Zweig

Memorial Fund News Capsule

A report on equine research at the College of Veterinary Medicine at Cornell sponsored by the Harry M. Zweig Memorial Fund

No. 13 December 1992

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Respiratory Mechanics Measured at High Speed

Equine researchers at Cornell believe they have developed reliable, noninvasive measurements of respiratory function in horses exercising at their maximum on the high-speed treadmill. These techniques will help veterinarians diagnose respiratory disorders and assess the results of various treatments. ▶

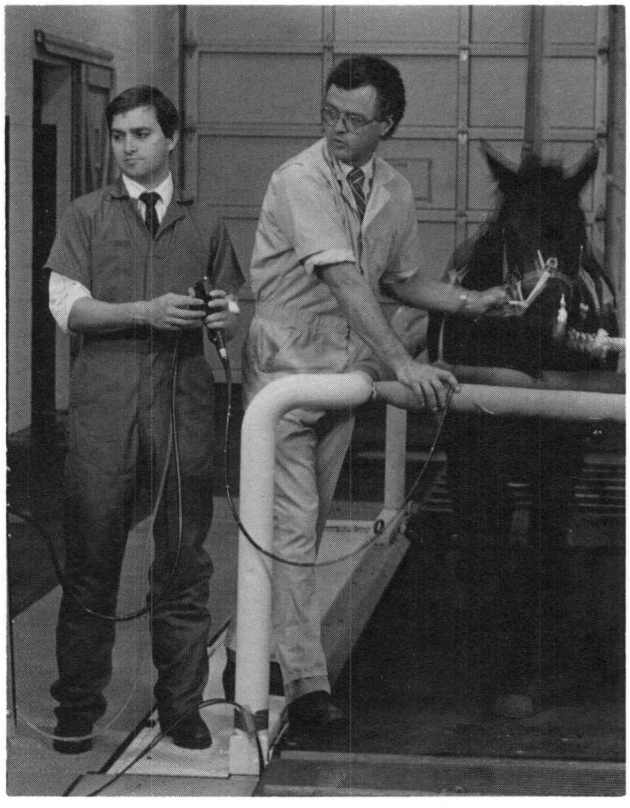
To develop these methods, Cornell equine surgeons Norm G. Ducharme and Richard P. Hackett, with grants from the Harry M. Zweig Memorial Fund, first developed an exercise protocol for testing respiratory function that produced repeatable results. This protocol takes into account the effects of speed, slope, and duration of exercise on measured respiratory parameters.

The protocol selected results in the greatest peak airflows (the maximum amount of air passing through the horse's airway) and greatest negative airway pressures. Researchers have determined these measurements in normal horses and now can better interpret variations from normal in horses that produce noise (roaring) during exercise or are exercise intolerant.

"Wind problems are probably the most common cause of impaired performance in equine athletes," says Ducharme. "The upper airway problems include common throat problems such as roaring, pharyngitis, subepiglottic cyst, epiglottic entrapment, arytenoid chondritis, and displaced soft palate. Lower respiratory problems include bronchitis, lung allergy, heaves, and lung bleeding." Together, these disorders affect up to 75 percent of racing Thoroughbreds.

In a previous study, the equine researchers used video-endoscopy to visually evaluate the upper airways of 103 horses (most of which were racehorses: 40 Thoroughbreds, 45 Standardbreds, and nine other breeds). Already, they have made significant progress by correlating measurements of upper airway pressure during exercise with what they see in horses at rest. They have been able to establish four levels of grading, from fully normal to a fully-diseased condition.

"We've been able to take much of the guesswork out of the grey zones in assessing horses at rest who have roaring problems during exercise. We can advise owners, for example, not to be concerned if they see one thing in a horse at a sale, yet know that another characteristic indicates a 50 percent chance of disease.



DAVID GRUNFELD

What is normal? What is abnormal? Cornell equine surgeons Norm Ducharme (left) and Richard Hackett use a series of high-speed treadmill tests to establish four grades of respiratory function in horses.

"We've been able to take much of the guesswork out of the grey zones in assessing horses at rest who have roaring problems during exercise."

"But endoscopic examination is limited to assessing upper respiratory tract morphology and may provide no indication of whether or not a given problem impairs ventilation during strenuous exercise," explains Hackett.

To overcome this limitation, the Cornell researchers coupled endoscopic information with pressure measurements taken by small pressure transducers placed in the horses' airways. They also measured volumes of incoming and outgoing air with a face mask they designed that has an ultrasonic flowmeter lined up with each nostril. This procedure is noninvasive and adds no substantial resistance, unlike other research tools that measure air volumes.

By correlating airflow measurements with endoscopic observations and computer-assisted measurements of pressures of the pharynx and larynx, the researchers have determined what the normal mask (nose), tracheal, and pharyngeal (in the throat) range of values are for inspiration and expiration during high-speed exercise. They have also been able to determine where pressure drops occur, which can indicate the specific site of a problem in the horse's respiratory tract.

This kind of information allows them to assess far more accurately the upper airway of the horse and how the appearance of the larynx during a rest-

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Learning to Compare Different Exercise Results

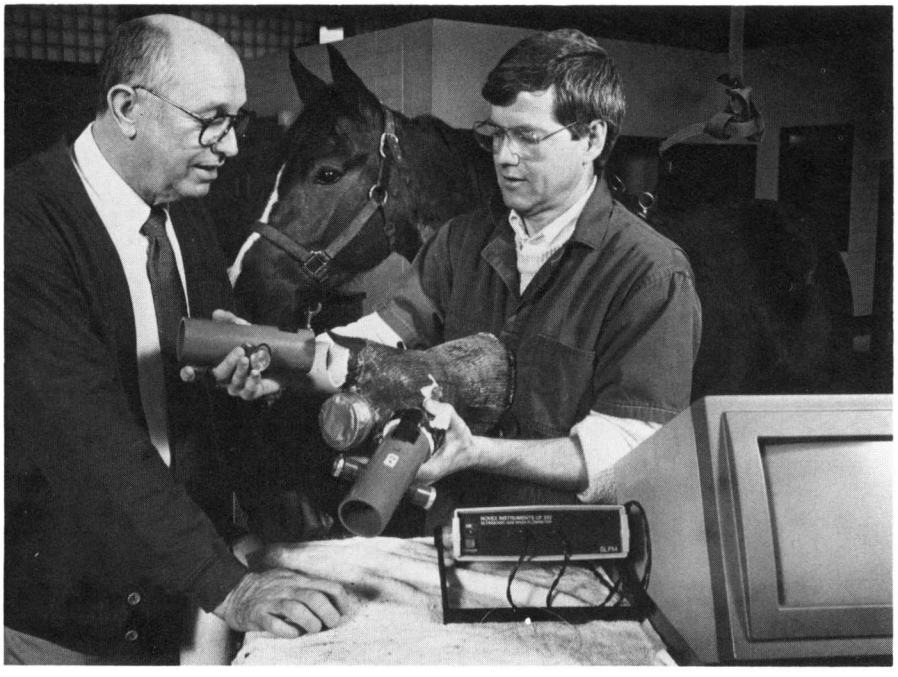
With the development of high-speed treadmills for exercising horses, equine researchers not only can control the intensity of a horse's exercise, but they also can measure a variety of physiological performance variables under controlled environmental conditions. With standard exercise tests, researchers can assess the physical condition of horses for clients and evaluate training and management procedures under experimental conditions.

Researchers not only use different treadmills but also a variety of exercise protocols. One set of researchers may increase the speed of their treadmill to produce a greater work load, another may raise the treadmill's incline to achieve a similar effect.

"A problem arises because standard exercise tests can be designed with infinite speed-slope-duration combinations," explains Harold Hintz, Ph.D., an animal scientist who specializes in nutrition and exercise. "Currently, there is no way to correlate the effects of speed and slope on work load. As a result, it is difficult to compare results from studies using dissimilar exercise protocols."

With a grant from the Harry M. Zweig Memorial Fund, Hintz and equine exercise physiologist J. Daniel Harkins, Ph.D., are evaluating the efforts of different treadmill speeds and slopes on five common performance variables—heart rate, respiratory rate, oxygen uptake, plasma lactate concentrations, and packed cell volume. All of these variables increase as exercise intensity increases with increased speed and slope. They will use that information to develop mathematical equations for comparing different exercise protocols.

"We are developing the correlations between treadmill speed and treadmill slope for each of the performance variables," explains Harkins. "For example, if a horse performs a test at 8 meters per second on a treadmill inclined at 5 percent slope, we will be able to determine the comparable speed on the flat at which the horses would have to run to perform an equivalent amount of work."



CHRIS HILDRETH

Harold Hintz (left) and Daniel Harkins examine a face mask used to measure a horse's breathing during different speeds on a treadmill.

Their first step has been to determine how long it takes for the plasma lactate concentrations in horses to reach a plateau during exercise. Plasma lactate is an important measurement for determining a horse's fitness and athletic ability, and plasma lactate concentrations take longer to plateau than any of the other performance variables.

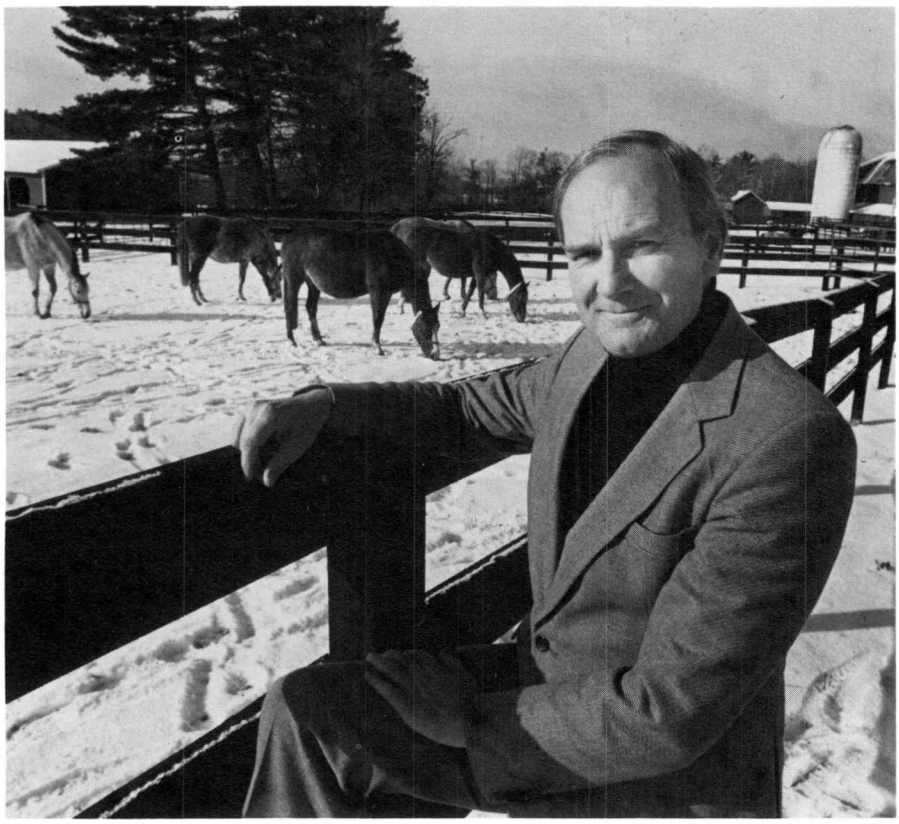
In other words, as horses exercise, their muscles produce lactic acid. The harder they work, the greater the lactate concentrations in the blood. At a certain point, however, the levels of plasma lactate cease to increase and plateau. It is important to know how long it takes horses to reach this plateau to avoid erroneous conclusions from data collected before "steady state" is reached.

Through a preliminary series of tests on the treadmill, Hintz and Harkins have determined that physically fit horses need to be galloped for three minutes, regardless of the work load, to reach that plateau.

With this knowledge in hand, they are preparing to test 12 Standardbred horses that are physically fit and experienced in galloping on treadmills. Each horse will be evaluated during four incremental tests of increasing slopes (from 0 percent up to 10 percent), and at four increasing speeds (from 8 to 14 meters per second). Each horse will be evaluated twice for a total of 16 tests per horse; with 12 horses participating, the researchers will have a total of 192 tests from which to derive the correlations.

Using these measurements, the researchers are confident that by the year's end, they will know how to equate a work load performed at a certain speed and treadmill slope with an equivalent work load performed at a different speed or different slope. This information will be vital in comparing the conditions and training regimes of Thoroughbreds and other galloping horses. ■

Brian Farrow



BRUCE WANG

Brian Farrow stops off at Cornell's Equine Research Park to visit with members of his "obsession."

The chairman of the College of Veterinary Medicine's Department of Clinical Sciences—one of the largest veterinary clinical sciences departments in the world—is a horse enthusiast. "In fact, horses are my particular form of insanity," admits Brian R.H. Farrow, who moved to Ithaca from Australia in 1990 to take his new post. "They have always been my hobby, my obsession."

A specialist in internal medicine and neurology, Dr. Farrow not only has been riding horses since he was four, but owned, bred, and raced Thoroughbreds for twenty years before coming here. His most recent horse was sired by Danger's Hour, champion multiple-stakes winner who won the Group I Manhattan Handicap and several other stakes races in New York. Danger's Hour is now a stud in Australia. For twelve years, Farrow was also a veterinarian for the Australian Jockey Club, and he has spent time as a veterinarian in Newmarket, England, and in Kentucky.

As the chairman of clinical sciences, Farrow oversees much of the equine research at Cornell, including most of the Zweig projects and other funded research at the Equine Research Park, on the high-speed treadmill, in the clinic, and in the laboratories. "The fact is that horses have always been a major interest of mine. In my new position, I have a special commitment to equine research and to the equine industry."

Growing up in farm country near Sydney, Farrow always had access to horses. His family owned a number of sheep and barley farms, and horses had been in the family for generations. Farrow rode dressage mostly until he stopped riding in his early twenties.

He went to an agricultural high school, where his interest in biomedical sciences was fostered, graduated from the University of Sydney and worked in private practice for four years. He returned to the university to earn a Ph.D. in veterinary pathology and taught equine and then small animal medicine there for 16 years before coming to Cornell on sabbatic. Dr. Farrow then taught equine anatomy and clinical neurology in the Veterinary Teaching Hospital at the University of Sydney.

As a researcher, Farrow specialized in therapeutic aspects of naturally occurring genetic diseases of dogs. This work resulted in early detection and prevention of diseases in dogs and served as a model for treating children with similar disorders. In particular, he focused on fucosidosis, a naturally occurring disease of English Springer Spaniels.

When Farrow was offered his position at Cornell, an Australian colleague called his new job "one of the most important veterinary clinical positions at one of America's 'blue-chip' universities, perhaps the finest in the world."

Moving to Cornell, however, has had its down side. In Sydney, Farrow enjoyed four racetracks nearby; in Ithaca he is suffering from acute track deprivation. "I really miss it, but I try to go to Saratoga every year," says Farrow.

The author of over 100 scientific papers and 16 book chapters, Farrow has been married to veterinarian Maureen Farrow for seven years. She is taking time off from veterinary medicine to raise their two small boys, Jackson and Benjamin, ages five and one. Although Farrow doesn't want to push horses on the boys, his future plans will most certainly include them. "When I retire, I plan to breed and race horses again, but then as a full-time interest." ■

BRUCE WANG

Animal behaviorist Katherine Houpt is looking for reasons why this mare attacks her foals.

Animal behaviorist and physiologist Katherine Houpt believes that her love of horses is genetic: as far back as she can remember, she and her father were crazy about them. She started riding when she was four years old, but it wasn't until she was nine and watched Ronald Reagan star as the veterinarian who discovered a vaccine for hoof-and-mouth disease in *The Stallion Road* that Houpt set her mind on becoming a veterinarian.

"I knew nothing about veterinarians before that movie, but as soon as I saw it, I knew I wanted to be one. I never looked left or right from that goal even though everyone said I couldn't become one because I was a girl," says Houpt.

When she graduated from high school in the mid-1950s, the editorial board of her yearbook refused to mention veterinary medicine, a profession almost totally dominated by men, under a woman's name; instead they reported that her future promised "a career working with animals and medicine." It may have been luck, helped by having the highest grades in her undergraduate class at Pennsylvania State University, that landed her a spot at the University of Pennsylvania's School of Veterinary Medicine, one of five women in a class of 45, where she married her physiology professor (Richard Houpt, V.M.D., Ph.D., now of Cornell) and earned her V.M.D.

"I knew by then that I could never be a large animal practitioner—society just would not have accepted it. I decided to go into research instead," says Houpt.

Forbidden to work in the same department as her husband, Houpt was forced to develop a new career. With two young sons in tow by then, she worked part-time as a small animal practitioner. "But I missed academia. As I saw friends get interesting positions in science, I longed to get back in there, so when my youngest was three, I went back to graduate school for my Ph.D."

When her husband was offered an appointment at Cornell, there was no veterinary position open to Houpt, so she started her Cornell career teaching the biological bases of sex differences for the Women's Studies Program in 1973. The next year the veterinary college asked Houpt to develop an animal behavior course, which has evolved into courses on behavior problems of horses, of dogs and cats, and a course on farm animal behavior. Houpt became the first woman veterinarian and eventually the first female full professor in the college; she is also the first woman editor-in-chief of the journal *Applied Animal Behavior Science.*

In her research, Houpt focuses on the physiological mechanisms of food and water intake in horses and the development and behavior of horses, looking, for example, at thirst in general; why Lasix makes a horse thirsty; how foal development differs depending on type of labor (natural or induced), environment (stall vs. a field), and extent of suckling; as well as why mares sometimes reject their foals.

Houpt also serves as the director of the Animal Behavior Clinic at Cornell. "I advise animal owners on how to change unwanted behaviors in their horses, dogs, cats, or any other animals through management techniques and drug therapy, when required."

The author of 100 scientific papers, half of which are on horses, Houpt has authored or co-authored four books, 15 chapters, and 119 technical papers, working long days teaching and doing research.

What does she do in her spare time, now that her children are grown? Ride her Arabian mare or care for her pony—after all, it's in her genes. ■

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 funds 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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ing examination is associated with its ability to transmit adequate airflow during intense exercise.

"In other words," says Hackett, "mechanical indicators of upper airway function, such as the degree of resistance across the larynx, can be determined in horses running at maximum speed."

With these measurements, the researchers will be able to mathematically calculate the resistance at various places in the airway. This will help veterinarians assess whether a horse has a problem, where the problem is, when it occurs (during inspiration, expiration, or swallowing), how it interferes with performance, and how the various problems respond to particular treatments. Hackett presented some of these findings to the American Association of Equine Practitioners in December.

"This information gives us a degree of objectivity in assessing upper respiratory disorders that is unparalleled anywhere in the world," says Ducharme.

"The ultimate goal is to look at horses and to use our pressure measurements to support whether what we see is normal or abnormal," adds Hackett.

The researchers will continue their work on the upper airway, especially pharyngeal collapse (palate displacement) and laryngeal hemiplegia, also known as roaring, and have begun to measure the lower airway mechanics during exercise. They will compare the respiratory functions of fit horses against unfit horses to determine the effects of conditioning upon various indicators of respiratory function.

They also will look into how the indicators of the lower airway relate to lung disease. "This is very important," Hackett says, "because almost all race horses have some degree of lung disease, although not all of it is clinically significant." ■

Zweig News Capsule
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The Zweig News Capsule is produced periodically throughout the year to report on research at the College of Veterinary Medicine, Cornell University, funded by the Harry M. Zweig Memorial Fund for Equine Research.
Writer: Susan S. Lang
Editor: James P. Titus
Designer: Barbara Drogo
Photographers: Bruce Wang, David Grunfeld, Chris Hildreth

1/93 MS 4.9M E20322N

Printed on recycled paper