Commentary

The role of the colleges of veterinary medicine in realizing the research mission of land-grant institutions to promote animal, human, and environmental health

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The period from 2011 to 2013 marks a convergence of milestone anniversaries for three major events important in the history of veterinary medicine in the United States and the world. In 2011, the veterinary profession celebrated the 250th anniversary of the founding of the first veterinary school in Lyon, France, in 1761 by the French veterinarian Claude Bourgelat. The school was commissioned by King Louis XV to promote the prevention of cattle diseases, most notably cattle plague (rinderpest), a disease that caused widespread deaths of cattle and famine for hundreds of years until its eradication in 2011.1 In the United States, 2012 marks the 150th anniversary of land-grant institutions, which were established by the Morrill Act of 1862.2 The Morrill Act of 1862 granted to each state 30,000 acres of federally controlled land for each of its congressional representatives, with the stipulation that the states develop the land or use the funds from the sale of the land to establish a land-grant college to promote liberal and practical education in agriculture, military tactics, and the mechanical arts. Congress enacted and President Lincoln signed the Morrill Act of 1862 in response to the needs of the industrial revolution and to make education accessible to the working class. In each state, the land-grant institution became known as the people’s university and, in most instances, evolved into the state’s flagship university and was considered the state’s leading comprehensive public research institution. Lastly, the AVMA was first established as the United States Veterinary Medical Association in 1863, and 2013 marks its 150th anniversary.

Many have written about land-grant institutions and their role in educating the citizenry of the United States, but we intend to highlight the research mission of these institutions, particularly the role that the colleges of veterinary medicine at these institutions have played in the advancement of science and how they have and can continue to have a positive impact on animal, human, and environmental health. This year, 2012, marks the midpoint of these three anniversary celebrations and should serve as an opportunity for the colleges of veterinary medicine and the veterinary profession as a whole to reflect on and learn from our rich collective past, use their knowledge and wisdom to nourish and strengthen our land-grant institutions, and develop, implement, and foster a strategic and forward-thinking approach to address complex challenges, seize once-in-a-lifetime opportunities, and help shape the future.

History, Purpose, and Evolution of Land-Grant Institutions

Representative Justin S. Morrill addressed the US House of Representatives on April 20, 1858, in support of a bill that eventually would be passed and signed into law as the first of the Morrill Land-Grant Acts. Most identify the Morrill Act of 1862 with the establishment of universities to educate the populace, but the intent of the original bill was more far-reaching as detailed in Morrill’s comments3:

We need a careful, exact, and systematized registration of experiments—such as can be made at thoroughly scientific institutions, and such as will not be made elsewhere. These tests and these tables, so furnished, will give us, when reported and collated, as is provided for in this bill, a rational induction of principles upon which we may expect to establish a proper science; and the more widely gathered are the facts, the sounder the science. The discoveries of Columbus-struck amateurs will not be trumpeted forth until they have received the sanction of a body less sanguine than the vendors of a patent. Spurious dogmas will be touched lightly with the spear of Ithuriel, and no longer squat around the ears of weary plowmen.

The passage of the Morrill Act of 1862 led to a monumental shift in higher education from private, church-sponsored colleges and universities that were accessible only to the elite to a system of public, nonsectarian, federally assisted universities accessible to all.4 The idea of land grants was innovative, in that Congress chose to use federally owned land rather than cash to encourage states to accept the land-grant charter. The land was to be sold to create “at least one college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics [which evolved into what we now know as the Reserve Off-
of Veterinary Medicine

Twenty-five of the 28 existing colleges of veterinary medicine in the United States were established by and are located at land-grant universities. Colleges of veterinary medicine and veterinarians working in many capacities have contributed to animal and human health and the land-grant mission through discovering the cause of infectious, often zoonotic, diseases; developing tests to diagnose various diseases; finding cures for or developing vaccines to prevent diseases; pioneering new surgical procedures to improve the health, lives, and function of animals and people; discovering methods to enhance milk production or feed efficiency and growth in food-producing animals; developing methods to improve reproductive efficiency and preserve genetics through assisted reproductive techniques; fostering production of a plentiful and safe food supply for the ever-growing human population in the United States and the world; participating in comparative and translational research involving spontaneous diseases of animals, clinical trials, and experimental animal models of human diseases that helps unravel the mysteries of major human health concerns (eg, cardiovascular disease, cancer, HIV infection and AIDS, osteoarthritis, and diabetes); helping to identify effective methods to protect and preserve ecosystems and the environment; and preparing tomorrow’s veterinarians, veterinary specialists, educators, research scientists, and vanguard thought leaders. Animal diseases are estimated to reduce livestock production by >20%; thus, the prevention and control of animal diseases have both health and economic benefits. In the United States, losses attributable to disease are minimal, compared with those of other countries, which has largely been due to research into and the eradication of many diseases still found in other parts of the world.

Research Contributions of Colleges of Veterinary Medicine to Animal and Human Health

The historic investment in land-grant universities and specifically the colleges of veterinary medicine at these institutions has produced substantial, meaningful research accomplishments that have benefited animals, people, the environment, and the economy. An early example of this type of research that resulted in multiple, sustained benefits is the control of Texas cattle fe-

Land-Grant Universities and Colleges of Veterinary Medicine

The fundamental principles of land-grant institutions, including accessibility, practical as well as classical education, research and discovery in the public’s interest, and connectedness to all the people (ie, teaching, research, and outreach) remain relevant, powerful, and profound. The Kellogg Commission on the Future of State and Land-Grant Universities modernized the mission of land-grant institutions and proposed reconsideration of the tripartite mission of teaching, research, and outreach, reframing it as learning, discovery, and engagement, which implies inclusivity, collaboration, a commitment to sharing, and reciprocity. Dr. John R. Campbell, former dean of a college of agriculture and president of a land-grant university, and whose daughter is a professor of clinical medicine at a land-grant college of veterinary medicine, eloquently summarized the immeasurable contributions and impact of land-grant institutions in Reclaiming a lost heritage:

Through teaching, research, and public-service programs, land-grant colleges and universities have contributed immensely to the overall growth, productivity, and efficiency of the U.S. economy. This greatly benefits all of society. Educated people contribute new ideas for the improvement of technology and organization applicable to business and industry, government, and nonprofit entities. Most ideas are not patentable, and they are quickly imitated, facilitating wide diffusion of their benefits.

Beyond the original land grants, each land-grant institution receives annual federal appropriations for research and extension on the condition that those funds are matched by state funds.

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The Morrill Act also established the system of historically black universities for its citizens to achieve a better life. The agricultural component was enhanced by the Hatch Act of 1887, by which the Congress added the charge to conduct research and experimentation in the public interest and provided federal funds to establish agricultural experiment stations at each institution. The Hatch Act furthered federal support for research and discovery, establishing the government’s role in stimulating economic growth and giving rise to today’s research universities. The Smith-Lever Act of 1914 promoted dissemination and application of knowledge to end users via the Cooperative Extension Service. With this act, Congress mandated a third mission for land-grant institutions and established a new funding mechanism involving a three-way partnership between federal, state, and county governments. The second of the Morrill Land-Grant Acts, the Morrill Act of 1890, established the system of historically black universities, and in 1994, 29 tribal land-grant institutions were established the system of historically black universities to serve the nation and the world.

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ver (Babesia bovis infestation). In 1893, Drs. Theobald Smith and Fred Kilbourne identified the parasite that causes Texas cattle fever and also identified the tick as the agent of the medical world, a discovery that introduced the concept of arthropods functioning as vectors of diseases. Dr. Mark Francis, the first graduate of the College of Veterinary Medicine at The Ohio State University, joined the faculty of Texas A&M University in 1888 and became the first dean of its College of Veterinary Medicine in 1916. Dr. Francis worked on methods to control Texas cattle fever and developed a method for SC vaccination against Texas cattle fever, an accomplishment that facilitated the expansion and improvement of the livestock industry and led Francis to be named the father of the Texas cattle industry. Additional advances that have greatly benefited animal agriculture include the diagnosis and prevention of coronaviral respiratory and enteric diseases in cattle and transmissible gastroenteritis and influenza in swine and the development of vaccines to prevent a host of viral and bacterial diseases of poultry. Horses and the equine industry have benefited from Coggins’ landmark work allowing for the identification of horses harboring the equine infectious anemia virus. Other researchers have advanced medical and surgical science, improving diagnostic testing and prognosis for horses with colic and laminitis, foals with septicemia, and animals with a variety of infectious diseases or performance-limiting conditions.

The increasing importance of cats and dogs in our lives has created a demand to extend the length and improve the quality of their lives. The veterinary research community’s response to the emergence of canine parvoviral diarrhea in the 1970s is an example of the benefits of developing and maintaining a capacity for research. The disease was initially reported in 1978. By 1979, the causative agent was characterized. By 1980, a diagnostic test and an inactivated vaccine were developed. By 1982, a modified-live virus vaccine was developed, and by 1984, a rapid diagnostic test became available.

Zooeya, the positive benefits on human health resulting from people interacting with pets, is well established, and there is a growing body of evidence documenting improved physical, social, and mental health in people who share their households and environment with pets. Animals, especially dogs, are increasingly being used in animal-assisted activities with humans, including oncology patients and veterans. This field of study is one that should not be diminished, and veterinarians are poised to take the lead in investigating the impact of pets on human health and wellness and to use this knowledge to improve the well-being of people.

The recognition that many conditions and diseases that affect people have analogs in animals has led to a number of scientific advances that have benefited both. Research directed at the origins of cancer in humans led to the development of a vaccine to prevent leukemia in cats. Veterinary research on FeLV, bovine leukemia virus, and FIV has contributed important knowledge toward the understanding of HIV. In addition, our early understanding of oncogenic viruses came from breakthrough studies conducted on poultry with Marek disease that led to a new appreciation of the role of viruses causing cancer. Advances in fracture fixation, total joint replacement, osteoarthritis, and cartilage repair are a few orthopedic examples of how knowledge flows bidirectionally to benefit both animal and human health. Foundational work on parasites such as Toxoplasma spp and Cryptosporidium spp has led to improved detection and treatment of related diseases in animals and humans. More recently, the rise of translational medicine and one health initiatives has brought these potential synergies to the forefront. Advances in the diagnosis, prevention, and treatment of zoonotic diseases such as encephalitis and influenza and conditions such as infertility and trauma benefit all. The current emphasis on facilitating the transfer of basic research from the bench to the bedside (or cage or stall side) has led to a new era in cooperation between researchers investigating animal and human diseases, particularly in the area of comparative oncology. Molecular genetics and comparative genomics, new fields that have provided important investigative and diagnostic tools, have contributed immensely to our understanding of human and animal diseases, especially those with a genetic or inherited component. Because animal and human genomes have so much in common and because correlates of some human diseases are also manifested in dogs and other animals, research can be advanced more rapidly through collaboration among veterinarians, physicians, and other scientists. Such interactions often facilitate important discoveries that have important diagnostic, therapeutic, and preventive applications in people and animals.

One Health—Animal, Human, and Environmental Health

Colleges of veterinary medicine have long been active in the arena we now know as one health or one medicine. Rudolf Virchow, a 19th century German physician, coined the term zoonosis and stated, “Between animal and human medicine there is no dividing line—nor should there be. The object is different but the experience obtained constitutes the basis of all medicine.” Dr. James Law, founding dean of the College of Veterinary Medicine at Cornell University, stated in 1878, “If physicians are left ignorant of the affection in the beast, and veterinarians of the same in man, they each miss the golden link which would reveal the true nature and dangers of the disease, and enable them to contend with it successfully…Both branches of medicine suffer from separation. Each is necessary to the rapid progress and highest advancement of the other.” More recently, Dr. Calvin Schwabe, who coined the phrase one health and is credited as the father of veterinary epidemiology, rearticulated this concept in Veterinary medicine and human health when he stated that “our increasing interdependence with animals and their products has spurred the medical and veterinary professions to readdress such an approach.” He spent his career practicing and teaching the principles of one health and laying the foundation for a collaborative and interconnected approach toward the animal-human-environmental health triad. Dr. Jim Steele, a veterinarian-
ian, was a leader who helped to pave the way for the contributions of veterinarians in public health.13

The convergence of people, animals, and our environment brought about in part by increased contact between humans and wildlife, import of exotic animals, intensification and integration of food production, and globalization with the expansion of international travel has created a new dynamic by which the health of humans and animals and the well-being of the environment of each are inextricably linked.14 The challenges associated with this dynamic are demanding, immense, and unprecedented. The demand for animal-based protein is expected to increase by 50% by 2020, wild animal populations are under heightened pressure to survive, and biodiversity is at risk. Of the more than 1,460 diseases now recognized in people, approximately 60% are due to multihost pathogens that affect multiple species. Our increasing connectedness and interdependence with animals and animal products may well be the single most critical risk factor to our health and well-being with regard to infectious diseases. The United States recently was declared free from canine rabies, in large part because of the role of veterinarians in vaccination campaigns. Yet, worldwide, there are approximately 50,000 deaths each year attributable to rabies. Improving animal health also improves human health, as with the elimination of rabies.15

The 1999 outbreak of West Nile virus infection in New York City reemphasized the linkage between animal and human health and disease. Initially, wild crows began dying, then people became ill. Human health experts failed early on to recognize the relationship between the death of crows and illness in people. It took the efforts of an astute veterinarian working at the Bronx Zoo to tie it together when exotic birds under her care became ill. Her persistence, observations, and discovery reaffirm the veterinarian’s role in the diagnosis, treatment, and prevention of zoonotic disease. In 2003, the United States experienced outbreaks of West Nile virus infection, monkey pox, and SARS; none of these zoonoses had ever been found previously in the western hemisphere. These events emphasize that we are living in a new era of emerging infectious diseases, in which the role of veterinarians is gaining in acceptance and importance. The broad-based educational background of veterinarians, including basic biomedical and clinical sciences, comparative medicine, population medicine, preventive medicine, and public health, combined with their familiarity and training with multiple species, critical thinking, clinical reasoning, and problem solving, prepares them well for serving important leadership roles in promoting one health. Veterinarians can best accomplish this and promote animal, human, and ecosystem health by fostering productive collaborations with other health professionals.

Continuing Research Roles and Opportunities for Colleges of Veterinary Medicine

Academic veterinary medical centers and animal disease diagnostic laboratories in the United States and around the world are the gatekeepers that oversee, monitor, manage, and influence decisions regarding veterinary and comparative medical research. These entities have the unique combination of access to spontaneous animal diseases, resources to provide state-of-the-art diagnostic testing and therapeutics, and the passion and commitment of veterinarian clinician-scientists and research scientists for scholarly pursuits that are essential to recognize and explore new and complex diseases that warrant further investigation. Previously unrecognized or poorly understood animal diseases are often first recognized at land-grant institutions, and veterinarians who work at these facilities must decide which of the challenging problems they encounter can and should be investigated in greater depth. In the words of Dr. John B. Tasker, “Through their work in the increasingly important areas of population medicine, preventive medicine and public health as well as through their continuing efforts to understand new diseases presented by individual animals with poorly understood problems, veterinarians and animal disease specialists will continue to be the giants upon whose shoulders others will stand.”10

Clinical trials devoted to discovering new or promising treatments for naturally occurring diseases can yield cutting-edge diagnostic tests, treatments, or preventive measures that advance veterinary medicine and improve animal health and well-being. Appropriately designed clinical trials can determine whether a new experimental treatment has a therapeutic effect on the animal’s disease, whether the new or experimental treatment is better than the current standard treatment, and whether the procedure or treatment is well tolerated. Clinical trials are a new, emerging, and growing field of research in veterinary medicine. In addition, studies involving the use of banked tissues (eg, tumors for cancer research), blood cells (eg, for genetic testing), and fluids such as serum, plasma, and urine (eg, for biomarker studies) have direct utility toward the advancement of animal health and often provide useful comparative data applicable to human medicine.

Investments in Animal and Human Health Research

The success of colleges of veterinary medicine at land-grant institutions in bettering the health and lives of animals and people has been possible because of the physical and human infrastructure that early visionaries worked to establish. Sources of funding and expenditures for all US veterinary colleges from 2001 through 2011 are illustrated (Figure 1). The mean amount of state funds contributed to the 28 US colleges of veterinary medicine was > $20 million in 2010 and 2011. From this investment, the colleges generated mean additional revenue of $48 million to attain mean total revenues of $68 million for 2010 and 2011. A major portion of this revenue is gained through faculty members successfully competing for research dollars. Research expenditures for the 28 US colleges of veterinary medicine totaled > $500 million in 2010 and 2011. Approximately 44% of this total originates from sources dedicated to human health. The remaining dollars come from sources with potentially broader intended outcomes, including the betterment of animals and the environment, with approximately 7% of expenditures being funded by the USDA. Faculty research funding...
what kind of financial support for colleges of veterinary medicine and the far-reaching benefits of the investments made in veterinary medical education and research on the well-being of people, families, and society as well as the economy. As we celebrate the 150th anniversary of the land-grant system, it is appropriate to reflect on this seminal piece of legislation that has greatly improved our lives yet is often underappreciated. The land-grant institutions that have served us so well in the past remain very much relevant today, although in a different context. Their commitment to education, research, service, and outreach represents the cornerstone of academic veterinary medicine and is critical in addressing contemporary challenges in our interconnected and complex world.

**References**


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