Duncan McEachran, Montreal, 1895. Credit Nicolas Reusens **Below, Dr. Louis Auzoux's anatomic model of a horse, at the Museum of Anatomy of the National Veterinary School in Toulouse, France.**

Duncan McEachran and the One Health movement

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The father of modern pathology, physician Rudolf Virchow wrote in the early 1880s "…between animal and human medicine there are no dividing lines—nor should there be." [1] He recognized the association between human and animal disease and medicine that had been loosely made for centuries, and presaged the concept now known as One Health—the integrative effort of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals, and the environment. The One Health Initiative includes physicians, veterinarians, dentists, nurses, and individuals in allied disciplines. Its mission statement is:

> Recognizing that human health (including mental health via the human-animal bond phenomenon), animal health, and ecosystem health are inextricably linked, One Health seeks to promote, improve, and defend the health and well-being of all species by enhancing cooperation and collaboration between physicians, veterinarians, other scientific health and environmental professionals and by promoting strengths in leadership and management to achieve these goals.[2]

The medical aspects of this mission include two principles:

1. There is a close biological relationship between humans and animals, with the implication that understanding one species can lead to better understanding of the other; and

2. There is an overlap of human and animal disease illustrated, for example, by the potential of its transfer from animal to man.

Duncan McEachran, veterinarian, professor, and founder of the Montreal Veterinary College (MVC), played an important role in promoting these ideas in the 19th and 20th centuries, foreshadowing the development of the One Health movement.

Disease associations

There are many examples of animal-human-environmental disease associations. Zoonotic (animal to human) transmission is one of the more obvious and important, representing the largest source of emerging infectious diseases today. It is associated with almost 60 percent of the 400 newly identified diseases since 1940.[3]

In 2002, a species of coronavirus—the cause of severe acute respiratory syndrome (SARS)—crossed the species barrier from bats to humans, and within four months spread globally, representing the first pandemic of this millennium.[4] Fortunately, it was quickly contained, and there were only 550 (14%) deaths among the 4,000 reported cases.

By contrast, avian influenza H5N1 represents a more serious and ongoing threat, with the virus sporadically jumping from chickens to humans. Although human-to-human transmission has not been documented, and only 846 cases of H5N1 influenza had been reported by February 2016, 449 (53%) of these were fatal.[5]

More recently, the West African Ebola virus epidemic, suspected to have originated in bats, caused more than 28,000 deaths, the largest and most protracted outbreak of human Ebola infection to date.[6]

Understanding the interconnectedness of humans, animals, and their shared environment forms the basis for prevention and control of diseases such as these. The One Health approach is the embodiment of this philosophy.

The early history of One Health is most clearly evident in the field of infectious disease. In the 18th and 19th centuries, general observation and advances in scientific

Pasteur inoculating a sheep against anthrax. Engraving, 1883. Courtesy Wellcome Images

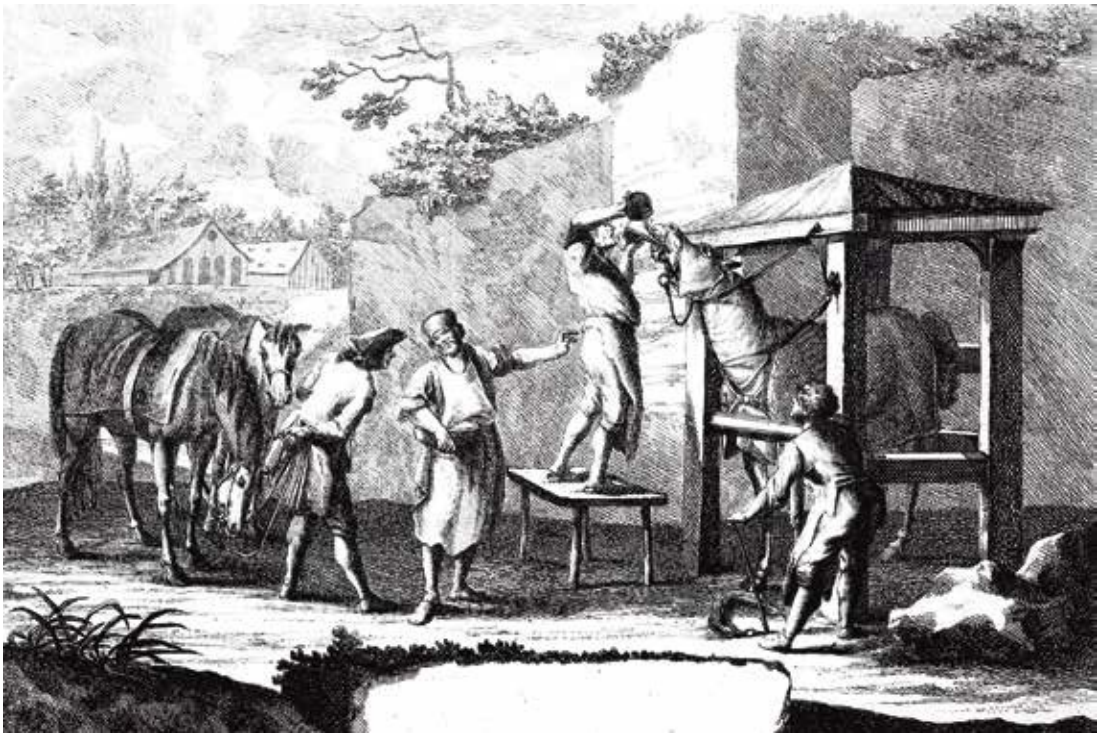
methodology led to the hypothesis that animal diseases such as glanders, anthrax, and rabies could be transmitted to people.

In 1820, Jean Hameau, a family practitioner in Bordeaux, France, first reported human death from glanders when he described a veterinarian who died with pustular disease after months of caring for infected horses under poorly sanitized conditions.[7] In addition to such direct human consequence, recognition of the socioeconomic importance of the animal-human association led to societal-political involvement. As a result, a national chair of comparative medicine in France was established. Pierre Rayer, a physician scientist who had a long-standing interest in a comparative approach to medicine, became the first director.[7]

Disease transmission research

Research involving animals was first directed toward understanding economically important disease. However, as the potential for transmission between humans and animals was increasingly appreciated, animals began to be used as models to study human disease. At the time, it was commonly thought that disease transmission occurred through contagion—either miasmatically (via "bad air") or zymotically (via direct contact).

The study of pyaemia and septicemia helped advance understanding of such transmission and was based, in part, on discoveries reached through collaborations



Horse doctor giving medicine to a horse, engraving with etching, 18th century.
Courtesy Wellcome Images

between human and animal research. For example, Bernard Gaspard, a rural physician, injected animals with putrid human vomit, bile, or urine in a variety of experiments between 1808 and 1821.[7] In the published report on his findings he anticipated the possibility of reciprocal transmissibility from animals to humans, and advised people to avoid eating "black gamy meat, stinking game-birds, putrid ragouts, and infected cheeses."[7]

Francois Magendie, the French physiologist infamous for his vivisectionist experiments, anticipated germ theory with the discovery that purulent fluid was less harmful after it was sifted.[8]

Following these and other discoveries, the concepts of One Health blossomed in Europe—particularly in France and Germany—where international political competition, stringent organization, and a spirit of collaboration between medical and veterinary science provided the perfect conditions for the field's development.[7]

Such collaboration was particularly productive in providing the foundation for germ theory. In 1850, French physician Casimir Davaine studied what would become known as anthrax.[9] Inspired by Louis Pasteur's work on fermentation, Davaine injected a rabbit with blood from sheep infected with anthrax. After the rabbit died, he injected a second rabbit with blood from the infected rabbit—the second rabbit also died. He then observed the second rabbit's blood under microscope and described a rod like structure in the blood, which he posited to be the cause of the disease. Pierre Rayer, who assisted in these experiments, had previously described the same corpuscles in infected sheep blood as "small filiform bodies in the blood, about twice as long as a blood corpuscle."[9]

In the 19th century, Robert Koch was inspired by Davaine's findings and began investigating anthrax.[9,10] After replicating earlier experiments on mice, Koch was able to more completely characterize the nature of the disease when he provided an explanation for why pastures inhabited by anthrax-infected animals were unusable for years after infected animals had grazed there. He found that Davaine's rod-shaped organisms were able to form long filaments and produce granules with a hard protective shell in favorable moist environments. In dry conditions the filaments would disintegrate, but the spheres would remain. When the dried granules were placed in a moist environment, the rod-shaped organisms would appear. Koch postulated the existence of "spores"—resilient but inactive forms of the microorganism developed under difficult environmental conditions.

Louis Pasteur helped to confirm Koch's discovery in 1878 when he placed anthrax-infected sheep blood onto sterile culture, allowed the bacteria to grow, and repeated this several times until he was certain that none of the original rods remained in the dish. He then infected a sheep with organisms from this final culture, proving that the bacterium was to blame.[11]

Duncan McEachran

McEachran was born in Scotland, and graduated from the Edinburgh Veterinary College in 1861. Following his immigration to Upper Canada in 1862, he joined the Upper Canada Veterinary School (later the Ontario Veterinary College) in Toronto. He taught pharmacology and, together with the school's founder Andrew Smith, coauthored a veterinary textbook for Canadian farmers, *The Canadian Horse and His Diseases*.[12]

As a result of pedagogical differences with Smith, McEachran moved to Montreal in 1865, and received a $300 grant from the Board of Agriculture of Lower Canada, which he used to found the Montreal Veterinary School, the first such institution in Quebec.[14] In 1873, the School was renamed the Montreal Veterinary College, and was relocated to a new, state-of-the-art building constructed at considerable personal expense to McEachran. In addition to offices and a student lecture room, the building included a teaching library and museum, a dissecting room, a large animal ward that could accommodate 20 horses, and a small animal infirmary.

The MVC was conceived in the context of McEachran's personal vision of veterinary medicine, and included a number of innovative features. It was the first institution to teach veterinary pathology in North America,[12] a feature that coincided with his invitation to William Osler to join the college's faculty.

The MVC syllabus was modeled after that of the McGill University Faculty of Medicine, and McEachran sought to have it affiliated with MgGill.[15] In contrast to the business-like model of Andrew Smith's Upper Canada Veterinary College, where a large number of students with lower credentials were admitted, McEachran placed high value on academic excellence. He established stringent requirements, including an entrance exam, a three-year course (unlike the two years of other programs), and graduated 10 students in the first few years, compared to 130 in Toronto.[15,16]

The MVC had a large museum with hundreds of models, casts, and other teaching specimens. One of the most spectacular was a life-size anatomical model of a horse fabricated by the French physician Louis Auzoux. At a cost of $1,000, it consisted of 1,000 painted pieces that the student could take apart and put back together to help learn the animal's anatomy.

The MVC curriculum had strong roots in the concepts of One Health.[13,17,18] It was broadly based, and included courses in anatomy, dissection, materia medica, medicine, surgery, veterinary obstetrics, physiology, histology, chemistry, and botany.[16] As a result of its ties with McGill, most teaching was performed by McGill professors from that faculty rather than veterinarians. If graduates from MVC completed an extra year of study in the McGill medical school they could be certified as physicians.

Two of the most noteworthy staff at MVC were Sir William Osler and Albert Clement. Osler was recruited in 1876 to teach physiology, histology, and pathological anatomy.[18,19] He was quite popular, and it was said that he "was able to bring his famous 'bedside teaching' methods to the stables."[19]

McEachran encouraged Osler to undertake research in comparative pathology, which he did on several occasions.[12] In his eulogy to Osler in the *Canadian Medical Association Journal*, McEachran wrote:

> He considered it of the greatest importance that students should be students of general medicine and their course of instruction should embrace comparative anatomy and comparative pathology, no matter which branch they intended to make their life work.[18]

Clement, a veterinarian, also made significant contributions to One Health. In 1885, he published the first pathology paper by a veterinarian in North America, in which he described the kidney in equine azoturia (later known as equine rhabdomyolysis).[12] He completed a year of postgraduate study in Berlin and England, where he was inspired by the potential for collaboration between human and animal medicine.[13] In a talk at the MVC he discussed examples of comparative medicine which he had seen in Europe, including treatment of human disease based on animal models. After his return to North America in 1889, Clement published a textbook on veterinary post-mortem examination, in which he advocated for the use of the animal autopsy such as that taught by Virchow for the investigation of human disease.

In 1889, the MVC became a formal part of McGill University and was renamed the Faculty of Comparative Medicine (in part on the suggestion of Osler).[18] This change was undertaken to enhance the status of veterinary medicine, and to emphasize the importance of general medical education to veterinary practitioners. At the same time, courses in bacteriology, zoology, cynology (the study of dogs), and comparative pathology were incorporated into the curriculum.[16,17]

McEachran pushed the bounds of One Health farther than pathology and physiology when he postulated similarities between the human and animal psyche. He founded

Montreal Veterinary College, Union Avenue, Montreal, circa 1895.
© McCord Museum

Sir William Osler, MD, taught physiology, histology, and pathologial anatomy at Montreal Veterinary College. Bettmann / Contributor

the Society for Comparative Psychology in 1887, and advanced the notion that the animal psyche has a depth and expression similar to that of the human child. Such ideas foreshadowed the evolution of veterinary medicine in the 20th century by focusing on animal emotions, particularly with respect to suffering.

McEachran's insistence on quality was partly responsible for the decline of the MVC, as its strict entrance requirements and longer study period hindered student enrollment. An additional complication was competition from new French-language veterinary schools in Quebec, led by McEachran's former pupils. The decreasing enrollment combined with a lack of an endowment and aging equipment, forced the MVC to close its doors in 1902. It had been a remarkable institution—ahead of its time—and because of his work, McEachran was named Professor Emeritus.

McEachran also had significant input in the second aspect of One Health—the overlap of human and animal medicine. During his inaugural lecture at the MVC he discussed the threat of contagious disease to national livestock and how, while living in the Scotland, he had witnessed the failures of a weak government in preventing the spread of animal disease.[14] He was outspoken to the Canadian government of "inspection, quarantine, and disinfection."[14] Recognizing his enthusiasm and knowledge, in 1876 he was named by the Canadian government as Chief Inspector of Livestock, and in 1884 Chief Veterinary Inspector, a position he held until 1902.

In the late 19th century, there was debate whether *Mycobacterium bovis*, the organism causing tuberculosis in cows, was transmissible to humans. McEachran rightly believed that the ingestion of cow milk from a tuberculous udder could lead to the spread of bovine tuberculosis in humans, and he published a paper promoting this concept.[18] He was also one of the first proponents of the tuberculin skin test in Canada and argued (unsuccessfully) for universal testing in presentations to the Montreal Board of Health, and other health agencies.[18] He was a member of the Milk Commission of Montreal, and recommended pasteurization and safe distribution of milk years before these measures were adopted. From 1890 to 1902, McEachran developed a research program to investigate bovine tuberculosis in animals using a rare variant with obvious udder disease compared to the more common variant without udder disease. He was unable to complete the project as he could not find enough experimental subjects.

Pig lung containing *strongyloides*, 1877.

One Health today

The concepts of One Health may not be integrated as formally in teaching as they were in McEachran's time; however, its ideas and practices are still important for practitioners of both veterinary and human medicine. Although not always successful, McEachran attempted to advance these concepts in his teaching, research, and everyday practice. T.W.M. Cameron, in an essay about veterinary education in Canada published in 1938, said:

> It is generally agreed that [the vet student's] training should have the closest association with human medicine, and if McEachran's ideas had been carried out by other colleges—not only in Canada—nothing but good would have resulted from them.[19]

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