

Zweig

A report from the
Harry M. Zweig
Memorial Fund for
Equine Research at
the College of
Veterinary Medicine
at Cornell University

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PETER MORENUS

Dr. Dorothy Ainsworth

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Dr. Dorothy Ainsworth—Examining Diaphragm Function in Exercising Horses

What limits the athletic performance in racehorses? Why do some horses fail to reach their potential?

"These questions remain among the most widely studied in equine medicine and surgery," says Dorothy Ainsworth, D.V.M., Ph.D., an expert in equine respiratory physiology. "Most researchers agree that the limitation lies within the respiratory system." ▶

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Each year, thousands of athletic horses are unable to perform to their potential, yet veterinarians do not yet know exactly why. As a result, they are unable to provide a clear diagnosis.

"We do know that certain disorders—upper respiratory obstruction such as roaring and lower respiratory diseases such as heaves and lung bleeding—require the horse to breathe harder to exchange air during strenuous exercise," Ainsworth explains. "We suspect that this places an excessive load on the muscles of respiration, especially the diaphragm, which is the major inspiratory muscle of breathing. This, in turn, may promote premature fatigue of the diaphragm and, hence, cause exercise intolerance. If diaphragm fatigue is indeed the limiting factor to athletic capability, we may be able to develop therapies directed at improving the output or efficiency of these muscles rather than simply trying to unsuccessfully dilate the airways in scarred lung tissue, for example, or use medications that only temporarily alleviate pulmonary inflammation."

Just recently, diaphragm fatigue has been documented as a limiting factor in healthy human athletes. Ainsworth, a large-animal pulmonologist, is trying to find out whether horses experience a similar problem in which the diaphragm fatigues and fails to generate enough pressure to push the normal amount of air out of the lungs. Prior to Ainsworth's work, techniques were not available to evaluate diaphragm function in the horse.

"The expertise and sophisticated facilities are available, however, at the Equine Performance Testing Clinic here at Cornell," she says. "We now have the tools to study diaphragm function and fatigue with hopes of better understanding the equine respiratory tract and its role in limiting athletic performance."

Some researchers have claimed that the diaphragm plays only a minor role

in the generation of air flow patterns in horses. They feel that the biomechanical motions of the running horse (the flexing and extension of the spine, the concussive impact of the limbs, and the movement of the abdominal viscera) generate the force necessary to compress and expand the lungs. Although Ainsworth believes that some pressure is generated by these biomechanical forces, she has shown that the equine diaphragm is an active muscle by being one of the first researchers to successfully record its

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electrical activity during high intensity exercise. She has found that as the exercise of healthy horses intensifies, the electrical activity of the diaphragm and the amount of pressure it generates to bring air into the horse's lungs both increase.

"This work shows that, in healthy horses, the diaphragm is an important and active muscle in exercise and that it probably does not normally fatigue, despite the development of severe arterial hypoxemia and hypercapnia," says Ainsworth.

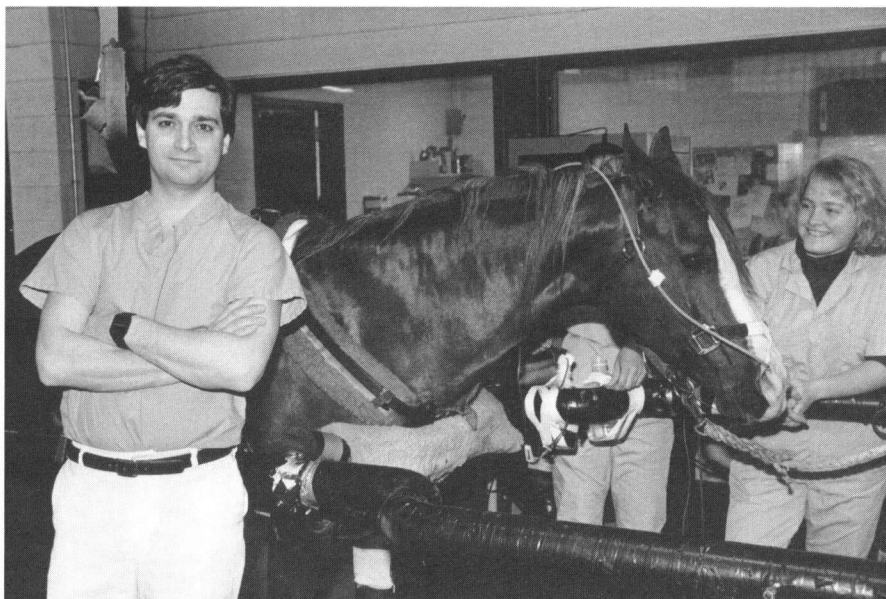
This year, Ainsworth is first working to measure changes in diaphragm length and contractions using specialized ultrasonic crystals. She expects to have a full set of values for assessing diaphragm function and respiratory muscle recruitment patterns in

healthy exercising horses by this spring. She will then repeat the exercise protocol with the same healthy horses except that the horses will have received a reversible anesthetic block to simulate the respiratory disorder known as roaring (laryngeal hemiplegia). This will allow her to determine if obstructions to breathing cause diaphragm fatigue in these horses. These studies will provide the foundation work for assessing fatigue development in horses with pulmonary inflammation-obstructive disease of the lower respiratory tract. She suspects that as bronchioconstriction and airway exudate make breathing more difficult, the electrical activity of the horse's diaphragm will continue to increase but will become ineffective in generating increasing pressure. The result? Diaphragm fatigue.

"Knowing under what circumstances diaphragm fatigue develops, we then can develop clinically useful diagnostic techniques and better treatments for horses that are performing poorly," says Ainsworth.

In addition to better understanding poor performance in athletic horses and finding ways to ameliorate it, Ainsworth's research may provide valuable insight into human lower airway diseases such as chronic obstructive pulmonary disease, asthma, and other causes of exercise intolerance.

■



Dr. Normand Ducharme

As a boy, Norm Ducharme spent summers with his two brothers and two sisters riding horses at their family's summer house, a 15-acre gentleman's farm an hour north of Montreal. His parents kept four or five horses there for the kids while they were growing up.

As he grew older, Ducharme began to entertain thoughts of a career working with horses. When he was about 18 years old, he spent a summer working with a local veterinarian who specialized in show and race horses and also worked with goats and sheep. Despite the experience, when he went on to Brebeuf College in Montreal for his undergraduate degree, he still wasn't sure what he wanted to do.

"At that point I really wanted to be a hockey goalie. But finally I thought better of it and decided to go on for a veterinary degree," recalls Ducharme, now 37.

In 1975, he began study at the University of Montreal, and by 1979 he had earned his veterinary degree. While in Montreal, he met his future wife, Deborah, who was studying to be a physiotherapist. He then came to the Large Animal Clinic at the New York State College of Veterinary Medicine at

Cornell for his internship and residency. During this period he worked closely with Dr. Richard Hackett on studies of upper airway diseases in horses. "I also performed a lot of surgery with him, which interested me a lot."

After finishing his residency, Ducharme became an assistant professor of large animal surgery at the Ontario Veterinary College at the University of Guelph, where he decided to study for a master's degree in large animal surgery. He received his degree in 1985.

Cornell reentered Ducharme's life shortly after when he was offered a position as an assistant professor of large animal surgery at the College of Veterinary Medicine. "Once here, it became clear to Dr. Hackett, Dr. Robin Gleed, Dr. Alan Dobson, and me that we needed to study the respiratory system of horses while they were exercising," says Ducharme. "Since there was no sports medicine facility here, we decided to start one."

Recruiting the help of college alumni, the four veterinary scientists were able to obtain a high-speed treadmill in August 1987. In 1989, they officially opened the Equine Performance Testing Clinic. Ducharme says he and his colleagues are now looking into

expanding the clinic and obtaining a second treadmill.

"It's difficult to get enough time on the treadmill to train our research horses to be fit as athletes for our various research projects, most of which focus on respiratory problems that compromise the performance of racehorses." He points out that there is also constant conflict between the need to train horses, conduct experimental testing, and evaluate clinical patients.

Ducharme's research has continued to focus on the respiratory system. He and his colleagues have developed noninvasive techniques to measure airflow without the complications of more invasive techniques, and they are continuing to work on similar techniques for other respiratory measurements. Working with Dr. Hackett and Dr. Dorothy Ainsworth, he also is studying the muscles of the upper airway during exercise and continuing to refine the surgical treatment and postoperative assessment of soft palate displacement.

In addition to his research, Ducharme teaches large animal surgery and the study of lameness and serves as coordinator of the Equine Performance Testing Clinic.

While not at Cornell, "I work as a taxi driver," quips Ducharme, referring to the chauffeuring of his three boys, Marc, Michael, and Richard, ages 7, 10, and 12 respectively, to their swimming, hockey, or soccer practices. And while he's surrounded by animals at work, he and his family are unable to keep animals at home.

"All three boys are allergic to all animals, including birds and horses," says Ducharme. "In fact, I must shower and change my clothes before I go home every night."

As for horses, although Ducharme hasn't been on one since he was 17, he will continue to work with running horses on a regular basis. Within the next few years, he hopes to solve more soft palate and upper respiratory problems in the horse with the most modern technology available. ■

Dr. Richard Hackett—Studying the Equine Respiratory System

The eldest of six children growing up on a farm in central Ohio, Richard Hackett, D.V.M., spent much of his childhood helping with his father's business housing and training standardbred horses. At any one time his father would have from 20 to 30 horses on the farm.

"From the time I was 8 or so until the end of veterinary college, I spent my summers on the race track with my dad, working my way up from hot walker to water carrier to groom to second trainer and driver," says Hackett, now 46 and an associate professor of surgery in the New York State College of Veterinary Medicine at Cornell.

In addition to the standardbreds, the family kept several horses of their own on the farm for saddle riding. Hackett was given his own pony at age six, and then a horse at age 10.

Hackett says he became attracted to veterinary medicine at an early age. "One of my heroes was the family veterinarian. He was from the old school. He'd always show up at the race track in a suit and tie—not a sports jacket, mind you, but a suit. He was a real gentleman who was very impressive to a young impressionable boy like myself.

"From that point on, veterinary medicine was the only show in town for me, just a natural evolution. I was on that path early on and just never deviated from it. Then, in high school, I became fascinated by the biological sciences. That, coupled with my love of horses, led to veterinary school."

By 1973, Hackett had earned a veterinary degree at Ohio State University and gone on to Colorado State University for an internship in large animal medicine, surgery, and ambulatory services. He stayed on for another two years as a surgical resident and received a master's degree. In August 1976, he came to Cornell as an assistant professor.

"If anyone told me then that I'd still be here in 1995, I would have keeled over," he says. "My career aspiration



Dr. Richard Hackett

"Once you spend time at a place like this, you find the atmosphere so stimulating, and the equipment and facilities so modern, that it allows you to do things that are difficult to do elsewhere."

was always to be working back at the race track in central Ohio. But once you spend time at a place like this, you find the atmosphere so stimulating, and the equipment and facilities so modern, that it allows you to do things that are difficult to do elsewhere."

When he first arrived at Cornell, Hackett found himself working on a caseload comprised largely of racehorses. Many had respiratory problems, an area in which he had very little experience.

"I recognized that as a deficiency, so I made it a point to get involved in as many cases and take advantage of as many educational opportunities involving the respiratory system as possible," he says. "Over the next few years, I had such intense exposure to this area that I became something of a clinical expert."

In 1986, the dean of the College of Veterinary Medicine summoned Hackett and his colleague, Dr. Norm Ducharme, to request that they look seriously into laryngeal function and endoscopy in horses. A friend of the college, the dean said, had just been bitterly disappointed when a potentially lucrative horse sale fell through because of a problematic endoscopic exam of the horse. Were certain factors in such an exam really predictive of upper respiratory problems during racing?

The two equine respiratory experts devoted the next several years to finding out. They developed a grading system for categorizing laryngeal function, which has since been adopted nationally, and determined which characteristics of the horse's larynx were reliable predictors for problems during exercise and which were not.

Hackett has also been studying problems of the soft palate, bleeding, and the effects of Lasix on horses. In addition to his research, he spends half his time on clinical service, working with senior students to treat animals in the Large Animal Clinic. He also teaches large animal gastrointestinal and respiratory topics to students and is chair of a college committee that is upgrading the computer accessibility of the clinic's medical records.

At home, Hackett is married to Susan Hackett, a veterinarian and lecturer on veterinary anatomy whom he met at Cornell. The couple married in 1981 and owned several horses until children came along. Now they devote their time to raising their two sons, ages ten and eleven.

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Charles "Charlie" W. Knauss Jr., a member of the Zweig Committee and the executive director of the Agriculture and New York State Horse Breeding Development Fund, recalls riding horses ever since he was a young boy in Poughkeepsie, N.Y. "My two brothers and I would ride with friends who owned farms whenever we had the chance," says Knauss, now 66.

As a young man, however, he had no intention of pursuing a career in the equine industry. After high school, he went to Rider College in Trenton, N.J., and then to the Sampson campus of the State University of New York on Seneca Lake. After graduation, he first returned to the family meat packing business and then worked for 18 years as vice-president of a contract machining company.

When he was in his late 20s, Knauss became involved in helping to organize the Dutchess County Fair, an activity that ultimately changed his life.

"I had always liked fairs and what they represented, and after participating in planning the Dutchess County Fair for

several years, I was invited to become a member of the board," recalls Knauss. He remained involved with the Fair for more than 30 years, becoming president before retiring in the late 1980s.

During that period, Knauss married a young woman with two children and bought a 100-acre apple farm in Livingston, N.Y., where he and his wife had a child of their own.

As he became increasingly involved with the Fair, Knauss developed a special interest in the harness racing that was held on the fairgrounds each summer. In 1971, he became executive director of the breeding fund that had been established in 1965 under the LaVerne Law.

"It was one of the first, if not *the* first, breeding funds established in the country," Knauss says. "The purpose of the legislation was to promote agriculture in general and to establish incentives to breed horses within the state in particular."

Knauss works as a liaison between the equine industry and the fund's board of

trustees, helps develop and execute policy, and monitors the money expended in the program. In 1993, for example, the fund received an income of more than \$12 million generated by race tracks, Off-Track Betting corporations, and horsemen payments.

This money was distributed to a wide variety of programs, including the "New York Sire Stakes" at the State Harness raceways, repair and racing programs at the New York State Fair and the 28 county fairs that hold races, the Zweig Memorial Fund for Equine Research at Cornell, and the Hall of Fame of the Trotter in Goshen, N.Y. The fund also provides broad-based support to the 4-H Program, particularly its Standardbred Management and Driving School in Morrisville.

Knauss, now divorced, still lives on the apple farm where he managed the crop for more than two decades. Recently, however, he had the orchards removed and now rents the land to a local farmer for cash crops. He still owns a horse and rides frequently. He also is an avid downhill skier. ■

Harry M. Zweig Memorial Fund for Equine Research— 1995 Research Awards

- \$55,000 to Dr. Dorothy Ainsworth for "Exercise-Induced Alterations in Diaphragmatic Length: Implications for Fatigue Development."
- \$60,600 to Dr. Barry A. Ball for "Gamete Physiology, Fertilization, and Embryonic Development in the Horse."
- \$31,000 to Dr. Peter F. Daels for "Regulation of Steroidogenesis in the Equine Corpus Luteum."
- \$37,500 to Dr. Robin D. Gleed and Dr. Alan Dobson for "The Effect of Lasix on Lung Water in the Exercising Horse."
- \$24,600 to Dr. Richard P. Hackett and Dr. Normand G. Ducharme for "A Study of Laryngo-Palatal Function in Exercising Horses: Part Two—Horses with Intermittent Soft Palate Displacement."
- \$40,000 to Dr. James N. MacLeod for "Transcriptional Response of Equine Articular Cartilage Chondrocytes to Corticosteroids."
- \$9,400 to Dr. Hussni Mohammed for "Genetic Studies on Equine Motor Neuron Disease."
- \$39,000 to Dr. Alan J. Nixon for "The Impact of Growth Factor Gene Expression Patterns on Repair of Equine Articular Defects."

Total Zweig Funds Awarded \$297,100

The Harry M. Zweig Memorial Fund for Equine Research honors the late Dr. Harry M. Zweig, a distinguished veterinarian, and his numerous contributions to the state's equine industry. In 1979, by amendment to the pari-mutuel revenue laws, the New York State legislature created the Harry M. Zweig Memorial Fund to promote equine research at the College of Veterinary Medicine, Cornell University. The Harry M. Zweig Committee is established for the purpose of administering the fund and is composed of individuals in specified state agencies and equine industry positions and others who represent equine breeders, owners, trainers, and veterinarians.

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Hackett
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"Almost all of my activities outside the college are linked to the boys and their scouting, wrestling, baseball, hockey, skiing, and soccer," says Hackett. In addition, the family has a Labrador Retriever, a gerbil, and a large number of fish in two aquariums—one salt water and one freshwater.

Between his family activities and coping with the changes at work—moving into a new hospital; adapting to a new curriculum; preparing for a new dean, a new department chair, and a new university president; and holding down the fort at the Large Animal Clinic while two of the four surgeons are on sabbatic—Hackett finds himself busier, but as productive and satisfied as ever. ■

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