were not susceptible to the plague of smallpox. The tale was true. It was the impetus for the greatest medical discovery of the century—and perhaps ever—which was reported in London in 1798 and had begun with a disease of cattle.

2. EDWARD JENNER:
ZOOLOGIST, PHYSICIAN, PIONEER

In the mid-1700s, human smallpox was a horrific and disfiguring lethal disease that decimated global human populations. Called by physicians variola (from the Latin varius, for speckled), smallpox spread from patient to patient through the mouth and nose. Physicians called it a contagion—a disease caused by contact. No one knew about the cause or that, after silently multiplying locally in the tonsils for a week or so, massive amounts of variola virus were released into the bloodstream. As it spread throughout the body, there was debilitating fever, headaches, and collapse; lodging in the skin, smallpox virus speckled the victim with ugly vesicles, pustules, and scabs, if the patient survived that long.13

To lessen the mortality, physicians offered a risky preventative, variolation—scraping a tiny piece of scab from a sick smallpox patient into the skin of the forearm of a healthy person.14 A local smallpox pustule would develop on the variolated arm and the variolated patient would sicken but survive; the peripheral site of infection would bypass massive viral replication in the tonsils, providing time for an immune response that could prevent disease from being fatal; but not always—variolation still carried a risk of serious disease and death from smallpox.

In the dairy farming country of Southwest England, cows carried their own pox virus. Cowpox appeared on the teats and udder of milk cows as vesicles, then pustules, and finally scabs that healed within a few weeks. The pustules would “degenerate into phagedenic ulcers, which prove extremely troublesome. The animals become indisposed, and the secretion of milk is much lessened.”15 The problem was, cowpox was a zoonotic disease—transmissible to people.