

R. K. Farrell,¹ D.V.M.; T. A. Johnson,² D.Crim.; and W. G. Buckley,³ B.S., M.P.S.

Freeze Marking and Other Techniques for Identifying Horses

REFERENCE: Farrell, R. K., Johnson, T. A., and Buckley, W. G., "Freeze Marking and Other Techniques for Identifying Horses," *Journal of Forensic Sciences*, JFSCA, Vol. 26, No. 1, Jan. 1981, pp. 82-90.

ABSTRACT: Detection and prevention of certain criminal activities within the horse industry would be facilitated if a permanent, unalterable, visible means of identification is used on the animal at a very young age. Techniques formerly accepted by the industry do not meet the test of adequate identification today. Freeze marking with unalterable symbols meets the modern needs of the horse industry and is acceptable in the National Crime Information Center computer network. "Trichoglyphs" and blood type are unalterable natural characteristics that augment the program.

KEYWORDS: criminalistics, horses, identification systems

The large amount and broad nature of illegal activity within the horse industry ranges from the sophisticated schemes of organized crime, such as undisclosed ownership of racehorses, to the habitual offender who steals horses to sell to slaughterhouses.

Of course, over the years law enforcement authorities have been aware of the problems associated with the drugging of horses, the bribing of jockeys, illegal bookie operations, and the many facets of political corruption that may be associated with organized horse racing. However, organized horse racing is only a small portion of the entire horse industry, and, to date, law enforcement efforts have at best been sporadic because of our fragmentary law enforcement system. In short, we find federal, state, and local police all having peripheral interest in certain segments of criminal activity within this small portion of the American horse industry. Because of this fragmentation, jurisdictional problems, and the use of private investigators by racing commissions and individual race tracks, the responsibility for the detection, control, and prevention of criminal activity is so dissipated among so many bureaucracies that it has been impossible to effectively control criminal activity within the horse racing industry. An area that appears to affect all law enforcement agencies in reality operationally affects very few of them. To compound this problem, we find horse racing commission investigators enforcing racing commission rules that in all too many instances have no relationship to state laws. Moreover, it appears that the training of those investi-

Presented at the 32nd Annual Meeting of the American Academy of Forensic Sciences, New Orleans, La., 22 Feb. 1980. Received for publication 8 April 1980; revised manuscript received 23 June 1980; accepted for publication 26 June 1980.

¹Veterinary medical officer, U.S. Department of Agriculture—Science and Education Administration, and professor, Veterinary Cryobiology, Washington State University, Pullman, Wash. 99164.

²Professor and chairman, Department of Criminal Justice, Washington State University, Pullman, Wash. 99164.

³Agent in charge, Colorado Bureau of Investigation, Denver, Colo. 80222.

gators is limited to prior law enforcement experience, which may or may not have addressed the contemporary problems in the horse industry.

The single greatest barrier to effective detection and prevention of criminal activity in the horse industry has been the absence of a system of identification that specifically distinguishes one horse from all other horses. Until recently, the scientific community has largely ignored this problem. With the recent development of "freeze mark" identification, however, it is now possible to identify a horse visually and conclusively; thus, law enforcement authorities can more effectively address such crimes as theft and fraud within the horse industry.

The sizable investment of money by horse owners and the scope of fraudulent practices associated with the absence of positive identification strategies have permitted criminal activities to occur. Moreover, the honest errors sometimes made by experienced horsemen indicate that a program for the positive identification of horses should be a priority for the horse industry. Furthermore, until such a program is implemented, the ability and effectiveness of law enforcement and other regulatory agencies will be severely constrained. With the development of an identification system and attendant protective legislation, the illegal destruction of horses may be abated. Moreover, law enforcement authorities would be more inclined to participate in cases involving the theft of horses when there are definitive identification systems as vulnerability to lawsuits would diminish markedly.

Compelling reasons for developing positive identification systems for horses are the following:

- (a) acting as a deterrent to theft;
- (b) tracing blood lines;
- (c) facilitating effective change of ownership;
- (d) preventing substitutions at shows and races;
- (e) obtaining loans and certifying insurance claims on a specific horse;
- (f) tracing stolen horses across state lines and international boundaries; and
- (g) documenting a horse's participation in equine health programs such as vaccinations, equine infectious anemia testing, and quarantines [1].

Identification Studies

Natural characteristics (chestnuts, "trichoglyphs" [hair patterns], white markings, and blood typing) and applied marks (tattoos, freeze marks, hot iron brands, and laser marks) used by horse breed registries have been evaluated at Washington State University to determine their alterability. Recent and proposed laws specifically relating to animal identification were evaluated, and procedures to enhance retrieval of missing animals were explored.

Blood Typing

Blood type is an unalterable natural characteristic. The Arabian Horse Registry and the Jockey Club (Thoroughbreds) require all active stallions to be blood-typed. Many other registries use blood typing to solve individual parentage cases. It can also be used as a strong deterrent to fraudulent substitution. As in human blood typing, parentage determination in horses has a 90% chance of excluding a false parent [2]. Possible phenotypes for 16 common testing systems for red blood cells and serum proteins of horses exceeds one trillion [3], many more than are known in human blood typing. The P_1 index (probability of two horses having the same blood factors) for Thoroughbreds is 1/25 000; for Arabians, 1/200 000; for Quarter Horses, 1/250 000; and for Standardbreds, 1/500 000.

Use of serum reference banks is less expensive than blood typing. Frozen serum from identified animals can be held indefinitely until the identity of a horse is questioned. If five common serum systems are tested, statistically there is less than one chance in a hundred

that the serum from two animals will be identical. The P_1 is approximately 1/100 for Thoroughbreds, 1/125 for Quarter Horses, 1/250 for Arabians, and 1/300 for Standardbreds. Additional systems can be tested if two serum samples do show identical characteristics in the five common systems. Eight of ten incorrect parents can be excluded in parentage studies using factors in only five serum systems. In blind studies on 194 horses [4] in which a serum sample was taken from each horse at the beginning of the study and a second sample was drawn from each horse at a later time, all samples except two that were badly hemolyzed were matched correctly. Serum typing procedures represent a strong deterrent against fraudulent misrepresentation of horses. Although serum reference banks seem to be an excellent means of identifying horses, difficulties have arisen because of laws that require direct veterinary supervision of blood collection in some states.

Caution must be exercised in relying on nonvisual methods of identification because they do not prevent the killing of stolen horses at slaughterhouses, but blood typing does give excellent supporting evidence after identity has been established by a visible, applied mark. Parentage fraud studies would, of course, be impossible without the use of blood typing.

Trichoglyph Prints

Trichoglyphs (hair patterns), like dermatoglyphics (such as fingerprints), contain a great deal of information. There are 23 common locations for trichoglyphs on the horse [5]. Recently, an inkless, one-step method for making a permanent imprint of the frontal (forehead) whorl has been developed. The same imprint records a vertical line determined by the frontal and nasal sutures and a transverse line corresponding to a line drawn between the two supraorbital foramina. Not only can the characteristic pattern of the hair flow be visualized, but the direction and distance of the pattern from the center point established by the vertical and transverse lines can also be determined. This method of location is similar to charting the position of a ship at sea except that millimetres are used for distance instead of nautical miles. Trichoglyphs cannot be altered without evidence that alterations have been made. The technique will be widely used in the future, especially when combined with unalterable applied marks.

Chestnuts

The chestnuts, also called night eyes, are horny growths of vertical fibrous tissue on the inside of horses' legs. They are used by the New York Jockey Club and by Equine Services, Inc., in identification procedures. The Jockey Club uses a technique administered by the Pinkerton Detective Agency that records size and contour by photograph and symbolic description. Equine Services has a program that records an optical scan on a computer. Studies at Washington State University indicate that the chestnut is the natural characteristic of the horse that is most amenable to surgical intervention for fraudulent alteration of identity. The chestnut has a vertical fiber that allows skin-to-chestnut or chestnut-to-chestnut closures that are usually impossible to detect. Only alterations that require skin-to-skin sutures are detectable [6]. Blind studies using 14 trained horse identifiers indicated not only that surgically altered chestnuts are difficult to detect, but also that false positives were frequently reported. Some chestnuts that had not been altered in any way were reported as having been altered.

White Marks of Signalment

Recording white marks of signalment (natural markings), especially on the face and legs of the horse, is one of the oldest and most common means of identification. But it is fraught with problems and, in the past, has been difficult to adapt to data retrieval systems because

of a lack of agreement in terminology and in judgment. For example, when does a star-stripe-snip connected (terminology used to describe a white marking extending from the forehead to the muzzle) become a blaze, or as a blaze widens, when does it become a “bald” face? Also, such marks are easily produced or altered by the use of lasers, freeze marking, and other techniques. Freeze-marked white hair can be detected by a process of polarization stress analysis [7].

White marks of signalment are easily dyed, and the dyed hair will last until the hair sheds in the normal hair growth cycle, once in the spring and once in the fall. Fraud by dyeing has been practiced for many years, but the technique became easier after the advent of diazo-dye-peroxide mixtures used to dye human hair. In one study, only 2 of 20 experienced horsemen detected the alteration by dyeing of one horse in a field of eleven even though the horsemen were informed that the alteration was present. The white marks of signalment deserve less trust than most horsemen presently give them, and they should not be used as the sole method of positive identification.

Coat Color

There are seven basic genes that determine the color of a horse. Many color variations can be described by genetic formula [8]. Much confusion exists in terminology used for colors from one breed registry to another, and a breed registry may recognize two or more colors that overlap genetically. For example, the two coat colors referred to as “sorrel” and “chestnut” are simply gradations in the degree of darkness expressed by the red pigment dilution gene, and, consequently, identifiers may not agree whether an animal is a dark sorrel or a light chestnut.

Natural change in apparent color is frequent in horses. Horses may start out dark as a foal and turn gray as they mature, or spotting may occur as in an Appaloosa. However, if a horse that is claimed to be the offspring of two dark horses turns gray, blood typing studies should be made. The genetic “gray rule” says that you must have at least one gray parent to have a gray foal. In a like manner, two parents with dominant red genes can have only a red foal.

Brands

Many western states today have offices where brand symbols can be registered to denote ownership. Many of the same symbols are registered in two or more of the states. In Texas, a county registry system exists so the same brand can occur in several counties. A major problem with the system is the fact that horses lose ownership identity when they cross state lines. Humane and other considerations have reduced the number of horses being hot-branded to a very few. Brand registries do not meet the demands of modern horse identification as they only identify ownership, which often changes, and fail to identify the horse as an individual. Systems should function to identify the horse as an individual.

Tattoos

Tattoos are used in some official systems to individualize horses, particularly on race tracks. These horses are not tattooed until they reach the track at two years of age or older, and the animal’s true identity may already be lost. While much of the public believes that tattoos are required for race horses, they are not. The method of identification for race horses is determined by the racing commission of each state, and then additional requirements may be imposed by individual tracks. For example, the Washington State Racing Commission does not require tattooing for a horse to run at any of the four tracks that the Commission supervises. The management of one of those tracks does require tattooing.

During the 1979 and early 1980 seasons at Playfair, the second largest track in the state, 18 to 22% of the horses that raced were not tattooed.

Studies at Washington State University show that tattoos can be erased by use of the laser, but of even more importance is the fact that tattoos do not work well when placed in the very young animal because of growth dilution and resorption of the ink. The identity of a horse needs to be established as soon as possible after birth, and marks should last for the life of the animal.

Freeze Marks

Freeze marking has replaced or augmented other means of identification in a number of countries under the International Identification System. Freeze marking will painlessly establish a mark that has a permanent production of white hair, a permanently bald area where the skin becomes darker, or a bald, dark-skinned area with white-haired edges.

Laser Marks

The laser mark can produce marks similar to the freeze mark, but the present cost has not allowed the laser to compete with the freeze mark.

The International Identification System

The International Identification System (IIS) combines the application of unalterable freeze-marked symbols with a record of observable signalment, including trichoglyphs. Blood typing is also suggested for breeding stock and valuable animals. The system utilizes angle numerical [9] and angle alphabetical symbols [10]. These symbols are patented and internationally copyrighted, and their use is licensed only for official programs. The system allows enough numbers to have a unique mark for each horse in the world and is adaptable to computer data retrieval.

In the IIS, unalterable angle numbers are used instead of alterable Arabic numbers. These angle symbols can be identified by human subjects at three to five times the distance Arabic numbers can be identified. When these angle numbers are combined with the alphabetical angle symbols, every horse in the world can be individually identified. The angle numerical symbols use a right angle to represent 2 through 9 (Fig. 1). The system is easily remembered if you visualize the basic square to represent the even numbers. The number 2 is in the upper left corner of the square. Turn the square 45° for the odd numbers.

The number 1 is represented by two vertical lines; 0 is represented by two horizontal lines. Double lines are used for the one and zero to avoid fraudulent alteration to angles. A horizon line is always used in conjunction with the angle numbers in order to interpret possible growth distortion.

The alphabetical angle symbols have been designed so that there are eight positions for each letter (Fig. 2), filling the need for more than 26 alphabetical characters.

Each letter in any of its eight positions is distinctive from any other letter in any of its eight positions, and each position is assigned a computer designation. Each of these 208 symbols can be a prefix to represent a separate state or breed registry. Alphabetical angle symbols used as a suffix represent a country and may also act as a period if less than a six-digit number is used. All countries except the United States use an alphabetical suffix. The alphabetical symbols are the key to finding registration details of the animal.

The appropriate alphabetical angle symbol is combined with a series of angle numbers into a single marking device. Each number plug is reversible with an angle at one end and parallel lines at the other end. Each plug rotates so one angle makes all numbers 2 through 9, or with the plug reversed, 1 or 0. Thus, the device is self-contained; no extra digits are required. A total symbol system is shown on the freeze-marked horse in Fig. 3.

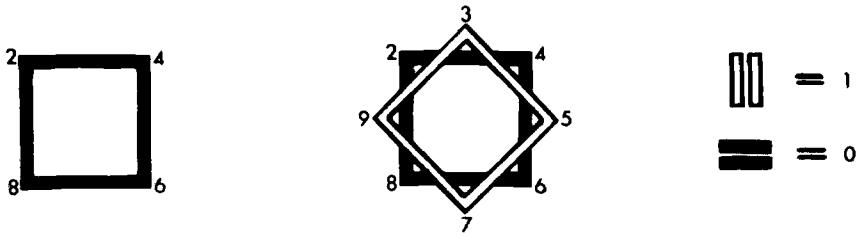


FIG. 1—The angle numerical system (U.S. Patent No. 3,633,584).

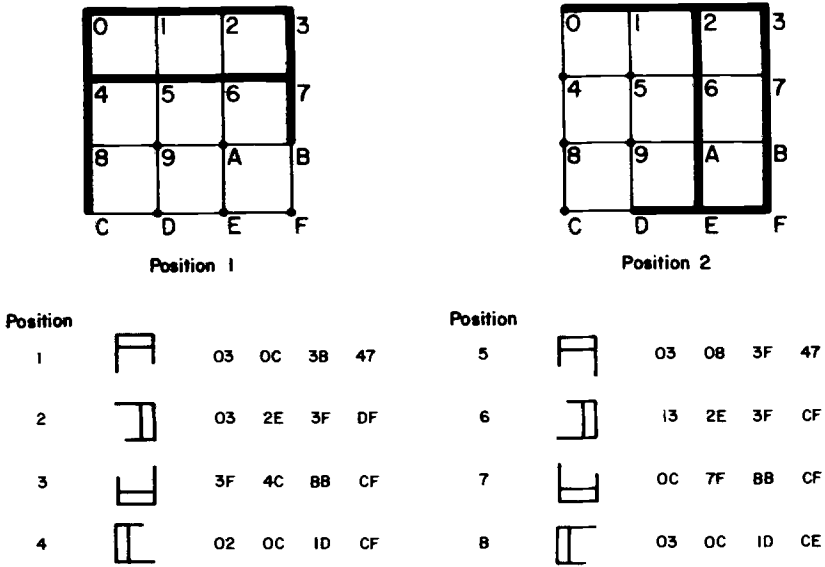


FIG. 2—The alphabetical angle symbols for the letter A with computer designations.

Only trained technicians apply the angle symbols. Thus, potential problems arising from improper equipment or techniques are minimized. Redness and swelling occur at the site for about 48 h after freeze marking, but this does not disturb the horse because the freezing destroys nerve endings temporarily. Loss of hair occurs in the marking site followed by a new growth of white hair.

The IIS is used in Canada, Mexico, Australia, and Sweden. In the United States, it is used by the Arabian Horse Registry, the Bureau of Land Management and the National Forest Service for wild horses, and by Kryo Kinetics, Inc., for all other breeds and grade horses. The system has been adopted by the World Arabian Horse Organization in Tunisia, Denmark, Egypt, Norway, Sweden, Austria, Belize, Costa Rica, Oman, Iran, Jordan, Morocco, and Switzerland.

Legal Aspects of the International Identification System

The potential for reducing fraud and theft has been greatly expanded by the use of unalterable symbols and an imprint of unalterable trichoglyphs. Washington state has accepted the symbols as evidence of ownership and inspection of horses for such marks is



FIG. 3—Freeze-marked U.S. Thoroughbred born (19)72, number (0)11594. The T_1 (T in the first position) prefix is reserved worldwide for a registered Thoroughbred. Other countries use an alphabetical suffix to indicate country.

required at slaughterhouses. Idaho has proposed a regulation to register the alphabetical angle symbols under its existing brand laws to enable the establishment of the mark as prima facie evidence of ownership and permit the holding of animals until proof of ownership is presented. A recent federal law requires all wild horses in the "Adopt-A-Horse" program to be identified by the IIS. The unalterable symbols have been placed in the Federal Register [11], which gives a precedent for recognizing symbols across state lines. A federal law, effective 28 Jan. 1980 [12], makes the slaughterhouse responsible for requiring proper documentation of federally freeze-marked horses presented for slaughter. Copyright and patent laws allow suit against infringers who might use the system illegally.

Senator Max Baucus (D—Montana) is the sponsor of an amendment that would make rustling and related crimes punishable under federal law by fines of up to \$250 000 and jail sentences of up to five years. Proving such crimes will be aided by a positive individual identification program.

National Crime Information Center

Stolen horses that bear the visible, individualizing symbols of the IIS are now eligible for inclusion in the National Crime Information Center (NCIC) computer system. The system was established by the Federal Bureau of Investigation as a service to all law enforcement agencies. The NCIC operates by means of computers and data transmission over communication lines. Its objective is to improve law enforcement effectiveness through the efficient handling of documented police information.

Police officials have recognized for years that stolen property moves regularly across town, county, and state lines. A person committing a crime in New York City at 10 a.m. can be in New Jersey by 11 a.m. and on a cross-country flight and across the Mississippi River by 2 p.m. Law enforcement agencies have been using the NCIC system to coordinate their efforts of identifying stolen property. The system is basically simple, but it depends on personal initiative for its success. Officers seeking stolen property list the property in the

NCIC computer file. Each item must be individually numbered to permit proper identification and quick search. A typical inquiry/response sequence to the NCIC can take less than 3 s and can advise the inquiring officer that there was no record found by the number he provided or provide him with a summary description of property reported stolen with that serial number on it. The NCIC having provided a lead, the officer can continue with his investigation.

Horse Identification

Until the advent of the NCIC, it was unlikely that stolen property transported interstate would be recovered and returned to its owner. It was even more unlikely that a stolen horse would be identified and returned to its master. The NCIC presented a means to exchange serially numbered police records (relating to property), but few horses were serially numbered.

The invention of the freeze marking system for animals represented a major historical accomplishment for authorities tracing stolen animals. The freeze mark is a unique, serial-type number. When properly applied and recorded, it is qualified for the NCIC entry as an "owner applied number" when the animal is reported stolen to law enforcement authorities. Subsequently, when a freeze-marked animal comes to the attention of a law enforcement official, an inquiry to the NCIC can determine quickly whether there has been a stolen report filed on that animal. The horse could have been stolen in Florida and then checked at a race track in California. The NCIC response would be prompt and effective. Were the animal embarking from Honolulu for the Far East, an NCIC file check would reveal immediately if the creature had been reported stolen and state when, where, and to whom the report was submitted.

The information required for listing a stolen horse in the NCIC file is brief and utilitarian: investigating agency name, investigating agency theft report number, date of theft, breed of animal or state, sex and color of animal, and identification number unique to the animal and which appears on the animal. Space is also provided for a brief description of any scars or marks on the animal.

An officer making an NCIC file check on the serial number by which the horse had been reported stolen would receive a momentary response from the NCIC repeating the information the investigating law enforcement agency had provided to NCIC. The officer then could use that NCIC "HIT" information much as post office "Wanted" posters are used. Further inquiry is made to verify the information, and appropriate law enforcement action is taken.

Discussion

From a perspective of effective law enforcement operations, a positive horse identification system must be developed, and the NCIC must be used. Once this identification system is widely adopted, there will be a method to monitor slaughterhouses, transportation of horses across state borders and international boundaries, operation of race tracks and horse shows, certification of insurance claims, and participation in equine health programs.

Concomitant with the development of a system of positive identification as afforded by the IIS freeze mark method, there remains the task of training personnel. It seems imperative that law enforcement agencies participate in identifier programs. To this end, state law enforcement and criminal justice training commissions would be well advised to initiate training programs immediately because emerging legislation and the inclusion of the freeze-mark system into the NCIC computer system will require law enforcement agencies to have the technical competence to function operationally in this area. Moreover, the competence of law enforcement personnel appearing in court and testifying on various issues of identification that may be under litigation can be validated only by prior training.

Obviously, not all law enforcement and regulatory agency personnel need to be trained as identifiers in the freeze-mark method. Selected personnel from a regional area may well satisfy that region's needs, which, of course, will be determined by the incidence of criminal activity involving issues of identification in the particular jurisdiction. However, since urban areas are not necessarily immune to what at first seems a rural problem, it would be advantageous for selected personnel from urban areas to be trained as identifiers. Race tracks are common in urban areas, and livestock slaughterhouses are often located in urban areas. Thefts of show horses occur at national shows that are periodically held in urban centers. Finally, it appears reasonable to expect, at a minimum, that every state criminal justice or law enforcement training commission sponsor a training seminar on the IIS freeze-mark method of positive identification. This would not necessarily have to be a part of the basic police officer training course, but it could be developed as a special training program for those agencies requiring specialists in this area.

Future Research

Research should concentrate on studying the effectiveness of the positive horse identification system in the reduction of the slaughter of stolen horses, the reduction of fraud at horse shows and race tracks, and the recovery of stolen horses. Australia, which has adopted this system nationwide for Standardbreds, should be examined and compared to a similar country that has not adopted this system, and the studies should consider cultural variables and be longitudinal. The effectiveness of law enforcement agencies before and after the implementation of such a positive identification system should also be analyzed.

References

- [1] Farrell, R. K. and Farrell, B. P., "Program of International Horse Identification," in *Proceedings of the 2nd International Horse Identification Seminar*, University of Arizona, Tucson, 1977, pp. 55-65.
- [2] Stormont, "Blood Typing Horses," in *Proceedings of the 2nd International Horse Identification Seminar*, University of Arizona, Tucson, 1977, pp. 101-107.
- [3] Stormont, C., "Special Report to the Profession: Positive Horse Identification; Part 2—Blood Typing," *Equine Practice*, Vol. 1, No. 5, 1979, pp. 48-54.
- [4] Smith, A. T. and Farrell, R. K., "Use of Blood Typing to Match Horse Serum Samples," *Newsletter* (American Association of Equine Practitioners, Golden, Colo.), No. 1, March 1979, pp. 56-57.
- [5] Baclig, A. F., "Cowlicks in Horses," *Philippine Agriculturist*, Vol. 35, 1952, pp. 186-195.
- [6] Farrell, R. K. and Farrell, B. P., "Special Report to the Profession: Positive Horse Identification; Part 1—Signalment," *Equine Practice*, Vol. 1, No. 4, 1979, pp. 13-20.
- [7] Bell, T. G. and Farrell, R. K., "Polarization Stress Analysis: A Method for Detecting Cryogenic Fraud in the Horse," *Veterinary Medicine/Small Animal Clinician*, Vol. 64, No. 11, 1969, pp. 968-972.
- [8] Smith, A. T., "Special Report to the Profession: Positive Horse Identification; Part 3—Coat Color Genetics," *Equine Practice*, Vol. 1, No. 6, 1979, pp. 24-35.
- [9] Farrell, R. K., Turley, G. E., and Johnston, S. D., "Angle Symbols for Numbers," *Vector* (British Columbia Association of Mathematics Teachers), Vol. 12, No. 4, 1971, pp. 5-7.
- [10] Farrell, B. P. and Farrell, R. K., "Expanded, Unalterable Alphabet for Animal Identification," *Western Veterinarian*, Vol. 15, No. 2, 1977, pp. 7-10.
- [11] Bureau of Land Management, U.S. Department of Interior, "Wild Free-Roaming Horses and Burros—Uniform Marking Procedure," *Federal Register*, Vol. 43, No. 33, 1978, p. 6842.
- [12] Bureau of Land Management, U.S. Department of Interior, "Wild Free-Roaming Horses and Burros—Management and Control," *Federal Register*, Vol. 44, No. 250, 1979, pp. 76 982-76 987.

Address requests for reprints or additional information to
 P. Farrell
 337 Vet. Sci. Bldg., Washington State University
 Pullman, Wash. 99164