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Finally, some individual entrepreneurs have been considering the initiation of their own tentative studies. Provimi, the largest U.S. manufacturer of milk replacer feed for veal calves and a veal meat packer, had planned to investigate the effect of the Quantock group pen method (as compared with confinement in individual crates) on the general health and well-being of veal calves. This was the result of public feeling that the crate method is unnecessarily cruel. However, the latest word is that Provimi, having gained a respectable yield of favorable PR about the endeavor, has decided to dispense with the actual performance of the study. Therefore, Quantock Veal, of England, will soon begin the test, on its own, in the United States.

Focus

Horse Racing and Drug Abuse: Untangling the Issues Involved

Some time during mid-January, hearings on a new bill, intended to stop the misuse of drugs in racehorses, will be held in the U.S. Senate. The Humane Society of the U.S. (HSUS) wholeheartedly supports the bill and, in fact, worked with the American Horse Protection Association as one of the co-authors of its specific provisions. But to many sectors of the racing industry, the bill is anathema. They believe that enactment of this legislation will surely spell financial ruin for the racetracks of America, given the costs that will be entailed in foregoing the alleged benefits of drugs, and in setting up the drug analysis labs which will be a required part of checking to make sure that no unsound horse enters a race temporarily fortified by pharmaceuticals.

From the racing industry, and from some other quarters, there has also been criticism that the provisions of the bill represent simplistic thinking. It is argued that regulation of racetracks is a matter for individual States to determine since racing conditions differ from one State to another (more about this matter later). Second, they feel that the bill is shortsighted in addressing only the *symptoms* (that is, the use of drugs and other pain-killing measures) of the problems confronting the various segments of the racing industry, rather than the actual problems, such as longer racing seasons and the high annual cost of maintaining a racehorse — currently about \$15,000 per year.

However, Marc Paulhus of The HSUS argues that their position is *not* based on a primitive kneejerk reaction, arising solely from righteous indignation at the thought of injured horses being drugged so heavily that they run until they collapse. Rather, it is based on a sophisticated analysis of the many factors involved in creating the necessary conditions so that horseracing will become (a) safer for the horses, their jockeys and trainers, (b) economically sounder for owners and racetracks, and (c) more trustworthy for bettors. In particular, the thinking behind the bill assumes that a ban on drugs will encourage a reassessment on the part of owners and trainers concerning the best way to breed and train faster and healthier horses. Recent studies by Tom Iver (manager of Olympic Stables in Greenwood, Delaware) on the optimal methods for training horse-athletes, computer-monitored investigations on the precise dynamics of the stresses involved in the movements of a running horse done by George Pratt of MIT, and new developments in knowledge of the intricacies of horse breeding genetics can make it possible to produce and condition horses in much the same way as human athletes. Techniques like aerobic conditioning can be used in horses to provide the animals with the same kind of endurance and resiliency under stress as, say, a Frank Shorter exhibits in a grueling marathon race.

What the Bill Says

First, it is important to keep in mind what the proposed bill actually says. Its specific provisions, discussed previously in the *Journal* at some length (7(1):53-54, 1980), include:

1. Prohibition of all pre-race administration of medications capable of affecting a horse's performance at the time of the race.

2. Prohibition of numbing an animal's legs with ice, dry ice or any other chemical agent on the day of the race, and elimination of the practice of permanent numbing through surgical neurectomy.

3. Establishment of uniform pre-racing inspection and drug testing programs.

4. Strict enforcement of penalties for persons convicted of wrongfully drugging or numbing a racehorse.

The Context of the Racing Industry

The gut-level reaction of the racing industry to the provisions of the bill has been negative. This feeling is, in part, simply a manifestation of the general sentiment being expressed in so many ways around the Nation: that "big government" is growing too fast and crowding the lives of individual citizens (and individual businesses) a bit too closely; that a knowledge of local conditions gives State and municipal governments insights that the Federal Government cannot possibly achieve; and that a snobbish "do-gooder" elite of bureaucrats and planners presumes far too much if it believes that it has the right to dictate how people in Peoria should live and think.

In the minds of the State racing commissioners and track owners, this kind of thinking translates to a consensus that the provisions of the proposed bill manifest a cavalier lack of knowledge about the industry's financial and political circumstances.

Racing industry spokesmen point out that one important aspect of the current racing situation is the recent increase in the length of the racing season, in most of the 30 racing States. Among the 54 tracks included in the Thorough-

bred Racing Association, the total number of racing days rose from 6,242 in 1978 to 7,515 in 1979, a 20.4 percent increase. Thus, either more horses are needed, or else the available horses must race more often, even when they are not in the best of shape. Therefore, the racing industry argues that drugs play a vital role in ensuring that there is a sufficient supply of horses to fill the racing calendar.

However, supporters of the proposed bill wonder about the economic wisdom behind this longer racing season. During the same period, total attendance rose only from 51.5 million to 55.1 million (a 7 percent increase). So, for some reason, the number of individuals at the track on a typical day appears to have declined. This decline may be a result of a decrease in available funds to spend at the track. It may also represent a growing lack of confidence in the integrity of the sport of racing as more and more bettors, looking at their racetrack programs, begin to wonder just what the asterisks beside the names of many horses, which indicate that the horse is running on "bute" or Lasix, actually mean in terms of performance.

Further complications in sorting out racing industry motivations arise from the fact that, for better or worse, the world of racing is very inbred. As reported in a New York *Daily News* series, "Scandals Poison Horse Racing" (April 1981), the racing industry itself is riddled with complex patterns of conflict of interest. Many racing commissioners are also horse breeders and make frequent bets at the track. Many track veterinarians own and race horses, often against other horses that they are treating. Therefore, when the racing industry argues against one or another provision in the proposed legislation, it is hard to tell who is speaking for precisely what interest groups, and to ferret out what motivations lie behind the particular arguments advanced.

But perhaps the most important factor in the racing industry's unease about any changes in the status quo stems from worry about any factor that

might decrease the enormous amount of money made at the racetracks each year. The *Daily News* article estimated that, for 1980, the total amount of all bets was about \$12 billion. Since a certain percentage of this gross goes into State treasuries, State governments also have a substantial interest in maintaining the racing status quo. Further, they tend to fear what would happen if careful investigations of the racing industry were instigated. Said Marc Paulhus of The HSUS: "The State commissions simply do not want to deal with a scandal of the proportions that would result from effective enforcement," because "State regulators are partners in racing; a portion of every dollar wagered goes to the State."

Finally, one must assume that the several groups that oppose the legislation, such as the American Horse Council and the Horsemen's Benevolent and Protective Association, honestly believe that drugs, Lasix and bute in particular, are essential elements in maintaining the health and racing soundness of horses.

A Brief Look at the Drugs in Question

The use of drugs in horse racing has received extensive coverage by the media. Much of this coverage tends toward the sensational, but a good source for a more balanced discussion on bute and Lasix is "The Use of Drugs in Horse Racing," a report issued by the Library of Congress' Congressional Research Service.

Phenylbutazone ("bute"), one of the two most frequently used drugs, is formally classified as an anti-inflammatory, antipyretic analgesic. Its anti-inflammatory action is similar to that of cortisone. In humans, the drug has been approved for the treatment of inflammatory conditions associated with the musculoskeletal system, especially arthritis, as well as general muscular soreness. It is important to note here that all package inserts that accompany the drug, whether for human or veterinary use, state that treatment with bute should never be prolonged (maximum, 5 days). This is because bute, like cortisone, suppresses the body's immune system. Inflamma-

tion has been termed "the body's cast," in that it comprises a whole variety of chemical and physical processes (such as release of white blood cells and macrophages into injured tissues to ingest irritating debris) that are an essential part of an organism's healing process.

At many racetracks, bute is given to some horses before each race, or even on a daily basis ground up into the feed. During the stress of a race, the drug acts primarily as a pain reliever (probably through the inhibition of prostaglandin release), such that an injured horse will fail to protect injured tissue, and will literally run until it drops. On May 3, 1978, a mare named Easy Edith, running under the influence of bute, fell in a race at Pimlico in Baltimore, setting off a four-horse spill that killed jockey Robert Pineda.

The other drug most frequently given to horses prior to a race is furosemide (trade name, Lasix). Lasix is a powerful diuretic that acts by inhibiting reabsorption of sodium by the kidney. Increased levels of the electrolyte are excreted together with water, to preserve the electrolyte balance in the body. The approved use of this drug is for edema, especially myocardial edema. But its use in racehorses seems, at least at first glance, distinctly unrelated to edema. It is supposedly given to horses because they are "bleeders," that is, to those who tend to rupture tiny blood vessels in the alveoli of the lungs, leading to hemorrhages during workouts or after a race. But the mechanism by which a diuretic drug might affect this type of condition is unknown. There has been some speculation, by those who want to believe in the effectiveness of Lasix treatment, that bleeding horses may obtain relief through the drug's ability to decrease pulmonary edema, or that Lasix may lower blood pressure by decreasing blood volume. But there are no hard data to support any of these kinds of hypotheses. What we do have, however, is a good estimate of the total percentage of horses with epitaxis (bleeding), made by R.W. Cook, Professor of

Equine Medicine and Surgery at the University of Illinois. He has stated that only 0.8 to 2.5 percent of all racehorses actually have epitaxis, yet the percentage running on Lasix ranges from 25 to 80 percent.

There are few data available on the efficacy of Lasix in the true bleeders. One recent study was conducted by Corinne Raphael and Lawrence Soma of the University of Pennsylvania's School of Veterinary Medicine. Fifty-three recognized bleeders were treated with Lasix and then raced under conditions similar to those before treatment. Forty percent were no longer bleeding, but 60 percent continued to bleed in spite of the treatment. The initial report of the study, in the *Horsemen's Journal* (June 1981), did not provide any details about the phrase "raced under similar conditions." It is therefore hard to tell just how many factors such as track condition and ambient temperature were controlled for in the experiment. It was established, however, that bleeding seems to correlate highly with the age and general condition of the horse.

Lasix also has other "useful" effects. First, since it causes such a tremendous increase in urine output, the concentration of other drugs that may have been given to a horse becomes greatly diluted in urine samples, which makes detection by conventional means of analysis very difficult. Second, the loss of water in urine can decrease a horse's weight to a significant degree, which can mean the difference between winning and losing a race. Bute also has the ability to mask the use of other, more powerful drugs that may be illegal.

There are an endless number of such other drugs, used for many different purposes, which seem to come in and out of fashion, being injected into every horse on the track one year, and then disappearing the next. Meperidine (Demerol), propoxyphene (Darvon), and pentazocine (Talwin) have all been implicated at one time or another, as well as their natural precursors, morphine and codeine. New analgesics come onto

the market at regular intervals, whereas it often takes months or years to devise a reliable, inexpensive assay for a track-side lab to use in detecting these drugs. There is also the complex problem of drug interactions. Opponents of drug use note wryly that a race is often won by the horse with the most knowledgeable chemist.

Drugs (and other analogous treatments) serve as a crutch that trainers and owners can use to race unsound horses. If drugs and other pain-killing practices are eliminated, and pre-race checks for horse soundness became a routine procedure, HSUS argues that two consequences will follow. First, the immediate goal of sparing much pain and potential for injury to horses and jockeys, as well as creating a more equitable climate for bettors, will be achieved. The second is a longer-range goal. It is hoped that, without currently available crutches, trainers and owners will have to reassess their current practices and that the outcome of such scrutiny will be the breeding of sounder, sturdier horses followed by improved conditioning regimens, in line with recent scientific findings.

Breeding Practices

Breeding practices have tended to favor the development of taller horses with larger, more muscular bodies but with smaller legs and thinner leg bones. This imbalance in bodily proportion has meant that hairline and major bone fractures, as well as tendon (and other) injuries, are becoming increasingly frequent. This is hardly surprising given the forces on spindly legs created by a horse running full-speed. However, in a racing environment, in which drugs were prohibited, there would be considerable motivation to breed stronger horses with greater levels of endurance and, in particular, sturdier legs with thicker bones.

How a Horse Runs, and What Gets Stressed

Important work in the area of scientific analysis of racehorses and stress is being done by George Pratt, professor of electrical engineering and computer sci-

ence at MIT and adjunct professor of veterinary medicine at Tufts. He is developing methods, using biomedical engineering techniques, for detecting soreness before lameness sets in, methods for testing the strength of bone as an indicator of a horse's soundness, and devices for analyzing the consistency and resiliency of track surfaces. He is also doing motion analysis to measure the forces and strains that act on a horse as it travels down the track at various gaits and speeds (see *Thoroughbred Record*, March 7, 1979). He views all of this work as a branch of sportsmedicine (which has become extremely sophisticated in recent years), specifically tailored for horse-athletes.

Gait analysis, an investigation of the basic timing of the horse's movement using a high-speed camera and computer analysis of the film data, is the first component of his work. Spinal nerves, he has found, determine the "motor program" that sequences the weight-bearing (stance) and non-weight bearing (swing) phase of each leg. The timing of these two phases, in turn, determines the efficiency of the stride. The superior horse not only possesses an innately efficient stride, he also has the conformation and physical stamina to maintain his gait at ever-increasing speeds.

To answer questions about the effects of differing conditions of a race such as track conditions and fatigue on the forces placed on the leg, Pratt has designed an instrumental horseshoe that can measure the force on a hoof. These measurements are made at a rate of 1,000/sec on all four feet; the results are then tape-recorded on a miniature recorder also carried on the horse and the data are analyzed by computer.

This work permits highly detailed gait analysis, and the results can be correlated with the performance and soundness of horses. The effect of different track surfaces, and possibly the effects of drugs like bute, can be examined. For example, Does the drug allow a horse to run with a safer gait, or does it just block a feedback signal that would tell the

horse to slow down?

Another avenue of Pratt's investigation has involved the effect of repeated stress on horse bone. We know that microcrushing and microfracture occur all the time as bone absorbs shock but, with rest, the strength of the bone is restored in a "remodeling" process. What we have not known is how to tell if balance between these two processes has been achieved in a given animal, such that he remains "racing sound," especially in light of the fact that medication with drugs like cortisone can greatly retard the healing process. Pratt mounts strain gauges on one of the upper leg bones of the horse, the cannon bone. He has found that the bone can withstand about 9,000 pounds while the horse is running, if the load is distributed evenly. But if the load is placed on only one side of the joint, as in a turn, the amount of weight that can be borne until fracture occurs decreases by a factor of 100.

This work has immediate practical consequences for track design: banking of turns on a track, and introducing a slight grade to its surface, can do much to make certain that the pressure on both sides of the bone remain roughly equal.

Pratt is also testing a noninvasive method for measuring bone strength, based on the velocity of ultrasound in the leg. The normal velocity of sound sent through the cannon bone is 2,000 m/sec. Using bones from deceased horses and computer-controlled stressing mechanisms, Pratt has found that simulated stresses typical of those occurring in a horse during a race decrease the sound velocity; after a 20 percent decrease, a fracture will form.

Lameness, too, can now be measured by a technique devised by Pratt. This device, a force plate, indicates the force exerted by one leg standing on a flat surface while the other leg is held up. The variability of force in the supporting leg gives a measure of the degree of lameness in an injured leg. This device has been used to show how and when the relief of pain from bute sets in, and how it wears off again.

Conditioning Horse-Athletes

In recent years, computerized and other scientific methods of training, including analyses of movement like those George Pratt is beginning to do on horses, have made dramatic differences in the performance of human athletes. Mile runners, for example, have shaved whole seconds off earlier records. Horse racing records, however, have remained pretty much in the doldrums. At most, only tenths of a second have been cut off earlier times. This suggests that there is untapped potential for enhancing almost any horse's innate abilities as a runner, through application of training procedures that were originally designed for humans. Tom Ivers, at his training stable in Greenwood, Delaware, is doing just that.

In most stables, training for horses is virtually nonexistent. On a typical non-racing day, a horse is sent out for a 1- or 2-mile spin around the track, a workout that just barely raises a sweat, and is then put back into his stall for the next 23½ hours. When the horse is prepared for the week before a race, the first five of his six workouts are usually too slow and do little to condition the horse. Research has shown that slower mile times—over 2:20 minutes—don't make use of the racing, or anaerobic, muscle potential. When the horse hits his sixth-day, full-speed workout, there is a good chance that stress-induced injuries will occur.

By contrast, Ivers uses a complex schedule, specially tailored to each horse's capacity and conformation, of carefully paced conditioning known as interval training (see *The Horsemen's Journal*, November 1980).

As in all training in humans, the basic goal of interval training is to increase the amount of oxygen used by working muscle cells. This factor, in turn, depends on getting the horse's heart to strengthen and work more efficiently, to achieve a steady-work pulse rate of about 150 beats per minute, coupled with a rapid recovery rate—back to 60-70 beats within 5 to 10 minutes.

The actual training program is com-

posed of four phases. The first phase begins with light aerobic exercise (commonly called long slow distance training, or LSD). Over a 3- to 6-month period, longer and longer distances are covered. Then, in the second phase, aerobic and anaerobic exercise are combined in a sequence of long, strenuous intervals that are alternated with shorter periods of complete rest. The third phase consists of fast interval rates that approach racing speeds. Finally, in the fourth phase, the horse runs short sprints at top speed.

This coaching program, if carried out with flexibility and sensitivity for the variation in performance among individual horses, conveys a number of benefits. Heart and local muscles are strengthened, the bearing surfaces of bones are thickened (thereby reducing the probability of stress fractures), tendons and ligaments are gradually stretched and joint cartilage thickened, and the capacity for aerobic running is increased. The tolerance for the anaerobic conditions that can occur at top speeds is also enhanced. And, for injured horses, this type of program can promote more orderly repair of tendons and ligaments than merely letting a horse rest in a stall.

A Final Word

As the Congressional Research Services report indicates, some of the controversies surrounding this issue simply cannot be resolved until better data are available about questions such as the etiology of lameness and injury, the causes of breakdown on the track, and the precise effects of drug control on the racing industry. These gray areas, the unresolved questions about the best way to run racetracks, have not necessarily obviated the need for immediate action, as set forth in the requirements of the proposed legislation. But they do mean that its proponents, including The HSUS, have had to acquire a broad knowledge about the myriad intricacies of a complex industry, that involves so much money, and so many diverse political interests.

Dana Murphy