Leadership Training
for Veterinary Students

1992 Program

COLLEGE OF VETERINARY MEDICINE
CORNELL UNIVERSITY
LEADERSHIP TRAINING PROGRAM

FOR

VETERINARY STUDENTS

"CLASS OF 1992"

COLLEGE OF VETERINARY MEDICINE
CORNELL UNIVERSITY
ITHACA, NY 14853
(607) 253-3276
LEADERSHIP TRAINING PROGRAM

FOR

VETERINARY STUDENTS

COLLEGE OF VETERINARY MEDICINE
CORNELL UNIVERSITY
ITHACA NY 14850
(607) 255-3310
For the past three years, the College of Veterinary Medicine at Cornell University has hosted a Leadership Training Program for Veterinary Students. The program has three major objectives: 1) to acquaint the participating students with career opportunities in research; 2) to crystalize their commitment to a research career, and 3) to establish a professional network that will benefit the students after they have finished their formal education.

The 1992 program was sponsored jointly by the Richard King Mellon Foundation, the Merck Foundation and the Robert W. Woodruff Foundation. Twenty students from thirteen different veterinary colleges were enrolled. In addition, Vicki June, a second year veterinary student at Cornell, served as Program Coordinator. Reflecting the now global character of veterinary medicine, more than half of the students came from veterinary colleges in countries other than the USA. This cultural diversity enriched the program. It afforded an opportunity for the students to share professional school experiences and to gain a perspective on the opportunities and challenges of veterinary medicine worldwide.

\[\text{CLASS OF 1992}\]

\begin{tabular}{|l|l|l|l|l|}
\hline
\textbf{Student Fellows} & \textbf{College} & \textbf{Sponsor} & \textbf{Mentor(s)} & \textbf{Department} \\
\hline
Tomasz Betkowski & University of Lublin & Woodruff & Grohn/Guard & Clinical Sciences \\
Stephen Davies & University of Bristol & Mellon & Pearce & Microbiology \\
Margaret Edwards & North Carolina State & Merck & Cooper & Pathology \\
Mathew Gerard & University of Sydney & Mellon & Pauli & Pathology \\
Robyn Hauser & Washington/Oregon State & Merck & Chang & Diagnostic Lab \\
Christine Hawke & University of Sydney & Woodruff & Parrish & Baker Institute \\
Stacey Karzenski & Oklahoma State & Merck & Lust & Baker Institute \\
Joanne L'Anglais & University of Montreal & Mellon & K./T.R. Houpt & Physiology \\
Julio Montero & Purdue University & Merck & Yen & Pathology \\
John Ober & Purdue University & Woodruff & Guan & Pathology \\
Jacque Phillips & University of Sydney & Merck & Horne & Pharmacology \\
Timothy Rocha & Texas A&M University & Mellon & Winter & Microbiology \\
Cristina Rodriguez & University of Mexico & Merck & Carmichael & Baker Institute \\
Michael Serdy & University of Sydney & Woodruff & Levine & Pathology \\
Johanna Sherrill & University of Georgia & Mellon & Bertram & Anatomy \\
Louise Southwood & University of Sydney & Merck & Ball & Clinical Sciences \\
Jane Stobutzki & University of Sydney & Mellon & Fewtrell/Schwark & Pharmacology \\
Reinhard Straubinger & University of Munich & Woodruff & Appel & Baker Institute \\
Susan Watson & Oklahoma State & Merck & Calnek/Schat & Avian & Aquatic \\
\hline
\end{tabular}

\textbf{Program Coordinator}

Vicki June & Cornell University & Woodruff & McGregor & Administration
This year’s program spanned ten weeks during the months of June, July, and August. Student fellows were assigned research projects which enabled them to explore a variety of subjects, and to learn new techniques. They also gained insight into the manner in which a research laboratory utilizes its personnel and material resources.

The Leadership Program is first and foremost a research experience. It is more than that, however. The program includes a variety of activities calculated to assist the students with their career decisions and to improve their critical capacity and communication skills. Highlights of the 1992 program included:

**Career Day**

Veterinarians who have achieved distinction as research scientists or administrators visited the College to discuss opportunities for careers in veterinary medicine and to advise the students regarding their career decisions. The following individuals took part:

- Dr. Gustavo D. Aguirre, Professor of Ophthalmology, College of Veterinary Medicine, University of Pennsylvania
- Dr. William A. Horne, Assistant Professor of Pharmacology, College of Veterinary Medicine, Cornell University
- Dr. N. Sydney Moise, Associate Professor of Medicine, College of Veterinary Medicine, Cornell University
- Dr. Julie A. Yager, Professor of Pathology, Ontario Veterinary College, University of Guelph

On the evening preceding career day, the students and counselors met informally to discuss the agenda. The latter included brief presentations by the counselors in which they described their own careers and recounted choices they were obliged to make. The presentations were followed by an open discussion and later still by meetings between the counselors and small groups of students.

**Visits to Other Research Institutions**

Merck Company Foundation hosted a program at its central research facilities in Rahway, New Jersey as it has done in each of the past three years. Table 1 lists the presentations made by Company scientists and administrators. Together they provided an overview of career opportunities for veterinarians in industry and at Merck in particular.

**Table 1. Visit to Merck Research Laboratories**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Speaker</th>
<th>Title</th>
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<tbody>
<tr>
<td>The Merck Commitment to Animal Health</td>
<td>Dr. Mervyn J. Turner</td>
<td>V.P., Animal Health and Agriculture R&amp;D</td>
</tr>
<tr>
<td>Basic Animal Science Research</td>
<td>Dr. Gerry J. Hickey</td>
<td>Asst. Dir., Animal Drug Evaluation</td>
</tr>
<tr>
<td>Laboratory Animal Resources</td>
<td>Dr. Lynn C. Anderson</td>
<td>Director, LAR</td>
</tr>
<tr>
<td>Animal Science Research</td>
<td>Dr. Dan O. Farrington</td>
<td>Sr. Dir., Field Operations</td>
</tr>
<tr>
<td>Tour of Basic Research Laboratories</td>
<td>Dr. Anne M. Gurnett</td>
<td>Research Fellow</td>
</tr>
<tr>
<td>Animal Science Research Dev. Projects</td>
<td>Ms. Paula M. Dulski</td>
<td>Research Associate</td>
</tr>
<tr>
<td>Animal Science Research Field Operations</td>
<td>Dr. Antoinette Jernigan</td>
<td>Associate Director</td>
</tr>
<tr>
<td>Animal Science Research Vet. Literature</td>
<td>Dr. Susan L. Longhofer</td>
<td>Assistant Director</td>
</tr>
<tr>
<td>Animal Science Research Vet. Literature</td>
<td>Dr. Jan A. Bergeron</td>
<td>Associate Veterinary Editor</td>
</tr>
<tr>
<td>U.S. Operations, Merck AgVet</td>
<td>Dr. Susan E. Aiello</td>
<td>Assistant Veterinary Editor, Manager, Technical Services</td>
</tr>
<tr>
<td>Creating New Medicine: Mirapril</td>
<td>Dr. Janice L. Nicol</td>
<td>Assoc. Director, Animal Science Research Develop.</td>
</tr>
<tr>
<td></td>
<td>Dr. Anthony M. Benitz</td>
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</table>

Novel features of the 1992 program included visits to the main campus of the National Institutes of Health and the research facilities of the United States Department of Agriculture, both in the Washington,
DC area. The agenda for these visits are listed in Tables 2 and 3, respectively. In each case, scientists in the host institutions discussed the range of their research programs, and opportunities for advanced research for veterinary graduates.

### Table 2. Visit to the National Institutes of Health

<table>
<thead>
<tr>
<th>Topic</th>
<th>Speaker</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview of NIH</td>
<td>Dr. Robert A. Whitney</td>
<td>Director, NCRR</td>
</tr>
<tr>
<td>PH Commissioned Corps</td>
<td>Dr. Robert J. Carolan</td>
<td>Chief, Res. Animal Branch, VP, NCRR</td>
</tr>
<tr>
<td>NCI Laboratory of Pathology</td>
<td>Dr. Kevin L. Gardner</td>
<td>Senior Staff, LP, NCI</td>
</tr>
<tr>
<td>NCI Lab of Experimental Carcinogenesis</td>
<td>Dr. Ritva P. Evarts</td>
<td>Senior Staff, LEC, NCI</td>
</tr>
<tr>
<td>Seminar “Localization of the gene causing familial mediterranean fever”</td>
<td>Dr. Daniel Kastner</td>
<td>Senior Staff, NIAMS</td>
</tr>
<tr>
<td>NIH Training Programs</td>
<td>Dr. C. Michael Fordis</td>
<td>Director, Office of Education</td>
</tr>
<tr>
<td>NINDS Lab of Central Nervous System</td>
<td>Dr. Clarence J. Gibbs</td>
<td>Deputy Chief, LCNSS, NINDS</td>
</tr>
<tr>
<td>Studies</td>
<td></td>
<td>Staff Fellow, LEN, NINDS</td>
</tr>
<tr>
<td>NINDS Lab of Experimental Neuropathology</td>
<td>Dr. Jefferson Mitchell</td>
<td>Senior Staff, CHB, NHLBI</td>
</tr>
<tr>
<td>NHLBI Clinical Hematology Branch</td>
<td>Dr. Robert E. Donahue</td>
<td>Senior Staff, BEIP, NCRR</td>
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<tr>
<td>In Vivo NMR Research Center</td>
<td>Dr. Alan W. Olson</td>
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### Table 3. Visit to the United States Department of Agriculture, Beltsville, MD

<table>
<thead>
<tr>
<th>Topic</th>
<th>Speaker</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>Overview of Beltsville Ag. Res. Center</td>
<td>Dr. G.C. Marten</td>
<td>Assoc. Dir, Beltsville Area</td>
</tr>
<tr>
<td>Overview Livestock &amp; Poultry Sciences Inst.</td>
<td>Dr. T.J. Sexton</td>
<td>Deputy Area Director</td>
</tr>
<tr>
<td>Zoonotic Diseases Research</td>
<td>Dr. Samuel Shen</td>
<td>Microbiologist</td>
</tr>
<tr>
<td>Helminthic Diseases Research</td>
<td>Dr. Michael W. Fleming</td>
<td>Research Physiologist</td>
</tr>
<tr>
<td>Biosystematics Parasitology Research</td>
<td>Ms. Patricia Pilett</td>
<td>Zoologist</td>
</tr>
<tr>
<td>Protozoan Diseases Research</td>
<td>Dr. Mark C. Jenkins</td>
<td>Molecular Biologist</td>
</tr>
<tr>
<td>Transgenic Animal Research</td>
<td>Dr. Robert J. Wall</td>
<td>Research Physiologist</td>
</tr>
<tr>
<td>Mastitis Research</td>
<td>Dr. M.J. Paape</td>
<td>Research Dairy Scientist</td>
</tr>
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### Group Discussions

The program included two group discussions. The first was moderated by Dr. Ari Van Tienhoven, Emeritus Professor of Poultry Science at Cornell. The discussion focused on biomedical ethics, and particularly on the use of animals as research subjects. The second discussion addressed issues of global significance to veterinary medicine. This meeting took the form of a round table discussion with audience participation. The panelists were:

- Dr. S. Gordon Campbell, Professor of Microbiology, Immunology and Parasitology in the College of Veterinary Medicine at Cornell
- Dr. Davydd J. Greenwood, Professor of Anthropology and Director of Cornell’s Mario Einaudi Center for International Studies
- Dr. David R. Fraser, Professor of Animal Science and Associate Dean in the Veterinary College at Sydney University

### Individual Presentations

Before leaving Cornell, the students reported on their research activities in an open meeting that included students, faculty and administrative staff of the College of Veterinary Medicine. The presentations were uniformly good, and some were outstanding. In the report which follows they introduce themselves and describe their individual and collective experiences.
I am a third-year veterinary student at the University of Agriculture in Lublin, Poland. As a Woodruff Foundation fellow, I worked in the Section of Epidemiology in the Department of Clinical Sciences. My project, under the guidance of Professor Yrjö Gröhn and Professor Charles Guard, involved work in different areas. In Professor Gröhn’s laboratory, I became acquainted with epidemiological techniques and their application to computer analysis of data from dairies. I also had the opportunity to accompany Professor Guard on visits to farms in the Ithaca, New York area. It was a rewarding experience that enabled me to acquire new veterinary skills, and to appreciate the importance of nutrition, ventilation, housing, crops, milk equipment, and feeding programs on the health and production efficiency of dairy cows. In the course of these visits, we gathered data for use in epidemiological research on animal production and disease mechanisms.

I found it especially valuable to discuss with my mentors how epidemiological studies can be a guide to dairy management in ways that improve milk production, and how this information is communicated to farm managers. Studies of the kind performed by my mentors is providing information on diseases such as, metritis, mastitis, milk fever, ketosis, retained placenta, silent heat, and cystic ovaries and how each of these diseases influences the economy of milk production. I now have a better appreciation of how disease incidence, environment, and genetic factors affect milk yield.

Owing to the fact that Professor Gröhn is from Finland, I became acquainted with disease recording in that country and also in Norway. I have become convinced that clinical care of individual animals is in itself an ineffective approach to intensive animal production. One of the greatest needs in veterinary medicine today is to perfect comprehensive epidemiological intelligence systems. The special contribution of epidemiology is providing information describing the frequency and distribution of health and disease, identifying the occurrence and severity of disease in animal populations, and quantitating the interrelationship between health and disease. The future development of production medicine requires a comprehensive understanding of the relationship between disease, production efficiency, and the genetic background of the individual cow.

The Leadership Training Program was important to me for several reasons. It not only provided insights gained from personal experience, but enabled me to appreciate the breadth and sophistication of the work conducted elsewhere in the veterinary college at Cornell and in the other institutions we visited. I also met veterinary students from different countries and learned how D.V.M. programs are designed in other institutions. My ambition is to be a bovine practitioner, but I would like to combine these duties with research in a relevant area.
Working in a parasitology laboratory afforded me an excellent opportunity to pursue my interests in infectious diseases, parasitology and tropical veterinary medicine. The laboratory investigates the biology of the trematode parasite *Schistosoma mansoni* and the immunology of the host response to parasite infection. *Schistosoma mansoni* is a human pathogen of immense importance in the developing world, affecting some 60 million people.

Under the guidance of Professor Pearce, my efforts concentrated on the investigation of isoprenylated proteins in *S. mansoni*, a subject about which nothing was previously known. Parasite proteins, modified with isoprenoids such as farnesyl or geranylgeranyl, can be radiolabelled by culturing parasites in vitro with the tritiated isoprenoid precursor, $^3$H-mevalonate. Synthesis of endogenous mevalonate can be inhibited by including the compound mevinolin (Lovastatin) in the culture medium. Mevinolin is a potent inhibitor of the enzyme 3-hydroxy-3-methylglutaryl coenzyme A reductase and is used in human medicine to inhibit the synthesis of cholesterol, also synthesized from mevalonate.

It has been observed that the administration of mevinolin to adult schistosomes greatly reduces egg production. Since adult parasites do not synthesize cholesterol but obtain all their cholesterol requirements from the host, it is possible that mevinolin mediates its effect by inhibiting the isoprenylation of a protein that has a crucial role in parasite reproduction. A wide variety of polypeptides in eukaryotic cells are modified by the addition of isoprenoids to cysteine residues located at the C-terminus. Examples include the undecapeptide fungal mating factor of *Rhodosporidium toruloides*, some nuclear lamins, the gamma subunits of G-proteins, ras proteins and many other related small GTP-binding proteins. Isoprenylation is thought to have a key role in protein function, possibly by increasing hydrophobicity of the C-terminus, allowing the protein to interact with the membrane bilayer, and bringing it into closer proximity with other membrane-associated proteins.

Radiolabelling of adult schistosomes and sodium dodecyl sulphate-polyacrylamide gel electrophoresis of protein extracts has revealed the presence of a major isoprenylated species, of c.21kDa molecular weight, that exists in both cytosolic and membrane-bound forms. The protein is present in both male and female worms, but not in the immature schistosomulum stage. We attempted to characterize this molecule further, by employing Western blotting, two-dimensional electrophoresis, GTP-binding assays and other protein chemistry techniques. The protein is similar in weight to ras. It is tempting to speculate that it is a schistosome GTP-binding protein, possibly with a role in the transmembrane signal transduction of messages between male and female worms, or between parasite and host. Our attempts to determine the function of the protein have, as yet, proved unsuccessful.

Working under the guidance of an enthusiastic and progressive mentor was an exciting and stimulating experience, and gaining hands-on experience working with various stages of the schistosome life-cycle and applying protein chemistry techniques to the investigation was a lot of fun. I very much hope to return to this line of investigation at a later date.

Needless to say, the Leadership Training Program was an amazing experience, socially and intellectually. I'd like to thank the Mellon Foundation for its sponsorship and Cornell University for a great summer!

Margaret Edwards
North Carolina State University

I graduated from the University of Virginia with a Bachelor of Arts in Psychology in 1987. Before applying to veterinary school in 1991, I spent four years working while taking several prerequisite courses. I worked in a private practice as a veterinary assistant; at the North Carolina State University veterinary school as a laboratory animal technician; and subsequently as a research technician in the same institution. It was the latter position which I enjoyed the most and which led me to explore further research opportunities in veterinary medicine.

This fall I will begin my second year as a veterinary student at NCSV. I planned to go into small animal private practice; however, my undergraduate career and veterinary school experiences exposed me to different opportunities in veterinary medicine.

My Merck Foundation summer fellowship at Cornell has given me a terrific opportunity. I worked in Professor Barry Cooper's laboratory characterizing the mutation responsible for Duchenne-type muscular dystrophy (MD) in a cat. Duchenne muscular dystrophy is caused by mutations in the gene encoding the cytoskeletal...
muscle protein, dystrophin. I had never before investigated a disease at its molecular “roots.” In the course of the summer, I learned and subsequently applied several techniques of molecular biology to locate the cat’s mutation. Using the reverse transcription polymerase chain reaction (PCR), I compared mRNA from normal cats and the dystrophic animal to detect possible differences in the character of the dystrophin message. This was particularly challenging given the size of the message (about 14 kb) and the lack of available sequence information for cat dystrophin cDNA. Under the guidance of Dr. Nena Winand, I was able to study areas of the cat gene which are highly conserved among species (i.e., human, mouse, and chicken).

RNA was isolated from normal cat muscle and reverse transcribed in vitro to obtain cDNA for amplification. Primer pairs used to analyze canine dystrophin cDNA were tested for amplification of cat cDNA. Several primer pairs gave reliable amplification of the normal cat dystrophin transcript, indicating that the cat sequence was similar enough to the dog sequence to screen with these primers. RNA was isolated from dystrophic cat muscle and reverse transcribed in vitro. Then, 250- to 1000-bp segments of the dystrophin transcript were amplified from the dystrophic cat cDNA and from normal cat cDNA which served as a “positive control.”

I was fortunate to discover that the first exon of the dystrophin gene was not present in the transcript of the dystrophic cat. Yet I knew that this cat produced some dystrophin in many of its muscle fibers, based on the results of immunostaining. I also knew that the cat’s dystrophin protein was not significantly smaller than a normal control on Western blot. From these observations we were able to conclude that the cat’s mutation did not involve deletion of a large segment of the coding region. My initial experiment demonstrated that the primer pairs encompassing exons 1 through 4 and exons 1 through 8 failed to produce the product. We have therefore localized the mutation to the first few exons and hypothesize that the dystrophin expressed in this cat may be transcribed from a brain promoter. This hypothesis is now being tested. The actual mutation will be identified by genomic cloning and sequencing.

My project was both challenging and exciting. It was rewarding to sort through a gene and find a mutation responsible for an important disease. I would like to thank my mentor, Professor Barry Cooper, for his constant support and enthusiasm throughout my summer. I would also like to thank Dr. Nena Winand for her patience in teaching me laboratory techniques used in my research project. My ten weeks at Cornell have been most rewarding and enjoyable.

I entered the Faculty of Veterinary Science at the University of Sydney, Australia in 1988 and will graduate in December of this year at age 22. I had no laboratory research experience whatsoever prior to coming to Cornell. A career in veterinary-related research was never an option I considered in my life goals. Instead, I began my veterinary studies with the specific aim of moving into private practice immediately after graduation and perhaps taking the opportunity to practice in other countries when the chance arose. My exposure at Cornell to a highly competent research unit has shown me an alternative to private practice — one that could potentially influence my future career decisions.

As a Mellon Foundation Fellow I joined the research team in Professor Bendicht U. Paul’s cancer biology laboratory in the Department of Pathology. A major interest of the laboratory is in the role of vascular endothelial cell adhesion molecules (ECAMs) in providing binding sites for organ-specific metastatic tumor cells. Murine melanoma cells which have a predilection to metastasize to the lung bind preferentially to a lung endothelial cell adhesion molecule (Lu-ECAM-1) when compared to “low lung metastatic” murine melanoma cells and other tumor cell lines. After the initial recognition and binding of tumor cells to ECAMs the process of extravasation ensues followed by colonization of the tumor cells in secondary target organ.

My project involved a similar analysis of prostatic carcinoma cells. A new rat tumor cell line developed in the laboratory mimics the tendency for prostatic carcinoma cells to metastasize to lumbar vertebrae, pelvis and proximal long bones as they do in man. The hypothesis that I set out to test was that cells of the rat tumor metastasize preferentially to bone because they have an affinity for a bone-specific ECAM expressed in vertebral and pelvic venules. The first step was to gain experience with cell culture techniques; fluorescent cell adhesion assays; Stamper-Woodruff adhesion assays; extracellular matrix isolation and endothelial cell vesicle isolation, all of which would be required. In the course of my research, I demonstrated preferential binding of vertebral-metastatic prostatic carcinoma cells to bone-modulated endothelial cells.
I also became familiar with the use of laboratory apparatus and had the opportunity to observe or to help other scientists, thereby increasing my knowledge and experience. Being in a “high-powered” research laboratory conducting meaningful experiments impressed me. I spent much time thinking about the purpose and value of my experiments and discussing them with others. In ten weeks I established protocols for rat bone matrix isolation and a fluorescent tumor cell-endothelial cell adhesion assay. Others will build on these findings as the project progresses.

Participating in the Cornell Leadership Training Program is an incredibly worthwhile experience both in the laboratory and outside. One’s days are packed with program events that aim to help the participants make relevant career decisions. The places one visits, the activities in which one participates, and most importantly, the people one meets is a once-in-a-lifetime opportunity!

Robyn Hauser
Oregon State and Washington State University

I am entering my third year as a veterinary student in a cooperative program between Oregon State University and Washington State University Colleges of Veterinary Medicine. Upon graduating with a B.S. in Biochemistry from the University of Oregon in 1987, I was employed as a biomedical research assistant for approximately three years. During my undergraduate education, and my time spent as a research assistant, I was involved in several aspects of research including, the study of genetic transposable elements, virally induced leukemia in mammalian systems, and gene regulation of Herpes Simplex Virus. A summer as a National Institutes of Health intern at the Rocky Mountain Labs in Montana, between my first and second years of veterinary school, allowed me to conduct research on a heat shock protein that may be of pathogenic significance in Lyme Disease.

A deep interest in medicine and clinical sciences, as well as my experience in basic science research, prompted me to enter veterinary school in 1990. I have been very happy with my decision and my continued involvement in research. I am amazed and encouraged by the diversity, opportunity, and challenges which veterinary medicine has to offer.

Being chosen as a Merck Foundation fellow at Cornell has given me an opportunity to expand my knowledge of bacterial infectious disease mechanisms and become familiar with several new research techniques.

Working with Dr. Yung-Fu Chang and his energetic, helpful research staff in the NYS Diagnostic Laboratory, I spent the summer studying the fine molecular structure of the secreted cytolytic toxins of Actinobacillus pleuropneumoniae. Molecular definition of these toxins will allow a better understanding of their pathogenic significance and possibly also their use as vaccine ingredients.

Several gram-negative bacteria, including A. pleuropneumoniae, secrete cytolytic toxins that are genetically and immunologically related. Many of these toxins have important roles in a number of human and animal bacterial diseases. The A. pleuropneumoniae cytotoxins AppI, AppII, and AppIII have been shown to be the main virulence factors involved in porcine pleuropneumonia, a major cause of economic loss to the swine industry.

My research this summer included subcloning AppIII gene fragments into M13 bacteriophage vectors, DNA template preparation, subsequent sequencing, and T4 sequential deletion analysis. I also gained experience in DNA and protein purification as well as Western and Southern blot techniques. I participated in the complete DNA sequence of the AppIII toxin structural and its activation genes. This allowed determination of the primary structure, start and stop codons, polymerase and ribosome binding sites, rho-independent terminator, transmembrane domains, and glycine-rich repeats.

As well as a dynamic research atmosphere, Cornell’s Leadership Training Program gave me an opportunity to learn about career options for veterinarians in industry and governmental institutions through visits to Merck and Co., the NIH, and the USDA. The Program also provided a lively forum for discussion of many currently relevant and important topics in veterinary medicine with an international group of veterinarians and students.

I view the Leadership Training Program as an invaluable step in my veterinary education and would highly recommend it to any interested student.
Christine Hawke  
University of Sydney

I have wanted to be a veterinarian for as long as I can remember. Therefore it was an easy decision to enroll in veterinary science at the University of Sydney when I completed high school. I am now halfway through my fourth year, having taken a year off in 1991 to complete a BSc(Vet) on lead toxicity in cats. This was a one-year project which was my first exposure to the world of research. Although I am not sure what I will be doing once I graduate, I would like to combine clinical practice with research, perhaps in an academic environment.

As a Woodruff Foundation fellow, I was able to spend the summer doing research with Professor Colin R. Parrish at the James A. Baker Institute for Animal Health. My project involved the study of the canine adenoviruses, CAV-1 (the etiologic agent of infectious canine hepatitis) and CAV-2 (associated with respiratory disease). These are closely related but distinct viruses, which differ in their pathogenicity and antigenicity.

Compared with the work on human adenoviruses, little has been done in characterizing the genes of the canine adenoviruses. Future plans for work with CAV-1 and CAV-2 in the laboratory include the study of their biochemical and pathogenic properties in greater detail, as well as investigations into the use of these viruses as recombination vectors in vaccine production.

Foreign genes can be expressed following their insertion into a region of the genome which is not essential to viral replication. It has been shown that the E3 region of human adenoviruses is such a region, and there is great interest in developing recombinant vaccines using those human viruses as vectors. It is anticipated that the canine adenoviruses also will be suitable for such purposes for vaccination of dogs. For example, insertion of the genes coding for canine parvovirus (CPV) capsid proteins (VP1, VP2) into the E3 region of the CAV genome should result in the production of empty CPV capsids in a dog which has been inoculated with the recombinant adenovirus vaccine. Therefore the dog would mount a protective immune response against both CAV and CPV.

CAV-2 in particular appears to be suitable for use as a vector for recombinant vaccines, as it can persist in the respiratory tract of puppies following oronasal inoculation. Therefore an effective immune response could be mounted without interference by maternal antibodies.

During my ten weeks of research, I was able to develop methods for growing and titrating CAV-1 and CAV-2 in tissue culture, and also methods for isolating viral replicative form (RF) DNA from infected cells. Once I had recovered large amounts of this RF DNA, I performed a preliminary analysis of the two genomes with a variety of restriction enzymes, and found that they were readily distinguished by their enzyme digest profiles. Double digests were used to map some of the restriction sites.

It was found that the restriction enzyme EcoRI created a fragment of the CAV-2 genome which, using genomic maps of human adenoviruses as a model, should contain the E3 region. I was able to clone that fragment into the plasmid vector pGEM3Z, and commenced its analysis with a range of restriction enzymes.

I feel that my summer at Cornell has been an excellent opportunity to continue my exposure to veterinary research, and to see how diverse the career options are for those with a veterinary education. It also has given me the chance to experience another culture, and to meet lots of great people from all over the world.

Lorrie Karrenbauer  
Ohio State University

I received a B.Sc. in biology from Denison University in 1990 and this fall will be entering my third year as a veterinary student at Ohio State University, College of Veterinary Medicine. During my undergraduate training I was introduced to research, first as an assistant, then by completing a year long independent project in environmental microbiology. I had not been presented with a research opportunity since entering veterinary school until the Cornell Leadership Training Program. I saw the program as a chance to become involved in research again, this time related to veterinary medicine. My goals after graduation include a combination of teaching, research and clinical medicine in one of two areas: cardiology or exotic animal medicine.

As a Merck Foundation fellow, I was able to work with Professor Sydney Moise and Professor Robert Gilmour studying an animal model of Sudden Infant Death Syndrome (SIDS). This project was especially appealing to me.
because it combined my interests in cardiology with an opportunity to work with research animals.

Every new or expecting parent considers the possibility of crib death or SIDS. In the U.S., it is the leading cause of death of children less than one year of age, with the peak incidence around two to three months. Victims die suddenly, in their sleep, with no structural defect or cause of death found at autopsy. Although a huge volume of information has been generated about this syndrome, a cause has not yet been defined. An animal model becomes important here, because it allows prospective studies to be done.

A model for at least some forms of SIDS has been developed at Cornell. A colony of German Shepherd dogs with an inherited disorder characterized by spontaneous ventricular arrhythmias which occasionally degenerate into ventricular fibrillation with sudden death has been selectively bred and studied by my mentors. The syndrome is similar to SIDS insofar as the dogs have been witnessed to die while asleep, with a peak incidence of death occurring between four and eight months of age. The hypothesis advanced by Professors Moise and Gilmour is that the ventricular arrhythmia in affected dogs is exacerbated by sleep and caused by a developmental imbalance in the sympathetic innervation of the heart.

In order to determine the extent and severity of the ventricular ectopy, 24 hour ambulatory Holter monitors are placed on the dogs. The more severely affected individuals are video-taped during this period to determine with which type of activity the ectopy is associated. As part of my project, I assisted in setting up the Holters and videos. Once the Holter data was manually read and the amount and type of ectopy recorded, I made graphic comparisons (using Stat-View Macintosh) between the age, time of day, and season that the ventricular premature complexes and ventricular tachycardia occurred. We have identified a circadian and periodic rhythm of the ventricular tachycardia in dogs that died suddenly.

I also was involved in the analysis of the pedigrees of affected dogs. Our goal was to determine if affected dogs are related. After reviewing the pedigrees of over 300 dogs we found a definite and consistent lineage: all affected dogs had an ancestral path which could be traced to a single dog. Using the results of the analysis we began linkage analysis in the laboratory of Dr. William Horne.

The Leadership Training Program has been a fantastic opportunity, not only to participate in research, but to meet veterinary students from around the world. Their experiences and perspectives of veterinary medicine made me more aware of my profession on a global scale. Career Day and our trips to NIH, Merck and the USDA were very helpful in that they gave me the opportunity to talk to veterinarians who did not follow the traditional path of private practice. Because of this summer experience, I feel more prepared to do the same.

Stacey Karzenski
Oklahoma State University

I will be a junior this fall at the Oklahoma State University, College of Veterinary Medicine. I completed my B.S. in Animal Science at Cornell University in 1984. My first exposure to research was in 1989 in the laboratory of a Howard Hughes Medical Institute grant recipient at the Oklahoma Medical Research Foundation. The work was directed toward development of a protocol for treatment of solid tumors. We used a monoclonal antibody to Protein C, an endogenous anticoagulant, and tumor necrosis factor, a cytokine produced by macrophages. I also worked to develop an animal model for coumarin-induced skin necrosis, a syndrome seen in human patients receiving coumarin for the treatment of vascular coagulopathies. I am coauthor on a paper which reviews case histories and the pathogenesis of that condition.

During my first year as a veterinary student I assisted in an evaluation of a variety of sutures in the surgical resection of artificially transfected digital flexor tendons in chickens. In my second year in veterinary college, I initiated two of my own projects. The first of these was a morphologic study of a case of schistosomus reflexus in a calf. A case report will be submitted for publication later this fall. My second project was concerned with the development of a veterinary teaching aid on diseases of the equine forelimb incorporating anatomic specimens and radiographs with written descriptions of some common causes of equine forelimb lameness. This will be displayed in the Anatomy Teaching Laboratory at Oklahoma State University.
laxity in young dogs.

My mentors are also studying the pathogenesis of osteoarthritis resulting from hip dysplasia in dogs. One of their goals is to develop an in vitro model that mimics the loss of proteoglycans and increased deposition of fibronectin within the degenerative cartilage of osteoarthritic joints. The model entails subjecting normal articular cartilage explants to mechanical and/or enzymatic trauma. Previous work by my mentors established the culture conditions required by chondrocytes in cartilage explants to maintain normal total protein, fibronectin and proteoglycan synthesis. Studies have been done on free-swelling explants and on explants under single cycle uniaxial load. A cyclic compression apparatus is being designed to test the effects of repeated mechanical loading on chondrocyte metabolism.

I wanted to assess the response of free-swelling cartilage explants to treatment with collagenase, since collagenolytic activity has been demonstrated in diseased cartilage and may be partially responsible for the development of osteoarthritis. As a preliminary study, I treated cartilage disks with three concentrations of collagenase over two time periods and then assayed water content, fibronectin synthesis, and hydroxyproline release from the tissue using techniques of radiolabelling and radioassay, gel affinity column purification and ELISA. The results disclosed a significant increase in water content of the disks treated with collagenase for 24 hours. This is probably a result of collagen fibril damage which allowed the proteoglycans within the cartilage to absorb water. After 24-hours there was a significant decrease in collagen remaining in treated disks compared to non-treated control tissue.

Overall, my research experience this summer was rewarding. I not only designed and implemented my own research project but learned many basic science research techniques — skills that will provide a foundation for further research endeavors. The laboratory atmosphere was very friendly, and I quickly felt at ease with both of my mentors and my coworkers. Off-work hours were always an adventure thanks to the super group of students who participated in the program. This summer not only offered insight into the research career opportunities available to veterinarians, but also gave me an international family of new friends.

**Joanne L'Anglais**
**University of Montreal**

My experience in the veterinary field is not extensive. This year, at the age of 23, I will complete my final year in veterinary medicine at the University of Montreal. It is only my love for animals and medicine that have guided me so far in my career choices, leading me to work for the Ministry of Agriculture as well as for a small animal practice. I have not yet formed long term plans for my career. This is why my participation in the Leadership Training Program has been so valuable: it offered me the opportunity to explore a whole new aspect of career options.

As a Mellon Foundation fellow, I had the opportunity to conduct research in the Department of Physiology under the tutelage of Professor Katherine Houpt and Professor Richard Houpt. My project entailed working with ponies and horses, which was very enjoyable but not always easy. In fact, I pursued several different projects that all revolved around thirst in the equine species, whether prandial or spontaneous.

Although it is well known that drinking is stimulated by a rise in plasma osmolality or by a decrease in blood volume, most drinking occurs in the absence of these parameter changes. My task was to determine if dry mouth was a stimulus to drinking. I also was involved in a project that related drinking to chewing. Using a polygraph, we were able to record every mastication as we fed the horse continuously until he drank. This demanded much patience because as the saying goes: "you can lead a horse to water but you cannot make him drink." Finally, I was involved in an experiment that examined body fluid changes when ponies were exposed to water with and without hay as well as thirsted with and without hay.

This summer has been an enriching experience. It has opened a window to research, not only through hands-on experience but also through discussions with faculty researchers and through visits to other laboratories. If my career does take a research turn, I will be able to make choices and decisions based on experience and will be more aware of my options.

Finally, this program has been unforgettable for the people I have met, the friends I have made and the places I have discovered. To be able to exchange ideas about veterinary medicine with people from around the world is absolutely incredible. It is for this reason that I am now exploring the option to work in a foreign country after I graduate.
Julio C. Montero  
**Purdue University**

I received a B.S. in Biology from the University of Puerto Rico (UPR) in 1983 and an M.S. in Biology from the same institution in 1987. My thesis research was concerned with the reproductive biology and ecology of freshwater shrimp from the Caribbean region. My working experience in Puerto Rico included two years as a research technician at the Department of Natural Resources and three years as an Instructor of Biology at the UPR. I started my veterinary education at Purdue University in 1990.

This summer I participated in the Leadership Training Program for Veterinary Students as a Merck Foundation fellow in the cancer research laboratory directed by Professor Andrew Yen. The research in Dr. Yen’s laboratory is concerned with cellular and molecular events that control and regulate mammalian cell proliferation. An *in vitro* model that uses leukemia cells of human origin as well as transfected cells, provides an excellent framework to study genetic mechanisms operating in neoplastic cells.

The objective of my project was to evaluate the cellular consequences of altering expression of the retinoblastoma (RB) gene in leukemic cell lines. The neoplastic cell lines utilized in my investigation included promyelocytic HL-60 cells and proerythrocytic K562 cells. Both cells possess the ability to differentiate into mature cells under the influence of chemical inducers like retinoic acid and vitamin D3. In the process of maintaining and studying these cells, I learned tissue culture, molecular biology and flow cytometric techniques. This research experience has made me consider the possibility of graduate studies after my veterinary education.

My participation in this program exposed me to veterinarians in academia, industry and government agencies. In addition to research, extracurricular activities designed to expand our knowledge were conducted in group sessions. Among the topics discussed were ethical considerations of biomedical research and global issues of animal health and animal production. Career counseling was another feature of the program. This summer experience at Cornell University gave me the unique opportunity to interact with and learn from veterinary students from Australia, Canada, Germany, Mexico, Poland, the United Kingdom and the United States.

When I graduate from veterinary school, I plan to apply for an internship program in small animal medicine in order to solidify my clinical and diagnostic capabilities. Thereafter, graduate work in parasitology is a strong possibility provided I am accepted into a doctorate program and can secure adequate financial assistance.

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John Ober  
**Purdue University**

Prior to beginning my veterinary education at Purdue University, I earned a B.S. in Animal Science from Cornell University, and conducted graduate research in Animal Science and Neuroscience at Purdue. After finishing my veterinary degree in 1995, I plan to pursue advanced clinical or research training. Eventually, I would enjoy a career as a clinical investigator (a fairly even balance between clinical activities and academic research closely related to clinical problems). Following research experience in both vision science (undergraduate) and reproductive neuroendocrinology (graduate), I regarded Cornell’s Leadership Training Program as an opportunity to sample a different area of research, and expose myself to a new set of fertile minds.

As a Woodruff Foundation fellow, I was fortunate to conduct my research under the supervision of Professor Jun-Lin Guan, in the Department of Veterinary Pathology. Professor Guan is interested broadly in molecular events involved in cancer cell metastasis. Recently, he has concentrated on determining the structure and function of an intracellular protein tyrosine kinase, pp125-FAK (Focal Adhesion Kinase), which appears to be involved in the process of cell adhesion via integrins (a class of membrane-bound receptors, some of which bind to fibronectin).
My project involved the use of recombinant DNA techniques to transfer the cDNA for pp125-FAK to plasmids appropriate for further work. I also made deletion mutations and other modifications for this cDNA, which will facilitate later determination of the critical functional domains of the protein.

In addition to offering a chance to conduct high quality research with “world class” scientists, this program caters to inspired students by introducing them to some of the most exciting opportunities and ideas available to future veterinarians. The Leadership Training Program shed a new light on career opportunities in veterinary medicine.

Jacque Phillips
University of Sydney

As a final year veterinary student at the University of Sydney, I am only months from graduation. At 24, I am slightly older than my classmates. I took a year off before starting University to work and to travel in Great Britain. Like many of my classmates, my initial career goal was simply to graduate. That being imminent, I must now make some definitive career decisions. I had a brief introduction to research before coming to Cornell. Between my third and fourth year I worked for the C.S.I.R.O. as part of a team seeking to develop a vaccine against helminths in sheep. My project involved a study of the gut immune response to Trichostrongylus larvae, in particular mast cell reactions. I accepted the offer of a Mellon Foundation fellowship in order to further investigate a career in research. The Leadership Program has shown me that a veterinary degree qualifies one for much more than a career in private practice. I still want to “be a vet” at least for a while. I then see myself entering an internship or residency or possibly a graduate research program leading to a PhD. My interests now lie in clinically orientated research.

I spent my summer in the laboratory of Professor William Horne in the Department of Pharmacology. Research in Professor Horne’s laboratory is directed toward characterizing the structural and functional properties of neuronal calcium (Ca) channels. Many Ca channel subtypes have been identified in the brain. These are distinguished by their pharmacological and electrophysiological properties. Using molecular biological and biochemical approaches, my mentor and his associates have characterized two Ca channel subtypes that are differentially expressed in specific regions of the brain. These channels are important regulators of neurotransmitter release. As a result, they are being investigated for their part in delayed glutamate-induced neuronal degeneration following cerebral hypoxia. This is the underlying mechanism responsible for CNS deficits seen in humans and animals following cardiac arrest. Pharmacological agents that selectively block Ca channels have been shown to reduce neuronal injury following cerebral hypoxia, and may have wide application in both human and veterinary medicine.

Professor Horne and his associates have cloned and sequenced five overlapping cDNA’s that code for the entire open reading frame of a 250 kDa Ca channel α1 subunit. My task was to design experiments that would enable these fragments to be ligated to form a single clone suitable for placement in a mammalian expression vector. The hope is that this construct could then be used in an assay system for large scale screening of potential therapeutic agents.

Once the map was complete, I isolated the required cDNA fragments for ligation using restriction endonucleases and agarose gel purification. I then performed the ligations in a step-wise manner, each step requiring successive bacterial transformation, DNA isolation, and sequencing.

Prior to coming to Cornell, I had minimal experience with biological techniques. However, everyone in the laboratory was more than willing to spend time demonstrating and explaining procedures. As the summer came to an end, I found myself one step away from completing construction of the entire clone.

Along with organized program events, I had time for many extracurricular activities, including softball, socializing, and sightseeing. It was a memorable experience. I have learned much, and made new friends. These experiences have a beneficial influence on my career decisions.
to gain admission to veterinary school, I temporarily forgot this profession and left my home state of Texas for undergraduate studies. I was liberally educated at Harvard College, where I earned a Bachelor of Arts degree in History and Science in 1989. While in college, I spent summers working in rural Mexico, Ecuador, and Paraguay with a non-profit volunteer group, Amigos de las Americas. In these experiences I came to appreciate the burden of infectious disease carried by people and livestock in developing countries. During my final undergraduate year, I considered my career options and discovered that not only did veterinary medicine still rank high on my list, but I had completed (most of) the prerequisites for admission. Now I find myself ready to begin the third year in the veterinary college at Texas A&M University. I now have minimal interest in a clinical practice career, but a firm idea of the non-clinical opportunities for which a veterinarian is uniquely suited.

Given my interest in infectious diseases, I was happy to be assigned to Professor Alex Winter's laboratory in the Department of Microbiology, Immunology and Parasitology, as a Merck Foundation fellow. Dr. Winter's group investigates the immunologic response of host species to infection with bacteria of the genus *Brucella*, with the ultimate goal of developing vaccines superior to those currently in use. Bovine brucellosis, caused by *B. abortus* and characterized by late-term abortion, has largely been eradicated in the United States due to vaccination and extensive test-and-slaughter programs. It is a persistent cause of lost productivity in the developing world, however. The economic importance of *B. ovis* and *B. melitensis* in areas where small ruminant herds predominate is also significant.

I learned several techniques of bacteriological research and data analysis while working with Mr. Philip Elzer, who is completing his Ph.D. research in Professor Winter's lab. During the first half of the summer, I was occupied with an in-vitro bactericidal assay involving *B. abortus*-infected mice. Brucellae, opsonized with defined antisera from infected mice, were placed onto glass coverslips containing mouse peritoneal macrophages. After an incubation period, during which the macrophages ingested and killed (or failed to kill) the bacteria, the macrophages were lysed and any surviving brucellae were cultured on blood agar and counted, thereby assessing the efficacy of the antisera used as opsonins.

The second half of the summer was devoted to using a kinetics enzyme-linked immunosorbent assay, or KELA, to analyze the isotype distribution of *Brucella*-specific antibodies and total immunoglobulins in cattle vaccinated according to different protocols. Unlike standard diagnostic ELISAs which measure antibodies via a single spectrophotometric reading, the KELA takes three separate readings and calculates the rate of color development between measured time intervals, thereby eliminating some potential technical errors associated with single-reading ELISAs. The data I generated should be useful in characterizing the protective components of a cow's immune response to *B. abortus* vaccine.

Apart from my research this summer, I have been most excited by the opportunities to see veterinary research in academic, industrial, and governmental settings, and the chance to interact with veterinary students with similar interests.

Cristina Rodriguez Sanchez  
National Autonomous University of Mexico

I received my bachelor degree in chemical and biological sciences in the National Preparatory School of Mexico. Thereafter I was faced with a choice between my interests in animal health and bacteriology. Veterinary medicine offered an opportunity to combine both interests.

I had worked as a volunteer in the Department of Bacteriology (School of Veterinary Medicine and Animal Husbandry, UNAM) since my second year at the Veterinary School. This provided me with experience in teaching and clinical research. This summer I was honored with a Woodruff Foundation fellowship which gave me the opportunity to take part in research at the James A. Baker Institute for Animal Health, and to work with an individual I had assisted last year in Mexico and whose interests were similar to my own: Dr. Leland E. Carmichael.

Several years ago Dr. Carmichael developed a *Brucella canis* diagnostic antigen which has proved useful in screening dogs for canine brucellosis. A slide agglutination test (SAT) based on the use of this antigen appears to distinguish between Brucella-infected dogs from uninfected animals that register as "false-positives" in the commercial diagnostic tests commonly used in veterinary practice. Dr. Carmichael suspected that buffer conditions might affect the sensitivity and specificity of the antigen in the SAT.

The SAT antigen currently
used at Cornell for initial screening of sera was developed empirically. The task assigned to me was to critically examine different buffer conditions and observe any effect they might have on SAT sensitivity/specificity.

My initial work involved preparing a large batch of SAT antigen according to a standard protocol. Except for staining and standardization, this was done in the Bacteriology Laboratory of the New York State Diagnostic Laboratory (NYSDL) in the College of Veterinary Medicine under the skilled supervision of its Director, Dr. Sang Shin.

Although no significant quantitative discrepancies were found between the buffers or conditions tested, some qualitative differences were observed. Several conclusions could be drawn from this study on the basis of the comparative observations: (1) The “less-mucoid” RM6-66 [M(-)] strain was found superior to the mucoid (type) strain RM6-66 [M(+)]. The latter antigen had a strong tendency to autoagglutinate during staining. (2) It was found most suitable to prepare the final suspension of Rose-Bengal stained cells in a 0.4m TRIS-Maleate buffer at a 8.6 pH instead of pH 7.5, as described in the original method. (3) Carbonate-bicarbonate buffers, suggested by Vasquez (Instituto Nacional Investigaciones Pecuarias, Palo Alto, Mex.), gave satisfactory results upon initial testing, but the CO\textsubscript{3}-HCO buffer was unstable over time.

A second study was carried out with the aim of determining the optimal conditions to prepare B. canis cultures for fatty acid extractions to derive gas chromatography (GC) “signatures” and to establish a data base for the comparison of isolates. If consistent GC signatures were obtained, the information could be introduced into Microbial Identification System’s (MIS) database.

A preliminary experiment was performed using 21 B. canis isolates from the Baker Institute collection. The study was made possible through generous help of Dr. Patrick McDonough (NYSDL). Brucella canis is a fastidious organism. It must be cultured several times in TSBA medium in order to obtain the various strains for MIS-GC analysis. After standardizing the cultures we made several successful runs. The general conclusions were: (1) Some B. canis strains have similar GC profiles, but other strains are distinct; (2) the M- strain was similar to the type M+ strain, and (3) none of the GC patterns matched with other Brucella sp., but they had remarkably close matches to Bradyrhizobium sp. It would be of interest to examine whether this unusual organism shares antigenic epitopes with B. canis.

Finally, I had the opportunity to participate in the routine diagnostic work of the Bacteriology Laboratory (NYSDL), which broadened my experience in several phases of diagnostic bacteriology. This is work that I enjoyed very much. The help and friendship of the laboratory staff was much appreciated.

I would like to express my gratitude to all who made my program such a success. I will take the benefits of this experience to my country and share them with colleagues there.

Michael Serdy
University of Sydney

I am a final year veterinary science student at Sydney University, Australia. My research experience before attending Cornell University was limited to high school work experience in a veterinary research laboratory. From about the age of eight I had always envisaged myself as a practicing veterinarian. While my high school work experience did not change my attitude, it gave me the confidence to apply for the Leadership Training Program. I felt that the experience would help me choose a career path by giving me the opportunity to appreciate the options available to qualified veterinarians outside of private practice. I also was interested in getting a taste of research.

My research as a Mellon Foundation fellow, under the supervision of Professor Roy Levine in the Department of Pathology, involved studying the differentiation of epithelial cells in fetal rat lungs. The primary epithelial cell in the lung, the alveolar type 2 cell, is a highly differentiated cell whose major function is the synthesis of surfactant proteins. Alterations in growth potential or differentiation of these cells block surfactant synthesis and are associated clinically with respiratory distress syndrome. Maturation of type 2 cells begins during day 18 of fetal development in the rat. Using differential hybridization techniques, I screened cDNA libraries to identify and to study genes that may regulate type 2 cell proliferation and differentiation.

My project involved isolating developmentally regulated genes from fetal rat lungs, using various techniques of molecular biology, including differential screening of cDNA libraries, mRNA isolation and purification, gel electrophoresis, plasmid DNA isolation and restriction enzyme analysis, Northern hybridization and DNA sequencing. This work resulted in the discovery of three new genes which we have reason to believe are developmentally regulated in the fetal rat lung.

My experience this summer
opened my eyes to the world of research. I now have the confidence to enroll in a Ph.D. program. Prior to participating in the Leadership Training Program, I could only envisage myself as a practicing veterinarian, perhaps in a university veterinary hospital. At a stretch of the imagination, I am now able to consider seriously careers in academia, industry or government sponsored research facility. I am now at the point where I believe I will pursue a clinical career for the next few years, followed by further research studies. The program has provided insights into life in the United States and has given me the confidence to apply for an internship in the U.S. after graduation.

Finally, the last ten weeks has been an invaluable experience, both in terms of research and the making of new friends.

Johanna Sherrill
University of Georgia

After graduating from Stanford University with a B.A.S. degree in Biology and Art History, I focused on a lifelong fascination with marine life and took a job as an apprentice marine mammal trainer at the Sea World of Texas. There I learned a great deal about four different species of whales and dolphins, including how they interact, their health requirements, and their behavior in a captive environment. A year later, I took a position as a dolphin trainer at the Dolphin Research Center in the Florida Keys where I gained more practical experience in cetacean husbandry and training. Although I greatly enjoyed being a dolphin trainer, I reached the conclusion that as a veterinarian I would be able to contribute more directly to the welfare of the animals. This motivated me to enter the D.V.M. program at the University of Georgia, where I am currently a sophomore.

As a Merck Foundation fellow this summer, I was given the opportunity of working in Dr. John Bertram's laboratory in the Department of Anatomy. Our project involved the use of microstrain “rosette” gauges to quantify the strain or deformation patterns of the outer hoof wall of horses running on a high speed treadmill. The primary objective was to gain information regarding the functional loading of the equine foot and afford a better understanding of how to treat and deal with common pathologies that occur in horse hooves. This is actually the first project of its kind using recent, advanced technologies to analyze experimental manipulations of the horse hoof during locomotion. I found the prospect of being involved in "groundbreaking" research especially exciting.

My main role entailed designing and building a system of circuits that run from the strain gauges on the hoof up the horse's leg and off the treadmill to our computer. Having had no previous training in mechanical or electrical engineering, I found this aspect quite challenging. (I am now a soldering iron, wire-stripping, and circuitry expert!) It was very satisfying to see the whole system in action during actual treadmill trials. Dr. Bertram plans to run more experiments this fall to further investigate effects of different shoeing techniques on hoof wall microstructure.

My background in research was previously limited to an underwater sea urchin study at Hopkins Marine Station in California. Prior to this summer fellowship at Cornell, I had an erroneous vision of veterinarians in research pipetting into endless rows of tubes and pouring infinite agarose gels! The Leadership Program has changed this viewpoint considerably by revealing tremendous and diverse roles for veterinarians who become research scientists in academia, industry, or government. I am now considering postgraduate training in a Ph.D. program and a career as a research veterinarian.

This program has been of inestimable value to me in many ways. While gaining excellent research experience, I have been allowed the opportunity to interact with highly regarded Cornell faculty, top veterinary students from seven different countries, and various professionals in related fields. I have also developed leadership skills by participating in the planning of group events such as Career Day 1992. Meeting the various people involved has been a truly memorable aspect of this outstanding program. In addition, my overall experience here was heightened by the beauty of Cornell and the surrounding area. I am very grateful to Dr. Bertram, the Merck Foundation, and to the participants and organizers of the program for such an extraordinary and happy experience.

Louise Southwood
The University of Sydney

Five years ago, my childhood ambition to become a
veterinarian became a reality when I was selected, in the second round of offers and with one mark to spare, for the program in veterinary science at Sydney University. I am currently a fourth year student. In 1991 I took a "year off" from my veterinary degree and completed a Bachelor of Science (veterinary). This involved a continuation of research, in racehorse nutrition and exercise physiology.

Following the completion of my veterinary degree I hope to undertake an internship and residency program in equine medicine and surgery. I would especially like to spend time working in a large animal practice. Research is a long term career option. Although my experience is still limited, I feel equine clinical research would be my preferred area; however, the fields of exercise physiology and equine reproduction interest me too.

As a participant in the Leadership Training Program, I had the great fortune of working with an enthusiastic and friendly group of people. Professor Barry Ball's Theriogenology Laboratory has been investigating the interaction of equine spermatozoa with oviductal epithelial cells (OEC). Co-culture of equine spermatozoa and OEC has been used to further knowledge of OEC and spermatozoa physiology, particularly in relation to in vitro fertilization and fertility evaluation of stallions.

The project that I was working on was sponsored by the Mellon Foundation. My task was to examine the viability, motility, and capacitation of spermatozoa co-cultured with OEC. Specifically, I compared simple, glucose, and serum-free medium and complex, glucose and serum-containing medium and the release from OEC monolayers in vitro. Various laboratory techniques including tissue culture and fluorescence microscopy were used. The work involved counting in excess of $5.2 \times 10^{14}$ sperm cells! I had the chance to learn about semen collection and transport, and various techniques to evaluate equine semen, including the motility and morphology of spermatozoa.

From statistical analysis of the data we were able to conclude that morphologically abnormal sperm cells, especially those with proximal droplets, do not bind as well to OEC, as normal sperm. I was unable to demonstrate a significant effect of treatment or time on viability or sperm motility, but the portion of capacitated spermatozoa was higher in co-culture when compared with control wells.

I took the opportunity on the weekends to visit the beautiful state parks around Ithaca and see other parts of North America and Canada, including Niagara Falls, New York City, Boston, Washington DC, and British Columbia. Living in a university residence with veterinary students from other countries was an experience to be remembered. The friendships we made will last for a long time.

Jane Stobutzki
University of Sydney

I am currently enrolled in my final year of veterinary science at the University of Sydney, Australia. In 1990, I undertook the intercalated honours year for the Bachelor of Science (Veterinary) degree. The subjects of my dissertation were the effects of season, the presence of females and stress on the testicular volume and the secretion of androgens by the male koala, Phascolarctos cinereus. Throughout my undergraduate education in veterinary science, I have tried to take advantage of every opportunity to further my knowledge and experience in the field of wildlife medicine and the management of endangered populations. However, I still find myself with many unanswered questions. The Leadership Training Program offered me the opportunity not only to share some of my experiences but also to explore further the research opportunities available to me after graduation.

My research in the Department of Pharmacology was generously supported by the Mellon Foundation. I spent the summer working under the guidance and careful instruction of Professors Clare Fewtrell and Wayne Schwark. My research focused on the characterization of the calcium response observed in equine eosinophils to stimulation with the complement factor C5a.

Horses suffer from a variety of conditions in which a prominent pathological feature is the increased circulating level and tissue content of eosinophils. These conditions include chronic obstructive pulmonary disease ('heaves') and parasitic infections.

Very little is known about the cellular mechanisms leading to eosinophil chemotaxis and the subsequent exocytosis of inflammatory mediators from intracellular granules. Equine blood is an excellent source of eosinophils. Moreover, the cells have particularly large and well-developed secretory granules. In view of the prevalence of helminth infections and allergy-related states in the horse, equine eosinophils were considered to be a highly relevant model for studying stimulus-response coupling in eosinophils.

Over the ten week period, under the supervision of my faculty sponsors, I refined the techniques for collecting and purifying eosinophils from horse blood. I then began characterizing the calcium
response of the cells to stimulation with the complement factor, C5α. The changes in intracellular calcium concentration were detected using the fluorescent probe, fura-2. After the initial increase in calcium in response to C5α, intracellular calcium falls to a level at or below the initial resting level. I showed that this decrease in calcium is not due to reuptake into stores, since it is still seen when the cells are stimulated with thapsigargin, a sesquiterpene from Thapsia garganica, which selectively inhibits the calcium ATPase located in the endoplasmic reticulum calcium stores. Having done this, I attempted to identify the plasma membrane extrusion pathway responsible for the fall in calcium. Selectively inhibiting sodium/calcium exchange failed to inhibit the C5α-induced efflux of calcium, suggesting that efflux is due to activation of the plasma membrane calcium ATPase pump. The next step is to try and inhibit this pump to determine whether or not it is responsible for the calcium response observed.

The foregoing experiments will be extended to the characterization of chemotaxis and secretory responses of equine eosinophils at the single cell level, in the hope that the information derived from such studies will widen the scope for future therapeutic intervention, especially with respect to the treatment of various conditions, including heaves in horses and asthma in humans.

The Leadership Training Program provided me with an amazing learning experience and invaluable insight into the world of veterinary research, as well as giving me the opportunity to visit the U.S.A. and to make many new and valuable friends.

Reinhard Straubinger
Ludwig-Maximilians Universität München

When I return to Germany later this summer I will take my final exams and will receive my veterinary degree in February 1993. My interest in studying veterinary medicine began after I graduated from high school ("Gymnasium") in 1983. But first I had to serve in the army for 15 months. After my military service was completed I entered the Ludwig-Maximilians Universität München. Although still interested in veterinary medicine, I decided to first study physics. I took an examination two years later and received my "Vordiplom in Physik". In the fall of 1987 I began my veterinary studies at the same university. This involved nine semesters of formal study and a 10th semester of practice in animal clinics laboratories and research. I was able to pursue the latter in this country. During the first part of my stay here I worked in animal hospitals in New York City where I acquired experience in small animal practice. Thereafter I enrolled in the Leadership Training Program as a Woodruff Foundation fellow.

My research at Cornell was conducted under the guidance of Professor Max J.G. Appel. It involved Lyme Disease research in dogs. Prof. Appel's group was the first to reproduce the disease in dogs in a controlled laboratory setting. This was achieved by exposing the dogs to ticks carrying the causative agent, Borrelia burgdorferi. After a long interval the dogs developed lameness. Their joints were swollen, hot and painful when manipulated. The synovial fluid and the joint capsule of affected dogs contain many white blood cells.

The goal of my project was to determine whether synovial fluid from dogs with Lyme Disease has chemotactic activity. Chemotaxis is the phenomena wherein white blood cells (typically neutrophils) respond to a chemical gradient by migrating toward the highest concentration of the chemoattractant. Characterizing the chemoattractant in the joints of dogs with Lyme Disease will help us understand the pathogenesis of that disease.

For my experiments I used a micropore filter chemotaxis assay. My first task was to adapt the assay to the particular needs of the project. Special chambers were used in which a 10μ thick filter with 3μ diameter pores separated polymorphonuclear neutrophils (PMN) on one side of the filter from the chemotactic substance on the other side. The PMNs were isolated from the blood of healthy dogs. The short lifetime of the PMNs made it necessary to use them immediately. I found that during a one hour incubation the PMNs were able to migrate through the filter.

During the first weeks I concentrated my efforts on standardizing the assay. To this end I used FMLP (N-formylmethionyl-leucyl-phenylalanine), which is a known chemotactic agent. FMLP is a synthetic N-formylated oligopeptide, structurally similar to chemotactants produced by many kinds of bacteria. I varied the conditions of the assay in ways that optimized its specificity and sensitivity. Next I quantified the chemotactic activity of synovial fluids of normal dogs and dogs showing acute lameness during infection with the Lyme Disease agent, B. burgdorferi by substituting these fluids for FMLP. I observed a fourfold higher migration of the PMN in dogs.
with Lyme Disease compared to uninfected, control dogs.

Besides working on my own project I had the opportunity to work with cell cultures and became familiar with techniques for virus isolation and electron microscopy. I also gained experience in handling ticks and drawing blood and taking skin biopsies from dogs.

The experience I gained by participating in the Leadership Training Program enabled me to think more about research and an academic career in veterinary medicine. I intend to return to the James A. Baker Institute for Animal Health next spring to continue my studies of Lyme Disease.

Susan Watson
Oklahoma State University

I received my BS in biology from Arkansas Tech University. This fall I will begin my second year at Oklahoma State University, College of Veterinary Medicine. As an undergraduate, I had little exposure to research. However, I did have the opportunity to serve as a teaching assistant in biology and chemistry laboratory courses. I have no definite career plans at this stage, but am interested in combining clinical medicine with research and teaching. I applied to the Leadership Training Program for Veterinary Students because it seemed an excellent opportunity to explore alternative careers in veterinary medicine, while participating in research.

As a Merck Foundation fellow, I was fortunate in being appointed to the Department of Avian and Aquatic Animal Medicine. Working closely with my two mentors, Professor Bruce Calnek and Professor Ton Schat, I was able to design experiments and conduct research on two different projects.

One project involved cloning and sequencing the genome of the Chicken Infectious Anemia Virus (CIAV) strain CIA-1, which affects young chickens. Since the virus is not adapted to cell culture and must be maintained in chickens, we elected to amplify the viral DNA to an amount sufficient for cloning using the polymerase chain reaction (PCR). The primers we used necessitated cloning the genome in two fragments. I was able to generate clones for each fragment, and began sequencing both. Our objective is to compare the sequence of CIA-1 with the known sequence of the Cux-1 strain of CIAV. The clones also will be used in bird experiments to determine which of the viral proteins are responsible for the pathogenicity of the virus.

My second project involved a different virus, Turkey Herpesvirus (HVT). The virus is used to vaccinate chickens against Marek's Disease, a T cell lymphoma of chickens. Although HVT is protective, it is not known whether all lymphocytes or only some become infected. My project called for identifying the subsets of lymphocytes infected with HVT early after infection. In order to study this problem, I was provided with a HVT strain that contained a LacZ cassette. Cells infected with this construct produce β-galactosidase, which can be detected using either an X-gal assay or indirect immunofluorescence staining. In the X-gal assay the β-galactosidase cleaves the provided substrate and generates a blue color in the cell cytoplasm. Chickens were inoculated with the modified HVT, and spleens were harvested 5 to 8 days post inoculation. Frozen tissue sections as well as lymphocyte suspensions were used to evaluate infection with HVT. This study is still in progress and further experiments must be performed before definitive conclusions can be reached.

The enjoyable summer I experienced at Cornell will be memorable for a number of reasons. Learning research techniques, participating in group discussions and giving a research presentation was the core of the program. However, traveling to Merck & Co., the USDA, and the NIH provided a valuable opportunity to meet and to establish contacts with individuals who are pursuing "alternate" careers in veterinary medicine. I made friends with veterinary students from all over the world, had time to travel, sightsee, and enjoy outside interests. I want to thank everyone in the Levine Laboratory, for taking me under their "wing," providing the best support, and making my research experience so successful and enjoyable.
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