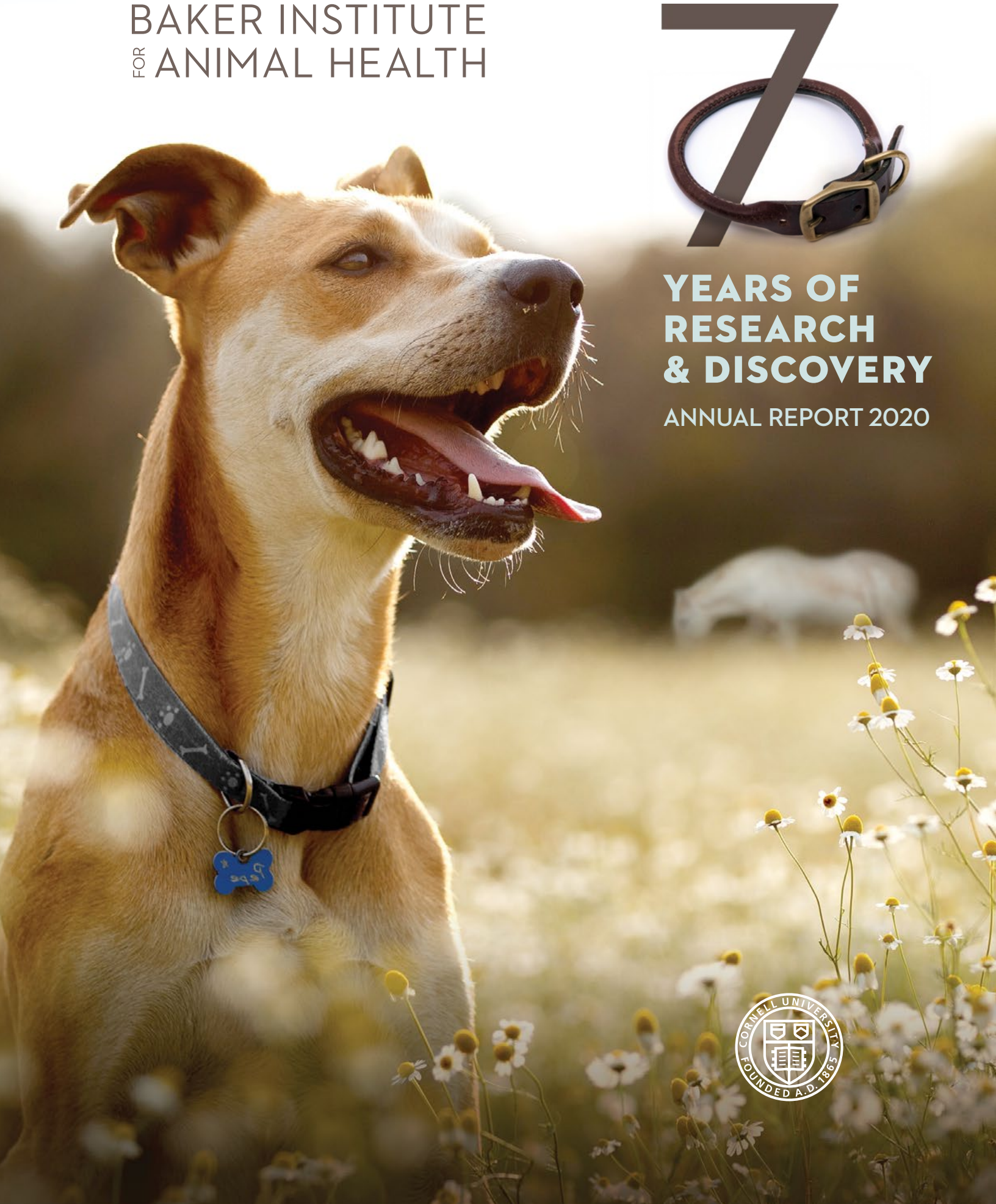
BAKER INSTITUTE
FOR ANIMAL HEALTH



7 YEARS OF RESEARCH & DISCOVERY

ANNUAL REPORT 2020

CORNELL UNIVERSITY
FOUNDED A.D. 1865

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Dear Friends,

The Baker Institute for Animal Health celebrated its 70th anniversary this year. To commemorate this milestone, in this year's Annual Report, we will recount some of the history that has taken place here on the hill overlooking Cornell University. Additionally, we will share how that history is impacting and guiding our current research and discovery efforts.

When thinking about my first full year as the Institute's Director, I never would have imagined that we would be operating under the "new norm" of a world-wide pandemic, however, in March of this year that is exactly what happened. While COVID-19 initially impacted the work of our faculty, staff and students at the Baker, upon research reactivation, our labs quickly got back up to speed and all of our research programs are now fully functional. Importantly, given our historical and ongoing focus on virology and infectious diseases, we were well-positioned to quickly help combat this disease head on. Similar to our proactive response to the parvovirus in 1980, as you will see in this report, our virology experts have responded to this pandemic by initiating cutting-edge COVID-19 research projects aimed at finding new ways to combat this horrific disease.

Additionally, this year's annual report will also give you many opportunities to learn more about the historical foundation that the Baker Institute is built on, and the direction we are headed. From our many great faculty that have left a lasting legacy, such as Leland "Skip" Carmichael, DVM, Ph.D. '59, who we sadly lost this year, to those faculty and trainees that are laying the groundwork of our future. This year, while we are looking back to celebrate our first 70 years, we also have an eye towards the future and are excited about what the next 70 years will bring.

Finally, I would like to note that, because we are highlighting some of the Institutes achievements over the last seven decades, this report is fairly content-rich. We hope that you appreciate this material and enjoy reading about our great history.

Sincerely,

Dr. Scott Coonrod
Judy Wilpon Professor of Cancer Biology
Director, Baker Institute for Animal Health

Directors: Past and Present

1950-1975 ..... Dr. James A. Baker
1976 -1991 ..... Dr. Douglas McGregor
1991 –1993 ..... Dr. Leland "Skip" Carmichael
1994 –2009 ..... Dr. Douglas F. Antczak
2009 -2010 ..... Dr. Judith A.Appleton, Interim Director
2010 –2016 ..... Dr.Colin R. Parrish
2016 –2019 ..... Dr. Luis M. Schang
2020 –current ..... Dr. Scott A. Coonrod

BEHIND THE SCENES

70 YEARS OF ANIMAL HEALTH DISCOVERIES AT THE BAKER INSTITUTE

Article written by Patricia Waldron, further edits by Baker Institute for Animal Health

The Baker Institute has evolved and grown since its founding 70 years ago on a hill overlooking Cornell University, when it was surrounded by mud from its construction. The Veterinary Virus Research Institute, as it was called at the time, was formed to address viral diseases in a menagerie of species, including cats, pigs, trout, and cattle. Over the ensuing decades, although research on livestock declined, an equine program was established, and the Institute's breakthroughs in the prevention and control of canine infectious diseases established the Institute as a global center for animal health research, including groundbreaking work in immunology, genetics, and cancer.

Over the 70 years the faculty grew in size, and the Institute underwent multiple expansions and renovations to accommodate new avenues of research.

What has not changed is the faculty's commitment to improving animal health. Through both basic veterinary and biomedical research that underlies our deepest understanding of biology, and applied work that bridges the gulf between laboratory results and new therapies, Baker Institute scientists have continued to tackle challenging problems and emerging diseases.

"The Institute has evolved but it has not lost its compass," said former director Dr. Douglas Antczak, Dorothy Havemeyer McConville Professor of Equine Medicine. "There has been continual necessary change that has kept the work at the Institute cutting edge, forged by the faculty and their passions for different aspects of veterinary medicine and animal health."

Baker's Beginnings

Dr. James Andrew Baker, known as Drew to his friends, was the driving force and founding Director of the Institute. The Cornell University Board of Trustees voted to establish the Institute on September 20, 1950, and the Cornell Research Laboratory for Diseases of Dogs was dedicated on January 5, 1951 as a division of the Institute. Baker had joined the faculty at Cornell in 1947, moving from the Rockefeller Institute, a prominent medical research center in New York City. During the Second World War he had worked on livestock viruses, including rinderpest, a now extinct relative of measles that was incredibly deadly for cattle. At the new Veterinary Virus Research Institute, he developed vaccines to protect pigs against hog cholera—now known as swine fever—and various diseases of cattle.

The Institute was the perfect place for disease research—close enough to be affiliated with Cornell, but sufficiently isolated on Hungerford Hill (off of Snyder Hill) for faculty to work safely with infectious organisms. Baker set up laboratories and facilities for rearing disease-free animals, including a herd of cattle from the Rockefeller Institute that had no exposure to known viruses or some disease-causing bacteria, so they were perfect subjects for studying pathogens.

Baker was not only an excellent scientist; he also had a genius for fundraising and recruited prominent philanthropists to support the Institute. Robert Woodruff, the president of the Coca-Cola Company was a co-founder. In the early years, Baker received support and guidance from John M. Olin, a Cornell alumnus and vice president of the Winchester Repeating Arms Company and Chairman of the board of the Olin Corporation. Olin was an avid duck hunter with kennels full of hunting dogs that Baker had vaccinated against infectious hepatitis virus, now called canine adenovirus. Olin helped recruit fellow hunting enthusiasts to support the Institute's work in dogs. Nancy Sayles Day and Colonel Lee Garnett Day, an executive of General Foods and Mrs. Rowena Teagle, the wife of the president of Standard Oil, were important early patrons. Geraldine Rockefeller Dodge, a Standard Oil heiress and avid dog enthusiast, donated funds to build the first ever tissue culture facility for veterinary research, so the institute's scientists could study diseases in cell cultures instead of live dogs.

The Cornell Research Laboratory for Diseases of Dogs was the first permanent unit established for conducting research on dog diseases to be funded by private donations. Hundreds of dog owners, veterinarians, kennel clubs, hunt clubs, philanthropists and companies fill the donor list of the 1951 annual report.

One of the first disease targets was canine distemper—referred to as simply "the disease"— which commonly struck puppies, causing respiratory symptoms, vomiting, neurological problems and death. Two Institute scientists who later went on to distinguished careers in the Cornell University College of Veterinary Medicine (CVM) made major discoveries about this disease. Dr. James Gillespie isolated the "Snyder Hill" strain of the distemper virus, which was used to develop a vaccine for the disease. Simultaneously, Dr. George Poppensiek (later Dean of CVM from 1959 to 1974) was developing the first vaccine for canine adenovirus, which caused especially severe symptoms in dogs that were already infected with distemper. The researchers also developed the first dual vaccine for dogs, which protected against both viruses. They reportedly tested the efficacy of the dual vaccine in Olin's hunting dogs before laying out guidelines for the nationwide vaccination program that occurred in 1960.

Research on distemper continued at the Institute all the way up to the 1990s, as canine distemper is still a threat to unvaccinated dogs, and is often severe in wild animals. For two decades, Dr. Max Appel's lab produced distemper vaccines for zoos. In the 1990s, he identified a strain of distemper that was killing lions on the Serengeti Plain in East Africa and helped protect endangered black-footed ferrets from lethal infection with canine distemper virus which threatened to drive them to extinction.

One of Baker's first graduate students was Leland "Skip" Carmichael, DVM, Ph.D. '59 who was appointed to the John M. Olin Professorship in 1963, just four years after completing his Ph.D. early in his 41- year career at the Institute, Carmichael discovered the bacterium Brucella canis and developed a diagnostic test for the organism which was widely applied by breeders in the control of the abortion that is caused by Brucella. Carmichael also discovered and isolated canine herpesvirus, which can affect puppies and also cause reproductive disease in adult dogs.

Additional research from the early days focused on the bacterium responsible for kennel cough and the development of vaccines for leptospirosis, a bacterial infection of dogs and other animals transmitted through soil and water.

In the 1960's, Olin urged the Institute to begin an "all-out campaign" to solve a scourge of hunting dogs—hip dysplasia. Biochemist Dr. George Lust was recruited to the faculty and spent decades researching the genetic and environmental factors that contribute to this degenerative condition. Richard King Mellon, the heir to the Mellon fortune, was also a great supporter of this research.

A TIMELINE: 70 YEARS OF RESEARCH AND DISCOVERY

1950'S

Sept. 1950 - The Baker Institute was founded. Formerly the Veterinary Virus Research Institute (VVRI), under the leadership of its founding director, Dr. James A. Baker. The institute made major contributions in its first two decades to the control of diseases of livestock, especially bovine and swine diseases such as rinderpest and hog cholera.

Location was selected so that the Virus Institute was close to the University, yet far enough in the country for the rearing of animals and un-contamination of feed supplies.

The Cornell Research Laboratory for Diseases of Dogs was dedicated on January 5, 1951 and paved the way for significant research into virus diseases and vaccine development for dogs.

1952 - Vaccine for Canine Infectious Hepatitis - John M. Olin, a Cornell alumnus and vice president of the Winchester Repeating Arms Company and Chairman of the board of the Olin Corporation was one of the Institute's original philanthropist. An avid duck hunter with kennels full of hunting dogs, the most well-know of which is King Buck, Olin relied on Dr. Baker to vaccinate them against infectious hepatitis virus, now called canine adenovirus.

The Cornell Research Laboratory for Diseases of Dogs was the first permanent unit established for conducting research on dog diseases to be funded by private donations. Hundreds of dog owners, veterinarians, kennel clubs, hunt clubs, philanthropists and companies fill the donor list of the 1951 annual report.

1955 – In its 5th year of operation, the Institute doubled its size of total laboratory facilities by replacing The General Laboratory with a Microbiology Building funded by Colonel and Mrs. Lee Garneet Day and Mr. John M. Olin.

That same year, Geraldine R. Dodge funded the establishment of the world's first tissue-culture laboratory for veterinary use at the Institute. This technological advance made it possible to cultivate a host-specific organism like infectious hepatitis without infecting dogs, and to attenuate, or weaken, the live viruses over time in culture, thereby greatly improving the predictability and safety of vaccines.

1960's

Vaccine for canine distemper Developed - Dr. James Gillespie isolated the "Snyder Hill" strain of the distemper virus, which was used to develop a vaccine for the disease. Simultaneously, Dr. George Poppensiek (later Dean of CVM from 1959 to 1974) was developing the first vaccine for canine adenovirus. The researchers also developed the first dual vaccine for dogs, which protected against both viruses. They reportedly tested the efficacy of the dual vaccine in John Olin's hunting dogs before laying out guidelines for the nationwide vaccination program that occurred in 1960.

1963 - Dr. Leland "Skip" Carmichael discovered the bacterium Brucella canis and developed a diagnostic test for the organism which was widely applied by breeders in the control of the abortion that is caused by Brucella.

1968 - Biochemist Dr. George Lust was recruited to the faculty and spent decades researching the genetic and environmental factors that contribute to the degenerative condition of canine hip dysplasia.

1970's

1972 - Dr. Leroy Coggins, invented the "Coggins test" for equine infectious anemia (EIA). Coggins completed his PhD at the Baker Institute in 1962. He studied viruses that cause diarrhea with Dr. James Andrew Baker. Later Coggins returned to Cornell University and developed his famous test for EIA.

1974 - First Practical Test for Diagnosis of Canine Brucellosis is developed by scientists at Cornell.

Carmichael discovered and isolated canine herpesvirus. Additional research during this time focused on the bacterium responsible for kennel cough and the development of vaccines for leptospirosis.

On April 14, 1975 - Dr. James Baker passed, and Cornell University honored him by renaming the Institute the James A. Baker Institute for Animal Health.

1976 - Dr. Douglas McGregor assumed leadership of the Institute as the Director.

1978 - A mysterious disease that caused vomiting, severe diarrhea and death spread in dogs worldwide, Drs. Carmichael, Pollack and Appel quickly responded. Appel first identified the canine parvovirus in the summer of 1978.

1978-1981 – Baker Institute researchers determined that parvovirus was a never-before-seen virus, developed a diagnostic test and created and licensed their vaccine strain to companies to produce a parvovirus vaccine that has since saved millions of dogs from this devastating disease.

Changes and New Challenges

On April 14, 1975, Baker died suddenly, just months before the institute's 25th Anniversary. That year the Board of Trustees of Cornell University honored him by renaming the Institute the James A. Baker Institute for Animal Health.

A year later, Dr. Douglas McGregor assumed leadership of the Institute. McGregor was a medical doctor who had most recently been working at the Trudeau Institute in Saranac Lake, New York, a former tuberculosis sanatorium and renowned biomedical research center. He had built up a large and active lab studying the role of white blood cells called lymphocytes in developing immunity and was excited to expand his lab and join the immunology research already underway at the institute.

With McGregor's leadership came a shift in how the institute funded its research. According to Appel, Baker had a "You give me results and I will give you the money" strategy for distributing the results of his fundraising. But McGregor realized that external research funding, primarily in the form of large, project-sustaining awards from the National Institutes of Health (NIH), was a more sustainable approach. As the faculty began securing external grants, McGregor continued to fundraise, building up the endowment. NIH funding enabled researchers to tackle biomedical problems that afflicted both humans and animals, while donations allowed them to confront new threats and to conduct veterinary research that was harder to support through external funding. This model continues to remain how the Institute operates today.

"I think we were very lucky having recruited a scientist of Doug's (Dr. McGregor's) caliber to lead the Institute at a critical point in its history," said Dr. Roy Pollock, chief learning officer of the 6Ds Company, and a former graduate student who worked with Carmichael. "He challenged the Institute to elevate its science to the next level."

In 1978, when a mysterious disease that caused vomiting, severe diarrhea and death spread in dogs worldwide, Carmichael, Pollack and Appel were quick to respond. Appel first identified the canine parvovirus in the summer of 1978. With nowhere else to turn, veterinarians and pet owners from all fifty states began calling the Baker Institute and sending fecal samples for testing. "I hated getting my mail," said Pollock. That summer the lab fielded more than 10,000 phone calls and letters about parvovirus.

In the next three years, Appel, Carmichael and Pollock determined that parvovirus was a never-before-seen virus, developed a diagnostic test and created a vaccine by growing a less virulent form of the virus in cell cultures. The Institute's isolation, disease-free dog kennels, tissue culture facility, faculty expertise and donor support, all made it the ideal place to tackle the disease. "That was a unique combination that allowed the Institute to make far more progress on this problem than anybody else. It was a very exciting, confusing and fascinating time," said Pollock.

The researchers licensed their vaccine strain to companies to produce a parvovirus vaccine that has since saved millions of dogs from this devastating disease. For many years, the parvovirus vaccine was also the largest source of patent income for Cornell University.

"Every dog in the U.S. now is vaccinated against distemper, adenovirus and parvovirus. The institute faculty were involved in the development of each of those vaccines," said Colin Parrish, Ph.D. '84, John M. Olin Professor of Virology. "The reason we don't talk about distemper or adenovirus anymore is because they've basically been controlled and eradicated by the vaccine. Although the parvovirus is largely controlled in dogs by the excellent vaccines available, some cases of severe or even lethal disease in puppies still occur due to the difficulty of ensuring that all puppies are vaccinated and protected before they encounter the viruses that circulate in nature."

Parrish completed his graduate work on parvovirus in Carmichael's lab and "we've been studying the virus since then," he said. He spent time in Australia as a post-doctoral researcher, then returned to the institute as a faculty member in 1988 and a year later identified the mutation that – before 1978 - had allowed a cat virus called feline panleukopenia virus to transform into canine parvovirus, triggering the pandemic. His lab continues to drill down into the structure and evolution of parvovirus, which enabled it to jump from cats to dogs with devastating results. Along with serving as Baker's director from 2010 to 2016, Parrish has remained on the forefront of emerging viruses, and his laboratory has also studied the H_3N_8 and H_3N_2 canine influenza outbreaks that occurred after 2000 and 2015, respectively.

The Growth of Molecular Biology

Throughout the 1980's and 1990's, the institute added faculty members and made improvements to the facilities and equipment. "The lab has a tradition of keeping up with technology," said Dr. Judith Appleton, Alfred H. Caspary Professor Emeritus of Immunology. Appleton joined the institute as a postdoctoral researcher in McGregor's group in 1982 to investigate how the immune system responds to trichinosis and other parasites that invade the body through the intestine, and stayed on as a faculty member. She retired in 2019 after serving as a Vice Provost for Cornell University for six years.

Appleton emphasizes, however, that "one of the most important products of the institute is the trainees who go on to other places." Numerous trainees, from high school students to postdoctoral researchers, have come through Baker's labs. Seven former trainees have been appointed deans of veterinary colleges and one is a university president.

Many students in DVM programs have participated in the Cornell Leadership Program for Veterinary Students, started by McGregor in 1983 to cultivate new generations of veterinary scientists. The program provides veterinary students with mentoring and a summer research experience. Since its inception, over 690 students have participated, and about one third have attained Ph.D's, and many have gone on to research careers in veterinary and other health research. The program is now directed by John S. L. Parker, BVMS, Ph.D. '99.

1980's

1981 - Baker Institute scientists created an improved attenuated vaccine for parvovirus. Carmichael was the principal researcher who investigated and developed the first CPV-2 vaccines.

1982 - Dr. Judith Appleton, Alfred H. Caspary Professor Emeritus of Immunology joined Dr. McGregor's lab at Baker as a postdoctoral researcher to investigate how the immune system responds to trichinosis and other parasites that invade the body through the intestine, and stayed on as a faculty member. She retired in 2019 after serving as a Vice Provost for Cornell University for six years.

1983 - Colin Parrish identifies the mutation that caused worldwide canine parvovirus pandemic: a virus that before 1978 - had allowed a cat virus called feline panleukopenia virus to transform into canine parvovirus, triggering the pandemic.

1983 - Cornell Leadership Program for Veterinary Students is started by Dr. Douglas McGregor to cultivate new generations of veterinary scientists.

1988 - Dr. Colin Parrish returns to Baker as a faculty member and begins his over 30-year career investigating viral host jumping and emerging viruses.

1990's

1994 - Dr. Douglas Antczak becomes director. During his 15 years at the helm, oversees the building of two new wings and renovation of lab spaces.

1995 – 2006 – Antczak's research focused on a study of the horse genome. Twilight, one of his research mares bred, born, and raised at Cornell's McConville barn, was the first horse to have its genome sequenced as part of the international Equine Whole Genome Sequencing Project.

1997 - Researchers at CVM's Baker Institute and the Fred Hutchinson Cancer Research Center publish the first linkage map of the canine genome in the journal Genomics.

2000's

2001 – Groundbreaking for the new west wing of the Institute, which includes the Thaw Charitable Trust Lecture Theater.

2001 – Patent issued for DNA-based test for Congenital Stationary Night Blindness (CSNB).

Drs. Gregory Acland and Gustavo Aguirre contributed to mapping the dog genome and made tremendous strides identifying and locating genes related to canine eye diseases and blindness.

2002- The new building is dedicated, making the Institute a world-class research center. The $12.5 million, 40,000 square-foot infrastructure houses 10 laboratory suites, tissue culture rooms, core space for high-tech microscopy work and a lecture theatre.

2006 – The Antczak's labs' horse, Twilight, serves as Genome Donor - after 10 years of work, the mare's 2.7 billion base pair genome was fully sequenced and served as a resource for genomics investigations around the world.

2007 – Dr. Alexander Travis successfully completes stem cell transplantation in a dog and also harnesses the power of proteins found in the tail of a sperm for a new field of science called nanotechnology.

2007 – Dr. George Lust and colleagues groundbreaking discovery of the first panel of genetic markers that lead to genetic testing for the diagnosis of canine hip dysplasia.

2008 – A patent is issued for Acland and Aquirre's Collie Eye Anomaly/Choroidal Hypoplasia (CEA/CH) Test. The OptiGen test for CEA/CH provides a powerful management tool for the breeder.

2009- Dr. Douglas Antczak inducted into the Equine Research Hall of Fame.

2009 – Dr. Alexander Travis receives one of NIHs most prestigious awards, the NIH Director's Pioneer Award.

2010's

2010 – Antczak's lab develops a genetic test to prevent the breeding of horses with Lavender Foal Syndrome, a deadly genetic condition in Arabian horses.

2010 - Origins and evolution of A/H3N8 canine influenza and equine influenza discovered by work in the Parrish lab.

2011 – Dr. John Parker takes over as Director of the Leadership Program for Veterinary Students.

2013 - First Puppy Born from a Frozen Embryo in the Western Hemisphere. Klondike was born from the frozen embryo of a beagle mother and lab father thanks to work by Baker Institute for Animal Health researcher Dr. Alexander Travis.

2015 - As a result of the continued work of the Travis lab, the first puppies born by in vitro fertilization (IVF) were delivered on July 10, 2015 at the Baker Institute. This advancement could help preserve endangered canine species and open new means for discovery in human and canine genetic diseases.

2016 – Dr. Gerlinde Van de Walle named the Harry M. Zweig Assistant Professor in Equine Health and receives the Zoetis Award for Veterinary Research Excellence and an Excellence in Teaching Award from Cornell.

In 1994, Antczak became the new director and during his 15 years at the helm, built two new wings and renovated many of the older lab spaces. The growth of the Institute also mirrors the huge expansion of molecular biology research that has occurred during the same era. Scientists at the institute made rapid-fire discoveries identifying the cause of genetic diseases affecting reproduction, the skeletal system and vision.

In his own work, Antczak has studied equine genetics and immunology. In one study he has bred horses with a very narrow gene pool to understand the role of a set of immune genes in responding to disease and also revealing how a pregnant mother is able to tolerate the developing fetus within its body. A member of this herd named Twilight was the first horse to have its genome sequenced as part of the Horse Genome Project that began in 1995. The sequence, completed in 2006 has revolutionized all aspects of equine research. Among other accomplishments, Antczak's lab has also developed a genetic test to prevent the breeding of horses with Lavender Foal Syndrome, a deadly genetic condition in Arabian horses.

In dogs, Drs. Gregory Acland and Gustavo Aguirre contributed to mapping the dog genome and made tremendous strides identifying and locating genes related to canine eye diseases and blindness. This work led to genetic tests for night blindness in Briard dogs, a malformation called retinal dysplasia in Labrador retrievers and Samoyeds, and a condition called Collie eye anomaly. With colleagues, they also developed a gene therapy technique to reverse blindness—the first gene therapy applied in a large animal. In 2017, the Food and Drug Administration approved a gene therapy to treat a rare form of human blindness based on Acland and Aguirre's work in dogs.

"There are children today who are no longer legally blind, having been treated successfully with the same gene therapy eye treatment that Aguirre developed in dogs," said Antczak.

Looking Forward

In the Institute's recent history, faculty have continued to make foundational discoveries and develop new technologies that will no doubt advance their field. For example, Dr. Alexander Travis is developing new reproductive technologies that resulted in the first puppies born by in vitro fertilization in 2015. And Dr. Charles Danko, Robert N. Noyce Assistant Professor in Life Science and Technology, is building novel computational tools to understand the processes by which different genes are turned on and off, and how that contributes to animal evolution, development and disease.

With the success of vaccines developed at the Baker Institute and elsewhere, most dogs no longer die from viruses or bacteria, but live long enough to suffer from diseases of aging, like cancer. Baker scientists are taking up the challenge to address these problems. "One of the strengths of the institute is that it does very high-quality basic science to help define the mechanisms of disease—both infectious and non-infectious diseases—and understanding those mechanisms are going to lead to better diagnostics and better treatments," said Keith Richter, '79, DVM '81, DAVCIM, a veterinary gastroenterologist and chair of the Baker Institute/Feline Health Center Advisory Council.

Currently, labs at the Institute are investigating human breast cancer and mammary cancer in animals. Brooke Marks, a graduate student working with Dr. Scott Coonrod, the Judy Wilpon Professor of Cancer Biology and current Institute Director is investigating why a common type of tumor called estrogen-receptor-positive (ER+) breast cancer becomes resistant to drugs that should keep it in check. About 70 percent of all breast cancer cases are ER+ and are routinely treated with drugs that block or degrade the estrogen receptors the tumors use to grow. However, up to 40 percent of those tumors will become resistant to the drugs and evolve new ways to proliferate. Marks is using gene editing technology in breast cancer cell cultures to turn on genes one at a time and see which ones are involved in developing resistance to the drugs.

"Our goal is to look at other mechanisms or pathways that promote resistance," said Marks.

"If we can identify these pathways, hopefully we can help these patients either with combination therapies or an alternate therapy." This work may also find biomarkers that can identify patients who are likely to develop resistance.

Dr. Gerlinde Van de Walle is taking a broader approach to mammary cancer by comparing cells from two types of mammals: those with high rates of the disease, like humans and dogs, and those that rarely develop mammary cancer, such as cows and horses. "Thanks to the wide variety of veterinary species and wild mammals we can examine, we can find clues as to why species differ in their likelihood of developing mammary cancer," said Van de Walle. So far, she has identified differences between the two groups in molecules called microRNAs, which regulate which genes are turned on or off inside cells. If these same differences can be detected in women or animals with mammary cancer, the research could lead to a useful diagnostic test for breast or mammary cancer.

Van de Walle's group also has identified defense mechanisms produced by cows and horses that may attack tumor cells as they arise. "Down the road, that could be a novel therapeutic," said Van de Walle. She recently received a grant from the Schwartz Research Fund for Women and other Underrepresented Faculty in the Life Sciences to explore these differences in more detail by transplanting mammary tissues from different species into mice.

"Mammalian species are so similar. Learning insight into one species is going to provide insight into other species as well," said Coonrod. "Putting those different types of researchers together is how we've really made progress in the past, and how we will continue to advance the health of animals in the future."

2018 – Release of the world's first canine embryonic atlas by Dr. Vicki Meyers-Wallen.

2018 – Dr. Douglas Antczak receives lifetime achievement award in equine reproduction.

2019 – Dr. Louis Schang identifies a new mechanism that plays a role in controlling how herpes virus alternates between dormant and active stages of infection.

2019 - Dr. Charles Danko, is named Robert N. Noyce Assistant Professor in Life Science and Technology. Danko's work focuses on building novel computational tools to understand the processes by which different genes are turned on and off, and how that contributes to animal evolution, development and disease.

2019 – Van de Walle's group confirms an equine parvovirus she discovered in 2018 with Dr. Thomas Divers is the source of Theiler's disease, a fatal liver disease in horses. This finding imparts regulatory change at the United States Department of Agriculture.

2019 - Dr. Roy Cohen along with Dr. Alex Travis develops a device that helps diagnose stroke, demonstrating proof of principle, that the technology eventually could be expanded and used in point-of-care testing devices to diagnose other conditions in humans and animals, including traumatic brain injury, some forms of dementia, and even some types of cancer and heart disease.

2020's -

Van de Walle's lab in their study of stem cells showed mesenchymal stromal cells (MSCs) from horses secrete protein-busting enzymes that break apart bacterial matts called biofilms allowing antibiotics to be more effective against bacteria, including MRSA.

Dr. Alexander Travis invents new 'Cap-Score' test designed to provide information on a man's fertility to help assist couples struggling to conceive.

Dr. Douglas Antczak leads international team of scientist to findings that genetic study of Arabian horses challenges beliefs about the ancient breed.

The Coonrod lab makes ground on splenic hemangiosarcoma, an aggressive vascular tumor often called a "silent killer" in dogs through a genome-wide Chro-Seq approach to better understand the molecular pathogenesis of this lethal disease so that they can identify novel tumor-specific molecules that can be developed as biomarkers and therapeutic targets.

LAB UPDATES: A GLIMPSE OF THE PAST...

THEN: In 1970 **Dr. Max Appel** was appointed to Associate Professor at the Baker Institute. Appel completed his DVM degree in Germany, and then was the first graduate student of Leland "Skip" Carmichael, DVM, Ph.D. '59, during which studies he became an expert on the canine distemper virus that was causing serious disease in dogs. His success in unmasking the origins and workings of distemper led to improved vaccines for dogs, as well as a vaccine that saved the once endangered species of black footed ferrets of the American West. His work has also helped to save lions in the Serengeti ecosystem in Africa, and also wild cats in the wildlife parks in the USA. Red pandas have also been protected from distemper thanks to Appel's vaccines. In 1978 when a virus similar to feline panleukopenia virus (FPV) was observed in dogs, Appel, along with Carmichael, set out and were successful in isolating what we now know as canine parvovirus (CPV). The team, along with then-graduate student, Dr. Roy Pollack, spent the next three years determining the pathogenesis and means of transmission of the disease, devising the first diagnostic test, and perfecting the first attenuated live vaccine for the disease. That vaccine brought millions of dollars in royalties to Cornell University, and similar products are still used worldwide today.

COLIN R. PARRISH, PH.D. '84

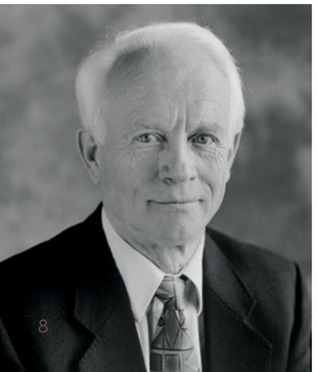
John M. Olin Professor of Virology

NOW: **Dr. Colin Parrish,** another graduate student of Carmichael, helped develop the first vaccines for canine parvovirus in the early 1980s. Since that time, Parrish, the John M. Olin Professor of Virology and former director of the Baker Institute, investigates the viruses behind global pandemics and epidemics, and also studies how diseases spread between different animals as well as to humans. The long-standing work on canine viruses started in the 1950's by Baker, Carmichael and Appel allows for extended studies, including 42 years of parvovirus research. Parrish's team have studied both the FPV and CPV, and have found that all aspects of their biology and ecology are relevant when considering their adaptability. These findings also provide new insights into other viruses that affect humans or other hosts. Parrish, is now a world-renowned expert in his field, and works closely with collaborators throughout the globe – most recently with the support of a Senior Fulbright Fellowship. These contributions are helping to shape what researchers understand of virus transmission and emergence.

DOUGLAS F. ANTCZAK, VMD, PH.D.

Dorothy Havemeyer McConville
Professor of Equine Medicine

THEN & NOW: **Dr. Douglas Antczak,** former Director of the Baker Institute from 1994-2009, has had over four decades of major research contributions in the areas of immunology, reproduction, infection, genetics and genomics contributing enormously to the research happening at Baker throughout our history and to this day. One of Antczak's most global reaching projects is sequencing the horse genome for the international Horse Genome Project. Twilight, a Thoroughbred mare bred, born and raised at the Cornell McConville Barn, was the sole DNA donor for the entire horse genome, which was fully sequenced by 2006. Antczak and a collaborator took the resources that were developed from the findings of the genome sequencing to develop a diagnostic test to identify the causative mutation of the lethal inherited disease of Arabian horses known as Lavender Foal Syndrome. This diagnostic tool allows breeders to avoid mating pairs that would result in affected offspring. The Horse Genome Project is a consortium of over 20 laboratories from more than a dozen countries and can help researchers study more than 80 known genetic conditions in horses that are genetically similar to disorders seen in humans including musculoskeletal, neuromuscular, cardiovascular and respiratory diseases. This year, Antczak' s recent paper, "Genome Diversity and the Origin of the Arabian Horse," published in Scientific Reports, received media coverage across the world.



A FOUNDATION FOR THE FUTURE

THEN: In the 1990's, **Dr. Vicki Meyers-Wallen** came to the Baker Institute for Animal Health to focus on veterinary reproduction, namely Persistent Mullerian Duct Syndrome (PMDS). Her research led her to create the Canine Embryonic Atlas as a necessary tool for investigating the abnormal reproductive tract development in dogs. This tool provides researchers with a resource to find data on canine development and gene expression, helping to identify ways that can prevent genetic disorders in dogs.

ALEXANDER J. TRAVIS, VMD, PH.D.

Professor of Reproductive Biology, Director Cornell University Master of Public Health Program

NOW: Today, **Dr. Alexander Travis,** a world leader in the research of male fertility, directs a laboratory focused on the investigation of sperm, fertilization, and new technologies of assisted reproduction. His research led to development of a diagnostic test called the "Cap-Score," which measures the sperm's ability to fertilize. Prospective clinical data show that the results predict the probability of a man to generate a pregnancy. "This new test will let doctors counsel their patients toward a personalized journey to parenthood, using the approaches most appropriate for them", Travis said. He hopes such targeted treatments will save couples time, emotional distress and money. "This is especially important for patients who are attempting to get pregnant later in life, when conception rates are reduced." The same underlying approach can be used in other species, including cattle and wildlife species, potentially solving problems in agriculture and with endangered species.

THEN: In 1968, **Dr. Leroy Coggins** returned to the Cornell Baker Institute for Animal Health from a five-year project in Kenya developing a new diagnostic test for African swine fever. Upon his return, he focused his studies on a viral disease of horses for which there is no vaccine or cure, Equine Infectious Anemia (EIA). Coggins translated the findings he gained in developing the diagnostic test for African swine fever and created a method to quickly and effectively check for EIA antibodies in a horse's blood. This test, now known as the "Coggins Test", was formally approved by the US Dept of Agriculture in 1972 and is routinely used today in controlling the equine disease.

ROY COHEN, PH.D.

Research Assistant Professor

NOW: Expanding on the need for diagnostic tools, **Dr. Roy Cohen's** current research focuses on using nanoparticles as the basis for Point-of-Care Tests (PoCT) for diagnosing time-sensitive illnesses. Originally he started looking at blood biomarkers for diseases such as stroke, concussion, and cardiac arrest. Because of the critical needs related to the COVID-19 pandemic, he modified his approach to be able to detect and diagnose specific viral infections. Early experimental results have been very promising and he is now beginning tests on samples from actual cases. This technology platform can potentially be used in both human health and veterinary medicine to diagnose viral infections as well as detect markers in bio-fluids (e.g. blood, saliva) that indicate conditions such as specific types of cancer, heart disease, or liver disease.

LAB UPDATES: A GLIMPSE OF THE PAST... A FOUNDATION FOR THE FUTURE

GERLINDE VAN DE WALLE, DVM, PH.D.

Associate Professor of Microbiology and Immunology

'THERE'S SO MUCH TO INVESTIGATE'

By Patricia Waldron | this story originally appeared in the Cornell Chronicle June 24, 2020

From an early age, Dr. Gerlinde Van de Walle wanted to be a veterinarian. Growing up with cats in suburban Ghent, Belgium, she aimed to become a feline practitioner specializing in cancer.

But during her veterinary studies at Ghent University, Van de Walle realized "instead of just treating the patient, it would also be very satisfying to do the research needed to improve the treatment options being used in veterinary medicine."

This passion to improve veterinary care led Van de Walle in 2013 to join the Baker Institute for Animal Health, part of Cornell's College of Veterinary Medicine. Now an associate professor of microbiology and immunology, Van de Walle's lab studies diverse issues in animal health, ranging from viruses and stem cells in companion and livestock animals, to mammary cancer (or the lack thereof) in various mammals.

"I have a hard time focusing on just one topic," says Van de Walle, who earned a doctorate in veterinary virology. "I'm so motivated and interested in these problems. And because veterinary medicine covers more than just one species, there's so much to investigate."

In one of her current veterinary virology projects, Van de Walle focuses on the spread and progression of a new equine parvovirus she discovered in 2018 with Dr. Thomas Divers, the Rudolph J. and Katharine L. Steffen Professor of Veterinary Medicine. Van de Walle's group recently confirmed that the virus is the source of Theiler's disease, a fatal liver disease in horses. The virus had been known to spread through equine biologic products, such as tetanus antitoxins; Van de Walle discovered that the virus can also be transmitted orally. This work has received Cornell support from the Harry M. Zweig Memorial fund for Equine Research and more recently, the Cornell Center for Immunology, as well as a grant from the U.S. Department of Agriculture (USDA).

This finding will be crucial to developing vaccines, diagnostic tests or treatments for the disease. In 2019, peers highlighted the findings as one of the "Best Large Animal Internal Medicine Papers of the Year" at the American College of Veterinary Internal Medicine's annual forum. And the work prompted the USDA to issue new regulations to ensure equine biologic products are virus-free.

"This is expected to greatly improve the safety of antitoxins, plasma transfusions and blood transfusions, which are frequently used in equine medicine," Van de Walle says.

In a different project in horses, Van de Walle's lab is studying stem cells called mesenchymal stromal cells (MSCs) that assist in healing wounds, including those that are infected. In a recent featured paper in the journal Stem Cells Translational Medicine, her team showed that MSCs from horses secrete protein-busting enzymes that break apart bacterial matts called biofilms.

"These bacteria are surrounded by proteins, which protect them from antibiotics like a shield," says Van de Walle. Without the shield, antibiotics are more effective against bacteria, including MRSA, a drug-resistant bacteria acquired by people in hospitals and a growing concern in equine medicine as well.

Van de Walle's team also aims to find out why some mammals – including cats, dogs and humans – have high rates of breast or mammary cancer, while others – such as horses, pigs, cows and some wild carnivores – almost never develop the disease. Using tissue from humans, rodents and a range of domestic and wild animals, they've discovered differences in gene regulation between high- and low-risk species. They also identified defense mechanisms in mammary cells from horses and cows that kill cancerous cells.

Despite the tremendous potential for developing new diagnostic tests and therapies for breast/mammary cancer, finding federal funding has been challenging for Van de Walle; funding agencies are not used to seeing comparative models for this type of research. Cornell has helped fill the funding gap, with a 2020 Schwartz Research Fund for Women and Other Underrepresented Faculty in the Life Sciences. The award will help her develop a new mouse model for comparing mammary cell behavior across different mammal species, which will provide the additional data needed to reapply for federal funding.

"I'm always very proud of my people and what we accomplish here," Van de Walle says. "Perhaps our lab can be an example for upcoming generations that it is possible to be successful in basic veterinary research, especially in an environment with strong internal funding opportunities, such as Cornell."

Gerlinde Van de Walle, associate professor of microbiology and immunology, discusses her research with her lab team.

ERS AT A GLANCE

32

STUDENTS TRAINED IN LABS THROUGHOUT THE INSTITUTE

- 18 Graduate Students
- 6 Postdoctoral Associates
- 5 Research Associates
- 3 Visiting Scholars

29

PUBLICATIONS FROM BAKER INSTITUTE RESEARCHERS

4

STUDENTS EARNED DOCTORAL DEGREES WHILE WORKING IN BAKER INSTITUTE LABS

16

PARTICIPANTS IN THE LEADERSHIP PROGRAM FOR VETERINARY STUDENTS

13

GRANTS AWARDS IN FISCAL YEAR 2020

40

CURRENT ACTIVE GRANTS TOTAL

9

LABS ARE LOCATED AT THE BAKER INSTITUTE

16

FEDERALLY FUNDED GRANTS

LAB UPDATES: A GLIMPSE OF THE PAST...

THEN: **Dr. George Lust** was recruited in 1968 to head a program that would study hip dysplasia in dogs. Hip dysplasia was considered a major physical defect in dogs which Dr. James A. Baker believed needed a biochemical approach to produce a basis for control of the defect. Lust, a graduate in biochemistry at Cornell ('64) worked to study the chemical changes in affected joints to gain a better understanding of the condition. Through his research he identified the many specific genes responsible, and as a result, many genetic markers for hip dysplasia. His research went further to identify nucleotide sequences of DNA that could be used as the basis of a test to identify the genes related to trait expression. Lust's decades of research (spanning from 1968-2010) addressed the genetics, diagnosis, pathogenesis and treatment of hip dysplasia and osteoarthritis in dogs. His studies also showed that the condition in dogs was very similar to developmental dysplasia of the human hip. This finding has led to dogs serving as a model for human hip dysplasia and to current studies to help develop predictive tools to identify the risk of hip dysplasia at an early age so that more efficient and cost- effective management of the condition can be applied.

LUIS M. SCHANG, MV, PH.D.

Professor of Chemical Virology

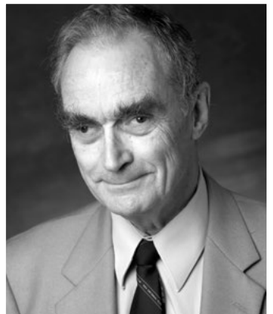
NOW: **Dr. Luis Schang** brought with him his expertise in chemical virology when he accepted the position of Director at the Baker Institute. His lab uses chemical virology as the main approach to study virus-cell interactions with a focus on identifying and characterizing previously unknown commonalities among unrelated viruses that can then be explored toward the development of broad-spectrum antiviral drugs. As a result of the selected approach, they also identify biologically active chemical scaffolds that become leads for the exploration of novel antiviral molecules. He and his team have focused on a number of important pathogens, including herpes simplex virus 1 and 2 (HSV-1; -2), hepatitis C virus (HCV), or influenza A virus (IAV), and emerging viruses such as SARS CoV-2, Zika and dengue viruses. When the COVID-19 pandemic emerged, Schang and his lab were well positioned to direct their efforts at identifying molecules active and inactive against the SARS CoV-2 virus to provide valuable information in the search for novel antivirals. He and his team have set a workflow to screen for broad spectrum antivirals active against SARS CoV-2 from medium sized screens to advanced pre-clinical studies. Using this workflow, they are following several active new chemical entities.

THEN: **Dr. Douglas McGregor** has had a distinguished career as a researcher, administrator and leader of research training programs. McGregor served as director of the Baker Institute from 1976-1991 and as the Cornell College of Veterinary Medicine (CVM) Associate Dean for Research and Graduate Education from 1988-2001. McGregor recognized the need to mentor veterinary students and provide them with the hands-on experience and encouragement to succeed as research scientists. He sought grant support to train biomedical researchers and in the early 1980s, secured the Institute's first NIH training grant. This international training program, called the Leadership Program, is still thriving today. In addition, McGregor maintained an active NIH-funded research program focused on immunology.

JOHN S. L. PARKER, BVMS, PH.D. '99

Associate Professor of Virology

NOW: After receiving his Ph.D. in virology from Cornell, **Dr. John Parker** joined the Baker Institute's Parrish lab where he identified canine and feline transferrin receptors as being the receptors for canine and feline parvoviruses. Having earned a NIH mentored award during his postdoctoral studies, Parker understood the importance of training and mentoring the next generation of scientists. Parker's unique ability to capture the attention of students and listen to their needs led him to take over as director of the Leadership Program in 2011. He also serves as director for the Comparative Medicine Training Program. This program supports US-born DVMs throughout the CVM that are undertaking advanced scientific training leading to a Ph.D. degree. Under Parker's leadership, these programs have become the corner-stone of training excellence within CVM and have produced graduates who have developed careers in academia, government, and clinical practice, world-wide. Parker maintains an active NIH-funded research program with collaborations with the University of Pittsburgh and within Cornell with Dr. Iwijn DeVlaminck in the Department of Biomedical Engineering. Parker's current research is focused on understanding how viruses usurp the cellular translational machinery; In a project with DeVlaminck the Parker lab is using spatial transcriptomics to understand the pathogenesis of viral disease at the molecular level within tissues.



A FOUNDATION FOR THE FUTURE

THEN: In the 1990s, **Dr. Gregory Acland,** along with former Baker Institute director, **Dr. Gustavo Aguirre,** isolated the gene that shows the carrier for progressive retinal atrophy in dogs later developing a genetic test that provided a powerful management tool for breeders. This genetic test, still in use today, can distinguish all three genetic states – normal, carrier and affected. With this information, breeders can plan matings that avoid producing any affected dogs by always selecting one parent that is normal. Acland and Aguirre's studies went onto produce a first-ever treatment in gene therapy that restored the vision of a dog suffering from congenital stationary night blindness, a disease found to be similar to that of Leber congenital amaurosis in children. This groundbreaking discovery provided hope for the field of gene therapy aimed at curing blindness and in 2017, resulted in the first FDA approved gene therapy for an inherited disease.

CHARLES DANKO, PH.D.

Robert N. Noyce Assistant Professor in Life Sciences and Technology

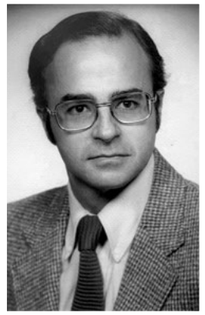
NOW: The legacy of unraveling genetic mysteries continues on with **Dr. Charles Danko,** the Robert N. Noyce Assistant Professor in Life Science and Technology at the Baker Institute. Danko's research focuses on the future of DNA research through studying how gene expression patterns are encoded in Metazoan DNA sequence, and how these patterns contribute to evolution, development, and disease. He and his group have developed a technique called ChRO-seq, which allows them to look at the subtle differences in gene expression in cells under different conditions. By understanding the detailed patterns of expression of all genes, the Danko laboratory is decoding the rules that underlie our health and well-being. This information leads to a better understanding of what happens when disease occurs, whether it be cancer or one of the many other diseases that arise when gene regulation is altered, ultimately leading to new designs of therapies for disease.

SCOTT COONROD, PH.D.

Judy Wilpon Professor of Cancer Biology

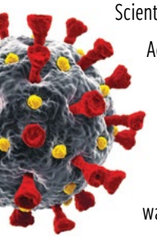
THEN & NOW: **Dr. Scott Coonrod,** Judy Wilpon Professor of Cancer Biology, Director of the Baker Institute. In recent decades, the impact of infectious diseases on our companion animals has been greatly reduced, due, in part, to the development of vaccines at the Baker Institute. In fact, because of these successes, our pets are now living longer, making them more susceptible to diseases of aging, such as cancer. When Coonrod first came to the Institute from Weill Cornell Medicine, his lab was primarily studying reproductive biology. However, soon after his arrival, Coonrod began to shift his focus from reproduction to cancer because he realized that there was a real need to develop new tools for treating cancer in both pets and humans. Given his background in reproductive biology, Coonrod first focused on studying hormone receptor positive breast cancer and his lab identified a new role for the enzyme, PAD2, in estrogen receptor binding and target gene activation. Additionally, his lab found that drugs targeting PAD2, blocked breast cancer growth in cell lines and animal models. This finding has the potential to lead to new potent therapies for breast cancer in women. More recently Coonrod began collaborating with Dr. Charles Danko at the Institute and they have been using Danko's state-of-the-art sequencing and computational tools to identify signaling pathways that are critical for the growth of hemangiosarcoma, a highly aggressive cancer in both dogs and humans.

Coonrod, understands the importance of having a stand-alone research institute that is populated with dedicated researchers, trainees and staff; all focused on basic veterinary and biomedical research. He has found that the diverse expertise of researchers at the Baker Institute provides an outstanding and synergistic environment that leads to highly productive collaborations which, in turn, give rise to groundbreaking discoveries in both animal and human health.



OUR COVID-19 RESPONSE

BAKER INSTITUTE RESEARCHERS WERE PREPARED TO RESPOND



Scientists at the Baker Institute focus on many aspects of animal health, oftentimes working across traditional scientific disciplines to break new ground.

Across the world, many are directly experiencing for the first time the impact of a major public health crisis, the pandemic of COVID-19.

Virologists at the Baker Institute seek to understand the ways in which viruses, bacteria, and parasites enter the body and cause illness or death. Their investigations into antiviral drugs, new vaccine targets, and the source of unexplained infections, yield insights into ways these infections could be prevented, controlled, or eventually eradicated.

In mid-March, like so many others, much of the research and laboratories dedicated to carrying out scientific discoveries related to animal health was temporarily suspended because of the COVID-19 pandemic. However, a core group of virologists at the Baker Institute quickly responded.

Work to Date

The Schang lab with research led by Dr. Luis Schang, has been screening for potential therapeutics. The group was poised to quickly direct their efforts to SARS CoV-2 using the expertise of team members Dr. Rodrigo Dos Santos, who has ample experience with emerging viruses and is trained to work in BSL3 and BSL4 biocontainment, and Consuelo Correa-Sierra, M.D./Ph.D. with ample experience in human virology, who is now also trained in BSL3 biocontainment. The group quickly began screening for compounds against COVID-19.

They have tested the antiviral activity of 185 compounds using a non-infectious model system for SARS-CoV-2, and are currently following up on 14 promising compounds, and testing seven of these compounds against SARS CoV-2 (BSL-3).

Three compounds have been tested for toxicity, pharmacokinetics in mice; they are scheduled to be tested for potency soon.

In addition, Dr. Schang has also been working with a large group at Weill Cornell and Columbia on the viral loads during the outbreak in NYC. This group includes Drs. Monika Safford, Michael Satlin, Nathaniel Hupert, Lars Westblade, Jason Zuker, Jorge Spulveda and Parag Goyal, among others. He is the virologist collaborator in a project evaluating how to minimize the spread of SARS CoV-2 in hospital environments, in a project funded by the Atkinson Center, and is the virology consultant for another Cornell spinoff company, HaloMine.

The Parrish Lab is carrying out a study on the structure of the COVID-19 spike protein that the virus uses to gain entry to cells. The lab is also investigating the structure of antibodies that may recognize this spike protein and be protective against infection. Dr. Parrish is also working with epidemiological modelers who are collaborating on computer and epidemiological studies aimed at predicting the current and future spread of the virus outbreak in the USA and elsewhere.

The Travis Lab with research led by Dr. Alex Travis, and Dr. Roy Cohen using their TET biosensor has been working on SARS-CoV-2 rapid diagnostic. They recently developed a biosensor for SARS-CoV-2. This biosensor can be integrated into hand held devices for point of care COVID-19 testing.

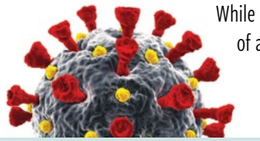
Webinars and Resources

The Baker Institute quickly planned a series of webinars aimed at helping veterinarians who would like to learn more about basic concepts in virology in order to help them better understand potential impacts of the coronavirus on companion animals and humans.

The first webinars kicked off in April and consisted of a panel of virology experts from the Baker Institute and The Cornell University College of Veterinary Medicine (CVM) including, Colin Parrish, Ph.D. '84, John M. Olin Professor of Virology, Luis Schang, MV, Ph.D., professor of chemical virology, John S. L. Parker, BVMS, Ph.D. '99, associate professor of virology, and Diego Diel, DVM, MS, Ph.D. associate professor of virology, director of the virology laboratory at the Animal Health Diagnostic Center. With over 2,000 participants from across the world attending. Others tapped to contribute their expertise included Dr. Scott Coonrod, director of the Baker Institute for Animal Health, Dr. Gerlinde Van de Walle, DVM, PH.D., associate professor and faculty at Baker Institute, Brian Wasik, research associate in the Parrish lab, and Bruce Kornreich, DVM, Ph.D., DACVIM, director of Cornell Feline Health Center.

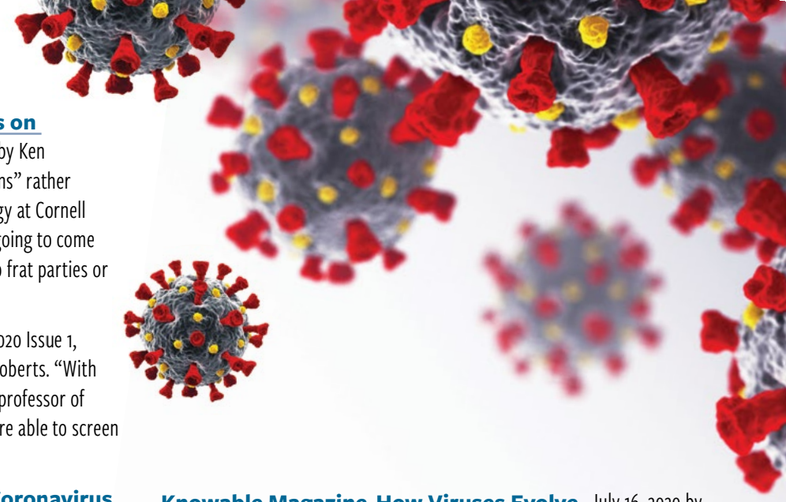
In July the webinar series continued by taking on a One-Health approach. This time joining the panel of experts was Dr. Alexander Travis, professor of reproductive biology, and director, Cornell University Master of Public Health program, and Laura Goodman, Ph.D., assistant research professor, Department of Population Medicine and Diagnostic Sciences, College of Veterinary Medicine.

In addition to the webinars, the Institute quickly created resources for information on COVID-19 on our website. Experts at the Institute have been a source of information for the media and the website continues to serve as a resource for updated information on research as it progresses.



While COVID-19 related research continues, reactivation of all Baker Institute research labs began in June.

RESPONSE FROM THE PUBLIC: *"Thank you for this excellent webinar. My husband is a public health emergency physician on an Army base and he also found the information given to be excellent as well, and it will help him to answer questions that are presented to him by base personnel."* • *"Thanks for hosting the virology seminar. Very informative for practitioners in the field. We'll watch for more in the future. We've witnessed many viral threats in past 51 years."* • *"Exciting that so many people are registered! That is by far the most certificates we have ever issued for one event." - NYSVMS, sponsor of CE credits* • *"I received information I need without having to travel to a meeting."* • *"I am formerly from the Johns Hopkins Med environment and your presenters were so polished! Fine work!"* • *"I am a human physiotherapist and the information was super helpful. You vets are smart and informative."* • *"Veterinarians are guardians of public health."* • *"It helps to hear from the experts rather than reported information."* • *"I can speak more intelligently about pandemic response strategies"* • *"All of the Baker Institute webinars I've attended about COVID have been great and I highly recommend them to colleagues. Thanks for doing them"*



In the News

Newsday, LI Company plans to begin tests on COVID-19 vaccine for cats, September 25, 2020 by Ken Schachter. Cats "are almost always being infected by humans" rather than other cats, said Dr. Colin Parrish, a professor of virology at Cornell University's College of Veterinary Medicine. "Most are not going to come in contact with cats outside the house. They're not going to frat parties or bars," states Dr. Colin Parrish.

'Scopes Magazine, Re-routing research, 2020 Issue 1, Cornell College of Veterinary Medicine, by Lauren Cahoon Roberts. "With the BSL-3 capabilities, researchers such as Dr. Luis Schang, professor of chemical virology at the Baker Institute for Animal Health are able to screen for potential therapeutics."

The New York Times, First Documented Coronavirus Reinfection Reported in Hong Kong, August 24,2020 by Apoorva Mandavilli. "The majority of patients likely have a cocktail of immune responses that activate on second exposure," said Brian Wasik, research associate at the Baker Institute for Animal Health at the College of Veterinary Medicine. "This Hong Kong patient also seems to have been asymptomatic on second infection, perhaps due to some immune response."

Knowable Magazine, How Viruses Evolve, July 16, 2020 by Bob Holmes, with reprints in **Smithsonian Magazine**, July 17, 2020, and **Discover Magazine**, July 22, 2020. "With the new coronavirus," Parrish says, "we're sort of in that 1918 period where the virus is spreading fast in a naive population. But that will change as more people either catch Covid-19 or are vaccinated (if and when that becomes possible) and develop some level of immunity. There's no question that once the population is largely immune, the virus will die down," Dr. Colin Parrish says.

Business Insider, Why some viruses jump from animals to people, and some don't, April 27, 2020 – **Dr. Colin Parrish** discusses animal to human virus transference, why some viruses jump from non-human animals to people and others don't, modes of transmission and prevention, and what needs to happen for a virus to go from animal to pandemic.

Discover Magazine, Coronaviruses often start in animals - Here's how those diseases can jump to humans, April 2, 2020

Cornell Chronicle, Cornell experts discuss state of pandemic, March 31, 2020.

Cornell Chronicle, CVM COVID-19 working group gears up, March 19, 2020.

Cornell Chronicle, Research Interrupted: CVM lab groups find their way together, March 19, 2020. Video Dr. Luis Schang, professor of chemical virology at the Baker Institute for Animal Health, is one of many researchers at Cornell University working on an antiviral solution to the COVID-19 pandemic.

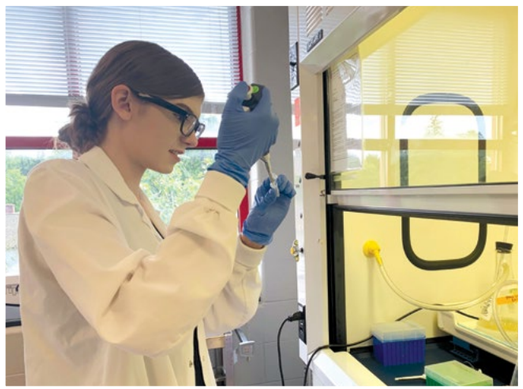
BICKNESE PRIZE

SHAO-PEI CHOU

Shao-Pei Chou, Ph.D. candidate in the Danko lab is this year's recipient of the Bicknese Family Prize. Her work has focused on: How DNA sequence difference affect transcription

How natural variation in our DNA sequences influence transcription remains poorly understood. Diploid organisms have two distinct copies of their DNA sequence that often function independently, providing a rich source of information about how genetic variation affects a wealth of biochemical processes in the nucleus. We generated a reciprocal F1 hybrid cross in multiple biological replicates from two genetically distinct breeds of mice: an inbred mouse strain (C57BL/6J) and wild-derived mice (CAST). The F1 hybrid mice contain a polymorphic site every ~160bp, which is about 10 times the rate of polymorphism in the human genome. We used Chromatin Run-On sequencing (ChRO-seq) to analyze the location of RNA polymerase in eight organs representing all three primary germ layers. We developed AlleleHMM, an analytical tool to identify regions that shown an imbalance of transcription between the two alleles using a hidden Markov model (HMM) that takes the allelic imbalance of the nearby SNPs into account to infer the most likely allelic imbalance of each SNP. AlleleHMM identified thousands of allelic biased transcription blocks from each organ without the aid of gene annotations. We found that allelic bias is organized into large multi-transcript domains. Most domains are only allelic bias in a specific organ despite the domain was also transcribed in other organs. Most are uniformly allelic biased with 7% of the domains containing a switch of allelic bias. Less than 1% of the domains are imprinted. The imprinted domains are not evenly distributed across organs and brain has the most imprinted domains. For the non-organ-specific imprinted domains, brain also has the widest genomic region imprinted compared to other organs. Finally, we use this system to study how DNA sequences specify the steps in transcription. We have identified hundreds of sites showing allelic difference in initiation, pause and termination. We are working on a manuscript to report how DNA sequences specify these steps in transcription.

Bicknese Prize Joanne Bicknese, '75, DVM '78, established the Bicknese Family Prize in 2005 in honor of her parents, Helen and Louis Bicknese, and her aunt and uncle, Grace and Carl Bicknese. The award supports a woman scientist-in-training during a key point in her career development.



DAVERSA SCHOLARSHIP

MERCEDES LEWANDROWSKI

This year's Daversa Scholarship Winner is Mercedes Lewandrowski, who started as an undergraduate student in the Parker lab. Mercedes' project in the Parker lab focused on the study of the genetic diversity of viral populations.

Lewandrowski graduated from Cornell in spring 2020, and started her PhD at the Harvard University Program in Virology in the fall. When asked, she stated, "For me the Daversa scholarship is a really wonderful opportunity for scientists-in-training to obtain their own funding. I applied for the Daversa scholarship as an undergraduate researcher and was lucky enough to be selected. By the time I applied for PhD programs I had already acquired my own funding, which I think was a big advantage for me going into competitive applicant pools."

Research summary: Mammalian orthoreovirus (MRV) is an RNA virus that infects a variety of different species ranging from livestock, to companion animals like cats and dogs, to humans. The machinery that viruses use to copy their genomes is far more error-prone than the machinery that animals use. This results in changes to the genome, or mutations, as the virus replicates within host cells. The high frequency at which these mutations are generated means that new viruses are often genetically distinct from the parental virus, and viral populations consisting of millions or billions of virus particles are thought to be extremely diverse, with random mutations scattered throughout the genome. This diversity actually gives viral populations an edge in the host-pathogen interaction, since some mutations may confer resistance to host defenses or help the virus to evade the adaptive immune system.

My project focused on studying the genetics of "reverse genetics" derived viruses. These viruses are engineered from DNA plasmids that the researcher introduces into cells to generate new virus. Reverse genetics viruses are important tools for virologists, as this system allows for manipulation of the virus genome at the DNA stage, and also allows researchers at different labs to re-isolate identical viruses. We were interested in seeing how plasmid-derived viruses change genetically after many generations of growth, since they are used in place of the diverse populations that exist in naturally circulating viruses.

We found that plasmid-derived MRV did not accumulate many mutations over the course of several passages in cell culture, which is good news for the use of these viruses in research. One of the MRV strains included in the study is in development for use as an oncolytic agent, so it's good to know that if isolated from DNA plasmids, this virus can undergo several rounds of replication without drifting from its original consensus sequence.

These findings are interesting because we know that when put under selective pressure, other RNA viruses like influenza and HIV can adapt very quickly since resistant variants within the population are strongly selected for. What we didn't realize was how low the frequency of many of these mutations are, some exist in less than 1% of the viruses in the population. However, because many viruses grow so rapidly, if a tiny subset of the population has a protective mutation, they can quickly expand so that soon the population size has been restored, but the protective mutant is now the primary type of virus in the population.

I presented my work as a poster at the American Society for Virology's (ASV) 2019 conference, and was planning to use some of the funds from the Daversa scholarship to cover travel to the 2020 conference. The ASV summer 2020 conference was moved to a virtual format because of the COVID-19 crisis, but I still got to give a talk at the virtual ASV reovirus workshop. Since there were no travel costs associated with the virtual ASV conference, I used the funding from the Daversa scholarship for direct research expenses.

I found this project to be incredibly interesting to work on. Since this was the first long-term project that I took on as a researcher, navigating this project taught me a lot about how research progresses over time, as well as how to deal with unexpected results or challenges in moving a particular experiment forward. The majority of my data was gathered using Illumina sequencing, a type of "next-generation" sequencing technology that has advanced rapidly within the last decade. It was a great opportunity to get to work with this platform that has revolutionized genomics, and practical experience in processing and analyzing this type of data will be valuable as I advance in my research career.

The Daversa Scholarship: The Daversa Family Scholarship Fund was created to memorialize Rayne, a seven year old German Shepherd who succumbed to a massive stroke in July 2007. Ms. Maria Daversa and her husband David Gulley learned of the Baker Institute for Animal Health after receiving a note explaining that Rayne's vet had made a contribution in her name to the Institute. A voracious learner, Ms. Daversa began investigating and found that the Institute's mission matched her own sentiments. Ms. Daversa and Mr. Gulley decided to pay tribute to Rayne by creating an endowed scholarship at the Institute to fund the pursuit of knowledge for scientists-in-training.

TRAINEE HIGHLIGHTS

MORRIS ANIMAL FOUNDATION SELECTS BAKER TRAINEES

Simon Früeh, DVM & Charlotte Marx, Ph.D., DVM

Two Baker Institute trainees have received fellowships from the Morris Animal Foundation in the last year, Dr. Simon Früeh, a graduate student in the lab of Dr. Colin Parrish, and Dr. Charlotte Marx, a postdoctoral associate working with Dr. Gerlinde Van de Walle. The two-year awards are designed to help young scientists launch their careers and to support research that will significantly impact animal health.

In September, Früeh received a fellowship to look into a challenging aspect of canine parvovirus. Despite the existence of a good vaccine, cases still often occur. This is primarily a problem when vaccination happens too early, and antibodies carried over from the mother bind to the vaccine, preventing it from stimulating an adequate immune response in the puppy. Additionally, there are a number of changes in the virus that may alter how it interacts with the antibodies that dogs develop against the vaccine. "We think that there is a 'cat and mouse game' occurring between the virus and host immune system," said Früeh.

To investigate the processes involved, Früeh is examining antibodies from dogs that have recovered from parvovirus infection or received the current vaccines, to see how the produced antibodies recognize the virus, and to clarify which types successfully stop it from infecting cells. The results will reveal whether antibodies are driving the evolution of new viral strains that alter their surface molecules to avoid detection. They will also show whether the different strains of parvovirus that are circulating are evolving to avoid the antibodies that puppies receive from the mother, or the antibodies produced in response to the current vaccine strains.

Marx received her fellowship in November 2019, to advance research into equine mesenchymal stromal cells (MSCs), a type of stem cell with the potential to fight bacterial infections and promote wound healing. Previously, Marx and Van de Walle demonstrated that the compounds these cells secrete break up biofilms of bacteria that commonly cause wound infections.

MSCs can be isolated from several parts in the body, but cells from different sources behave slightly differently. Through the grant funding, Marx was able to perform single cell RNA sequencing – an advanced technique that reveals which genes are being turned on in an individual cell – using MSCs from bone marrow, fat tissue and blood. "We're trying to find out what the differences are, and if we can use this knowledge to find the best possible therapy for several conditions," said Marx.

Ultimately, both Marx and Früeh are interested in pursuing careers in academia. "I think it's really a stepping stone for my future career in research," said Marx. Früeh adds, "it feels good to contribute to the lab as well."

Left: Charlotte Marx | Right: Simon Früeh

NIH CAREER GRANT IS A STEPPING STONE TO CAREER IN VIROLOGY

Joy Tomlinson, DVM '10, DACVIM

For 4 years, Dr. Joy Tomlinson has investigated viruses that infect the liver in horses, as a research associate in the lab of Dr. Gerlinde Van de Walle. Now, as the recipient of a five-year Clinical Investigator Award from the National Institutes of Health, she will advance this work as she forges her own research career.

"The award is a real opportunity to gain independence and start charting my own path to being a principal investigator," said Tomlinson. The grant is designed to prepare individuals with clinical experience for a research career and will position Tomlinson to apply for faculty jobs and additional NIH funding. Coursework is also required and Tomlinson will concurrently earn a doctoral degree from Cornell University.

In her previous research, Tomlinson has worked with several equine viruses that infect the liver. She has shown that one virus – equine hepacivirus – almost universally causes very mild infections in horses. However, she is following new data suggesting it sometimes results in fibrosis, much like hepatitis C in humans. With this knowledge, veterinarians can now diagnose this infection in patients. Tomlinson has also demonstrated that a newly discovered equine parvovirus is the cause of Theiler's Disease, a common cause of liver failure, which frequently occurs after a horse receives blood products, such as an antitoxin or plasma.

With the new grant, Tomlinson will investigate how equine parvovirus is transmitted naturally between horses – whether through inhalation, ingestion or other means, how quickly it spreads through a herd, and how the horse immune system responds. Ideally, the work will inform strategies for preventing and controlling the virus' spread, and explain why some horses have mild disease, while others die. This lays the groundwork for vaccine development. Dr. Douglas Antczak has generously volunteered his own herd for the research, and Tomlinson is thankful for the ongoing support she has received from Van de Walle, Dr. Colin Parrish, Dr. Jon Cheetham and Dr. Tom Divers at Cornell University, and from the Baker community at large.

Investigating these viruses will occupy Tomlinson for several years, but long-term, she sees herself continuing in the field of virology. "I like investigating infectious disease, particularly the pathology aspect," said Tomlinson. "As a veterinarian, I like my research to have a clear connection to benefiting animals."

DR. JOANNE BICKNESE, BS '75, DVM '78
SUPPORTING THE INSTITUTE FROM ALL ANGLES

Dr. Joanne Bicknese, a longtime Advisory Council member, has taken an active role in supporting the Institute's research and careers of its most promising trainees. She brings her expertise as a large animal veterinarian and more than three decades working for biomedical companies to the Council, which she chaired from 2000 to 2006.

Bicknese joined the Council in 1998 after meeting then-director Dr. Douglas Antczak. He opened her eyes to the incredible breadth of research occurring at the Institute – from immunology to genetics and parasites – and how it benefits not just pets, but horses, farm animals and people. In 2006, she received the Institute's Founders' Award.

But her service to Baker isn't limited to the Council. In 2005, she established the Bicknese Family Prize to honor her parents, Helen and Louis Bicknese, and her aunt and uncle, Grace and Carl Bicknese, who supported her throughout her career. The award is a competitive bridge grant to help women researchers at the institute to take an extra step – pursue additional training, present at a conference, or purchase a piece of equipment – that will advance their careers.

"It's been very satisfying for me to see where the winners of the Bicknese Prize have gone and to develop a personal connection with the recipients," said Bicknese. "It's rewarding to know you've had an impact on a young person's life."

Bicknese also makes small grants to support research projects at the Institute, and provides valuable tissue samples through her work with a large kennel of hounds. These hounds appear to be more resistant to cancer than many other breeds, so she arranges to send healthy and cancerous breast and spleen tissue to support Dr. Gerlinde Van de Walle's comparative breast cancer research, and Dr. Scott Conrood's work on hemangiosarcoma. "We're hoping that these contributions will help define the genetic basis for these cancers and to find mutations that could perhaps be corrected in the future," she said.

Now that Bicknese is "retired," she works part-time as a regulatory veterinarian at harness tracks in New Jersey and Pennsylvania and has more time to devote to her goat farm. Currently, she is applying the knowledge she has gained through her long tenure with the Institute to improve the breeding of her Boer and Savanna goat herds.

KYLE'S LEGACY WALK

"Kyle was pretty much my human child in a dog body. When he passed, I wanted to find a way to honor him and I decided I wanted to do a walk," states Tina Visalli, Kyle's "mama" and organizer of Kyle's Legacy, a nonprofit organization formed in Kyle's memory.

Kyle was a lovable 11-year old Puggle when the family lost him to cancer.

Tina first learned of the Baker Institute for Animal Health when her veterinarian made a donation to the Baker Clinic Memorial Giving Program in memory of Kyle. She reached out to the Institute to learn more, and shortly after received an unexpected email from current Baker Institute Director at the time, Dr. Luis Schang.

"We needed somebody to be the beneficiary of the funds we were raising from the walk, and when I received the email from Schang, and I learned more, I was very touched. This is what we were looking for, someone who's actually doing work in canine cancer research and will hopefully be making breakthroughs and make a difference," said Tina.

Schang informed Tina of the research specific to canine cancer taking place in Dr. Scott Coonrod's lab. In a collaboration with Dr. Charles Danko, Dr. Gerlinde Van de Walle, and Dr. Roy Cohen, Coonrod's laboratory is working to find targeted treatments for hemangiosarcoma, a common and often untreatable form of cancer in dogs. Using new sequencing technologies developed in Danko's laboratory and mouse cancer models, Coonrod's team is identifying the genes that make these tumors tick, then they aim to test drugs specifically intended to target the pathways that those genes control.

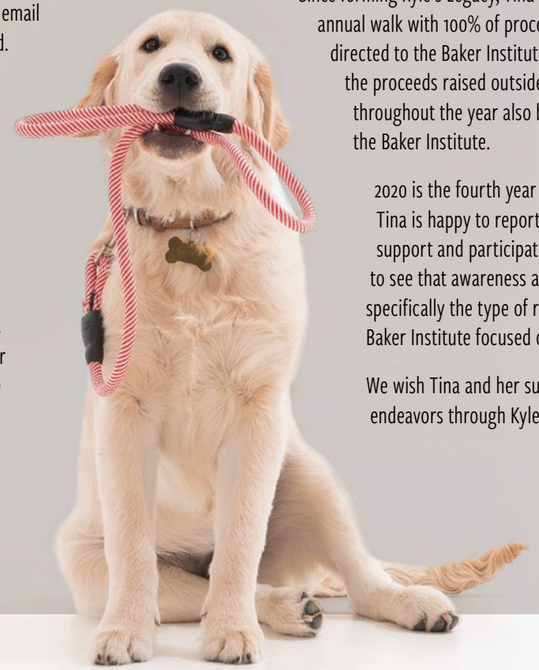
The first year of Kyle's Legacy walk and other smaller fundraisers they held took off with great success.

"After that first year, Dr. Coonrod surprised me by saying, 'would you like me to come speak at your walk?' and I think I fell off my chair," states Tina. Coonrod attended the walk, which Tina has chosen to hold annually in Kyle's favorite place, Borderland State Park in Easton, MA. She states, "I think it meant a lot to the supporters to actually get to meet him in person and talk to him." Tina feels that this has made the biggest impact. Coonrod was able to describe the research, provide feedback and answer questions, and supporters were able to witness the real results that their dollars were supporting.

Since forming Kyle's Legacy, Tina has continued to organize an annual walk with 100% of proceeds from ticket sales being directed to the Baker Institute. In addition, a portion of the proceeds raised outside of the walk at other events throughout the year also benefit research happening at the Baker Institute.

2020 is the fourth year of Kyle's Legacy walk, and Tina is happy to report that each year their donor support and participation grows. She's also thrilled to see that awareness around cancer research and specifically the type of research happening at the Baker Institute focused on canine cancer has grown.

We wish Tina and her supporters the best in future endeavors through Kyle's Legacy.



LAB HIGHLIGHTS

Work from the **Van de Walle lab** this year has found that Equine parvovirus-hepatitis appears to be the cause of Theiler's disease (a.k.a. serum hepatitis), a highly fatal liver disease in horses. This finding has caught the attention of veterinarians nationwide. The research, published in the Journal of Veterinary Internal Medicine, has been highlighted in:

- the **Kester News Hour,**
- a summary of the most important papers of the year in **equine medicine,**
- the 2019 **American Association of Equine Practitioners** (AAEP) Convention,
- the 2019 **American College of Veterinary Internal Medicine** annual forum, where it was voted as one of the "Best Large Animal Internal Medicine Papers of the Year"

This work has resulted in the **USDA** issuing new regulations to ensure equine biologic products are free of this virus. This is expected to greatly improve the safety of antitoxins, plasma transfusions, and blood transfusions, which are frequently used in equine medicine.

Research led by **Dr. Alex Travis** and **Dr. Roy Cohen** uses their TET biosensor technology for ultra-rapid, highly-sensitive, and highly-specific detection of SARS-CoV-2. This biosensor will likely be both cost-effective and easy to use as a rapid Point-of-Care-Testing tool for detecting COVID-19. Their team will be using clinical human samples collected by the Medical Pathology lab at Weill Cornell, and Guthrie Medical Center (Sayre, PA) to validate their technology.

Dr. Doug Antczak received the **Harry M. Zweig memorial Fund** for Equine Research grant for the 2020 Horse Genome Project Workshop at Cornell, and a research grant for Functional Gene Annotation in the Horse. Antczak' s recent paper, "Genome Diversity and the Origin of the Arabian Horse," published in Scientific Reports, received media coverage across the world in publications such as **The Peninsula**, to **Daily Veterinary News**.

Dr. Luis Schang, collaborator as virology expert in a team received an academic venture seed grant from Cornell Atkinson Center for Sustainability addressing "Developing near-term and long-term strategies to protect the safety of healthcare workers and mitigate infectious disease transmission."

Lauren Choate, most recently part of the **Danko Lab**, was a recipient of NIH F31 Fellowship.

Undergraduate student, **Sanjna Das**, in the **Van de Walle lab** received research funding from the Dextra Baldwin McGonagle Foundation for research she will be doing related to the role of miRNAs in determining susceptibility to carcinogen-induced cell death of mammary cells.

Robert Lopez-Astacio of the **Parrish lab** was the recipient of the NIH Diversity R01 Supplement.

Mridusmita Saikia of the **Danko lab** was awarded a Caroline Coffey Travel Fund Award.

Alexandra Chivu, graduate student in the **Danko lab** received a Center for Vertebrate Genomics 2020 Genomics Scholars' Award and she will be known as the Center for Vertebrate Genomics (CVG) Scholar for the full calendar year of 2020. On top of that she was given a CVG Travel Award.

Chinatsu Mukai, research associate in the **Coonrod Lab** recently published a paper entitled "Chromatin run-on sequencing analysis finds that ECM remodeling plays an important role in canine hemangiosarcoma pathogenesis" in BMC Veterinary Research. This paper explores the molecular underpinnings of hemangiosarcoma, a deadly cancer that affects both dogs and humans alike.

Left: photo credit: Dr. Samantha Brooks, University of Florida, collaborator on genetic study of Arabian horses.

Below: Chinatsu Mukai, research associate in the Coonrod Lab.

LEADERSHIP PROGRAM

2020 LEADERSHIP PROGRAM IN THE "NEW NORMAL"

The goal of the Leadership Program for Veterinary Students is to provide a summer research experience for students who seek to influence the veterinary profession through a science-based career. The program was originally started by Dr. Douglas McGregor in 1983. The program provides veterinary students from all over the world with an opportunity for travel to Ithaca for mentoring and a summer research experience. John S. L. Parker, BVMS, Ph.D. '99 took over the reins of the program in 2011.

While the program was carried out a little differently in 2020, with the cohort meeting in a virtual environment, student outcomes were still very successful.

16 students participated in the program in the summer of 2020

The program was truly multinational, with students from Australia, Canada, China, Nigeria, the Netherlands, UK, and the United states.

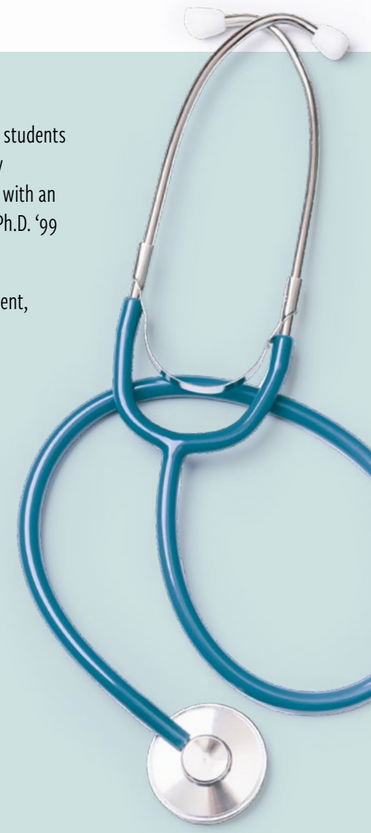
The NIH T35 grant supporting the participation of US students was re-funded. This is our 31st year of the Leadership Program.

History and Numbers:

Over the last 30 years, the Leadership Program has trained over 690 veterinary students from throughout the world.

Many of those alumni are now themselves academic and industry leaders – just a few are mentioned here:

- Dr. Thomas Vahlenkamp, Professor and Head, Institute of Virology, Leipzig University
- Dr. Linda Barent, Associate Dean for Academic affairs, University of Illinois
- Dr. Reinhard Straubinger, Dean, School of Veterinary Medicine Ludwig-Maximillians University
- Dr. Oliver Turner, Director of Pathology, Novartis Institute for Biomedical Research, NJ.
- Dr. Peter Florian, Director of Pharmacology, Sanofi Inc.



Below: Leadership students meet virtually via Zoom in the summer of 2020.

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BEVA | PLOS PATHOGENS | scientific reports

nature ecology & evolution | Genes & Immunity | STEM CELLS JOURNALS

Nucleic Acids Research | Journal of Virology | AMERICAN SOCIETY FOR MICROBIOLOGY

FOR A FULL LIST OF PUBLICATIONS, VISIT OUR WEBSITE.

LEGEND

Bold denotes Faculty

Underlined denotes other Institute member

ACTIVE GRANTS

DOUGLAS F. ANTCZAK LAB

Zweig Memorial Fund
Functional Gene Annotation in the Horse

Zweig Memorial Fund
2020 Horse Genome Project Workshop

SCOTT A. COONROD LAB

New York State Department of Health
Histone Citrullination in Estrogen Receptor Signaling and Breast Cancer

Research Grants Program in Animal Health
Novel Biomarkers for Canine Hemangiosarcoma

Breast Cancer Coalition of Rochester
Role of PAD2 in ER-DNA Binding and Endocrine Resistance

CHARLES G. DANKO LAB

NIH (National Human Genome Research Institute
Mapping RNA Polymerase in Tissue Samples with ChRO-seq

NIH (National Human Genome Research Institute)
Evolution of Chromatin Architecture and Transcriptional Regulation in Mammals

NIH (National Institute of Allergy and Infectious Diseases)
Host-Pathogen Interactions Drive Regulatory Evolution of the Anthrax Toxin Receptor
Lauren Choate, Graduate Fellowship

NASA (National Aeronautics & Space Administration)
Pol II Pausing as a Milestone on the Road to Complex Animals

JOHN S. L. PARKER LAB

NIH (National Institute of Allergy and Infectious Diseases)
Mechanisms of Virus-Mediated Compartmentalization of the Host Translational Machinery

NIH (Office of the Director)
Graduate Training Program in Comparative Medicine

NIH (National Institute of Allergy & Infectious Disease)
Droplet-Assisted RNA Targeting by Single-Cell Sequencing to Dissect the Single-Cell Heterogeneity of RNA Virus Infection

NIH (National Institute of Allergy and Infectious Diseases)
Short Term Training for Student in the Health Professions

Burroughs Welcome Fund
Becoming Faculty Workshop

COLIN R. PARRISH LAB

NIH (National Institute of Allergy & Infectious Disease)
Structural Controls of Functional Receptor and Antibody Binding to Viral Capsids

NIH (National Institute of General Medical Sciences)
The Evolutionary and Biological Bases of Host Switching in Viruses

NIH (National Institute of Allergy & Infectious Disease)
Effects of Common Sialic Acid Modifications on Virus Binding and Infection

LUIS M. SCHANG LAB

NIH (National Institute of Neurological Disorders and Stroke)
Menage A Trois - Zika Virus, DNA Damage Responses and Microcephaly; Is PNKP the Molecular Link?

NIH (National Institute of Allergy & Infectious Disease)
Chromatin Dynamics in the Regulation of Herpes Simplex Virus 1 Gene Expression

University of Alberta
Broad Spectrum Antivirals against RNA Viruses Which Block Cellular Entry

ALEXANDER J. TRAVIS LAB

NIH (National Institute of Child Health & Human Development)
Membrane Lipid Regulation of Calcium Channels in Sperm

GERLINDE R. VAN DE WALLE LAB

USDA (National Institute of Food and Agriculture)
The Antimicrobial Properties of Mesenchymal Stromal Cells as a Biological Alternative to Conventional Antibiotics in Veterinary Medicine

USDA (National Institute of Food and Agriculture)
Epidemiology and Pathogenicity of Equine Parvovirus Hepatitis

NIFA Federal Capacity Funds (U.S. Department of Agriculture
The Mesenchymal Stem Cell Secretome: A Biological Alternative to Treat Bacterial Infections of Agricultural Importance

Rockefeller University
Characterization of Recently Discovered Liver-Tropic Viruses in Horses

Zweig Memorial Fund
Studying the Replication Kinetics of Equine Parvovirus Hepatitis (EqPV-H)

Zweig Memorial Fund
The Mesenchymal Stem Cell Secretome Against Equine Herpesvirus Type 1 Infections

NIH (National Institute of Allergy & Infectious Diseases)
Comparative Animal Models of Viral Hepatitis
Joy E. Tomlinson, PI

Morris Animal Foundation
Evaluating the Unique Transcriptome Profiles of Individual Equine Mesenchymal Stem Cells to Improve Regenerative Therapies
Charlotte Marx, Postdoctoral Fellowship

Cornell Feline Health Center
Characterize MicroRNAs with a Potential Role in Feline Mammary Cancer Pathogenesis

Cornell Office of Faculty Development and Diversity
A Novel Xenotransplantation Mouse Model to Study Breast Cancer Resistance/Susceptibility Mechanisms

Cornell Biotechnology Resource Center
Metabolomic Analysis of the Equine Mammary Stem/Progenitor Cell Secretome

Cornell Center for Immunology
Determining the Mechanism of Hepatocellular Necrosis in Equine Parvoviral Hepatitis

CLINIC MEMORIAL GIVING

The Baker Institute Clinic Memorial Giving Program offers veterinarians a special way to memorialize a client's beloved pet.

Memorial gifts, whether from an individual or a veterinary clinic, provide vital support to the Baker Institute's renowned research programs. To learn more about our Memorial Gift Programs, please contact our Office of Alumni Affairs & Development at: 607.256.5604 or petfriends@cornell.edu. | July 1, 2019 - June 30, 2020

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Manchester Veterinary Clinic
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North Windham Animal Hospital
Salmon Brook Veterinary Hospital
Schulhof Animal Hospital
South Windsor Veterinary Clinic
Suffield Veterinary Hospital
Winsted Hospital for Animals

DELAWARE
Lums Pond Animal Hospital

MAINE
Down Maine Veterinary Clinic
Farmington Veterinary Clinic
Windsor Veterinary Clinic

MARYLAND
Fallston Veterinary Clinic
Flower Valley Veterinary Clinic
Layhill Animal Hospital

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Blandford Animal Hospital
Brockton Animal Hospital
Cape Ann Veterinary Hospital
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West Roxbury Animal Hospital

MONTANA
Glacier Animal Hospital

NEW JERSEY
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Animal General
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Marsh Hospital For Animals
Matawan Animal Hospital
Oradell Animal Hospital

NEW YORK
Adirondack Animal Hospital
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Animal Kind Veterinary Hospital
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Fountain House Veterinary Clinic
Genesee Valley Equine Clinic
Goosepond Animal Hospital
Gracelane Kennels
Greenpoint Veterinary Hospital
Dr. Raymond Hayes
Highland Animal Hospital
Jacobson Veterinary Clinic
Hilton Veterinary Hospital
Dr. Jean Ferreri
Lagrange Veterinary Hospital
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Manhasset Animal Hospital
Manlius Veterinary Hospital
Meadowridge Veterinary Hospital
Moriches Hospital for Animals
Nanuet Animal Hospital
North Country Veterinary Services
North Shore Veterinary Hospital
Parkside Veterinary Associates
Pet Partners
Pleasant Plains Animal Hospital
Pleasant Valley Animal Hospital
Pleasantville Animal Hospital
R. M. Stack Veterinary Hospital
Ridge Animal Hospital
Rondout Valley Veterinarian
Saugerties Animal Hospital
Sleepy Hollow Animal Hospital
South Towne Veterinary Hospital
Springville Animal Hospital
Stone Ridge Veterinary Clinic
Storybook Farm Veterinary Hospital
Suffolk Veterinary Service
Sutton Animal Hospital
The Moriches Hospital For Animals
Thorn Avenue Animal Hospital
Three Village Veterinary Hospital
Town and Country Hospital for Pets
University Animal Hospital
Veterinary Care of Ithaca
Veterinary Center of East Northport

OHIO
Westvale Veterinary Clinic
Woodbury Animal Hospital

PENNSYLVANIA
Wrights Corners Animal Care Center
Veterinary Oncology & Referral
Veterinary Oncology and Referral Clinic
Cummings Veterinary Hospital

RHODE ISLAND
Milford Animal Hospital

SOUTH CAROLINA
Thoreau Veterinary Hospital

UTAH
Thornwood Veterinary Hospital
Vermont
Ferguson Animal Hospital

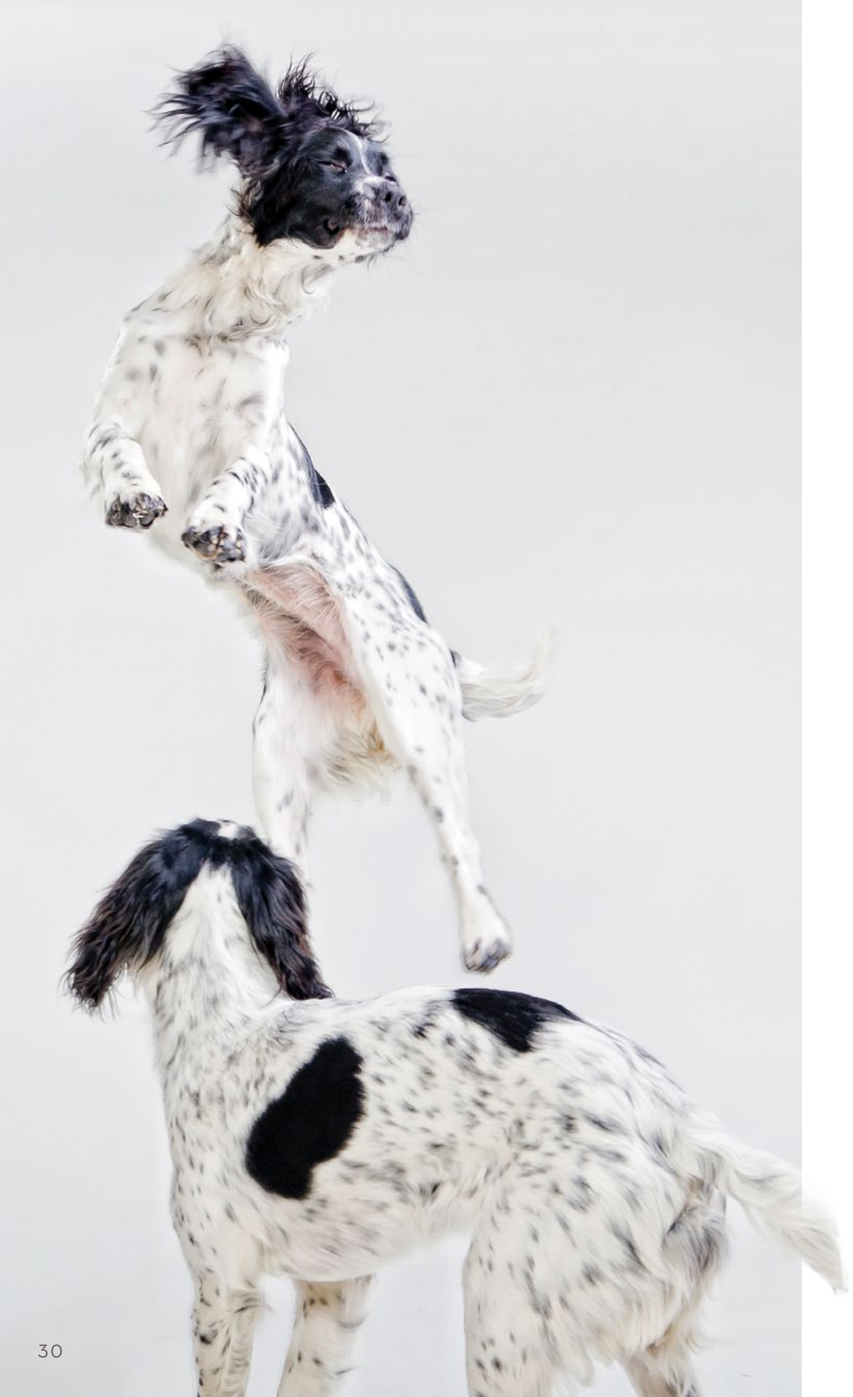
VIRGINIA
Creekside Veterinary Clinic
Pet Stop Veterinary Clinic
Otterside Animal Hospital
Godspeed Animal Care
Montrose Animal Health Center

When you make a gift in memory of your client's deceased pet, your client will receive a letter informing them of your kind gesture in addition to a copy of our Grieving brochure. Produced in collaboration with licensed social work and psychiatric professsionals, this brochure discusses the grieving process, how it can manifest itself in peoples' lives, and when to consider seeking assistance after the loss of a cherished pet.

HONOR ROLL OF GIVING

We wish to express our gratitude to all who contributed this past year.

While space prevents us from listing all names, please know that your support is deeply appreciated. | July 1, 2019 - June 30, 2020



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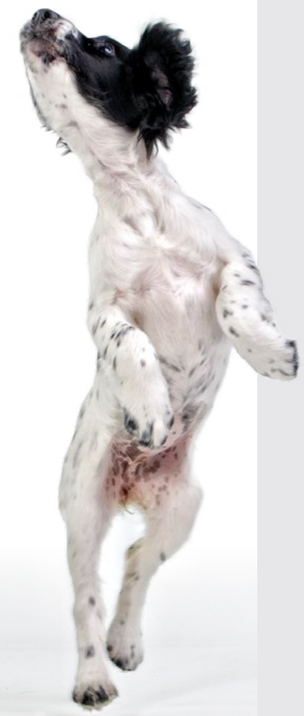

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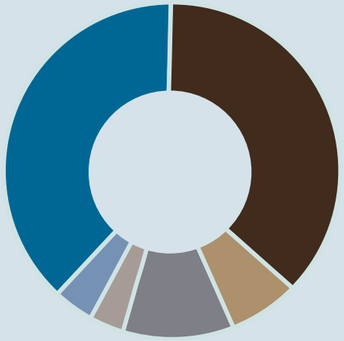
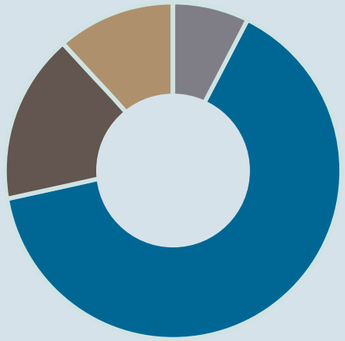


2020 REVENUES

- **Endowment Income** ..... 38.7% $3,341,173
- **Grants & Contracts** ..... 35.9% ...$3,097,255
- **Gifts & Bequests** ..... 7.1% ..... $ 608,830
- **Faculty Support** ..... 11.0% $953,874
- **College Support** ..... 3.4% $291,859
- **Revenues & Royalties** .... 3.9% $340,443



2020 EXPENSES

- **Research Support** ..... 64.0% $7,035,212
- **Infrastructure** ..... 16.9% $1,861,424
- **College and University Support & Services** ..... 11.6% $1,277,987
- **Administration & Development** ..... 7.5% $820,042

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Advancing animal health takes people who care. The following individuals have carefully and generously planned their contributions for the Baker Institute through their will. Their generosity is honored with membership in the Cayuga Society.

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