Pioneer Science and the Great Plagues

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Runnells, and Leon (Zlotnick) Saunders achieved international fame in Texas, Michigan, and Pennsylvania. Perhaps his greatest legacies were two graduate students who became pioneers in veterinary medicine: Margaret Sloss, a woman, and Frederick Douglass Patterson, an African American.

25. NEW DEAL: DISCOVERIES IN INFECTIOUS DISEASE

Comparative medicine appeared as an academic department in the largest and more progressive medical institutions in the 1930s. Their mission was to exploit animal models of human genetic diseases, cancer, and nutritional deficiencies. It was a golden opportunity to systematically investigate how those diseases developed, using experiments in animals that could not be done in humans. Departments dedicated to comparative pathology appeared at research institutions as diverse as the University of Michigan, the Armed Forces Institute of Pathology, and the Mayo Clinic.

As microbiology had become an integral part of medicine, zoonotic diseases—tuberculosis, tetanus, and other diseases transmitted from animals to humans—moved to a dominant position in scientific research. Brucellosis was a centuries-old killer that caused abortion in cattle, contaminated milk, and involved a spectrum of disease in humans that included acute “undulant fever,” neurobrucellosis, and chronic infections of the spine. It was taking a heavy toll on farmers and consumers alike. In 1936, the Bureau of Animal Industry did field trials in Illinois, Ohio, Maryland, and Wisconsin on a new vaccine for brucellosis that would prevent abortion in cattle. The results were so good that strain 19 vaccination of calves was officially adopted to control brucellosis in cattle.

The brucellosis success story had started with a sick cow in the BAI dairy herd in Maryland. Victor’s Lady Matilda, born in Pennsylvania, joined the BAI’s herd, where she established two records for milk production before becoming sterile. Serologic tests indicated she had brucellosis, and John Buck, a BAI bacteriologist, isolated the causal *Brucella abortus* from Lady Matilda in June of 1923. Having determined the bacterium to be virulent, he moved on, mislaying a single slant culture under some papers, where it stayed for two years.16

Later, when Buck’s research had not been going well (killed bacteria were not working as vaccines), he remembered Louis Pasteur’s vaccine for fowl
cholera, which had come from a dried bacterial culture that had been mislaid. He wondered if his cultures stored at room temperature for two years might also have become weakened—that they might not cause disease yet persist as an infection long enough to make a cow immune. The resurrected bacteria were passed through 19 cultures in the lab (the final culture was called *Brucella* strain 19) and injected into calves. The results astonished Buck: calves given strain 19 developed antibodies and were protected as pregnant adults from abortion; and, just as important, the mutant strain 19 did not spread within the herd. By 1936, the new strain 19 brucellosis vaccine was being used by veterinarians throughout North America.

PROGRESS IN TECHNIQUES FOR CULTURE of bacteria and for understanding how bacteria caused disease in animals and humans had been astonishing. Viral diseases were another matter. Some viruses would infect mice in the laboratory, but most had been impossible to culture in the lab and were difficult to propagate in any meaningful way. A major breakthrough in virus research appeared in 1931. Ernest Goodpasture, a medical pathologist at Vanderbilt University, discovered that many viruses would grow in membranes of the developing chicken embryo. Within a year, influenza virus was being grown in chick embryos. Viruses that caused smallpox, chickenpox, mumps, and yellow fever also grew in chick embryos and were funneled successfully into vaccine production. Research laboratories studying viruses began to order embryonating chicken eggs by the thousands. A chick embryo rabies vaccine was developed to replace the dangerous Pasteur vaccine made of animal brain emulsion. The newly emerging encephalitis-causing mosquito-borne viruses—named arboviruses—grew well in chick embryos; the system was used to produce vaccines for horses against a newly emerging disease, western equine encephalitis. In 1938 a brain-tissue, formalin-killed vaccine had been available, but it was replaced the next year by a more effective vaccine grown in the new chick embryo technology.

AT IOWA STATE COLLEGE, funds accrued from the disenfranchised and demolished State Biological Laboratory for hog cholera antiserum production were used to purchase land south of the campus and to build the Veterinary Research Institute. One of the first mandates was to investigate the confusing syndromes of encephalitis in cattle and horses. One of the institute’s contributions was to differentiate the emerging mosquito-borne viral disease western equine
encephalitis from “moldy corn encephalitis,” which was shown to be due to a
toxin from the *Fusarium* fungus that grew on corn."

The Veterinary Research Institute at Iowa State had dropped some projects
to concentrate on this new emerging disease. Western equine encephalitis virus
in horses was most serious west of the Mississippi River. In the U.S. there were
3,929 cases reported in 1936, 173,889 in 1937, and 184,862 in 1938. The virus had
been first isolated from a horse brain in the San Joaquin Valley in California
by veterinarian Karl Friedrich Meyer, an American Swiss-born veterinarian.
WEE had slowly moved through the West, spreading in a bird-mosquito life
cycle. Horses and humans were dead-end hosts; they did not circulate virus in
the bloodstream to perpetuate the infection back into the mosquito vector.

The institute had just solved a similar problem in cattle. For four decades a
lethal brain disease of cattle called sporadic bovine encephalomyelitis had been
killing young cows throughout the Midwest. Calves would become stiff, knuckle

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Veterinary students were taught the practical aspects of veterinary pathology in the postmor-
tem room, where they collected specimens of diseased tissue for microscopic examination.
Here: autopsy tables in the new Stange Memorial Clinic in 1939. Professors Runnells *(left)*
and Benbrook *(right)* are in white coats. Runnells finished his career at Michigan State
University, where he wrote the first complete textbook on veterinary pathology.
at the fetlocks, stagger, circle, and fall over. Most would have peritonitis and inflammation in membranes lining the other body cavities. Some veterinarians suspected the disease was caused by a virus; others, a plant poison or toxin. The villain turned out to be a tiny bacterium (now named *Chlamydia percorum*). It was discovered in Iowa at the Veterinary Research Institute in the late 1930s by veterinarian Sam McNutt, who grew the bacterium in the yolk sac epithelium of a developing chicken embryo. According to historian Leon Saunders, “the delineation as a clinical, pathologic, and etiologic entity was due to the efforts of one man—S. H. McNutt.”

**Driving out to the west edge of Eden Township in August 1939, Iowa veterinarian Roy Conaway was to attend to a three-year-old quarter horse stallion owned by Hugh Alexander. The acreage lay on the timbered and grassy valley of Clear Creek. Hugh was a good horseman and had two days previously noticed that his stud had been off feed and unable to drink, the water running out of his nose as he tried. By the end of the day he was grinding his teeth and the muscles of his lips and jaw as well, as his tongue and tail seemed to be paralyzed. The next morning, he was lethargic and “stupid,” his head hanging low, his demeanor depressed, and unresponsive to stimuli; by nightfall he was walking in circles in one direction, swaying and stumbling. This morning he had been unable to rise after falling.**

For Conaway, the diagnosis was easy: high fever, time of year, grassy lowland, progressive neurologic signs—all of which had appeared in three other horses in the area the previous weeks. The brain of one had been sent to the diagnostic laboratory at “the college” and the report had come back as western equine encephalitis—scary because human patients had developed encephalitis caused by the same virus. It was very closely related to the more ferocious eastern equine encephalitis virus isolated in 1931 from horses in Massachusetts (and from thirty children who died in 1938 in the Northeast).

Roy Conaway had been an outstanding athlete who had played football and run track in college. A good student, he was strong and sleek—and highly intelligent. He taught surgery for one year at the new veterinary school at Oklahoma A&M College and had been assistant state veterinarian in Missouri. At the top of his game, he had a beautiful wife and two handsome children. But in the physically demanding rural practice, he would tragically succumb to common risks for veterinarians in rural practice of the time—speed and alcohol. The
faster you drove through the countryside the more calls you could make, and more calls meant more money. But speed and alcohol proved fatal. Driving late and alone on a bitter cold January night, Doc Conaway was killed instantly in a one-car crash.

Late summer of 1939 was an uneasy time. Hitler’s troops had massed along the German-Polish border, Franco ruthlessly consolidated power in Spain, and a Soviet-Japanese confrontation in Mongolia exposed Japan’s plans for Asia. Life was unsettling at home as well. Residue of the long Depression and the 1925 Scopes Monkey Trial had fostered conservatism and even creationism that was
persisting in rural areas of the country. Steinbeck published his earthy novel *The Grapes of Wrath* in 1939 as a literary response to the Dust Bowl and Great Depression. An immediate best seller, it was burned in bonfires of protest to its language in several places and was banned in Kern County, California, one of the locations in the story. The book was banned in Illinois, St. Louis, and Kansas City, as well as in Ireland and Turkey (where publishers were arrested). Defenders took to the press, suggesting that those banning the book were “afraid of change and new ideas.”