PROCEEDINGS FROM

1984
SEMINARS
VIRGINIA HORSE CONVENTION

January 20-22
Holiday Inn - Midtown
3200 West Broad Street
Richmond, Virginia

Seminars Sponsored By
VIRGINIA COOPERATIVE EXTENSION SERVICE

In Cooperation With the
VA. TECH ANIMAL SCIENCE DEPARTMENT
VIRGINIA-MARYLAND REGIONAL COLLEGE
of VETERINARY MEDICINE
VIRGINIA DEPARTMENT OF AGRICULTURE
and CONSUMER SERVICES
VIRGINIA HORSE COUNCIL
VIRGINIA HORSE INDUSTRY ORGANIZATIONS

* * * * * * * * *
Commercial products and/or services are named in this proceedings for information purposes only. The Virginia Cooperative Extension Service and the Virginia Polytechnic Institute and State University do not endorse these products or services nor do they intend discrimination against other products or services which also may be suitable.

Articles may be reproduced if credit is noted to the Virginia Horse Convention, Virginia Horse Council and Virginia Cooperative Extension Service and the author (contact author direct for permission).

Virginia Cooperative Extension Service programs, activities, and employment opportunities are available to all people regardless of race, color, religion, sex, age, national origin, handicap, or political affiliation. An equal opportunity/affirmative action employer.

# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPLIED GENETICS AND HORSE BREEDING</td>
<td>1</td>
</tr>
<tr>
<td>(Dr. Elizabeth A. Tolley, Research Associate, Animal Science Department, N.C. State University, Raleigh, North Carolina)</td>
<td></td>
</tr>
<tr>
<td>BASIC EQUINE REPRODUCTIVE PHYSIOLOGY</td>
<td>7</td>
</tr>
<tr>
<td>(Dr. T. N. Meacham, Associate Professor, Animal Science Department, Virginia Tech, Blacksburg, Virginia)</td>
<td></td>
</tr>
<tr>
<td>POTOMAC HORSE FEVER</td>
<td>16</td>
</tr>
<tr>
<td>(Dr. Ralph C. Knowles, D.V.M., Maryland Department of Agriculture, Division of Animal Industries, Annapolis, Maryland)</td>
<td></td>
</tr>
<tr>
<td>FEEDING THE STALLION, THE BROOD MARE AND THE GROWING HORSE</td>
<td>21</td>
</tr>
<tr>
<td>(Dr. Michael S. Hand, D.V.M., School of Veterinary Medicine, North Carolina State University, Raleigh, North Carolina)</td>
<td></td>
</tr>
<tr>
<td>BROOD MARE MANAGEMENT</td>
<td>35</td>
</tr>
<tr>
<td>(Dr. D. G. Pugh, D.V.M. and Dr. R. A. Magnusson, D.V.M., Virginia-Maryland Regional College of Veterinary Medicine, Blacksburg, Virginia)</td>
<td></td>
</tr>
<tr>
<td>DISEASES AND SPECIAL PROBLEMS OF THE FOAL</td>
<td>49</td>
</tr>
<tr>
<td>(Dr. Polly Modransky, D.V.M., Virginia-Maryland Regional College of Veterinary Medicine, Blacksburg, Virginia)</td>
<td></td>
</tr>
<tr>
<td>MANAGEMENT OF THE PROBLEM MARE</td>
<td>54</td>
</tr>
<tr>
<td>(Dr. R. Reynolds Cowles, Jr., D.V.M., Blue Ridge Equine Clinic, Inc., Rt. 1, Box 260, Free Union, Virginia)</td>
<td></td>
</tr>
<tr>
<td>EVALUATION OF THE STALLION FOR BREEDING SOUNDNESS</td>
<td>58</td>
</tr>
<tr>
<td>(Dr. Robert W. Lipscomb, D.V.M., 1104 Oaklawn Dr., Culpeper, Virginia)</td>
<td></td>
</tr>
<tr>
<td>EQUINE A.I. FROM A BREEDER'S VIEWPOINT</td>
<td>70</td>
</tr>
<tr>
<td>(Mr. Ken Fletcher, Manager, Rapidan River Farm, Box 45, Lignum, Virginia)</td>
<td></td>
</tr>
<tr>
<td>TECHNOLOGY IN THE HORSE BREEDING INDUSTRY</td>
<td>81</td>
</tr>
<tr>
<td>(Mr. Steven Jennings, Leesburg, Virginia)</td>
<td></td>
</tr>
<tr>
<td>WHY YOU NEED AN AGENT</td>
<td>95</td>
</tr>
<tr>
<td>(Mr. M. Tyson Gilpin, P. O. Box 207, Boyce, Virginia)</td>
<td></td>
</tr>
<tr>
<td>MARKETING HORSES AT AUCTION</td>
<td>104</td>
</tr>
<tr>
<td>(Mr. Mike Jennings, Professional Auction Services, Inc., Leesburg, Virginia)</td>
<td></td>
</tr>
</tbody>
</table>
APPLIED GENETICS AND HORSE BREEDING

Dr. Elizabeth A. Tolley, Research Associate
Animal Science Department, N.C. State University, Raleigh

In recent years the genetic principles for improvement of livestock have been applied extensively to the breeding of nearly every livestock species – except the horse. However, improving the performance of horses through breeding may be accomplished if the breeder understands and applies a few basic practices.

When an animal breeder or geneticist is approached about discussing genetics with a group of producers, he (or she) inwardly cringes. He realizes that, unfortunately, most people are intimidated by the biology and statistics behind the genetic principles and, therefore, think genetics is difficult. However, genetics has a great deal of practical importance and dollar value. And on an applied basis, genetics involves the logical application of a few simple concepts. Since recently there is an effort to research genetics in the horse, it is essential that producers understand the vocabulary of genetics to be able to apply the results of this research to their breeding programs.

The body of each of our animals is made up of millions of cells. Most of the outer part of the cell is a material called cytoplasm. At the center of each cell is a nucleus. It is the nucleus which contains the hereditary material on thread-like bodies called chromosomes. We call the hereditary material genes. Each chromosome is made up of many genes.

The genes control the thousands of biochemical reactions in an animal’s body. These reactions determine all the body processes: what the animal will look like, how large it will grow, how it behaves and performs.

We refer to the description of an animal’s appearance or performance as its phenotype. The genotype is what we call the genes that determine the phenotype.

An individual’s genes come from its parents and are unchanged after conception. These genes determine the phenotype. However, non-genetic factors may also determine what the individual looks like. Generally, these are environmental factors such as nutrition, training or diseases. The environment can change the appearance or expression of the genes. Therefore, the phenotype is determined by both the genotype and the environment.

Let us examine how genes are passed from one generation to the next. A horse has 32 pairs of chromosomes (64 total chromosomes) in each cell. However, an individual will pass (transmit) only one chromosome of each pair to its offspring through its sex cells, the sperm or egg. Only one gene of each pair is
transmitted to the offspring. Which gene of each pair the progeny receives depends on chance.

This process, called segregation, is why we say that an individual receives a random half of its sire's genes plus another random half of its dam's genes. In the offspring the genes from the sire and dam are recombined to form a uniquely new individual or progeny. The segregation and recombination of genes is the subject of most basic genetic courses.

Genes are expressed in the phenotype (and genotype) by different types of gene action. This means that genes act differently when they are alone or in various combinations. The effect of genes acting alone is called additive gene action. Dominance and various interactions are the causes of non-additive gene action. Therefore, genes are not expressed the same way in two different individuals. This results in phenotypic variation.

In animal genetics we are concerned with two types of inheritance — qualitative and quantitative. Qualitative traits are the result of one or a few pairs of genes. Phenotypes are easily distinguished. Examples include the inheritance of coat colors, abnormalities and blood proteins.

Quantitative traits are produced as the result of a large number of gene pairs. Most quantitative traits are measurable, such as height at withers, racing ability, cutting ability, conformation and strength.

In a large population (group), the graph of the frequencies for measures of a given trait tend to resemble a bell-shaped curve. The shape of this phenotypic distribution curve is determined by the frequencies of various genes in the specific population. For example, genes for high rates of speed occur more frequently in Thoroughbreds than in other breeds.

The environment affects the expression of quantitative traits more than qualitative traits. Therefore, the phenotypic distribution of measurements is different from the genotypic (or breeding value) distribution of the trait.

We measure quantitative traits so that we can compare individuals on a standard basis. After making comparisons, we breeders select those individuals which are superior to be the parents of the next generation. The average superiority of the selected parents is called the selection differential or selection differential.

This brings us to one of the most important concepts in animal breeding — heritability. Remember heredity and environment determine phenotypes. Genotypes are affected by several types of gene action.
Heritability is that portion of genotypic variation (the distribution curve) in a population that is determined by the additive action of genes. The higher the heritability the greater proportion of phenotypic variation is due to heredity. Heritabilities are estimated by how much more relatives resemble each other than the average member of the population does. A few heritability estimates for horses are presented.

Only the superiority of the parents resulting from genes can be transmitted (passed) to the offspring. Superiority due to being raised in a favorable environment is not passed to the next generation. A heritability estimate tells a breeder how much improvement in his herd he can expect to achieve by selecting superior parents.

If the heritability is high, the accuracy of selection is high. If heritability is low, he should improve some aspects of the environment. In other words low heritabilities say that management practices mean more to success than genetic differences of the horse being compared.

A breeder uses selection methods to find individuals with desirable genes and attempts to concentrate these desirable genes in his herd. Individuals with undesirable genes are culled.

Individuals superior for a particular trait have higher breeding values than other individuals in the population. The breeding value (a measure of the genotype) is predicted by the product of the heritability and the individual's selection differential.

The genetic progress that can be made in one generation of selection is the product of the heritability and the selection differential of the parents. To obtain the yearly genetic progress, we must divide the genetic progress by the generation interval. The generation interval is the average age of the parents when they produce offspring. This age is approximately 10 years for horses.

The heritability of the trait, the selection differential and the generation interval all affect the rate at which we can make genetic progress. Of these, the selection differential is the one most easily controlled by the breeder. Heritability does not usually change and it is difficult to lower the generation interval.

In horse breeding, we are often interested in more than one trait. We may wish to consider several traits in selecting parents. Generally if we select for more than one trait the genetic progress will be lowered to \(1/\sqrt{n}\) of the amount that could have been made by selecting for only one trait. \(n\) equal to the number of traits under selection.
Genetic correlation may be important with multiple trait selection. A genetic correlation occurs when certain traits are frequently present together in members of a population. Correlations may be negative as well as positive. For instance, the gray coat color gene appears to be associated frequently with the occurrence of melanoma in horses.

There are several selection methods available to the producer. If he only uses the individual's type or performance in comparison to others, he is using mass selection. Mass selection should be used only with highly heritable traits. Use of the performance and type of ancestors is pedigree selection. This method is often used with selection of young stock. This method is easily overemphasized by horse breeders. Selection of parents based on the performance of their offspring is progeny testing. Because this method is time-consuming and expensive, it is usually reserved for stallions. Sib-testing uses the records of half and full brothers and sisters. Family selection includes the records of all relatives. A successful breeder uses a combination of all selection methods in choosing parents and planning matings.

When a breeder is selecting for more than one trait, selection becomes much more complicated. Independent culling levels, tandem culling or selection indices replace simple mass selection. The effectiveness of selection is reduced as we increase the number of traits.

After selecting parents, a breeder must plan his mating scheme. Mating systems are categorized into three groups: (1) random mating, (2) mating based on phenotypic resemblance and (3) mating based on relationships of parents.

Negative assortive mating or "corrective mating" is probably used frequently by breeders. Producers often breed a mare with a good breeding value to a particular superior stallion because he has strong points where she is weak. Race horse breeders practice positive assortive mating when they mate two very fast parents.

Because inbreeding tends to increase the incidence of defects and reduces the vitality of offspring, breeders rarely practice this method of breeding. However, linebreeding, a special form of inbreeding, is often used to keep the relationship high between an offspring and a particular outstanding ancestor. Many Arabian breeders have practiced linebreeding for several generations to Raffles. Since linebreeding can have the same detrimental effects as inbreeding, breeders should take care in using this practice.

Outbreeding mating systems, in which individuals from separate lines are crossed, can produce heterosis or hybrid
vigor. Heterosis means that the offspring perform better than the average of the parents.

Since most horses are purebreds, crossbreeding is of limited importance in horse breeding. A notable exception is the modern Quarter Horse which has recently received a large infusion of Thoroughbred breeding. This crossing has altered the type as well as the performance abilities of the Quarter Horse.

Improving the quantitative traits of our horse herds can be profitable. However, it requires that the breeder expend time, effort and money. To be successful, we must be able to complete two steps: (1) distinguish individuals possessing superiority due to heredity (rather than environment) and (2) combine these individuals effectively in a mating scheme.

One of the problems which must be minimized is avoiding confusion of genetic and environmental variation. There are a few ways we can minimize this problem (adapted from J. F. Lasley):

1. **Use accurate records for selection purposes.** Make a list of those goals which are important. Keep some system of records on each important trait. Remember a lifetime of good records is better than one outstanding record and several mediocre ones.

2. **Compare horses in the same environment.** Give all individuals a fair chance to prove themselves. Playing "favorites" with feed or training increases the probability of confusing environmental superiority with genetic superiority.

3. **Don't directly compare individuals from different farms.** More of the difference between individuals on different farms is due to environment. Comparisons of horses from different farms can be made if we remember environmental differences.

4. **Select the best horses from the best families.** Cost may enter the picture here. We need to remember our goals. Realistically, we must answer the question whether we can more cheaply and more quickly breed or purchase superior stock. We are more likely to choose a genetically superior horse if it comes from a superior family. It has a greater chance of having desirable genes. A superior animal from an average family is often a lucky combination of genes and unlikely to pass the superiority to its offspring.

5. **Select for a few highly heritable traits.** Improve your management practices for those traits which are lowly
heritable, such as reproduction. Breeding goals are important here, too. Choose those traits which have economic importance to your breeding enterprise.

References


Harvey, W. R. How to select and mate parents. Mimeograph: Ohio State University.


My charge this evening is to outline to you the normal patterns of reproduction in horses. Later in this conference, my more learned colleagues will discuss with you techniques and management procedures which will enhance the efficiency of these reproductive processes.

Stallion Reproduction

The reproductive organs consist of two testes, each suspended by spermatic cords, two epididymides and deferent ducts, paired vasicular glands, a prostate and paired bulbo urethral glands and the penis (figure 1). The testes produce the sperm cells in their seminiferous tubules. The sperm move into the epididymus where they mature and are stored. Sperm entering the head of the epididymus are infertile whereas those leaving the tail segment are fertile. At the time of breeding the sperm are carried up the deferent ducts to the urethral penis by muscular contractions. The sperm are mixed with secretions from the accessory glands and expelled through the penis at the time of ejaculation. In addition to sperm cell production, the testes are also the site of production of the male gonadal (sex) hormones, primarily testosterone. The Leydig cells in the interstitial tissue within the testes manufacture and secrete these gonadal hormones.
Hormonal control of male reproduction involves the hypothalamus, pituitary and the testicular hormones (figure 2). The hypothalamus secretes gonadotrophic releasing hormone (GnRH) into the portal circulation which carries it to the anterior pituitary (AP). The AP, stimulated by GnRH, secretes luteinizing hormone (LH) and follicle stimulating hormone (FSH) which are carried by the blood to the testes. The Leydig cells of the testes secrete testosterone in response to LH stimulation. GnRH is released in a pulsatile fashion resulting in a pulsatile discharge of LH from the AP. This in turn results in episodic bursts of testosterone release from the testes.

![Figure 2](image.png)

Pickett, 1981

There seems to be a constant basal level of these hormones in the circulation with periodic sharp increases as described above. Testosterone reaches the hypothalamus and pituitary via the circulatory system. When the testosterone concentration reaches a certain level, it feeds back on the hypothalamus and AP to reduce GnRH release and also responsiveness of the AP to GnRH. When testosterone levels subsequently drops, the feed back control is removed and GnRH is again released, LH stimulated and testosterone production increased. Testosterone is essential for sperm production, accessory gland function and male sexual behavior (libido).
In the prepuberal stallion, the AP sensitivity to testosterone is high and inhibits release of sufficient LH and FSH to stimulate the testes to produce sperm or testosterone in functional amounts. As the stallion reaches puberty around 18-24 months of age, the AP loses its high sensitivity and the release of LH and FSH increases until the normal function of the testes is established.

A number of factors affect the reproductive performance of the stallion. Age has a definite effect on the quantity of semen produced and consequently the number of mares that can be bred (Table 1). Younger stallions cannot be bred to as many mares as older stallions.

<table>
<thead>
<tr>
<th>Effect of Age on Seminal Characteristics of Stallions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
</tr>
<tr>
<td>-------------------------------</td>
</tr>
<tr>
<td>Seminal volume, ml</td>
</tr>
<tr>
<td>Total no. sperm, $10^9$</td>
</tr>
<tr>
<td>Motility, %</td>
</tr>
</tbody>
</table>

Pickett, 1981

Both semen production and libido (testosterone production) are affected by season. Total sperm per ejaculate ranges from 10 billion in January to 22 billion in July. Seminal volume ranged from 45 ml in January to 104 ml in June. Testosterone levels declined from a peak in May to low levels in December and January. These changes must be considered when breeding in late winter and early spring. You may be working with only "half a stallion" in February.

How often the stallion is bred or collected also has an effect on sperm cell concentration and total number of sperm ejaculated. Research indicates that stallions used once a week or every other day produce about the same number of sperm per ejaculate. However, ejaculates from stallions used every day contained half the number of sperm compared to those used every other day. For normal mature stallions this frequency would not adversely affect fertility provided libido is adequate. As a rule, 500 million motile sperm should be deposited either naturally or artificially for maximum fertilization rates.

There is a tremendous amount of individual variation among stallions in both sperm output and libido or sex drive. These two factors determine how many mares can be bred to a stallion. The stallion owner or manager must determine that particular horse's capabilities and book him accordingly.
Reproduction in the Mare

The reproductive track of the mare (figure 3) is basically a tubular structure with two ovaries attached. The anterior end is forked, two uterine horns joining to form the uterine body. The cervix separates the uterus from the vaginal area which terminates at the vulva, the external opening posteriorally. The ovaries are connected to the tips of the uterine horns by the oviducts. The ovaries, female gonades, produce the ovum (eggs) as well as several types of hormones, estrogens and progesterons. The uterus serves as an incubator for the prenatal development of the fetus. The cervix functions to seal off the uterus during pregnancy. The vagina, and the cervix, are sites of semen deposition during mating.

The Estrous Cycle. The mare is classified as being seasonally polyestrus in her reproductive pattern. The normal mare exhibiting periods of estrus or sexual receptivity cyclically during a restricted period of the year or the breeding season. The age at puberty (first ovulatory cycle) varies from 12 to 24 months, depending on time of birth and plane of nutrition. The length of the cycle is about 20-22 days with a range of 18 to 24 days considered normal. The length of the cycle is measured from the interval between ovulations. The
cycle can be divided into two basic phases, an estrous or follicular phase and a diestrous or luteal phase (figure 4). Estrus is characterized by the rapid growth of ovarian follicles, a period of sexual receptivity and ovulation. The length of estrus is approximately 5 to 7 days. From a management standpoint, these phases are determined by "teasing" the mare usually every other day until she exhibits receptivity to the stallion. The actual time of ovulation during estrus has normally been determined by palpation of the follicle on the ovary until it ruptures. Alternative methods of determining the time of ovulation will be discussed later on in our conference. Diestrus is 14-15 days in length. During this phase the mare is not receptive to the stallion and the reproductive tract is preparing for a possible pregnancy under the influence of progesterone from the corpus luteum (CL). The cycles are erratic in length early and late in the breeding season. Ovulation may not occur during these early and late cycles.

Hormonal Control of the Estrous Cycle. The control of the estrous cycle involves a complex series of neural and hormonal interactions. The initiation of the breeding season is stimulated by the increasing amount of daylight which occurs in the early spring. This increase in light is reflected through the eye to the pineal gland via the optic nerve. The pineal gland in the brain gradually reduces its secretion of the hormone melatonin which has been inhibiting the release of the hormone GnRH from the hypothalamus in the base of the brain. The pituitary gland is then stimulated by GnRH to secrete the gonadotrophic hormones, FSH and LH which in turn control follicular development, ovulation and CL formation in the ovaries. FSH controls follicular development and estrogen production while LH is involved in ovulation, CL formation and progesterone secretion.

Ovarian function and blood hormone concentrations are shown in figure 4 during a normal 21 day estrous cycle. Starting on day 2 of the cycle (Day 0 = ovulation) FSH is elevated and follicle growth is stimulated. LH and estrogen levels are declining. These follicles do not mature since LH remains low. Around day 10 FSH peaks again, stimulating another group of follicles to develop. These follicles start producing estrogen in increasing amounts around day 14. By day 16 estrogen levels have reached the threshold for behavioral estrus and the mare exhibits estrus or heat ("in season"). The high estrogen level stimulates a surge of LH from pituitary gland. LH causes further development of one follicle and ovulation of that follicle, releasing the ovum (egg). Estrogen levels then decline rapidly and the mare goes out of heat 24-48 hours after ovulation. The ovulated follicle transforms into a CL and begins secreting progesterone by day 2 all under the influence of LH. Progesterone peaks at day 6 and remains high until day 14 or 15. At this time if the mare has not conceived, prostaglandin (PGF2α) is secreted from the uterus and causes rapid breakdown of the CL and decreased progesterone levels. The
Diagram of follicular development and ovulation in the mare in relationship to serum concentrations of gonadotropin hormones (FSH and LH) and estradiol during the normal 21-day estrous cycle. The vertical arrows represent ovulation and the horizontal bars indicate estrous behavior. Day 0 = day of ovulation. The concentration of estradiol is not given because of the differing results reported in the literature from the various assays used. However, the fluctuation of estradiol concentration within each assay corresponds to the indicated curve. (Adapted from references 10, 11, and 15.)

Diagram of corpus luteum development and regression in the mare in relationship to serum concentrations of progesterone and PGF₂₀ during the normal 21-day estrous cycle. The vertical arrows represent ovulation and the horizontal bars indicate estrous behavior. Day 0 = day of ovulation. The concentrations of PGF₂₀ are not given due to the significant variation in concentrations between mares. (Adapted from references 25 and 26.)

Neely, 1983
absence of significant levels of progesterone allows the increasing levels of estrogen to initiate the next estrous period and subsequent surge of LH. Progesterone has a negative feedback effect on LH release while estrogen has a positive effect. The estrous cycles continue in this manner throughout the breeding season or until the mare conceives.

Conception and Gestation

As indicated above, the complex hormonal interactions of the estrous cycle do a good job in most cases of synchronizing sexual receptivity with ovulation in the mare. This obviously enhances the chances of conception since mating and sperm deposition can only occur near the time of ovulation. This is critical since the viability of both the egg and the sperm are quite limited. Lifespan of the ovum probably is only 6-12 hours. Stallion sperm are estimated to be viable for 2 days with a range from a few hours to six to seven days. This area has not been studied extensively in horses. In practice we recommend breeding the mare daily or every other day during estrus to insure that viable sperm are present when ovulation occurs. How often the mare is bred depends on the fertility level of the stallion and the number of mares he is breeding at the time. Palpation of the ovarian follicle can also assist in proper timing of the breeding and reduce the number of services required.

Fertilization takes place in the oviduct. The fertilized ovum is in the blastocyst stage when it enters the uterus 6 days after ovulation. Unfertilized ovum do not reach the uterus. The embryonic vesicle can be palpated per rectum by 17-19 days after ovulation. Nutritional support for the developing embryo is from the yolk sac for 35-40 days and from uterine secretions, or "histotrophs." Uterine secretions are progesterone dependent. The allantochorionic placenta (A-CP) is established by day 35. Cells from the conceptus invade the endometrium to form the endometrial cups in the uterus around day 38 to 40. By day 45 villi appear on the A-CP that will eventually interdigitate with cripts in the uterine lining (Figure 5).

Endocrine control in gestation is diagrammed in figure 5. Progesterone secreted from the initial CL peaks at day 25 and continues until about day 180. The prolonged life of the CL results from the inhibition of PGF2α secretion due to the presence of the embryo. Secondary CL's are formed around day 20 and are stimulated to produce progesterone by the hormone pregnant mares serum (PMSG) secreted by the uterine endometrial cups. PMSG is active from day 30 until day 150. The placental membranes begin producing progesterone at day 60 and are the major source after day 150. The ovaries are no longer needed for pregnancy. Progestogens continue to increase until parturition. Estrogens of placental origin gradually increase until 210 days and then decline to parturition.

The duration of gestation is about 335-340 days. There is however a great deal of variation; 305-400 day gestations producing normal foals have been reported.
Fetal development is slow during the first two-thirds of gestation. Two-thirds of the fetal growth occurs in the last 100 days. This has significance on the management of pregnant mares.

Pregnancy Detection

Rectal palpation of the uterus is the most commonly used procedure. It is quite accurate after 25 to 30 days. Skilled examiners can be fairly confident at 18 to 20 days. There are several immunologic tests that have been developed to detect PMSG in mares blood from day 40 to 120 of gestation. Fetal loses after day 36-40 can result in false positive indications. Rectal palpation at 40 days however is very accurate, economical and fast. Recently ultrasound instruments have been used to detect pregnancies. Pregnancies should be confirmed around 90 to 100 days.

Parturition is the final step in the reproductive process. It occurs around 335 to 340 days or approximately eleven months from the time of fertilization. In reality, gestation may last from 330 to over a year. The mare as usual is quite variable.

The first visible indication of parturition is the gradual development of the udder or mammary glands around one month prior to the event. The major development occurring in the last two weeks. The udder will be fully distended including the teats 24 to 48 hours before foaling. Secretion of wax like material from the teats occurs in the last 24 hours, normally. Over the last few days, there is a noticeable relaxing of the muscles and ligaments around the tail head.
Just prior to foaling, the vulva becomes elongated and relaxed. The mare prefers solitude and quiet at foaling and usually foals at night.

The hormonal control of parturition has been fairly well established in cattle, sheep and swine but that in the mare remains a mystery today. Rising PGF₂α and oxytocin levels have been observed after parturition has started. What triggers the onset is unknown.

The foaling process can be divided into three stages. Stage one is the early uterine muscle activity and movement of the foal into the birth position. The cervix dilates during this stage. The normal mare (there are not many of these) will have increasing signs of uneasiness and restlessness. There are no signs of straining yet. As stage I terminates, the cervix is dilated, the foal is pushed into the birth canal by the uterine contractions and the outer fetal membrane breaks. Stage II is characterized by strong contractions of the abdominal muscles. The transparent, bluish amnionic membrane appears at the vulva and the mare lays down. Powerful contractions occur at this time as the head passes through the pelvis. The amnion is broken and one foreleg appears followed by the other. The nose lies on the knees. Contraction continues until the hips clear the vagina. Stage II normally lasts about 20 minutes. The mare will rest at this point. The membranes should be cleared from the foal's head and both foal and mare left alone. The umbilical cord should remain intact until the mare or foal breaks it by struggling and/or getting to their feet. Do not break the cord. The membranes contain up to one liter of the foal's blood and this needs to flow to the foal. Stage III is the expulsion of the fetal membranes by contractions of the uterine muscle.

The foal should be on its feet and nursing within two to three hours. The foal must consume the colostrum within 12-14 hours after foaling to get the antibodies needed for immunity. The intestine of the foal cannot absorb antibodies after 24 hours. The mare and foal need peace and quiet now.

This is how the reproductive process in the horse is supposed to work. Nature did a magnificent job of engineering these many complex and interacting events without any help from us. Our job is to understand the process and provide the necessary management and environment to allow it to succeed. We must remember that we are not essential. Horses did it by themselves for about 50 million years.
INTRODUCTION: Acute Equine Diarrhea Syndrome (AEDS) is also known as Potomac Fever, and Potomac Horse Fever. This is a preliminary report on a newly identified disease entity seen in Maryland, Virginia and Pennsylvania. The summer of 1983 was the fifth year that AEDS has been recognized in Maryland with the majority of cases located in Montgomery County. Since the veterinary profession is still "pioneering" with AEDS many important questions remain unanswered.

This report is oriented to findings in Maryland and doesn't attempt to report or interpret the Potomac Horse Fever situation in other states.

DEFINITION: An acute disease entity of horses characterized by loss of appetite, depression, fever, low white blood cell count, explosive diarrhea, dehydration and terminal shock. Veterinary science has circumstantiated evidence that this is a "specific" disease of horses and ponies with a spectrum of clinical signs. The severity of clinical signs varies to transient fever, depression without diarrhea to shock, diarrhea and death.

CAUSATIVE AGENT: As of this writing the causative agent has not been identified. Several viruses have been isolated from AEDS cases; however, none have been shown to be the causative agent of this disease entity. The disease can be transmitted from natural cases to normal horses and ponies using whole blood. The incubation period between

*Authors' address: 50 Harry S. Truman Parkway, Annapolis, MD 21401
time of inoculation and development of fever and lowered white blood cell count varies from 8 to 15 days based on limited studies.

**CLINICAL SIGNS:** A typical case of A.E.D.S. would follow this sequence. On Tuesday evening animal would be off feed but would finally eat after an unusual delay. On Wednesday would refuse feed, be depressed and have a fever (102 - 102.5 degrees F). Wednesday evening a veterinarian would be called to see the sick animal. Sounds indicating hyper activity in the gut would be very evident, and the white blood cell count would be markedly low 4,000 - 5,000 cells per milliliter of blood. On Thursday an acute "explosive" watery type diarrhea would be evident. In approximately 20% of the cases of A.E.D.S. founder (laminitis) has appeared usually in 3-4 days following the acute episode. Fecal consistency may be normal at the initial examination, but the patient often develops diarrhea within the following 24-48 hours. Diarrhea is a common occurrence but does not occur in all cases. The diarrhea can be profuse, "pipe stream" in character with a duration of 24 hours to 10 days. In some horses the diarrhea may be less profuse and transient, in others no diarrhea occurs. Colic variable severity (mild abdominal pain or crampiness to severe intense pain resembling a "surgical" colic) occurs in a small proportion of horses. Most horses that have colic also develop moderately severe diarrhea and seem to have a higher incidence of founder than other affected horses. Founder occurs in 20-30% of the cases, the onset usually occurs within 3 days of the initial diarrhea. Three cases with founder that survived (avoiding death or euthanasia); involved months of difficulty
for the horse and owner. In the 60-70% of the horses that survive Potomac Horse Fever, recovery is usually complete, with the horse returning to its former performance level.

LABORATORY FINDINGS: Notable laboratory findings nearly always include a very depressed white blood count. Fecal analysis has been negative for certain parasites, and, more notably, for Salmonella species.

EPIDEMIOLOGICAL OBSERVATIONS: Anecdotal history in Maryland revealed in 1979, 1980 and 1981 that most cases were seen within a mile or two of the Potomac River in a geographical strip approximately six miles long. In the summer of 1982 closer observations disclosed that early cases (May and June) were "along the river" but as the summer progressed cases were seen in the uplands of Montgomery County, Maryland. Several cases were also recorded in adjacent Maryland counties, namely Frederick and Howard, up to a distance approximately 20 miles from the Potomac River. Cases were reported as follows: June 11, July 23, August 47, September 21, October 5. Among these 113 cases, 28 died or were euthanized. They occurred on 51 premises. In the summer of 1983 116 cases of AEDS were reported, among these 42 died or were euthanized for humane reasons. These cases occurred on 75 farms in Maryland. With the exception of one case each in Carroll, Frederick and Howard counties, all cases have been in Montgomery County. Cases reported in 1983 were: May 1, June 8, July 67, August 25, September 11, October 2, and November 2. Again, geographically in Montgomery County many cases were located along the Potomac River and as the summer progressed, cases were reported in areas away from the river.
Pastures on several affected premises were inspected for poisonous plants. Several kinds of poisonous plants were present; however, it was evident that such plants were not being eaten by horses. All ages and breeds of horses appear to be susceptible to this disease. So far this disease has only been reported in the summer and fall in the states of Maryland, Pennsylvania and Virginia, but is likely to occur throughout the country.

It has been reported that recovered horses do not have recurrences when "exposed" in subsequent summers. While it cannot be conclusively stated that it is not contagious, it would seem that it is not highly contagious as reflected in the low attack rate among horses at risk. A.E.D.S. appears similar to Colitis X, but the mortality rate is much higher with Colitis X.

**AUTOPSY FINDINGS:** Inflammation of the lower gastro-intestinal tract is notable and is most severe in the areas of the caecum and colon. A breakdown of the vascular system is seen as inflammation of both small blood vessels - both arteries and veins. Many small widely dispersed blood clots (Thrombi) are seen.

**TREATMENT:** Since the cause of A.E.D.S. has not been identified specific treatment directed at the cause can not be carried out. The next best thing is to direct treatment against the disease signs of severe diarrhea and dehydration, thus digestive tract protective medications are given. Also large volumes of fluids are administered intravenously to combat the dehydration.

**PERSPECTIVE:** Investigations as to the cause and characteristics of A.E.D.S. were not really formalized until the summer of 1982, then
limited epidemiological studies were done, however further investiga­tions and studies are needed. Certain studies have revealed the presence of a virus, however it is not conclusive that the virus is the causative agent or that it is often found within the horse population and that its present is simply identified due to intense scrutiny.

The bacterium, Salmonella, often a cause of a disease problem involving diarrhea has not been identified even though three different laboratories have investigated the possibility of Salmonellosis.

It remains that investigations so far have not found a "common thread" that "is woven" into enough of these cases to identify the cause and to thus "open the door" to prevention or specific treatments to cure A.E.D.S.

Pioneering is often difficult and this is borne out with "Potomac Fever". Meanwhile, field investigation and research work need to be pursued to solve the problem of Potomac Horse Fever.

ACKNOWLEDGEMENTS: The principal scientific investigations have been a cooperative effort by: Equine Practitioners (EP) in Montgomery County, Maryland; The Maryland Department of Agriculture (MDA), Animal Health Section; The University of Pennsylvania (New Bolton Center); The Virginia-Maryland Regional College of Veterinary Medicine (VMRCVM); and The U.S. Department of Agriculture (USDA) National Veterinary services Laboratory. The author thanks the following scientists for their efforts in these investigations: C. Anderson, E. Gard, E. Gaughan, H. Holbrook, R. Scullin, P. Radue, J. Magurn, H. Larson (EP), J. Davidson, J. Huang, E. Sacchi, W. Shipley, J. Shcok, S. Joseph (MDA), R. Whitlock, J. Palmer (U of PA), S. Dutta, B. Perry, F. Troutt (VMRCVM), and A. Jenny (USDA).
FEEDING THE STALLION, THE BROOD MARE AND THE GROWING HORSE
Michael S. Hand, D.V.M., N.C. State University

Introduction

When done properly, formulating an equine ration is relatively simple because it involves:

1) no magic or witchcraft
2) only an average amount of basic nutritional knowledge and common sense
3) minimal supplementation.

The horse is much more easily nourished than many owners would like to believe. Some of the most successful breeding and rearing farms use rations based on good quality roughage, supplemented with simple grain and mineral mixes, when necessary. These basic, natural rations meet every nutritional requirement of the horse, and avoid excesses as well as deficiencies. This point is further emphasized when we redefine two seemingly obvious nutritional terms:

a) malnutrition - abnormal nutrition
b) balanced ration - one which provides the proper amounts and proportions of all the required nutrients.

Notice that the term "malnutrition" would include overfeeding as well as underfeeding. Notice also that the term "balanced ration" excludes overfeeding as well as underfeeding. In fact, overnutrition is currently much more of a problem in our companion animal population (including the horse) than is undernutrition.

If we avoided the practice of overfeeding with the same fervor we discourage underfeeding, our horses, dogs and cats would surely be healthier and longer lived. The utility of the horse depends upon a sound musculoskeletal system. Proper nutrition (avoidance of under and overnutrition) can have a significant influence on the durability of the equine musculoskeletal system.

Much of the material provided herein was adapted from veterinary class notes written by Dr. Lon D. Lewis, and has been included with his permission. More extensive information about equine nutrition may be obtained from his book, "Feeding and Care of the Horse," published by Lea and Febiger. If this book is purchased through the American Quarter Horse Association (2736 West 10th Avenue, Amarillo, Texas 79168, 806-376-4811), five dollars of the purchase price is donated to equine research. The selling price is essentially the same whether purchased from the publisher or the AQHA.

Nutrition in General:

Feeds are parcels of nutrients, and in a sense, nutrients are what we are made of. The basic function of nutrients are:

\[
\begin{align*}
\text{a) to provide heat to maintain body temperature} \\
\text{b) to provide energy for essential body processes} \\
\text{c) to repair worn out tissues}
\end{align*}
\]
production (d) for growth and increase in weight
production (e) for the production of offspring
production (f) for the production of milk and work

The first three functions are termed maintenance functions. When feedstuffs are consumed, these requirements are satisfied first. If feedstuffs are eaten in amounts greater than the maintenance requirements, production can occur. The last three functions represent production. A horse might be involved in one or several of these productive endeavors simultaneously. The availability of nutrients for production (in excess of maintenance requirements) can, and often does, limit production.

The major nutrients of concern for the horse include:

1) H₂O
2) trace mineralized salt
3) energy
4) protein
5) calcium and phosphorus
6) Vitamin A

Water: Generally speaking, horses and other large animals require 1 gal H₂O/100 lb body wt/day. This can vary tremendously due to factors such as environmental temperature and humidity, stage of production (lactation or work) and type of feed. Therefore it is best to always have good quality water available free choice except if the horse is hot, following exercise. In the case of the hot horse, allow R & R (rest and roughage) for 30-90 minutes before watering. During exercise, encourage as much water intake as possible. Grain can be fed after watering.

Trace mineralized salt:

The feeding of trace mineralized salt and is good low cost insurance. It can be offered in either loose or block form. It contains: NaCl (salt), zinc, manganese, iron, copper, cobalt, and iodine; but contains no calcium or phosphorus. Like water, trace-mineralized salt should also be fed free choice. The soils of certain areas of the country, may be deficient in specific minerals (e.g., selenium). Your local veterinarian or nutritionist should be contacted about specific trace mineral supplementation.

The nutrients remaining are: energy, protein, calcium and phosphorus, and vitamin A. Therefore, we need only be concerned about balancing these nutrients unless in a specific area as previously stated (e.g., selenium).

Energy:

Approximately 50-70% of the feed ingested is utilized to meet the animal's energy requirements. There are three sources of energy in feeds: a) carbohydrates, b) fats, and c) proteins.

Carbohydrates are sugars, starches and cellulose. In a feed analysis, sugars and starches are called the nitrogen free extract (NFE). They are
readily utilized and provide most of the horse's energy. The crude fiber part of an analysis is made up primarily of cellulose. It is difficult to digest and is less well utilized as an energy source. Much of it ends up in the manure. Therefore, the higher the fiber content of a feed, the lower the amount of energy the feed will provide.

Fats are an excellent energy source. They provide over twice (2.25x's) the energy of an equivalent weight of carbohydrate or protein. They are readily utilized, but should be limited to 16% of the total ration or 30% of the concentrate. Excess dietary fat can result in decreased palatability and loose stools. In the feed analysis fats are called the ether extract. They are also referred to as lipids or oils. Fats, especially plant or vegetable oils, are believed to improve glossiness of the hair coat and may help the horse shed off in the spring. Many coat conditioners contain fats. The same effect can be achieved by adding 1-2 ounces of cooking oil to the horse's ration twice daily. It is much less expensive. Besides being an energy source, fats have important structural functions as well.

Dietary and stored protein can be used for energy if there is inadequate intake of carbohydrates and fats, or if excess protein is ingested. It can even be converted to sugars or fat.

Energy is measured in:

1) Kcal = the amount of heat necessary to raise the temperature of 1 liter of water from 14.5° to 15.5°C.

2) TON (total digestible nutrients) = 1 lb of TON equals approximately 2000 Kcal of digestible energy. TON is calculated by multiplying the percentage of the energy nutrients in a feed by their digestibility, and then summing them, as follows:

% nitrogen-free extract x % digestibility =
+ % crude protein x % digestibility =
+ % crude fiber x % digestibility =
+ % crude fat x 2.25 x % digestibility =———

Total % TON

In general, animals will eat the amount of feed needed to meet their energy requirements if the feed is available and their gastrointestinal tract will hold that amount. The maximum amount of dry matter (that portion of a feed that is left after the water is removed) that a mature horse can eat is approximately 3% of its body weight/day. Therefore, a 1000 lb horse could eat 30 lb of dry matter/day. In certain stages of production, a horse simply cannot physically eat enough hay to meet its energy requirements. When this happens, a portion of the hay in the ration is replaced by a feed of greater energy density such as grains or other concentrates. See Table 1 for specific energy requirements based on stage of production. It is important for the horseman to be aware of the different weights of feeds. For example:

1 quart (1 lb coffee can) = 1 lb oats
1.5 lb corn
.5 lb bran
Once the weight of a feed is established, it can accurately be fed by volume. It is also important to know the weight of the horse being fed. An experienced eye, a horse-weight tape or a good scale can be used. In most instances, the latter two are more reliable. In the final analysis, the horse still must be fed as an individual. Table 1 is only a guideline.

Protein:

Animals are approximately 20% protein. Proteins function structurally (muscle, tendon and bone) but also function to direct and speed up chemical reactions in the body (hormones and enzymes). Dietary protein is used in the horse for tissue replacement (maintenance) and the building of new tissue (pregnancy, lactation and growth).

Proteins are long chains of amino acids. Some amino acids can be manufactured by the body and some cannot. Those that cannot are called essential and must be included in the diet or a deficiency of certain body proteins may result. The clinical signs that develop as a result of these deficiencies depend on the function of the protein that is lacking. There could be bone or tendon problems, or problems associated with body chemistry. The protein quality of a feed depends upon whether or not the protein in question contains all of the essential amino acids required by a given animal. In most instances we are not concerned with essential amino acid supplementation in the horse. However, in the growing horse, a greater amount of the amino acid lysine is required than is present in many feedstuffs. At least 0.65% lysine is needed in the total ration dry matter for optimum growth and development of the horse. The effects of inadequate lysine are well illustrated in the study shown in Table 3 in which (1) soybean meal, (2) cotton seed meal, and (3) cotton seed meal fortified with lysine, were used as the protein supplements in the ration. Although all three rations had an identical protein content, when cotton seed meal without additional lysine was fed, growth rate was slower and more feed was required.

The quality of protein depends upon how many of the essential amino acids it contains. Specific amino acid deficiencies can have the same limiting effect as inadequate total ration protein (see Table 1 for protein requirements). Feed intake, growth, physical activity and endurance, milk production and fetal development are all impaired if the diet is inadequate in protein.

Protein excesses are expensive. When excess protein is ingested and energy requirements are already satisfied, the protein will be converted to fat. The utilization of protein for energy generates 3-6 x's more heat than using carbohydrates or fat. This can be desirable in a cold environment. However, it can be detrimental in a warm environment coupled with exercise. Under the latter conditions, the likelihood of heat exhaustion would be increased. Feed protein correctly.

Calcium (Ca) and phosphorus (P):

Horses are more likely to suffer from a lack of Ca and/or P than any other mineral. Ca and P make up 70% of the minerals in an animal's body and most is found in bones and teeth. These two minerals provide the compressional strength
and rigidity inherent to normal bone and teeth. Bone also serves as a storehouse for these minerals because Ca and P are involved in many biochemical functions as well. These functions have priority over the mineral content of bone. When a diet is inadequate in Ca and/or P, the body will pull from the bone reserves. If the situation persists, the bone can be weakened. Therefore, Ca and P consumption must be adequate to meet the horse's requirement.

Not only is an adequate amount of Ca and P in the diet important, but so is the ratio of these two minerals. When one or the other is in significant excess (particularly P), they bind with each other and are poorly absorbed from the gut. Ratios have been determined that minimize this problem. Interestingly enough, they are approximately the same as that measured in normal bone, blood and milk (about 2-3:1). The Ca:P in an adult horse can vary from 0.8:1 to 6.0:1. The growing horse cannot tolerate this degree of variability. He requires Ca:P between 0.8:1 to 3:1. However, it is safer to use 1:1 to 6:1 in the mature horse and 1:1 to 2:1 in the rapidly growing horse (see Table 1).

Many commercial "vitamin-mineral supplements" contain inadequate amounts of Ca and P and frequently contain a multitude of other ingredients which are not known to be of benefit to the horse. Ca and P can be supplemented least expensively by using the minerals in Table 4. For Ca and P requirements, see Table 1.

Vitamins:

Vitamin A is usually the only vitamin that may be inadequate in rations routinely fed to the horse. However, even it and/or its precursor, beta carotene, are usually present in adequate quantities. The liver can store a 3-6 months supply of vitamin A. The approximate amount of beta carotene present in a forage can be judged by its green color. If the hay being fed is bleached out, feed 30 IU of vitamin A lb/day. During the last 3 months of pregnancy, during lactation, and for the weanling, twice this amount is recommended. For the yearling, 75,000 IU/day is recommended. However, feeding less than 1/2 or five times these amounts may decrease growth rate, hematocrit and blood plasma concentrations of iron, albumin and cholesterol. A vitamin A deficiency may be confirmed by finding plasma vitamin A levels of 10-20 µg/dl, or less. Again, feed according to requirements and do not overfeed.

Feeding the Stallion:

The stallion should be fed like any other mature horse for maintenance and work (see Tables 1 and 2). A problem on many farms is excessive feeding of the stallions. Stallions that receive limited exercise and are chronically overfed are prime candidates for founder. Very active stallions that pace and exercise themselves constantly should be fed to maintain their condition. This can be done with additional hay or the same grain mix that the mares receive.

Feeding the Brood Mare:

Three feeding programs are necessary for the brood mare:

1) The period between weaning and the last three months of pregnancy; 2) the last three months of pregnancy; and 3), the lactation period. There is very
little increase in fetal size during the first eight months of pregnancy. During this period (except while lactating) the pregnant mare should be fed the same as the mature horse for maintenance or work (see Tables 1 and 2). A common error is to feed excessively during this period. The mature horse needs 1.5 to 1.75 lbs. of average to good quality roughage (hay) per 100 lbs. of body weight daily for maintenance. Many roughages contain adequate quantities of all nutrients to meet the horse's requirements for maintenance. However, some roughages may be deficient in phosphorus (both alfalfa and grass hays) and some grass hays are protein deficient (Table 1). They should be supplemented accordingly.

During the last three months of pregnancy the amount of protein, calcium and phosphorus the mare requires increases at a more rapid rate than her energy needs. This is because nearly two-thirds of the growth of the fetus occurs during this time. These extra nutrients are necessary to support this level of production. Simply feeding a greater amount of a strictly maintenance ration may not provide the additional protein, calcium and phosphorus needed. Failure to provide adequate nutrition to the brood mare can lower reproductive efficiency, decrease milk production and potentiate problems for the foal. If good quality alfalfa is being fed, simply increasing the amount fed will provide the additional protein and calcium the mare requires. The additional amount of feed needed on a body weight basis is small. It is important that the 15% increase in the mare's body weight during this period is also be taken into account. The extra phosphorus that may be needed when alfalfa is fed should be provided by allowing free access to a high phosphorus salt-mineral mix as the only available salt. If the mare is on grass pasture or grass hay, generally more calcium, phosphorus, and occasionally protein are needed (see Table 1). Green grass pastures will usually have adequate protein but mature grass pastures and grass hays often will not contain enough protein for the mare at this level of production. However, if the pasture contains a mix of grass and legume, the forage is probably adequate in calcium and protein. Have a laboratory analysis done if there is any question. If protein is adequate, additional phosphorus and possibly calcium should be provided by a free choice salt-mineral mix containing approximately equal amounts of calcium and phosphorus as the sole salt source (Table 4). If grain is being fed, three ounces/day of a mineral mix containing 12% calcium and 12% phosphorus should be added to the grain. If the grain does not contain molasses, it may be necessary to wet the grain to prevent the added mineral mix from sifting out. If the forage is deficient in protein in regard to the mare's requirements, a concentrate mix similar to those in Table 5 is needed (or one can be formulated). From 0.5 to 0.75 lb/100 lb body weight/day of the concentrate mix should be fed with the amount of mature grass pasture or grass hay being fed.

Feeding the lactating mare is more critical. A common error is to underfeed her because many horse owners don't recognize the level of production in which she is involved. She requires nutritional support for maintenance as always, but has the additional burden of lactation and reproduction. The daily milk production of a lactating mare can be competitive with some dairy cows (25-30 lbs/day). Her energy needs are doubled and her protein, calcium and phosphorus requirements are increased considerably. The concept of "flushing" thinner mares during this period to maximize breeding performance is being more seriously questioned in light of some results from a recent Texas A & M study.
"Fleshy" mares had as good or better reproductive performance than thinner, flushed mares. It takes considerable amounts of feed to cause weight gains in thin lactating mares. Costs of feeds are usually higher during this time of the year. Also, potential health hazards (colic, founder) exist when feeding large amounts of concentrates. Therefore, it may be better to carry the mares into the breeding season in a moderately fleshy condition.

If good quality alfalfa is being fed, additional nutrients for this period may be provided by increasing the amount fed and by allowing free choice consumption of a high phosphorus salt-mineral mix (Table 4). Feed as much hay as the mare will eat. This means 2.5-3.0 lbs/100 lbs body weight/day. If grass is fed, increasing the amount fed as well as feeding grain will still not meet the lactating mare's protein, calcium and phosphorus requirements. Again, a concentrate mix similar to the one in Table 5 is needed or one can be formulated to specifically meet the mare's requirements. From 1-1.5 lbs/100 lbs body weight daily of the grain mix should be provided with all the grass hay she can eat. As her milk production decreases, feed intake should be decreased to maintain proper body weight. A summary of feeding programs for the lactating mare is given in Table 5.

Weaning:

Several days before weaning, stop feeding grain to the mare and decrease her hay to the amount needed for maintenance (1.5-1.75 lb/100 lbs body weight/day). This will decrease milk production and help prevent excessive distention of her mammary gland.

Feeding the Growing Horse:

In general, when feeding the growing horse from nursing to maturity, make sure there is good quality water and trace mineralized salt available free choice, always. Also, make readily available all the forage that the young horse can consume. During growth, good quality alfalfa or other legumes are preferred over grass forage if they are available at a reasonable cost and are good quality. When comparing forages, legumes contain two to three times more protein, three to six times more calcium and beta carotene (provitamin A), an equal amount of phosphorus, and several times more lysine than grass hays. All of these nutrients are needed in increased quantities for growth (Table 1). If a good quality legume hay is not available at a reasonable cost, then grass roughages should be fed and supplemented with a concentrate mix higher in protein and calcium (and possibly phosphorus). None of the natural feeds contain adequate phosphorus, and grass roughages and cereal grains do not contain adequate protein or calcium to meet the horse's requirements for growth (Table 1). Therefore, a concentrate mix must be fed that contains sufficient quantities of protein, calcium, and phosphorus supplements to make up the difference between that required and that present in the roughage. Concentrate mixes of this type are given in Table 5 or can be formulated. High lysine-containing protein supplements, such as soybean meal or animal source protein supplements are always recommended for the growing horse because of his higher lysine requirements. If lysine is inadequate, growth rate and feed efficiency are decreased (Table 3).
Three feeding programs are necessary for the growing horse to meet the differences in nutritional requirements at the different stages of growth (Table 1). These are for: 1) nursing foals; 2) weanlings; and 3), yearlings, until they reach 90% of their predicted mature weight. The mare's milk plus the pasture, hay or concentrate being fed the mare (which most foals will start nibbling by a couple of months of age) is sufficient to meet the foal's nutritional requirements during the first 2-3 months of life.

Unless the mare is not producing adequate milk, it is best not to feed the foal concentrates until it is at least two months of age. Usually after the third month of lactation, milk production and energy content of the milk are both declining while the foal's nutritional needs are increasing. This discrepancy can be managed by feeding a creep ration. Feed 0.5 to 0.75 lb of creep feed/100 lbs body weight/day. Be extremely careful about feeding free choice concentrates to the nursing foal or any other horse. If it is necessary to creep feed free choice, you may want to blend in 1/3 to 1/2 ground hay (on a weight basis) or feed a concentrate-roughage pellet.

Weaning at approximately four to five months is recommended. Later weaning causes some mares to lose condition and it becomes more difficult to properly feed the older foal while still on the mare. It has been demonstrated that some foals can be weaned at two months of age. This necessitates feeding increased amounts of concentrates at a younger age. The potential exists for over-consumption of concentrates, thereby predisposing foals to epiphysitis.

Besides all the good quality forage he wants, the weaned foal should be fed 1-1.5 lbs and the yearling 0.5 to 1 lb, per 100 lbs. body weight daily of a concentrate mix (grain plus any necessary protein and mineral supplement). A concentrate mix similar to those given in Table 5 or one can be formulated to meet the weanling's and yearling's requirements (Table 1). Continue feeding this amount until the horse reaches 90% of its anticipated mature weight (approximately 24 months). At this time, feed the same as the mature horse for maintenance or work. Be sure that at least 1 lb per 100 lbs. body weight daily of good quality roughage is also being consumed. If this amount is not being eaten, the quantity of concentrates available should be reduced until this amount of roughage is ingested. Again, feeding excessive amounts of concentrates may result in bone and tendon problems. A horse maturing at a normal rate will be a better performer and more durable athlete than one fed to accelerate the rate of growth. In addition, there will be no difference in size at maturity.
Table 1. Minimum Nutrients Needed for Maintenance and Production as Compared to those in Feeds (Dry Matter Basis)

<table>
<thead>
<tr>
<th>Required or Present in the Feed</th>
<th>Energy (% TDN)</th>
<th>% Crude Protein</th>
<th>% Calcium</th>
<th>% Phosphorus</th>
<th>% of body wt eaten/day</th>
<th>Ca:P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mature horse at rest and first 8 mo of pregnancy</td>
<td>50</td>
<td>8</td>
<td>.3</td>
<td>.2</td>
<td>1.5</td>
<td>1:1-6:1</td>
</tr>
<tr>
<td>Last 3 mo of pregnancy</td>
<td>50</td>
<td>10</td>
<td>.45</td>
<td>.35</td>
<td>1.75</td>
<td>1:1-6:1</td>
</tr>
<tr>
<td>Lactation</td>
<td>50</td>
<td>12.5</td>
<td>.45</td>
<td>.35</td>
<td>2.75</td>
<td>1:1-6:1</td>
</tr>
<tr>
<td>Nursing foal (3-5 mo) requirements above milk</td>
<td>70</td>
<td>16.0</td>
<td>.80</td>
<td>.55</td>
<td>2.75</td>
<td>1:1-2:1</td>
</tr>
<tr>
<td>Nursing foal (3-5 mo) requirements above milk</td>
<td>70</td>
<td>16.0</td>
<td>.80</td>
<td>.55</td>
<td>.75*</td>
<td></td>
</tr>
<tr>
<td>Weanling (6-12 mo)</td>
<td>52</td>
<td>14.5</td>
<td>.65</td>
<td>.45</td>
<td>3.00</td>
<td>1:1-2:1</td>
</tr>
<tr>
<td>Yearling 12-18 mo.</td>
<td>50</td>
<td>12.0</td>
<td>.50</td>
<td>.35</td>
<td>2.5</td>
<td>1:1-2:1</td>
</tr>
<tr>
<td>(18-24 mo.)</td>
<td>50</td>
<td>10.0</td>
<td>.40</td>
<td>.35</td>
<td>2.0</td>
<td>1:1-2:1</td>
</tr>
<tr>
<td>24 mo - maturity</td>
<td>55</td>
<td>9</td>
<td>.40</td>
<td>.35</td>
<td>1.75</td>
<td>1:1-2:1</td>
</tr>
<tr>
<td>Cereal grains</td>
<td>65-85</td>
<td>10-14</td>
<td>0.02-0.10</td>
<td>0.30-0.45</td>
<td>-</td>
<td>0.04:1-0.3:1</td>
</tr>
<tr>
<td>Grass</td>
<td>45-55</td>
<td>5-13</td>
<td>0.30-0.60</td>
<td>0.10-0.35</td>
<td>-</td>
<td>0.8:1-3:1</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>49-47</td>
<td>15-20</td>
<td>0.80-2.0</td>
<td>0.10-0.35</td>
<td>-</td>
<td>3:1-15:1</td>
</tr>
</tbody>
</table>

*The maximum amount of creep feed consisting entirely of concentrates that should be fed daily.
Table 2. Grain Needed for Physical Activity

<table>
<thead>
<tr>
<th>Physical Activity</th>
<th>Pounds of grain per hr. of activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light (e.g., pleasure ride)</td>
<td>0.5-1.5</td>
</tr>
<tr>
<td>Moderate (e.g., ranch work, roping cutting, barrel racing, jumping)</td>
<td>2-3</td>
</tr>
<tr>
<td>Heavy (e.g., race training, polo)</td>
<td>4 or more</td>
</tr>
</tbody>
</table>

1In addition, feed 1.5 to 1.75 lbs/100 lbs body weight daily of average or better quality hay. Adjust the amount fed as necessary to maintain optimum body weight and condition. A similar amount of grain should be fed each day based on the average amount of work performed. For example, for 2 hours of light work, 3 days a week, feed 1 lb of grain daily.

Table 3. Effect of Dietary Lysine Content on Growth of the Horse

<table>
<thead>
<tr>
<th></th>
<th>SBM(^1)</th>
<th>CSM(^1)</th>
<th>CSM + LYSINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lysine</td>
<td>0.65</td>
<td>0.49</td>
<td>0.65</td>
</tr>
<tr>
<td>Initial Wt (lbs)</td>
<td>580</td>
<td>580</td>
<td>580</td>
</tr>
<tr>
<td>Gain (lbs/day)</td>
<td>1.23</td>
<td>1.01</td>
<td>1.23</td>
</tr>
<tr>
<td>Feed Efficiency</td>
<td>12.2</td>
<td>15.5</td>
<td>12.3</td>
</tr>
</tbody>
</table>

\(^1\)Soybean meal (SBM) or cottonseed meal (CSM) used in the ration. All three rations contained the same total protein content.
Table 4. Calcium and Phosphorus Content of Mineral Supplements

<table>
<thead>
<tr>
<th>Mineral Supplements</th>
<th>% Calcium</th>
<th>% Phosphorus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biophos</td>
<td>18</td>
<td>21</td>
</tr>
<tr>
<td>Bone Meal</td>
<td>24-32</td>
<td>12-14</td>
</tr>
<tr>
<td>Dicalcium phosphate (Dical)</td>
<td>20-2</td>
<td>18-21</td>
</tr>
<tr>
<td>Limestone (calcium carbonate)</td>
<td>33-36</td>
<td>0</td>
</tr>
<tr>
<td>Monosodium or disodium phosphate (monophos, XP-4)</td>
<td>0</td>
<td>22-27</td>
</tr>
<tr>
<td>Monodicalcium phosphate</td>
<td>15-21</td>
<td>22</td>
</tr>
<tr>
<td>Rock Phosphate, defluorinated</td>
<td>29-36</td>
<td>12-18</td>
</tr>
<tr>
<td>Sodium Tripolyphosphate (phopolyphosphate, XP-4)</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Calcite</td>
<td>34</td>
<td>0</td>
</tr>
<tr>
<td>Oyster Shells</td>
<td>35-38</td>
<td>0</td>
</tr>
<tr>
<td>Gypsum (calcium sulfate = 18% sulfur)</td>
<td>22</td>
<td>0</td>
</tr>
<tr>
<td>Phosphoric Acid</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>Diammonium phosphate</td>
<td>0</td>
<td>20-23</td>
</tr>
<tr>
<td>Rock Phosphate, soft</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>Purina's 12:12 (+5% TM salt)²</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>CO-OP Perfect 36 (+12% TM salt)²</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>CO-OP Hi-Ratio (+30% TM salt)²</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>CO-OP Pro-Ten-4 (+20% TM salt)²</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>CO-OP Dairy Phos (+8% TM salt)²</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>CO-OP OP-T-MIN (+8% TM salt)²</td>
<td>8</td>
<td>16</td>
</tr>
</tbody>
</table>

¹Many of these mineral supplements are available at most feedstores but may be called names other than those given here.

²The CO-OP (Farmland Ind., Kansas City, MO 64116) and Purina (Ralston Purina Co., Checkerboard Square, St. Louis, MO 63188) minerals contain 100,000 IU of vitamin A per pound, and Purina 12:12 contains cottonseed meal and molasses to increase its palatability and consumption. There are many commercial calcium and phosphorus supplements available. These are given as examples. Their inclusion here does not indicate that they are any better or worse or are recommended as compared to other commercial supplements.
Table 5. Equine Feeding Program

All Horses: Condition desired is when the ribs aren't visible but a little fat can be felt between the ribs and skin. Always have trace mineralized salt available free choice unless a different mineral mix is given.

Stallions:

**Mares During the First 8 Months of Pregnancy and Lactation:** Feed as much alfalfa or grass, hay or pasture as needed to maintain condition. For maintenance most will need 1.5-1.75 lbs/cwt/day. Grain is needed only as necessary to maintain condition, such as for work. The pounds of grain generally needed per hour of actual work is: light use 0.5-1.5, moderate use 2-3, heavy use 4 or more (see Table 2).

**Mares During the Last 3 Months of Pregnancy and Lactation:** Alfalfa or green grass and a salt-Ca-P mineral mix all available free choice. No other salt should be available. Feed grain mix #1 only if needed to maintain condition. If dry brown grass pasture or hay is fed, feed 0.5 to 1.5 lbs/cwt/day of grain mix #1.

**Nursing Foals Beginning 1 Month Before Weaning:** Weaning is recommended at 4 to 5 months of age. Alfalfa or green growing grass free choice + 3/4 lbs. of grain mix #2/cwt/day. If grass hay is fed, feed 2 lbs. soybean meal or 3 lbs. dehydrated alfalfa pellets + 3/4 lbs. of grain mix #2/cwt/day.

**Weanlings to 2 Years of Age:** Alfalfa or grass free choice + 1 lb. of grain mix #3/cwt/day up to a maximum of 8 lb. total. Continue feeding this amount until 2 years old.

**Grain Mixes For Equine Feeding Program First 8 Months of Pregnancy, Stallions and Mature Horses for Maintenance or Work:** Any cereal grains - oats, barley, corn, wheat, sorghum grain or rye (don't use over 50% wheat or 33% rye in the grain fed).

**Grain Mix #1 for the Last 3 Months of Pregnancy and During Lactation:**

1500 lbs/ton of any grain or grain combination
300 lbs/ton of soybean meal
140 lbs/ton of molasses
60 lbs/ton of dicalcium phosphate

OR

1200 lbs/ton of any grains
650 lbs/ton of Calf Manna, Start-To-Finish, or Brewer's Grain
100 lbs/ton of molasses (wet)
50 lbs/ton of dicalcium phosphate*

OR

Commercial grain mixes such as Purina's "Omalene #200," Carnation Albers "Trophy," "Tizwhiz 12."
Grain Mix #2 for Nursing Foals:

Purina's "Big-Un" or "Omalene #300," Carnation Alber's "Super Foal," "Tizwhiz 16"  

OR

1400 lbs/ton of any grains  
400 lbs/ton of soybean meal  
150 lbs/ton of molasses (wet)  
50 lbs/ton of dicalcium phosphate*

Grain Mix #3 and #4 for Weanlings and Yearlings Up to 2 Years Old:

Grain mix #3 to be used when alfalfa is being fed:

Purina's "Omalene 200," Carnation Alber's "Super Foal," "Tizwhiz 16"  

OR

1850 lbs/ton of any grains  
120 lbs/ton of molasses (wet)  
30 lbs/ton of dicalcium phosphate*

Grain mix #4 to be used when grass is being fed:

Purina's "Big-Un" or "Omalene #300," Carnation Alber's "Super Foal," "Tizwhiz 16"  

OR

1400 lbs/ton of any grains  
400 lbs/ton of soybean meal  
140 lbs/ton of molasses (wet)  
30 lbs/ton of dicalcium phosphate*  
30 lbs/ton of limestone*

OR

900 lbs/ton of any grains  
900 lbs/ton of Calf Manna, Start-to-Finish, or Brewer's Grain, e.g. "Coor's Pellets"  
140 lbs/ton of molasses (wet)  
30 lbs/ton of dicalcium phosphate*  
30 lbs/ton of limestone*
Feed Costs are the lowest when the different grain mixes given above are used. However, it requires the use of 2 to 3 different grain mixes and a cereal grain alone. The best feeding program at a reasonable cost and minimum complexity for most stables is to:

1. Feed all of the mature horses, except during lactation and the last 3 months of pregnancy, any of the cereal grains alone.

2. Feed the growing horse, the lactating mare and during the last 3 months of pregnancy:
   a. Grain mix #4 if grass forage is fed
   b. Grain mix #1 if alfalfa or other legume forage is fed

* 10 lbs of mineral/ton of feed = 1/2 tsp or 0.1 oz/lb of feed, and lb/ton is 0.005 lbs/lb of feed. Example: If 50 lbs/ton of dical and 400 lbs/ton of soybean meal are required and 6 lbs of grain/day is being fed, add (5) x (6) x (0.1oz) = 3 oz of dical and (400) x (0.0005) x (6) = 1.2 lbs. of soybean meal and 4.8 lbs (6 - 1.2) of grain daily.

If Epiphysitis or Contracted Tendons Occur:

1. First 4-6 weeks of treatment:
   a) Feed grass roughage free choice
   b) Add 3 oz/day of a 12% Ca-12% P mineral mix to just enough grain so the horse will eat it. If the grain doesn't contain molasses, it should be moistened when fed to prevent the mineral from sifting out.
   c) Allow free access to a salt mineral mix equal in Ca and P as the only salt available.
   d) Complete stall rest for epiphysitis and crooked legs but not for contracted tendons.
   e) Give phenylbutazone daily for contracted tendons but not for epiphysitis and crooked legs.

2. If improvement is noted after 4 to 6 weeks of the above, begin feeding:
   a) 1/2 lb/cwt/day grain mix #3 or #4.
   b) After 2 to 3 weeks, if improvement is seen, the amount of grain mix fed may be increased to the same as recommended for other weanlings and yearlings.

3. If no improvement is noted or in severe cases surgery may be necessary.
BroodMare Management

D. G. Pugh, D.V.M., M.S.

and

R. A. Magnusson, D.V.M.

It is now Winter. We have finished another breeding season and by now we are either painfully or pleasantly aware of the extent to which we were successful in our breeding programs. If we did well, we want to continue on this course; if we did not do well, we want to make some changes. We should begin planning now to make these changes. I believe that we should divide our mares into three groups: foaling mares, maiden mares, and barren mares. Foaling mares are the ones that are pregnant now and will foal this year. Maiden mares are mares which will be bred for the first time this season. Barren mares are the ones that have been bred at some time in the past, but for a number of reasons will not foal this year. They have usually been open for one or more seasons. Many of the management considerations we will discuss apply to more than one group of mares, but each group has its need for special considerations. I want to emphasize that these are just a few of the management ideas, not the only ones. They should be viewed as a framework to which you may add lots of extra material. In other words, this is where we can begin in our quest for good reproductive management of the mare.

Foaling (pregnant) Mares

A. Feeding - The pregnant mare has special dietary requirements, but should not be "fed for two" until there are two. I would much rather have them slightly thin than too fat.

1. The first eight months - The mare has no increased requirements over maintenance. Her needs can be met by feeding good quality pasture free choice or by feeding 1.5 - 1.75% of her body weight daily in good quality grass or grass legume hays. Grain supplementation may be necessary only to make up for poor quality roughage. I believe that the key here is good quality hay. I would avoid fescue and stemmy or moldy hay at all costs.

2. The last three months - The mare's calcium, protein, energy, vitamin E, Vitamin A, and selenium needs increase during these last three months. These needs can be met by feeding either 1.75% body weight daily of good quality alfalfa hay with free choice high phosphorus mineral and selenium or good quality grass hay or pasture supplemented with 0.5 - 0.75% BW grain mix plus free choice dicalphos mineral including selenium. I might over emphasize the selenium, but our area tends to be
slightly selenium-deficient, and this could be more of a problem if our mares are on fescue pastures. One to two selenium, vitamin E injections during the last three months, might help alleviate this problem.

3. Lactation - Now feed for two! Needs can be met by increasing alfalfa hay to free choice with free choice high phosphorus mineral or with free choice good quality grass hay or pasture and grain mix increased to 1.0 - 1.5% BW daily. Continue DiCal Phos mineral free choice with this option. The mare's milk production increases to a peak at about two to three months and then drops off by five months. Watch the mare's condition and regulate grain feeding to parallel this demand on the mare's system. In other words, keep the mare in good flesh, not too thin, but not too fat (both extremes may predispose poor breeding, and we have got to breed her back).

4. Additives - When Vitamin A content in the roughage is in question, it should be added to the diet to supply 40,000 i.u. per day. But a good quality grass or hay probably has plenty of Vitamin A precursors, and supplements shouldn't be needed. Selenium is deficient in locally grown Virginia feeds and should also be supplied to mares in late gestation.

5. Fescue toxicity has been blamed for agalactia (lack of milk) and thickened placental membranes causing perinatal foal deaths. The agalactia or decreased milk production has been reported to occur as high as 53% of mares grazing fescue. These problems can be avoided by removing mares from fescue pasture or hay during the last 60 to 90 days of pregnancy. I prefer removal of the mare from the fescue pastures as soon as she is diagnosed pregnant. Not all fescue pastures are at fault, only the ones where the grass is infected with fungus Acremonium coenophialum. You can contact the extension service in your area to help you determine if your pastures are so infected. It has been reported that on straight fescue pastures, 26.8% of the mares have reproductive problems and on pastures with mixed fescue grasses only 17.7% of the mares have reproductive problems. This tells us that we may decrease the possibility of acalactia and other problems in the mare by decreasing the feeding of fescue. Dr. Meacham, Fontenot, and I are now investigating this syndrome. Dr. Reynolds Cowles has also worked with this problem in mares in the past. Hopefully in the next several years, we will know more about this problem and have better recommendations.
B. Deworming Considerations

1. Ivermectins are not yet cleared for pregnant mares, but will probably be cleared for breeding and pregnant animals very soon. It should be remembered ivermectins are also a boticide.

2. Deworm every six to eight weeks with anthelmintics that are effective on your farm. Avoid Cambendazole in early pregnancy as it has been associated with leg deformities in the foal.

3. There are conflicting views on boticides in the pregnant mare. I have never recognized an abortion due to organophosphate or carbon disulfide use in a pregnant mare, but the potential for abortion in late pregnancy when using an organophosphate is very real. I would avoid the use of organophosphates in pregnant mares.

4. I personally don't deworm pregnant mares the first two to three months of pregnancy, unless there is a serious parasite problem. These first several months are when the organ systems of the foal are being developed.

C. Vaccination Consideration

1. Rhinopneumonitis - This viral disease is a constant threat in Virginia. All pregnant mares should be vaccinated with Pneumobort K at least at five, seven, and nine months of gestation. If record keeping is a problem, vaccinate all pregnant broodmares on the farm every two months.

2. Prefoaling vaccinations - To provide maximum levels of colostral antibodies to the new born foal, vaccinate all broodmares about four to six weeks prior to foaling against tetanus, sleeping sickness, and influenza.

D. Hormones during pregnancy

In the past, progesterone deficiency has been blamed for a lot of early fetal loss. There is less feeling now that this is a common problem. Many mares still are given progesterone to prevent abortion and it is possible that some benefit may be derived. Experimental evidence shows that to reliably maintain pregnancy in a mare that is producing no progesterone, you must give 1000 mg respositol progesterone every four days during pregnancy. There are many regimes that are used in practice, my personal feeling is that supplemental progesterone may be of benefit in certain (NOT ALL) mares with a history of fetal resorption and abortion.
E. Lights

1. Increasing the hours of light to which mares are exposed will help start mares cycling earlier in the year.

2. Increasing light should begin in late November or early December to have mares cycling by February. It will usually take 60-90 days of increased daylight to initiate the normal reproductive cycle in the mare.

3. We need 16 hours of light daily to induce cycling. This can be done by additional 30 minutes to 1-hour increases in the artificial light daily, or by starting with 16 hours. Both of these methods have been shown to be equally effective. It should be emphasized that the period of dark which the mare is exposed to is extremely important, so don't leave these mares under lights greater than 16 hours daily. Research is being carried out at this time on the subject of lighting to induce cycling in mares in both Wisconsin and France and I expect that this field will change drastically within the next several years.

4. Light can be provided by one 200-watt incandescent bulb or more economically by two 4-foot 40 watt fluorescent bulbs per stall. Best results are attained when the mares are within seven to eight feet of the light source. They need a minimum of two foot candles of light exposure during this 16-hour period.

5. All mares, including pregnant mares that are to be bred early, should be under these lights. To help you understand this, the lights will go through the nerves and tracts of the eyes to the brain. In the brain is the pineal gland, which under the influence of increasing daylight, slows down its secretion of the hormone melatonin. Melatonin inhibits the pituitary from secreting its hormones which turn on the ovaries and allow the mare to come into and go out of heat. Thus, increasing the light will decrease the melatonin which allows the mare to cycle. Conversely, decreasing the light will increase the melatonin which decreases the mare's ability to cycle as is seen during the winter time.

F. Induction of Heat

In certain instances, we may modify the reproductive cycle of mares with several drugs, such as the Prostoglandins. These enable us to better manage our breeding program. The Prostoglandins will bring most mares into heat anywhere from two to six days after their injection. They usually work only during the breeding
season (not in winter) and will not be effective unless injected at least three to five days following a heat period. If the prostoglandins are used in conjunction with hormones that aid in ovulation (i.e. hCG) we may better control the time of ovulation and therefore synchronize our breeding more efficiently. This allows us to better manage our stallion, particularly if he is booked to many mares.

G. Embryo Transfer

This is a technique by which we may remove the embryo from one mare and transfer it to another, recipient mare. It is usually done on the sixth through tenth day of gestation or post breeding, and it may be performed surgically or nonsurgically. We have been doing some joint research at Virginia Tech with Blue Ridge Embryo, Inc. We are attempting to perfect this technique in the mare. I can foresee this being done by both VPI&SU and other private organizations in the very near future. The possible uses will be in mares who are old, who have health considerations for not carrying a pregnancy to term (i.e. pelvic abnormalities, founder, etc.), whose uterus are unhealthy and cannot maintain a pregnancy (i.e. Grade III uterus), or who are valuable as performance animals and can't take time off from showing or the track to carry a baby. Equine embryo transfer will take off in the next two to five years.

H. Preparation for foaling

1. Site selection - We need a clean, well constructed 12 X 12 or larger stall or a clean, well drained and sheltered pasture area. I prefer that the area be neat, "homey," and quiet.

2. Colostrum storage - Arrange to obtain and freeze colostrum from an early foaling older mare. I would attempt to avoid keeping colostrum more than one year, to assure its quality.

3. Caslick's removal - Make sure the mare hasn't been sutured. If she has been, the vulva must be opened prior to foaling. Be conservative! Open the Caslick's as soon as you suspect the mare may foal.

4. Fescue withdrawal - Plan ahead so that the mare can be removed from fescue pasture 60 to 90 days prior to her foaling date, if not sooner. I don't wish to indict all fescue pastures. The only ones where we need to follow this rule are the ones that are infected by the fungus, which we discussed earlier.

I. Foaling Procedures
1. Signs leading up to foaling (average).
   a. Relaxation of pelvic ligaments occur, making the base of the tail elevate. You can usually feel these around the hip.
   b. Edema under the abdomen - walking 20 minutes twice daily may help alleviate this to some extent. This edema or swelling will usually form in front of the udder and on the belly.
   c. Udder develops usually several weeks prefoaling.
   d. The teats fill with fluid usually about one week before foaling.
   e. Clear droplets on the teats may be seen three days prefoaling.
   f. "Wax" forms on ends of teats about 24-48 hours prior to foaling.
   g. White milk can be expressed from the teats usually 12-48 hours prior to foaling.

2. Put the mare in an area where she can be easily watched and assisted if necessary.

3. Wrap tail and wash the perineum and surrounding area just prior to foaling, if you can.

4. Stages of Labor
   a. Stage I - Mare is restless and will pace or get up and down frequently. This is the preparatory phase and will last approximately two hours. Stage I ends with rupture of the first waterbag.
   b. Stage II - Activation and Delivery. In approximately 15 minutes, the second waterbag is presented (greyish blue color). Delivery begins and is completed in about 20 minutes. The foal is usually delivered with the mare lying down on her side. The mare will usually stop straining after the foal's hips are delivered. The umbilical cord will still be attached and the foal's feet will remain in the birth canal. Don't pull the foal! Let the umbilical cord break naturally. Fifteen to 20% of the foal's blood is still in the placenta and must drain into the foal prior to the cord's breaking. This is extremely important.
c. Stage III - Delivery of the placenta. This usually occurs in 15 minutes to one hour post foaling. Call your veterinarian if the placenta is retained more than two to three hours or earlier if the mare isn't acting normally. The placenta should be examined before it is discarded. Make sure that it can hold water, check to see if there are any holes or tags missing, and make sure there is not excessive bleeding from the mare after the placenta is passed. If there is any question, call your vet.

5. Post foaling examination

Examine or have the mare examined after foaling to make sure there has been no serious tearing or damage to her reproductive tract. This should be obvious from excessive bleeding or swelling around the vulva. I believe a postpartum examination should be done to make sure all is well. We want to get her bred next year if we can. Some veterinarians replace the Caslick's suture as soon as the mare has passed the placenta.

6. Parturition Induction

Parturition may be induced by a veterinarian, some of the reasons for which this may be required are:

1. Management problems, such as deficient labor.
2. Health considerations for the foal or mare which warrant such a procedure.
3. Mares with history of producing icteric foals.
4. Mares with known anatomical problems which may interfere with normal foaling.

I don't recommend this procedure in all cases, it can be potentially dangerous. The criteria which I follow for parturition induction are:

a. A minimum gestation length of 330 days
b. Enlarged udder with teats distending with grey-white or yellow-white colostrum.
c. Cervical dilation.
d. Relaxation of the sacrosciatic ligaments.

J. Preparation for rebreeding

1. Pre-breeding exam
a. Vaginal exam - It is extremely important to look for excessive bruising and trauma resulting from foaling. If damage has been done, it needs to be repaired.

b. Culture for bacteria or fungus may be indicated. If there are abnormal discharges from the uterus, a culture is warranted. Cultures must be interpreted carefully, especially during foal heat when a lot of insignificant bacteria may be obtained. I usually do a culture and cytology concurrently. This tells me if the bacteria in the uterus are the real problem. If they are causing reproductive problems or infection in the uterus, then we need to treat them. The cytology will tell me, generally speaking, whether or not a true infection exists.

c. Rectal palpations are a must along with a culture and cytology to see if the uterus is involuting normally.

2. Foal Heat Breeding

   a. Indicated only if:

      - Mare and foal are healthy, if the foal dies or became sick shortly after birth, we need to know if it is something the foal got from the mare's uterus before birth. We need to check out in such instances the uterus to see if an infection exists.

      - Foaling was uncomplicated. We didn't need to pull this foal, in other words, it was totally unassisted and without incident.

      - Mare passed placenta quickly and completely. Make sure of this, check out the placenta and let your vet see it if possible.

      - No abnormal uterine discharges post foaling. Any abnormal discharges occurring should be seen to at once. Call your vet. If we have a puss-like discharge, we need to treat the uterus or it could become so scarred from the infection that the mare might never be able to conceive again.

b. At this time, a lot of controversy exists about foal heat breeding. Most studies show that foal heat breeding has no poorer or better reproductive incidence than does breeding later in the season. Foal heat breeding, therefore, is acceptable if the above criteria are met.

II. Maiden Mares
A. Preparation for new lifestyle

Letting mares down - Mares should be allowed as much time as possible to adapt to their new career as a broodmare. If they were show mares, they will usually need to lose weight. If they were being raced, they need time to relax and learn how to live in a pasture with other mares. If they have been on anabolic steroids, they need time for their endocrine system to normalize. This could be several months (possibly greater than six months). Mares that are expected to carry on two careers or those that are retired in the middle of a season, are more likely to experience problems becoming pregnant.

B. Pre-breeding examination

1. Rectal - It is necessary to make sure the uterus and ovaries are normal and functional. An experienced veterinarian may glean a tremendous amount of knowledge from such an examination.

2. Vaginal - Examination for persistent hymen, will occur at this time. During the vaginal examination, other problems may be seen and could possibly be corrected. The cervix and vagina themselves can be explored and checked for adhesions and scars. This again, is very beneficial procedure.

3. Culture and Cytology - As we have previously discussed, cultures are extremely important. It is possible, but unlikely that a maiden mare with good conformation will have a uterine infection. The key here is good conformation. Wind sucking and urine pooling due to poor conformation are two of the worst problems mares may have. These contribute to more reproductive insufficiencies than possibly any other problem. If we have a true infection, we need to remove it.

4. Caslicks suture - This may be necessary to correct poor vulvar conformation. Plastic surgery in the vagina can possibly be performed which might decrease urine pooling. The vestibule which is part of the mare's natural defense against bacteria can be destroyed or poorly functioning in mares with poor conformation. It is possible to correct vestibular malformations to some extent with forms of plastic surgery. Again, urine pooling may cause chronic irritation of the cervix and along with wind sucking, may lead to serious uterine infections (endometritis).
5. Uterine Biopsy - This is a very meaningful and rewarding procedure. It may tell us if the mare is infected or if she is even capable of having a live, full-term foal. Extremely useful in older mares.

C. Deworming and vaccination considerations employ routine procedures.

D. Nutrition

1. Breeding requires only maintenance level nutrition on any animal over two years of age. Add to this any energy required by other activities that are expected from the mare. We must remember if she is under two, she is still growing.

2. The best fertility rates are achieved by mares that are in good flesh and are gaining weight. Breeding success is much less in mares that are excessively fat or excessively thin. I can't overemphasize this, because it is true. If mares are too fat, then not only do they have a tendency to cycle less efficiently, but they also have more obstetrical problems, difficulty giving birth.

III. Barren Mares

A. Reasons for infertility in cycling mares.

1. Insufficient chance to become bred - this should be ruled out before other causes are pursued. Was she covered enough times, were the coverings properly carried out by the stallion????

2. Endometritis - There is a tremendous insult to the uterus at both foaling and breeding. Large numbers of potentially pathogenic bacteria are deposited into the uterus along with semen each time the mare is bred. The higher conception rates in young, healthy mares are evidence for a very active uterine defense mechanism. Older mares with a history of infertility are not as successful in controlling this bacterial insult. There is evidence that mares lose their ability to cope with uterine contamination over time. A poor conformation leading to "wind sucking", difficult foalings, or repeated breedings can also speed up the loss of reproductive immune capacity and lead to chronic endometritis. We need to culture, do cytology, or biopsy these chronically open mares. The biopsy may tell us if it is even possible to get in foal at all. The biopsy may also tell us whether or not her uterus is capable of maintaining a pregnancy for the entire 330 plus days.
3. Early embryonic death - the embryo dies and is reabsorbed causing a return to estrus usually prior to 35 days of gestation. This can be due to endometritis, genetic factors, or nutritional deficiencies.

4. Endometrial cystic or fibrotic changes - usually, these types of changes occur in older mares, or mares with poor or faulty conformation of the vulva. They are very easily detected by biopsy.

5. Embryo transfer - embryo transfer is a technique that again maybe employed in certain instances for mares which are incapable of carrying a foal to term.

B. Preparing for next year

1. Rectal palpation - May allow us to detect ovarian or uterine abnormalities and possibly adhesions involving the ovaries, oviducts, or uterus.

2. Culture and sensitivity - Determine if mare has pathogenic bacteria in the uterus and what antibiotic should be effective in removing it. These are extremely important in the infected mare.

3. Endometrial biopsy - Can be used to confirm uterine infection and to judge amount of permanent uterine damage (fibrous tissue). The endometrial lining can be damaged to the extent that it can never support a pregnancy, as previously mentioned.

4. Uterine endoscopy - This allows direct visualization of uterine lumen for any abnormalities, such as cysts.

5. Laparoscopy - This allows viewing of the ovaries and uterus through the abdominal wall. This may be an important technique in the future.

6. Hormone Assays - Can be done during the breeding season to determine a mare's endocrine activity. Hormone assays are of little value outside the normal breeding season, that is, they will not help us much during winter. They are techniques which aid greatly in our knowing if the mare is capable of cycling properly. Hormone assays also help us detect certain types of ovarian tumors.

7. Corrective Surgery

   a. Caslick's surgery - To prevent "wind sucking" and associated chronic inflammation and infection.
b. Urine pooling surgery - Some mares have a conformational defect that allows urine to flow back into the vagina and pool below the cervix, as previously described. This creates a chronic inflammatory situation that may lead to sterility.

8. Genetic evaluation - Some mares have chromosomal abnormalities that prevent normal cycling and pregnancy. These mares can be identified by chromosome examination.

9. Put mares under lights - Let's get these mares to cycle earlier, if possible. As previously discussed, to aid us in doing this, we must put them under lights earlier in the season. By having these barren mares cycling earlier in the season, we have more time to breed them and more opportunity to get them pregnant.

10. Reduce stress - Many people are recognizing stress as a very real factor in reducing fertility and contributing to prenatal death loss. Reducing changes and anxiety will be beneficial to many mares. Anxiety may be caused by stabling, by pasturing with strange mares, by hauling, and by changes in farm help. Anything that may make the mare uncomfortable or stressful, should be discontinued.

11. Last but not least, make sure she is in good overall health. Poor nutrition, high parasite loads or systemic infections or metabolic diseases may very well lower her overall reproductive ability.

12. Reduce trauma and infection at breeding.

   a. Artificial insemination - Reduces physical trauma, reduces amount of semen exposed to the uterus, and allows the addition of antibiotics to the semen. Artificial insemination which is discussed in a different section is a tremendous tool particularly when used in mares which have a history of reproductive diseases. Artificial insemination may be used to better manage not only our mares, but also our stallions.

   b. Reduce number of breedings - This reduction in total number of natural covers may decrease the physical trauma the mare may undergo. On the other hand, it necessitates pin pointing ovulation time more accurately by the stallion and mare manager. This more accurate pinpointing of ovulation may be carried out by having
veterinarians routinely palpate mares, to using one of several drugs to help regulate period of ovulation in the mare as previously discussed.

c. Use of extenders during natural breeding period. In instances where artificial insemination can't be used, (i.e. thoroughbreds), the mare can be infused with extenders containing antibiotics immediately prior to being covered by the stallion. This will aid greatly in providing adequate protection in some mares against the possible disease producing bacterial organisms living in the stallion's semen.

A PROPOSED EQUINE HEALTH PROGRAM TAILORED FOR THE BROODMARE

Vaccination and Parasite Control

This is usually given in a two-shot series followed by a booster program.

Tetanus Toxoid - should be given once yearly, generally in the spring.

Eastern and Western Equine Encephalitis - (EEE/WEE) - this should be given once to twice yearly, generally speaking in the spring.

Influenza - this should be given to horses that have the possibility of being exposed to outside animals. For it to be very effective, influenza should be given every three to four months year round.

Strangles - we do not, at this time, recommend strangles vaccination unless we have a farm/herd problem. Consult your veterinarian about this.

Rhinopneumonitis - if horses are exposed to this disease, from their other herd mates, then we suggest vaccinating no less than twice yearly. Broodmares should be, as previously discussed, vaccinated every 60 days during pregnancy.

Rabies - no vaccine is currently approved for the vaccination and prevention of rabies in the United States. Contact your veterinarian if you are in a high-risk area.
We suggest deworming every six to eight weeks with a combination of different wormers. This combination may include ivermectin, Parvex Plus, Pyrantel Pamoate, Benzimidazoles, or other which may be applicable. The mares which are pregnant, in my opinion, should be dewormed the last month of gestation and prior to breeding. I would deworm these pregnant mares on the same schedule as the rest of my herd with the exception that they should not be dewormed during the first 60-90 days of gestation and as previously mentioned no organophosphate dewormer should be used. Try to vaccinate the mares with Pneumabort K at 3, 5, 7, and 9 months during gestation, and give them a Tetanus Toxoid and Influenza booster 4 to 6 weeks prior to foaling. If they are going to a breeding farm, I would strongly suggest an influenza booster prior to this time. If the foal is scheduled to be born later than April, I would strongly suggest boosting the mare with EEE/WEE four weeks prior to foaling.

Pregnancy Examination

Try and have scheduled routine examination of the mare by a veterinarian during her pregnancy. I would strongly suggest diagnosing pregnancy prior to 35 days if possible. Additional check to determine if she is maintaining a normal pregnancy, may be carried out 90, 100, 120, and 300 days if needed. It is extremely important to know that she is still pregnant and has not aborted.
From birth through the first few months of life is a critical time for foals. During this time they are very susceptible to changes in their physiologic and microbiologic environment. The purpose of this seminar is to provide an introduction to a variety of disease conditions which are commonly encountered. It is very important that these conditions be recognized early and therapy initiated.

**Infectious conditions** (septicemia, "navel ill", "joint ill")

Septicemia is a condition caused by the presence of large numbers of infectious agents circulating in the blood stream. Many neonatal infections are caused by opportunistic organisms which can be cultured from the cervix, vagina, skin or gastrointestinal tract of normal pregnant mares or from the external environment. Infection can therefore originate in utero, from the environment or from other horses. The umbilicus, the respiratory tract, and the gastrointestinal tract are common portals of entry for the infectious agents.

Clinical signs can occur any time after birth, especially during the first few days of life. Although the signs are frequently non-specific, some infectious organisms have a predilection for certain organ systems, thus the terms "joint ill" and "navel ill". Usually the first sign seen is depression and lack of interest in suckling. If the mare's udder is watched closely, a full udder or milk dripping from the teats may serve as an early warning. The temperature will be elevated (102-106 degrees) initially and will be subnormal terminally. Dehydration may be apparent giving the foal's eyes a sunken appearance. Joint swelling, lameness, colic, and neurologic signs can also be seen.
Mortality is high unless therapy is started early. Treatment with the proper antibiotic is essential. Supportive therapy (intravenous fluids and electrolytes, caloric requirements) is also important to better the foal's chance of survival.

Preventative measures can be taken. These include providing the foaling mare with a clean, dry environment, making certain that the foal suckles soon after birth so that colostral antibodies are obtained by the foal, and dipping the navel with an iodine preparation within the first hour of life.

Noninfectious conditions

Neonatal Maladjustment Syndrome (barkers, wanderers)

Major physiological alterations associated with adaptation to the extrauterine environment take place during the first few days of a foal's life. Abnormalities are recognized by observing deviations from normal behavioral patterns. These foals are often born as normal appearing active foals which develop signs during the first 24 hours of life. The foal begins to lose its ability to suckle and frequently appears blind and aimlessly wanders. Some will have convulsions, spasms, or simply make incessant chewing movements.

The cause of this condition is not known but may be due to premature rupture of the umbilical cord by forced traction, lack of oxygen to the brain, or improper inflation of the lungs for some reason. If maladjusted foals can be kept alive through the course of the disease, they often make full recovery to a normal foal. Treatment is mainly supportive: restraint to prevent injury, control convulsions, oxygen, intravenous fluids, antibiotics, maintain body temperature, and feeding.

Meconium impaction

Meconium is the first material passed from the rectum of the foal after birth. If this is not passed normally during the first few days of life, it will collect and become hard thus causing a blockage. Clinical signs include elevation of the tail, humping of the back, abdominal discomfort, continuous straining, and refusal to suckle.
Mild cases usually respond to warm soapy enemas. It's important to keep in mind that the rectum of a foal is very delicate and can be easily ruptured. Mild painkillers can also be administered until the impaction is passed.

**Gastric ulcers**

Gastrointestinal ulceration can be seen as a primary entity or can occur secondary to other gastrointestinal disease or stress in foals. Affected foals will be depressed, show abdominal discomfort, salivate excessively, and have a tendency to lie for prolonged periods of time on the back.

Treatment includes the use of antacids, cimetidine\textsuperscript{R} and antibiotics. Duration of therapy is often prolonged. Death is usually due to perforation and fecal contamination of the peritoneal cavity.

**Immunological conditions**

**Neonatal Isoerythrolysis**

Neonatal isoerythrolysis is a hemolytic disease of the newborn. It is caused by an incompatible blood group reaction between the dam's serum antibodies and the foal's red blood cells (these anti-red blood cell antibodies are concentrated in the colostrum and are then absorbed by the foal following ingestion of the colostrum).

Foals are usually normal at birth but within 24 hours show weakness and lethargy. They may stop nursing as with many of the other diseases. By 2 days of age, anemia, icterus, and respiratory difficulty may be evident.

Treatment generally involves blood transfusions, antibiotics, mineral oil to help prevent absorption of the dam's antibodies, and intravenous fluid and electrolytes. Prognosis is guarded. If the disease process goes undetected and untreated, death usually occurs.

This can be prevented if blood samples from the dam and sire are sent to a laboratory with the capability of determining equine isoantibodies two to three weeks prior to foaling. If the results indicate a problem, precautions
can be taken to prevent the foal from nursing the mare following birth. A muzzle can be placed on the foal and colostrum from another mare given to the foal immediately following parturition. A milk substitute should be provided for the foal at 2-3 hour intervals over the next twenty-four hours. During this time, the mare should be stripped out. After the first day, the foal can be allowed to nurse the mare without problems.

**Congenital abnormalities**

**Persistent urachus**

This is due to failure of the urachus to close at birth. Urine dripping from the umbilicus will be apparent in these foals. As mentioned previously, the umbilicus is a common portal of entry for infectious agents. Therefore, these foals are predisposed to infections i.e. navel ill, septicemia. Other congenital abnormalities may be present in the same individual.

Repeated cauterization of the umbilicus with silver nitrate or Lugol's solution usually will be sufficient. In a few cases, surgical intervention is required. Prognosis is good if there are no secondary complications and the condition is not longstanding.

**Umbilical hernias**

Many umbilical hernias will correct themselves during the first year of life. Immediate veterinary attention is needed if the animal becomes colicky since there is the potential for a loop of bowel to become entrapped within the hernial sac.

Manual reduction of the hernia daily in the early life of the foal will usually stimulate closure of the defect. Extremely large defects or those that are nonresponsive should be surgically repaired.

**Other congenital conditions**

- cleft palate
- cataracts
- atresia coli, atresia ani
- hydrocephalus
Other problems of foals

Weak flexor tendons

Placid flexor tendons are primarily a problem of newborn foals and frequently the limbs are only mildly affected. Exercise is essential to strengthen the limbs and reverse the problem. In some instances, light support wraps are needed to protect the back surfaces of the affected limbs.

Contracted tendons

Contracted flexor tendons can be due to uterine malpositioning, secondary to chronic pain, or nutritional errors. Foals can exhibit a wide range of involvement regarding contracted tendons: some foals will be able to stand but knuckle over; others can't stand or else attempt to walk on the dorsal surfaces of their fetlock joints.

Various splints and casts can be used for foals with contracted tendons. Protective leg wraps should be applied to foals with the tendency to knuckle over onto the dorsum of the fetlock to prevent further injury. Passive extension of the limbs several times during the day will also help solve the problem in the majority of cases.

Ruptured common digital extensor tendon

This condition is generally seen early in the life of a foal. It is thought to be due to excessive stress on the tendon during the first couple days of life i.e. running with the mare.

Angular limb deformities

The carpus and fetlock areas are the most common sites for angular deformities to occur. Many of the early cases will respond to splints and stall confinement. If this is unsuccessful, surgical correction should be performed.
Our subject today is much too vast for coverage in our allotted time. We could spend days discussing it and many of us have spent years working with the subject and yet still know very little. We will try to lay down a few guidelines for the most common problems.

Needless to say a barren mare is a major economic loss and often a frustrating problem. Management requires close attention to detail. We can achieve conception rates of 60-70% with normal effort, but it takes good management to achieve 80-90%. The mare is a difficult breeder by nature and man complicates this by imposing artificial nonphysiologic breeding seasons, poor nutrition, fanciful whims, etc.

When we are presented with a barren or problem mare, we first must identify the causes of our problems before we can manage or correct them.

First we must get a good history or past reproductive performance. This will give us a good idea of the category of our problem. Are we dealing with:

A. Infectious Diseases
B. Seasonal or Cyclical Problems
C. Problems of Optimum Breeding Time
D. Infertility of the Stallion
E. Pregnancy Maintenance
F. Other Possibilities: ie. Nutrition, Temperament

Many mares will exhibit combinations of these types of problems, but we must decide to start at some point.

Let's look first at infectious diseases or the infected "dirty" mare. We must first conduct a good thorough veterinary examination that will consist possibly of rectal palpation, vaginal speculum examination, bacterial and fungal culture, cytological smears and endometrial biopsy. Your veterinarian will compile the findings from these examinations to arrive at a diagnosis concerning your mare.

A decision will be made as to whether or not your mare needs any treatment for infection. This may consist of appropriate antibacterial or antifungal infusions, corrective surgery such as a Caslicks operation or vaginoplasty, or other means. Treatments are usually conducted while the mare is in estrus. Reevaluation will be conducted on subsequent heats to determine
the success or failure of such therapy. Many, in fact, most infected mares need to be treated more than one heat period.

On the barren mare we like to conduct these examinations and treatments in the early fall to allow time for sexual rest after an infection has been corrected before the mare is bred back.

If we are faced with a barren mare from the previous season and we want to attain the most opportunities to breed her next season, an artificial light program will be started December 1st. We will discuss this lighting program further a little later.

We have discussed the infected barren mare but we often have problems with the foaling mare not cleaning up from normal bacterial contamination after foaling. This can be due to age of the mare, foaling trauma, retained placenta, or placental infection that existed during gestation. These mares may not cycle normally and may evidence a discharge when in estrus. Often they are void of external signs and the same diagnostic procedures as discussed previously will be applied to discover the problem.

When we have cleaned up a previously infected mare whether barren or foaling mare, we have to be concerned about rebreeding. The method of choice is artificial insemination if the breed registry allows. Obviously this is not an allowed possibility with the Thoroughbred mare. AI offers less bacterial contamination at breeding, allows us to keep a mare sutured more tightly and allows use of semen extenders and antibiotics. An alternate technique is the so-called minimum contamination technique with live cover where we add extenders and antibiotics to the uterus and allow the stallion to breed into it. This has been useful in some mares.

Obviously we want to hold our number of covers to a minimum so as not to cause any more contamination than is necessary. This will require rectal palpation to determine the best time to breed.

Now let's move on to seasonal or cyclical problems. We don't have time to review the physiology of estrus, but remember the mare is a seasonal breeder cycling best in May and June. We are usually trying to breed her earlier than this.

Mares coming out of winter anestrus go through a transitional period when they may show
estrus but are only bringing up small follicles and are not ovulating. This nonovulatory estrus can be very frustrating for the breeder. It requires frequent rectal palpation if you want to breed the mare and frequent use of the stallion if palpation is not done. This is obviously not what we want for the problem mare.

Earlier I mentioned an artificial lighting program and this will alleviate much of the transition period. Sixteen hours of light a day, starting December 1st will usually have a mare cycling well by mid to late February. This will allow many more opportunities to breed the mare and thus get her pregnant, than will waiting for May and June.

Light programs may now be combined with progesterone-like drug therapy such as altrenogest to further cut down the transitional period and increase the efficiency of breeding. This is highly recommended for mares with previous cyclical problems.

We are also often confronted with the mare, either barren, maiden, or foaling that "refuses to cycle." Many of these your veterinarian can detect to be cycling silently. Often the teasing program is not adequate and this can not be stressed too heavily. A good teasing program is essential to any breeding effort. You can't tell when many mares are in heat by just watching them in the back paddock.

Some foaling mares do not cycle after the foal heat and may require special therapy and handling. Many mares with foals by their side are anxious over their foals and don't show external signs of heat. They are usually best teased with the foal held at a safe distance away, but in sight. For mares that are having cyclical problems, prostaglandins are often used. Maiden mares that are just off the racetrack or show ring often take some period of time to "let down." Many have been given anabolic steroids during training and these hormonal products will cause altered ovarian function for varying periods of time.

It goes without saying that any mare should be bred to a fertile stallion just before ovulation occurs. If a stallion has fertility problems then he is not usually a good choice for a mare that also has problems.

We have already mentioned timing breeding using rectal palpation. This is, of course, very necessary when a stallion is heavily booked using either natural service or AI. It also allows for accurate determination of ovulation or lack of such. Some mares benefit
from the use of hormonal therapy to induce ovulation and this must be coupled with palpation.

Now that we have bred our mare, we must determine if she is pregnant and if so, will she maintain such. Rectal palpation coupled with good teasing is the method of choice. We check mares at 18 - 20 days post breeding, then again at 30-36 days, 40-45 days, and after 60 days. Mares that are false pregnant, or suffer early embryonic death are thus picked up and returned to estrus before the end of the season.

Recently ultrasound scanners have been used in early pregnancy detection and allow us to detect twins and pseudopregnancy much earlier than with rectal palpation.

Hormonal assays may be used to detect pregnancy after 40 days and are useful in diagnosing the mare that aborts at 40-45 days when coupled with rectal palpation and ultrason scans. These tools allow us to identify some problems that we previously only guessed at.

The mare that is an habitual aborter, usually at the 35-60 day period is usually one with severe uterine pathology. This can be determined by uterine biopsy. Often there is nothing that can be done for these mares. Hormonal assays can be useful in some mares with a history of early abortion and often veterinarians will elect to use progesterone therapy on the mare with such a history.

One other significant cause of abortion is pneumovagina and this can be prevented by a Caslicks operation.

Other factors that may contribute to abortion are general poor health, ie. poor parasite control, poor nutrition and infectious disease such as rhinopneumonitis. The latter can be prevented with a good vaccination program and you should consult your veterinarian to establish such a program.

In summary, problem mares are expensive, either in the cost of identifying the problems and correcting them or in the cost of maintaining them as nonpregnant. It takes alot of effort to manage the problem mare and a half way effort is likely to meet with a poor result. Commitment to attention to detail and good cooperation between the mare owner, the stallion manager, and the veterinarian is the only path to getting such mares back in production.
EVALUATION OF THE STALLION FOR BREEDING SOUNDNESS

Robert W. Lipscomb, DVM

The purpose of evaluating the fertility of a stallion is to assess libido, mating ability and the quality of semen. The fertile evaluation may be as a pre-purchase exam, a routine exam at the beginning of the breeding season or it may be as problems arise during the breeding season. As has been said, the best measure of a stallion's fertility is the foaling rate when bred to a large number of mares managed and serviced under recommended conditions. There is no single test that is directly proportional to fertility of the male horse, therefore we must evaluate a number of factors including libido, semen evaluation, season of year, frequency of ejaculation, age, testicle size, physical condition and method of seminal collection. Mismanagement is often a cause of poor fertility. Management includes record keeping, drugs used, stallion handling and training (in the breeding shed), teasing, breeding, nutrition. Management is another subject, but is directly related to the success of any breeding program. The stallion is obviously 50% of any breeding program. Routine monitoring of the stallion is as important as routine examination of the mares. The stallion should be checked two or three times during the breeding season to see if his fertility is being maintained.
Responsible stallion management requires evaluation of the potential fertility of the horse on a regular basis. Until "you" as a stallion manager have experienced the frustration of standing a "slow breeder", you will not appreciate the ease of handling a cooperative stallion. Until you as a stallion manager, experience the frustration of having only 1 or 2 of the first 15 mares conceive or experience the "flak" you get from the mare owners because all their mares are not in foal by May 15 will you appreciate the pre season or pre-purchase reproductive evaluation of your stallion.

The evaluation should begin with a complete physical examination of the stallion with particular emphasis on the reproductive structures. This exam would be much the same as an insurance exam or pre-purchase soundness exam. The procedure would include head, teeth, eyes, wind, heart, legs, feet and internal and external parasites.

It is very important to evaluate the back and rear legs as to conformation, disease and old injuries. Most of the physical stress of breeding is orientated to these structures. Such disease or injuries may cause pain, weakness, or incoordination which in turn may prevent normal breeding or reduced libido. "Disturbed libido associated with pain may be reflected by lack of interest in mares, failure to achieve an erection, repeated attempts to mount or dismounting prior to ejaculation." Decreased libido may be related to psychological or management problems and should be differentiated from those associated with pain.
All perimeters should be evaluated toward determining the ability of the stallion to "maintain and withstand a vigorous breeding regimen." Poor condition may indicate either chronic disease or nutritional deficiencies. If it is nutritional this is a management problem that should be corrected before the reproductive examination. If it is a chronic disease problem, then it should be diagnosed and evaluated. Since it takes about 60 days for spermatogenesis to occur then we should wait 2 months after the management and disease problems have been eliminated before attempting the reproductive evaluation.

REPRODUCTIVE ANATOMY

A. Scrotum - Serves to cover and protect the testicles but the primary function is to regulate temperature of testes and epididymis.

1. Testes - Produces sperm (starts about 18 months)

   Produces Testosterone (Predominant male hormone)

   Average size 11 cm. long, 6 cm. wide.

   Millions of sperm are produced daily, but an individual sperm takes 55 days to be produced - i.e. if disease, etc. cause all sperm to be killed it will be 2 months after sperm production before new sperm are released from testes.

   The number of sperm produced is a function of testicle size. (Also age of animal)

   The testes descends into the scrotum from 30 days before birth until 10 days after birth. Failure of the testes to descend through the inguinal ring into the scrotum is called cryptorchism.
2. Epididymis - A tubular structure that lies over the top of the testes and attached to caudal aspect of testes.

This structure acts as a storage and maturing area for the sperm that are produced in the testes.

3. Spermatic Cord - Suspends the testes in the scrotum and acts as a passage way for the deferent duct (sperm goes through during ejaculation), nerves and blood vessels.

B. The Reproductive Tract

1. The Deferent duct - Ampulla (widened area of Deferent duct). A continuation of the epididymis, that runs through the spermatic cord to the urethra.

2. Vesicular glands (seminal vesicles) secrete a major portion of the seminal plasma in the ejaculate.

3. Prostate gland - a thin, watery secretion that cleans the urethra during ejaculation.

4. Bulbourethral glands (coeuper's glands) produces a mucoid secretion into urethra.

5. Urethra - A long tube that extends from the bladder and through the penis.

6. Penis - The male organ of copulation
   (a) The root or bulb
   (b) Body
   (c) Glans

The scrotum is exposed to physical and chemical trauma and should be examined closely for enlargements, swelling, thickness of skin, dryness, etc; that would indicate traumatic disease. The testicle should move freely within the scrotum. When relaxed, the testicles lie in a horizontal position. The average size
of the adult horse is about 10-12 cm. (4 1/2 - 5 "") long and 6 to 7 cm. (2 1/2") wide and weight 200-300 gms. The larger the testicle, the more semen produced, therefore it is considered that the stallion with larger testicles is more fertile. It is very uncommon for the two testicles of a stallion to be of equal size, usually the left one is slightly larger. The testicle should be firm but not hard. Orchitis (inflammation of the testicle) is usually due to one of two causes, i.e. infection or trauma. Testical degeneration and/or abscesses come from such infectious agents as the influenza virus, viral arteritis or Salmonella abortus. Traumatic causes may include injury from kicks during breeding, contusions or torsions (twisting) during racing or from chemical burns from washing or insecticides (sprays and wipes). Tumors of the testicles are very rare in the equine.

The spermatic cord should be palpated as it leaves the scrotum and goes through the external inguinal ring. This is a good time to examine for inguinal hernias, which can cause pain at breeding time as well as more severe problems.

The penis and prepuce are examined closely for swelling, abrasions lacerations or hematomas that may result from breeding, trauma, paralysis of the penis, infection, neoplasams or parasites (summer sore).

A rectal examination of the internal reproductive organs should be performed (have adequate restraint); i.e. prostate, seminal vesicles, etc. The bulbo-urethral glands usually cannot be palpated due to a muscle layer covering them.
As we continue our examination we should observe the stallion as he covers a mare. Things to watch are libido, ability to mount, enter and ejaculate. If there are problems during this process then a record should be kept as to the number of mounts, etc. This is important in management as well as future evaluations.

SEmen Collection

This subject is being covered by another speaker, however I will mention a few important factors pertaining to semen collection. There are several methods that have been used but have been unsatisfactory in my hands. Electro-ejaculation has been very successful in collecting bulls, rams and boars, but not stallions. Some people have used it as a last resort with only moderate success. Collection of a dismount sample has been a common occurrence in many breeding sheds, but is quite unreliable because this portion of the ejaculate contains accessory gland fluids, which have very few sperm, and often contains urine. On microscopic examination of this sample we may see white blood cells, red blood cells (clots) or bacteria which are very significant if this would have been a reliable semen sample. Semen samples collected from the vagina of the mare either by capsule, pipette or tampon have been sufficiently altered by vaginal secretions to give false information. Although a representative ejaculate can be collected using an equine condom or breeder's bag, it is not normally used. Problems associated with its use include
loss of semen from the condom, loss of the condom from the penis and the difficulty of the stallion to enter the mare. The best method and most commonly used today of semen collection is by use of the artificial vagina.

Semen evaluation is a very important aspect of the stallion fertility exam. Collection and handling of the semen is very critical and greatly influences the results obtained. Because no single test of semen or sperm quality is highly correlated with fertility, a number of parameters must be evaluated. These tests of semen quality include volume of gel-free semen, motility, concentration of gel-free semen, sperm morphology, semen pH, longevity and color. The total volume and gel-free volume should be recorded, however this is not nearly as important as the total number of sperm per ejaculate, which is related to testicular size, frequency of ejaculation, season and age. The volume of a particular stallion may vary. Total ejaculate volume averages about 75 ml with a range of 30 to 250 ml. Gel-free volume varies with the season and frequency of use of the stallion. A stallion that is in regular use (3-7 ejaculates per week) will have much less gel than the one used sparingly. The gel fraction is much larger in the fall and winter, than during the normal breeding season. This only becomes important when breeding a large number of mares with a single ejaculate, as we do sometimes in our A.I. program.
The motility of the sperm in raw semen should be estimated immediately after collection. We usually estimate the total percent of motile sperm and then the percent of progressive motile sperm. If we are using extender then we repeat this process with the semen diluted with extender. Motility estimates are made by placing a drop of semen (raw or extended) on a prewarmed slide and observed under low or medium power magnification. Motility can be adversely affected by the presence of gel, debris, soap, water, urine, etc. Therefore we must be sure that the cleansing of the stallion and equipment, the collection technique and handling of the semen is correctly accomplished. We must remember that when we compare motility percentages that certain factors are present. First there is considerable variation in estimates of different examiners. Motility is lower in sexually rested horses as compared to the same stallion in regular usage. The sperm of some stallions tend to clump or agglutinate. This decreases motility. Morphology changes will decrease motility. Motility from the second ejaculate (1 to 2 hours after the first) should be as high or higher. Most examiners feel that a fertile stallion should have semen in which 50 percent or more are progressively motile for six hours or more after ejaculation if stored in a dark, draft free area at room temperature. If a stallion ejaculates semen that has less than 50 percent progressively motile sperm or that has less than 10 percent motile sperm after 2 hours from collection, then he must be suspected of
having infertility problems. We like to see 70 percent motility in raw or extended semen and 20 percent motility after four hours. Some factors that affect motility are infection, hemospermia, testicular degeneration, sperm morphology changes and urospermia.

The PH of semen should be measured immediately after collection using a PH meter. The PH of normal semen is 6.9 to 7.8. Urine in the semen or inflammation of the urogenital organs will cause the PH to be elevated. We normally expect a slight rise in PH on our second sample collected.

The concentration of sperm is usually determined by using a spectrophotometer. Concentration is the number of sperm per ml of raw gel-free semen. Daily sperm output for a normal, healthy stallion averages from 3 billion to 6 billion, and is directly related to testicular size. Total scrotal width should exceed 10 cm. Stallions in regular usage that have less than 3 billion sperm per day should be considered suspect. Similar results from stallions evaluated in the off season should be re-evaluated during the breeding season. Common causes of low numbers of sperm include small testicles, testicular degeneration, overuse, incomplete ejaculation and administration of hormones or other drugs to the stallion. The stress and use of drugs during the racing and showing of stallions requires a let-down period before evaluation can be meaningful. We know that testosterone, estrogens, and anabolic steroids can cause decreased numbers and motility of sperm and decreased size of the testicles. The withdrawal periods
for these drugs varies tremendously among stallions and has to be dealt with on an individual basis. We must remember that we need 500 million live motile sperm in not less than 10 ml. of semen or semen plus extender to breed a mare. Also, we should not use a ratio of greater than 4:1 extender to semen. This is true when breeding A.I. or natural.

Morphologically abnormal spermatozoa are found in the semen of all stallions. The causes of many of these changes have not been determined. The abnormalities (of sperm shape) may originate in the testes or epididymis or may be caused by the storage and handling after collection. Certain abnormalities such as head shape changes, proximal cytoplasmic droplets, tightly coiled tails, detached heads and midpiece abnormalities are usually considered as resulting from testicular disease and cause some degree of infertility.

It is very important to realize that sperm morphology changes can result from critical temperature changes, storage of raw semen, or poor staining techniques. No exact limits have been established for abnormal sperm cells in fertile stallions. However, we do know that as the number of abnormal sperm increases, the fertility decreases. It is important to remember that 500 million normal progressively motile spermatozoa are recommended for inseminating mares artificially. It is not known how many sperm are needed for natural service. Many researchers feel that we need from 60 to 70 percent morphologically normal sperm for good conception.
If a stallions semen evaluation is below normal then we should determine the cause. Many of these causes can be corrected. We must be certain the collection and handling of the semen is as error free as possible. Many times when we find changes that indicate infertility we should re-examine the stallion. Infertility is usually not 100 percent, so even if we have some problems that can not be corrected we may be able to manage our way through the breeding season and have a respectable conception rate. Factors such as time of year, nutrition, fertility of mare, and others affect the conception rate and must be considered.

To summarize I will list a number of factors as stated by Dr. B. W. Pickett from Colorado State University:

1. Semen from each stallion should be evaluated prior to the breeding season and before sale if the animal is to be used for breeding.

2. The stallion should have at least four days of sexual rest prior to semen evaluation.

3. At least two ejaculates should be collected an hour apart for evaluation. Ideally, two ejaculates should be collected followed by daily collections for 1 week.

4. The volume of gel-free semen is relatively unimportant.

5. Second ejaculates normally contain about one half the number of spermatozoa found in first ejaculates.

6. Total spermatozoal output per ejaculate from normal stallion will vary from one billion to thirty billion, depending upon testicular size, frequency of ejaculation, season, and age.

7. For reliable estimations of motility, equine semen should be extended in an extender that presents clumping of the sperm.

8. The PH of normal first ejaculates is always lower than the PH of second ejaculates. (Exceptions - very young stallions.)
9. The semen and urethra should be cultured during the exam as well as periodically during the breeding season.

10. The variation in stallion seminal characteristics is extremely large because of season. This must be considered when evaluating semen.

11. Testicles should be measured.

References:

1. Clinical Fertility Evaluation of the Stallion
   R. M. Kenney, 1975 Proceedings of American Association
   of Equine Practitioners.

2. Factors Affecting Stallion Management
   B. W. Pickett, Colorado State University, Fort Collins
   Colorado

3. Breeding Soundness Examination of the Stallion
   A. B. Caudle, Equine Reproduction Seminar
   University of Georgia, Athens, Georgia.

4. Physical Examination and Genital Disease of the Stallion
   Dean P. Neely, Maryland Equine Center, Inc.
   Cockeysville, Maryland.

5. Evaluation of Stallion Fertility
   John P. Hurtgen, New Bolton Center, Kennett Square, Pa.

6. Disorders Affecting Stallion Fertility
   John P. Hurtgen, New Bolton Center, Kennett Square, Pa.

7. Artificial Breeding Of Horses
   Wendell L. Cooper, Veterinary Clinics of North America

8. Management of the Stallion for Maximum Reproductive Efficiency
   B. W. Pickett, J. L. Voss, E. L. Squires and R. P. Amann
   Animal Reproductive Lavoratory, Colorado State University
   Fort Collins, Colorado, August 1981.
Artificial insemination is one of those subjects which, like politics, children, budgets, and horses themselves, engenders a great deal of involvement and emotion for those who must deal with it on a continuing basis. But A.I. is simply a tool for use in breeding livestock (and people, now); it is not an end in itself, though it may appear to be in the midst of breeding season. Understood and implemented properly, it can provide a significant advantage in the management of breeding horses, however, it does have drawbacks which can utterly defeat its effectiveness in a variety of situations. Recognizing the pitfalls beforehand can be of value to the uninitiated horseman considering its use.

First Considerations:

There are several disciplines that are directly involved in the management of an A.I. program, and a functional degree of proficiency for personnel should be given careful consideration before any A.I. program is undertaken.

1. A thorough awareness of the anatomy and physiology of equine reproduction is essential to understand what is normal or abnormal about any stallion, mare, ejaculate, technique or result. Reference points for comparison are critical for a system that must be continually monitoring its own performance. Veterinarians knowledgeable in equine practice are an indispensable asset to any operator breeding horses but the total management of an A.I. program is a 24 hour affair year-round; for most non-resident vets the burden of managing the A.I. program for a particular farm is impractical. Realizing the potential of A.I. depends upon the combined skill and cooperation of personnel, the efficiency of the organization producing semen, the inseminator, and the manager of the herd. The more that on-site staff know about what their work entails, the better their chances for success.

2. The ability of personnel to train and handle horses in a mating situation that is intended to produce optimum results day after day, without risk to staff or stock, necessitates understanding the behavior and psychology of horses - and people. Procedures or techniques should have a consistent pattern yet be readily adaptable to individual horses or situations in the breeding shed.

3. Comprehensive herd health management and veterinary care will keep the breeding herd predisposed to reproductive success. For a commercial breeding farm this includes pre-arrival care and quarantine procedure, as well as a sound teasing and palpation program.

4. Laboratory techniques including microscopy, pipetting, autoclaving, etc., contribute to accuracy in processing semen and minimal contamination. These techniques are not difficult to learn nor is the equipment difficult to acquire; it can be difficult to motivate staff into using them properly.
consistently — there is temptation to take shortcuts which may prove detrimental in the long run.

Pros and Cons

In situations other than for research or teaching, an A.I. program is usually justified by some over-riding consideration such as economics or safety, but for the average breeder there are plenty of other positive and negative points to weigh. The following is a list that covers many of them:

Advantages

(1) Minimizes spread of reproductive infections via (a) minimal contact between mare and stallion, (b) reducing inseminate volume and dilution with extender decrease the concentration of bacteria that enter the uterus, and (c) the use of antibiotic-treated extender.

(2) Eliminates stress of live cover — lameness, incapacity of old age, differences in height, shy breeders, show horses, etc.

(3) Reduces risk of injury to handlers and breeding animals.

(4) Conception rates overall can be enhanced.

(5) Stallions can be used more efficiently, without overuse, and fertility status can be monitored through breeding season; decreased fertility can be corrected or circumvented with management.

(6) More mares can be bred per day.

(7) Mares can be bred while in quarantine.

(8) Mares can be bred at the most opportune time for maximum chance of conception. Works well with synchronized mating schedules and embryo transfer.

(9) Mares with windsucking conformation can be bred via speculum insemination and left sutured.

(10) Increased number of progeny of desirable sire.

(11) Shipped semen provides potential benefit in cost reduction of breeding, labor and care of a stallion.

(12) Frozen semen — ditto.

(13) Encourages careful record-keeping.

Disadvantages/Criticisms

(1) Prohibited by some breed registries.

(2) Detrimental effect on fertility when performed improperly — management related.

(3) Expense — start-up costs and labor-intensive for maintenance of sanitation.
(4) Inhibits natural selection and decreases genetic variation.

(5) Invites fraud and error with parentage.

(6) Less popular stallions may have marked decrease in demand.

(7) Larger number of A.I. foals may decrease the average value of each.

(8) A.I. does not provide a stimulus for oxytocin release.

(9) Requires trained personnel.

The pros and cons of using A.I. in a breeding program have to be evaluated on a personal basis by the operator. Some of the criticism leveled at A.I. is highly arguable. Perhaps the foremost consideration of all is whether or not it would complement your existing management and your facilities. Both of these factors are important. A management program that is struggling with problems of labor, layout, work load, conception rates and health care is unlikely to find A.I. to be a cure-all solution. It may simply compound the difficulties since it is a system requiring a great deal of attention paid to detail; A.I. has often been criticized as being responsible for lowered fertility when in fact it really just aided in pointing out problem individuals or weaknesses in management. The need for effective teasing, palpation, uterine cultures and biopsies and administration of antibiotics will not be offset by the use of A.I. Likewise, a physical plant that is difficult or impossible to keep clean, or that absorbs numerous man-hours in compensating for its flaws will sorely test the advantages that a well-run A.I. program is capable of providing.

The cost of a fully-equipped A.I. set-up can run up to $10,000 exclusive of facility renovations or labor, but average expense for start-up programs in existing facilities falls more in the range of $3,000 - $5,000. Artificial vaginas, lab instruments, glassware and supplies are specialized equipment items that are essentially mandatory for efficient operation but some items such as microscopes and incubators can be purchased used in very serviceable condition. Annual budgets for operating will vary according to the number of mares bred, of course, but upkeep for supplies and replacement of worn out equipment in an operation breeding about 50 mares can be held below $1,000, again exclusive of labor, utilities, insurance, etc.

A good breeding area that is free of hazards, can be kept clean, well-lit and conveniently located near the lab is very advantageous. Holding stalls for foals and breeding stocks are also helpful. Most phantoms are homemade; ours is simply a log notched to fit over stout posts sunk in concrete, covered with plasticized canvas that can be washed, fitted over dense foam padding. Some farms mount their phantoms on a wall bracket that allows it to be swung out of the way when not in use. There are some manufactured types available that can be adjusted for height. Good footing around it is a must.

Our lab is very small, a converted stall, with adequate space but I'd prefer more. We keep the room quite warm when in use, around 90° or so, even in summer. Hot and cold running water, big sinks, cabinets and counter top space, power supply and room for expansion are points to consider.
Factors Affecting Fertility:

Guidelines for Artificial Breeding

1. Fertility, the ability to reproduce biologically, is affected by several factors, only some of which can be enhanced by management. Adequate nutrition, freedom from disease and season of the year are items that breeders have some degree of control over. The age of the horses, their inherent fertility and their sexual behavior are factors that we have little or no control over, but must attempt to manipulate or "manage around" to stack the odds in our favor. Inherent fertility depends upon all the right parts being in all the right places - good sexual conformation, etc. - and functioning normally. The best proof of this is live foals, but for stallions we attempt to evaluate it on the basis of semen quality (i.e., motility, longevity, morphology), settling rate per breeding cycle, conception rate for maiden mares, and overall conception rate. In the case of mares we use foaling history, ease of settling, biopsy, cycling lengths and palpations to make a similar evaluation. Sexual behavior depends upon hormonal balance, past experience, the opportunity to interact in a favorable environment, teasing techniques, and the interpretation of teasing patterns.

2. The care with which semen is collected and processed is critical since it is sensitive to temperature, light, time, water, blood, urine, chemicals and pathogens. All of the equipment that contacts semen needs to be kept incubated within a narrow temperature range (38-44° C), and maintained in a condition of minimal contamination. The usual recommendations call for an effective program of hygiene for the horses, staff, and facilities as well as sterile or disposable items used for semen wherever possible. Semen quality remains best when handled as little as possible over the shortest period of time.

3. Semen extenders can enhance the viability of sperm from stallions with low fertility and are especially beneficial with stallions known to be shedding pathogenic bacteria since they permit the use of antibiotics in the inseminate itself, usually without detriment to the sample. Extender without antibiotic will routinely prolong the survival of sperm and protect a sample from unfavorable environmental conditions. In most cases the addition of extender will show an increase in sperm motility in comparison to raw semen viewed under the microscope, but we have found that this is not foolproof, nor necessarily restricted to particular stallions. It is easier to make a proper evaluation of semen motility for "high count - low volume" stallions when the sample is diluted with extender, and this applies as well for extending the total volume of an inseminate for infusion of the mares being bred. There are several formulae in use in the industry, and they can be prepared well in advance of breeding, packaged in individual doses and frozen until needed. "Skim milk" extenders have an advantage over "cream-gel" in that motility of sperm can be observed microscopically unobscured by fat globules, and they are usually simpler to prepare.

We have found it highly advisable to test each batch of extender for motility results before using it to breed mares. If it appears to suppress motility, we discard it and prepare a new batch of extender, or breed with raw semen alone. Antibiotics and buffers (if needed) are added to extender after thawing.

4. The skill of the inseminator does contribute to overall fertility. Mares can be damaged by incautious technique, and semen requires gently handling.
Nothing can substitute for training by knowledgable experts. The procedure we follow is standard and involves the inseminator going through a mental checklist before and during the actual insemination process for each mare:

Equipment sterile and with no defects in assembly, mare washed, sterile sleeve and lubricant, mare relaxed with handler, vulva not sutured, pipette covered by hand and arm, syringe secure, go in easy, up into vagina (not in urethra - it can happen), no hymen, membranes not sticky, find cervix, check dilation and twists or adhesions, check angle and align pipette, insert pipette slowly short distance into cervix along the finger and gently test for ease of passage (if it feels sticky, the mare might be pregnant) or obstructions (the pipette might be stuck in a fold), proceed slowly into the uterus, seat the cervix around the pipette, gently expel the semen, take your time - like 15 seconds - feel for resistance or semen coming back out the cervix (bad positioning, back up a bit), move with the mare if she does, withdraw slowly when the semen is infused, stay aligned along the arm and finger, get the tip back in the palm, withdraw your arm and pipette, keep the vulva closed, check sleeve and pipette for pus, urine, blood or discharge when you are done.

With practice the procedure becomes second nature. No two are exactly alike and breeding, like life, is full of surprises. The approach we use is geared to be calm, relaxed, with minimum upset to the mare, maximum safety for the inseminator's arm and her tract, minimum contamination for the semen and the mare's uterus.

5. The number of sperm per individual inseminate is another factor which has an effect on fertility, and in this regard management has its greatest degree of control over the situation. The total number of sperm contained in an ejaculate sample collected from a stallion is dependent upon that stallion's libido, testicular size, age of the animal, season of the year, his frequency of ejaculation and freedom from the influence of inhibiting drugs. Average figures usually fall in the range of 50-150 ml. of total volume gel-free, with a concentration (count) of 100-300 million sperm cells per ml. Not all the sperm are alive, nor are all of the live cells capable of fertilizing an ovum.

We use a ratio to establish sperm motility that has worked well for us over the years in evaluating semen samples. Observing a sample under the microscope, we make an estimate of the percent of sperm that show obvious motion (alive) to give us the bottom figure of the ratio, i.e., "total motility". Then we estimate the percent of sperm that show progressive forward motion, i.e., "progressive motility", to give us the upper figure. We do this routinely with each sample, both raw semen and after adding semen to extender in equal volume (1 to 1 ratio). For us, a motility of "75 over 90" means that a sample showed 75% progressive motility in an ejaculate in which 90% of the cells appeared to be alive. Usually the extended sample will produce a higher percentage, which may be slightly or dramatically different. This method gives us not only a little more comparative information about the stallion's performance, but also monitors the effect or quality of the extender. If sperm motility is depressed and the extender contained antibiotics, we will test again using untreated extender. If that still does not restore motility to the level observed in the raw sample, then we will breed the mare with raw semen. The point here is, again, to stack the odds in our favor regarding the quality of inseminate.
It is the progressive motility percent that is used to determine the amount of semen needed to breed each mare and it is calculated:

\[
\% \text{ Progressive Motility} \times \text{Concentration} = \text{No. motile sperm/ml}
\]

e.g. \[
.75 \times 200 \text{ million sperm/ml} = 150 \text{ motile sperm/ml}
\]

The researched recommendations that we use call for an inseminate of 500 million motile sperm for "maximum efficiency" or "the least amount of semen that will have the best results" for achieving pregnancy. Recent research suggests that perhaps just 100 million motile sperm is sufficient, but we are still mindful of the odds. Based on the former figure, this would require:

\[
500 + 150 = 3.3 \text{ ml of raw semen alone}
\]

or

\[
3.3 \text{ ml semen} + 3.3 \text{ ml extender} = 6.6 \text{ ml of extended inseminate at a 1:1 dilution to breed a mare from this collected sample. If the stallion had produced an ejaculate of, say, 70 ml gel-free semen, it would be possible for us to inseminate up to twenty mares from the single collected sample of that day.}
\]

Preparation for Breeding:

The normal care and management of the breeding herd does not differ in any respect for horses used in a program of A.I. from the methods employed on operations performing strictly natural covers.

Stallions

General good health is maintained by the usual methods. All of our stallions get plenty of free exercise every day and several are kept on a schedule of training for condition year-round as well. They are driven in harness, worked under saddle, lunged or all three combined. Occasionally, we have exercised them by swimming in a pond in summer. Some of our stallions have mares as pasture mates year round, which will tend to keep them contented. They are all used for teasing to varying degrees.

We will put the breeding stallions under a lighting program of 16 hours circa December 1, and will begin training new breeding stallions, making periodic semen collections, culturing and flushing from the end of December on. We aim toward a peak of condition at roughly the spring equinox, maintain them through the breeding season, and then begin to take some weight off them in late summer through the fall. This will depend on the length of their season, since some of our stallions have continued to breed through October.

Throughout the breeding season there will be a number of criteria beyond simple conception rate that we will use to monitor and evaluate a stallions performance:

- average time to mount
- average time to ejaculate
- total breeding time
- collections per conception
- repeat mares w/pos. cultures post-breeding
- conception rate: by month; per cycle; for maiden mares; overall
- periodic cultures of semen and/or stud
In warm summer weather, the horses are stabled daytime and pastured at night, the reverse of winter, so stallions go off the lighting regime when this changeover occurs.

Mares

Health maintenance and lighting schedule is the same as for stallions. Teasing, culturing, uterine treatments, biopsies and flushing are also commenced in December. We tease mares at least every other day, usually early in the morning before the vet arrives, and frequently every day during heat. Records are kept updated daily. The early winter is spent getting the open mares ready to breed so that by February 15, both they and we are prepared for the first fertile estrous cycle.

We have not put foaling mares under lights, but recent literature has recommended it. These mares are pastured separately and monitored as a group since they will most likely spend several months as pasture mates. It is the extremely rare occasion that we will breed a foaling mare on her foal heat, but if all criteria are met and a mare's owner specifically requests it, we will do so.

If possible, we try to obtain two consecutive clean uterine cultures before we breed open mares, but this is not always practical for contract mares. Often a culture is taken when a mare starts in a breeding heat; if positive results are called in 48 hours later, we can be sure to inseminate with antibiotic extender later in that same heat. We have had good results with this method. If we are presented with any indication of an infection in a repeat mare that does not show up in prior cultures, such as discharge or short cycling, we will often re-culture at the return heat and follow this procedure. It quickly becomes evident that accurate records, a good working relationship with the vet and a reliable link with a bacteriology lab are key elements in managing problem mares.

All of our rectal palpations are performed by the vet on an every other day basis through the breeding season whenever possible, but occasionally there will be mares that need to be followed more closely than that. This can be a costly part of total breeding expense which managers are held responsible for most of the time. There appears still to be some controversy concerning the advisability of frequent manipulation of the mare's reproductive tract and its effect on pregnancy rate. We have had no concrete evidence in our experience to indicate that palpations interfered with breeding success. Until mares are made with windows for viewing their internal organs, there seems to be no alternative other than breeding based upon behavioral heat signs alone if palpations are not performed. This system can and has worked well with excellent conception rates for many horse breeders, however, for a commercial breeding operation striving for the highest degree of success in the shortest period of time with mares of all ages coming from all types of management backgrounds, there really is no alternative to palpating. Weighed against the total expense of stud fees plus the cost of boarding an open mare for a year, the cost of even the most intensive palpation program remains proportionately small by comparison. From the stallion manager's point of view, if a contract mare is shipped home open, with the ensuing disgruntlement of the owner to follow, it is far better to possess documentation in hand supporting both the fertility of the stallion (which is usually the first criticism volunteered) and your efforts at getting the mare in foal or
managing around her problems (usually the second) to verify the approach taken for that particular mare. A complete record of palpation findings can be invaluable in this regard and, in addition, is the only reliable starting point for methodically plotting a road-map to the source of a mare's reproductive difficulties.

In the normal course of events, teasing will produce the first indication that a mare is coming into estrus and we evaluate her behavior in the teasing chute in a graded fashion (Out, Indifferent, Fair, Good, Hot) according to the manner in which she displays before the stallion. If we are suspicious of a mare's behavior based upon the history supplied by an owner or farm manager, we will have her palpated every 4 - 8 days until we can determine a starting point for a heat according to ovarian activity, should the mare not "show" to a stallion for a prolonged period of time. Once the mare has begun a definite estrus, the vet will examine her to monitor the presence and development of maturing follicle, accompanied by favorable uterine tone and a relaxing cervix. If a mare has had Caslick's surgery, the vulva may be opened enough to allow insemination to be performed without discomfort. Usually by the third to the fifth day of estrus the follicle will have reached the size and consistency where it is approaching ovulation, and the mare is determined ready to breed. Normally, the mare is inseminated every other day until the vet palpates an ovulated follicle. "Cliff-hangers" may be recommended for daily service since we'd like to have fresh semen in the mare's tract when ovulation occurs.

Collection Procedure:

Since the bulk of the breeding season is also foaling season, we are able to have our night crew member wash, sterilize and prepare the breeding equipment from the previous day's work during the shift of watching over mares that are due. Incubators in the lab run round the clock and are sufficiently large to contain all of the items that are needed. Final preparations before collection entail assembling the artificial vagina, filling wash buckets, washing the phantom, and thawing extender samples.

The stallion being collected is brought to the breeding shed, where a mare in heat is used to tease; when the stud presents an erection, the handler moves him onto the wash rack where a staff member washes his penis. We use two stainless steel buckets with disposable plastic liners; warm water and cotton (and a dash of Ivory if he's dirty) in one, warm water and a rinse cup in the other. The stallion is about 25 feet from the mare at this point, usually aroused but far enough away to be calm with her in plain sight. If the stallion loses the erection in the midst of washing and rinsing, the mare handler can move the mare closer as needed to stimulate the desired response. The person washing checks the stallion's penis for lesions, cleans the diverticulum, shaft, rinses and pats dry with paper towels.

In our set-up, the stallions are conditioned quickly to the sights, sounds, and movements in the breeding shed. A right turn away from the teasing chute means "wash rack", a left turn means "phantom", and a human coming out the lab door with an A.V. in hand means "final approach". The handler takes the
stallion to the teasing chute and when ready turns to the phantom about 25 feet away for a mannerly walk up. A "click" from the collector means "mount". When the A.V. is placed on the stallion's penis, nature will take its course within 10-20 seconds. In the event that a new stallion is reluctant to ejaculate or is distracted by the unfamiliar surroundings, we will stand the mare on the opposite side of the phantom from the stallion and tease right over it as the barricade. Allowing the stallion to become highly aroused by the mare, we simply direct the stallion onto the phantom and quickly apply the A.V. when he makes his instinctive mount, at the same time turning the mare so that her tail remains in close proximity to the stallion's nose. This method rarely fails to precipitate an ejaculation in short order and we use it routinely to collect for breeding evaluations on stallions totally unfamiliar with an A.V.

Novice stallions are watched closely for signs of fainting which will happen occasionally. The slope of our phantom allows studs to mount and dismount comfortably while forcing them to bear weight on their hind legs; horizontal phantoms often permit the vigorous stallion to get all four feet off the ground and become hung up off balance, which can be dangerous for staff and stud alike. For footing, we use cocoa mats on top of our rubber flooring around the butt end of the phantom. studs are handled with a stud shank through the mouth or with a bridle. The idea is to keep the situation very controlled while inflicting little or no pain on fractious animals that would tend to inhibit breeding ardor. With young stallions that are being trained to breed, we are aware that the patterns of behavior we instill in them will most likely imprint for life, so it is necessary to leave them with a good impression. We have found whips to be far less desirable or effective than a bridle with an experienced handler on the shank who can keep a stud calm, attentive, and willing to perform. It has also been our policy to have the person who is in the position of highest risk call the shots - either the stud handler or the collector - and talk is kept at a minimum so that directives can be spoken quietly and still be heard.

Stallions are allowed to dismount when they are ready, with steady legs, given a pat on the neck if they performed well and returned to a stall. In hot weather, we'll rinse them off and cool them out before stabling or turn-out.

The mares to be bred are brought into the shed after the stallion leaves, put into breeding stocks, tails wrapped and prepared for insemination by washing in the same manner as for the stallion. We will often have a handler hold a foal at the nursing mare's head or put two mares next to each other in the stocks so that the mare being bred will stand quietly. It can be dangerous (as well as frustrating) if a mare is vocalizing and moving about when the inseminator is trying to work inside a fragile target in motion.

Lab Procedure:

A detailed description of our lab procedure for the semen sample would read as complex and time-consuming in print, but it really is not. The normal work-up includes motility evaluations, mixing with extender, determination of count, loading the breeding pipette and getting sleeved up. One person can do it all in less than ten minutes while mares are put into the breeding stocks, and prepared for insemination by one or two other staff members. It
is easy to have all services finished within 20 minutes of ejaculation if the crew is organized and the lab has been well-prepared. Some key elements at this stage include making certain that the right mare is inseminated to the right stallion's service, that records are kept of who got bred, by whom, with what and when, and note any pertinent remarks right away. Handle semen in as few steps as possible and do not pour the left-over raw sample down the drain until after the last mare is bred. Breeding kits can come apart at very inopportune moments, and mares with full bladders tend to evacuate them when someone's hand inadvertently applies pressure; and, flies have been known to walk up the length of a pipette as it enters the vulva. We've found it much easier to start over again with an uncontaminated breeding kit (compared to treating an infected mare) at the cost of a few minutes delay.

Cleaning lab equipment, A.V. parts and buckets is boring, tedious and absolutely critical to the success of the whole program in our estimation. The procedures that are recommended by research people have changed over the years as practice in the field by people like us has come up with some questions regarding types of chemical disinfectants and residues, particularly for rubber items that contact live semen. I expect that the techniques used will continue to evolve. For now, we disinfect everything with Nolvasan solution in water for 20 minutes, rinse in tap water again, followed by thorough rinsing with de-mineralized water, hung or shelved to air dry. Glassware and other items that can withstand autoclaving are packaged for steam sterilization and encased or covered with sterile Whirl-pak bags when cool before storage in the incubator. Breeding kits are purchased complete and disposable. Damaged or defective kits are saved, unused, for return to the manufacturer. The A.V. liners we use require refrigeration between use; we slip them inside a clean sleeve before storage. We behave as if we function in an operating room environment, exclusive of gowns and gloves, but with clean hands and minimal contact. It is the best we can achieve with practical effort and expense. The diligence pays off in clean pregnant mares.

Incidentally, an unused sample of raw semen that is left accidentally overnight inside an incubator will generate a nasal assault capable of bringing the very rottenest of eggs to their knees. It usually doesn't occur more than once a given season at our farm. Fortunately, the odor doesn't linger after the offending sample is removed.

The A.V.

There are several types of equine A.V. available in the industry (Colorado, Japanese, Nasco, Haver-Lockhart), all of them designed on the same principle: a water-jacket that can simulate natural breeding, maintain temperature and allow semen to be harvested in good condition. They vary in factors of weight, removable parts, flexibility, durability and cost. The R.R.F. version is a conglomerate of mixed parts, flagrantly stolen ideas and home-spun innovation. It took us several years of inquiring with researchers, complaining to manufacturers and trial/error to develop a lightweight, tough, reliable device that is easily maintained and rarely malfunctions. It allows us to filter out the gel as a stallion ejaculates, which eliminates one or two later steps in semen handling, holds temperature even on cold winter days outside for up to 15 minutes without a recharge, won't squirt water on a stud or collector, assembles in minutes, all parts washable, and it can withstand a considerable beating. It (she?) has to be seen to be appreciated.
Seems like a lot of details to handle, doesn't it? Well, this is really just a brief description with some experience-based views thrown in, hopefully to help horsemen who might be considering A.I. to negotiate the curves before they arrive. The "cookbook" that we compiled on the farm to use in instructing our staff is considerably longer than this article and still it only serves as an introduction to the real task. The best training for A.I. is given at Dr. Pickett's course in Colorado; a brief list of references for reading up on the subject is included below. Digesting a great deal of information beforehand was very helpful in keeping us oriented when we embarked on an A.I. regime nearly 10 years ago, and we continue to pour over the scientific and popular literature now to stay up-to-date in our techniques.

My predecessor, Jack Conner, had this to say about the subject in a similar article written after four years of using A.I. at R.R.F.:

"Every stallion collected and every mare inseminated will add to the expertise of those involved in the operation of the program. When starting, the time consumed will be far greater than with natural service. However, as a routine is developed and the procedure becomes more familiar, the time will decrease. Ineptness may result in a lower conception rate in the early stages. This will improve as the personnel develop their talents."

We have found this to be quite true. We are still learning and still using A.I. for all but our Thoroughbred clients. And what we've learned has helped us be more efficient in our breedings by natural cover.

Selected References:


TECHNOLOGY IN THE HORSE BREEDING INDUSTRY

Steven Jennings, M. S.

"High tech" is a term we have all heard quite often in the last few years. Computers, gene splicing, in vitro fertilization and other advances have been the subjects of numerous news stories. This onslaught of new technology has not missed the livestock industry. The greatest advances are seen on dairy farms. Recent developments in superovulation, embryo transplants and even splitting embryos are at the forefront of advancing technology designed to improve the quality and efficiency of livestock production.

Although not quite as advanced as the dairy industry, the horse industry has received its share of new technologies in recent years. Considerable progress has been made in freezing stallion semen. It is not unreasonable to expect that within the next decade the use of frozen semen will be as efficient as the use of fresh semen. Advances in the diagnosis and treatment of problems that have plagued horses for centuries are bringing equine medicine ever closer to the level of sophistication of human medicine.

The breeding farm has not been left out of this new jump into the computer age. There are technologies available today that can aid in improving the reproductive efficiency of most breeding operations. The advances discussed here have all been introduced recently. Some of them can be used by the average producer. Others will be available only to the veterinarian or large breeding operation because of cost or the level of expertise required to use them. Most of these, however, will soon become integral parts of horse breeding management.

**Oral Progestins**

Progesterone is commonly known as the hormone of pregnancy. It also plays an essential role in sexual development and in the normal estrous cycle of the mare. After ovulation, the cells that once formed the wall of the follicle are altered to form the corpus luteum on the ovary. The corpus luteum produces progesterone which creates a uterine environment that allows an embryo to survive and develop. Progesterone is the best known of a class of compounds known as progestins. Progestins have similar chemical structures and perform similar functions, although specific functions may differ slightly.

A synthetic progestin known as altrenogest (now sold as ReguMate) has been developed to be administered orally to mares. It is suspended in an edible oil and simply added to the feed. This compound has just been approved by the FDA and is now on the market. It can serve several purposes on the breeding farm: a) to block or shorten transitional estrus; b) to synchronize estrus among mares; c) suppress estrus in mares being raced or shown; and

*aReguMate, American Hoechst Corp., Somerville, N.J. 08876*
use during the transition period

d) aid in the maintenance of pregnancy.

For the purposes of this discussion, the transition period is defined as February to mid-April. Note that the transition period is simply a period of time. It is not a physiological event. It is the time of year between winter anestrus (when most mares are not cycling at all) and the breeding season.

The transitional estrus is the first estrus of the year. It takes place during the transition period. This is the estrus about which many breeders tell stories. Mares may be in behavioral estrus for two, three or even four weeks. One breeder told of a mare that was in heat for 44 days. Split estrus and other abnormal patterns can also be seen during the transitional estrus.

Altrenogest can be used to shorten the transitional estrus or even block the transitional estrus if administered at the right time during the transition period. The oral progestin is fed to mares daily for 15 days. Mares in estrus at the onset of treatment will stop showing estrus within a few days and will not be in estrus during treatment. Four to five days after treatment is stopped mares will begin to demonstrate estrus. Altrenogest can also be given to mares not in estrus. They will also demonstrate estrus four to five days after treatment is stopped. This estrus is a normal one for most mares.

Altrenogest does have limitations. It cannot be used on mares still in winter anestrus. The ovaries must be active. A field study of 440 mares at 17 different locations indicated that administration of altrenogest prior to early March was ineffective in inducing normal estrus. This was probably due to the fact that many mares treated during this early transition period were still in winter anestrus. After mid-March, however, altrenogest made a significant difference in the percentage of mares that demonstrated normal estrus (75%) when compared to mares that received no treatment (55%). The length of the first estrus was also shorter for altrenogest treated mares (7.7 days) than for untreated mares (12.1 days).

Two conclusions can be made from this and other research on the use of altrenogest during the transition period. First, mares must have some ovarian activity for treatment with altrenogest to be effective. They do not have to be in estrus for the treatment to work, but the small inactive ovaries of anestrus will not respond. Secondly, the best candidates for altrenogest treatment appear to be mares that have been in estrus for 10 days or more.

Altrenogest is more effective during the early transition period if used in conjunction with artificial lighting. Placing mares under artificial lights to expose them to a total of 16 hours of light per day has long been known to stimulate mares to begin cycling earlier in the season. Research was conducted at Colorado State University's Animal Reproduction Laboratory to test the effect-
iveness of this combination of management practices.

Mares were placed under artificial lights (200 watt incandescent bulb placed 4 meters above the stall floor) for 16 hours per day beginning on December 1. On January 25, half of the mares were placed on an altrenogest regime. Treatment lasted for 15 days. All treated mares demonstrated estrus within 12 days after the end of treatment. Less than half of the mares that did not receive altrenogest demonstrated estrus during the same time period. In addition, the first estrus after the treatment period was significantly shorter for treated mares (6.8 Days) than for untreated mares (11.8 days).

The authors concluded that the use of altrenogest with artificial lighting works well for inducing normal estrus at an early date in most mares. It must be noted again that there must be some ovarian activity in order for altrenogest to work. The mare does not have to be in estrus, but even with an artificial photoperiod, mares with the inactive ovaries of winter anestrus will probably not respond to this treatment.

Use in Estrous Synchronization

Estrous synchronization is a process that allows a group of mares to be in estrus at the same time. From a practical standpoint, this practice is of limited value in the horse industry. Estrous synchronization can, however, help a farm manager maximize use of a stallion in an artificial breeding program where only a few mares are bred with each ejaculate.

Some claim that estrous synchronization could be used to shorten the breeding season. It can be applied to open mares so that they can be bred earlier in the season. However, it is doubtful that estrous cycle manipulation can actually reduce the length of the breeding season on most farms. Most mares bred late in the season are usually late foaling mares and mares that did not conceive as a result of previous breedings during the season. Therefore, the breeding season cannot be shortened unless these mares are eliminated from the stallion's book.

Altrenogest will prove to be superior to prostaglandins as a tool for estrous synchronization. Prostaglandins are only effective when the corpus luteum is active. Some mares in a group will not respond to prostaglandins because they will not be in the right stage of the estrous cycle. Altrenogest works regardless of the stage of the cycle.

Mares are treated with altrenogest daily for 15 days. Mares in estrus at the onset of treatment will generally stop demonstrating estrus in two to three days. After treatment has ended, most mares will demonstrate estrus in three to six days. Research has also proven that fertility is not adversely affected by the treatment. If altrenogest is to be used for estrous cycle manipulation, mares must be fed individually to ensure they receive the proper dosage.
Specific indications for altering the estrous cycles of certain mares may occur during a breeding season. The circumstances involved would determine whether prostaglandins or altrenogest would be best suited for the purpose. If any doubt exists, a veterinarian should be consulted.

**Use in Suppression of Estrus**

Almost everyone who has shown or raced mares has had mares that do not perform well while they are in estrus. Altrenogest can provide a safe method of suppressing estrus in mares. Research has shown that prolonged treatment with altrenogest has no toxic or pathological effects on the mare. In addition, there is no reduction in mare fertility as a result of long term treatment with altrenogest.

**Use in Maintenance of Pregnancy**

Progesterone deficiency has been suggested to be one cause of embryonic and early fetal loss in mares. Until the introduction of oral progestins, no reliable and practical treatment for progesterone treatment has been available.

Several methods of maintaining pregnancy in the absence of a natural source of progesterone were studied by researchers at Colorado State University's Animal Reproduction Laboratory. Forty-eight mares were divided into six groups containing eight mares each. The ovaries of all mares were removed at 34 to 35 days of gestation. Three groups of mares were given one of three progesterone treatments. Two groups of mares received one of two concentrations of altrenogest. Treatments continued until 100 days of gestation or until abortion took place. The sixth group of mares received no treatment.

The results (Figure 1) indicate that the only reliable methods of treatment were 1000 mg of repositol progesterone administered every four days and the two altrenogest treatments. One mare from each group of altrenogest treated mares aborted during the experiment. The researchers speculated that these mares did not abort because of progesterone deficiency. The repositol progesterone treatment was found to be impractical for field use. Therefore, treatment with altrenogest was the only effective and practical treatment for progesterone deficiency studied.

As with all other technologies, oral progestins cannot be a substitute for sound management practices. This substance also has the potential for the types of abuses now occasionally seen with prostaglandins. Altrenogest will not eliminate all problems with the estrous cycle. It will not prevent all abortions, in fact, it will not produce the expected results in all mares. There are exceptions to practically every rule for broodmares, and nothing will be effective 100% of the time. Despite these limitations, altrenogest may prove to be the greatest breakthrough yet in terms of hormonal treatments because of its versatility, reliability and ease of application.
Ovulation Indicators

The idea of using a vaginal probe to predict ovulation is not new. Russian scientists began applying this principle to cattle in the early 1960's. Since then, a fairly large body of research has been published concerning the use of these devices on cattle and some work has been done with sheep and swine. The application of this principle to horses had only been discussed until a few years ago.

Now there is an ovulation indicator on the market that can be used on cows, mares, ewes, or sows. It is known as the Ovascan. The unit consists of a plastic probe with several electrodes arranged in a circular pattern around the end of the probe. A cord links the probe and power unit that has a digital readout. The unit is completely portable.

The probe is designed to measure changes that take place in the mare's vaginal tract during estrus. These changes are believed to be caused by hormonal changes. The follicles on the ovaries secrete estrogens. Estrogens are hormones that stimulate changes in the mare's reproductive tract which create an environment suitable for conception to occur. They also cause a mare to demonstrate the characteristic behavior of estrus. The levels of estrogens in the blood increase until they reach a peak concentration approximately 12 to 24 hours prior to ovulation. A very sharp decrease in estrogen levels is then seen after the peak value has been attained (Figure 2).

Theoretically, the changes in estrogen levels stimulate changes in the composition of fluids secreted by cells in the vagina and cervix. These changes are measured by the probe. As estrogen increases, the concentration of ions (salt content) in the fluids increases. The increase in ions causes a decrease in electrical resistance (i.e., the resistance to an electrical current passing through the fluids is reduced). When the estrogen concentration reaches its peak, the electrical resistance of the vaginal fluids is at its lowest point (Figure 2). Thus, the resistance of the vaginal fluids is lowest approximately 12-25 hours prior to ovulation. Research has shown that this is the best time to breed the mare.

The Ovascan can be used by a layman. The probe is inserted in the vagina and moved around enough to assure that the electrodes are evenly coated with vaginal mucus. A reading is then obtained and recorded. This procedure is repeated daily while the mare is in estrus.

Samples of patterns obtained by using the probe are shown in figure 3. Note that not all mares demonstrate the same pattern. The general pattern is a baseline at the beginning of estrus followed by a sharp drop in reading toward the end of estrus. Some scientists and users of the device contend that there is

Animark Corp. - Available through Ideal Instruments, Chicago, Il.
to much variation among mares for the probe to be beneficial. Other users have had considerable success with it. Further objective research using adequate numbers of mares would be beneficial in resolving this controversy.

Occasionally air will enter the vagina when the probe is used. This introduction of air stretches the walls of the vagina so that the probe cannot make adequate contact. The condition is known as pneumovagina. Once the air is eliminated from the vagina, the probe will function normally.

The Ovascan sells for $1,680. Effective use of this product does require some practice and skill, but it can be used by the layman. Using the probe has the advantage of being less traumatic to the mare than palpation. Most mares in estrus offer no resistance to the vaginal probe. It has been suggested that this vaginal probe can indicate the presence of a vaginal infection. However, the ability of this device to detect multiple ovulations and other abnormal physiological occurrences in the mare has not been conclusively determined. It is suggested here that mares undergo a thorough prebreeding examination at the onset of estrus and that this probe is only used for purposes of indicating ovulation.

Despite the controversy surrounding the use of the vaginal probe, it has the potential for widespread use in the horse breeding industry. Improvements have been made in the device since objective studies were made. Further research in the field and under controlled conditions are needed to more clearly define the applications and limitations of vaginal ovulation indicators.

Ultrasound Devices

The adoption of devices that use ultrasonic waves is probably the most exciting technology to be introduced in the horse breeding industry. While the owner of a small breeding operation may not be able to afford these devices, he or she may be able to take advantage of them. Ultrasound is finding its way into the field of veterinary medicine as a diagnostic tool for lamenesses and will probably aid in the detection of other problems in the future. In this discussion however, only the use of ultrasound devices as an aid in the diagnosis of early pregnancy and other applications in reproduction will be explored.

All of the devices discussed here are adaptations of the same principal. Ultrasonic waves are sound waves that are beyond the range of human hearing. Ultrasound devices send these waves into the animal's body. The waves bounce off the tissues and return to the machine. The waves bounce off of different tissues at different intensities. Denser tissues reflect the waves more intensely. These reflected waves (echoes) are then translated into some form that the user can interpret. The final forms in which the echoes are presented vary among the devices.
Audible Scanners

The least expensive of the ultrasound machines used on horses is essentially a sonar device. The ultrasound waves are reflected as audible echoes. The only one of this type of scanner on the market is known as the Echo-Tone©. A probe is inserted into the rectum of the mare and placed over the uterus. The probe is then moved along the uterus until the echoes of the embryonic blood flow changes (sort of a primitive heartbeat) are detected. According to the manufacturer, the Echo-Tone can provide accurate detection of pregnancy at 30 days of gestation.

This device cannot be used to detect pregnancy at 15 days of gestation and does not eliminate the need to tease mares through the first estrus after breeding. The other ultrasound scanners have that ability. To be able to use this device effectively, the examiner must have sufficient skill at palpating to determine the approximate location of the uterus. Practice at the interpretation of signals may also be required. Despite these limitations, the Echo-Tone has applications in some breeding operations. This is the only one of the ultrasound devices that can be considered affordable for the owner of a small breeding operation ($980).

A-Type Scanners

The more sophisticated ultrasound devices can be divided into two categories: A-type and B-type scanners. The A-type scanners translate ultrasound echoes into spike-like lines on an oscilloscope screen. B-type scanners actually produce a picture based on the ultrasound echoes.

The Boveq® is an A-scan model that has been on the market for a few years. This device can be used by laymen because it works externally. The transducer (the probe that sends out the ultrasound signals and detects the echoes) is placed on the left flank of the mare directly beneath the point of the hip. It is set at about the same height as the base of the vulva. It is then aimed straight across the mare or slightly to the rear. For younger mares or mares that have not had many foals, the transducer is aimed slightly to the rear.

The oscilloscope screen has a baseline that is divided into 10 centimeter increments. Each mark represents a penetration of about 4 inches in the animal (figures 4 and 5). There will be a series of small, grassy spikes on the screen if the mare is open (figure 4). The pregnant uterus at about 14 days of gestation will produce a single spike that goes to the top of the screen in the 20-30 cm range (figure 5). The spike will be seen in this area whether the pregnancy is in the left horn or the right horn of the uterus. This spike actually reflects changes in the density of the uterine wall and fluid accumulation associated with pregnancy instead of detecting the embryo itself.

©Animark Corp. Available through Ideal Instruments, Chicago, Il.
®Animark Corp. Available through Ideal Instruments, Chicago, Il.
The manufacturers claim that two week pregnancies in mares can be detected accurately by the Boveq 85% to 90% of the time. Researchers at Colorado State University reported that the Boveq was accurate 65% of the time on 35 day pregnancies. They stated that the biggest problem was false positive readings created by other organs in the same area. They also noted that the machine performed as advertised. The sources of error were placement of the transducer and operator interpretation.

Part of this problem may be alleviated by testing mares with the machine before they are bred. This may help the operator determine the location of the uterus and if other structures (e.g. cysts) are present that may interfere with an accurate reading at two weeks of gestation. This procedure is recommended by the manufacturer.

Another possible source of error not previously mentioned involves the location of the uterus in mares. After a mare has had several foals, the uterus and the ligaments that support it lose elasticity. This may result in uterine placement below the plane of projection of the ultrasound machine. In other words, the uterus of a mare that has had several foals may lie lower than the level of the base of the vulva. It is speculated that this problem of variation of position of the uterus would be simple to overcome where palpation is part of a normal prebreeding examination. Simply have the palpator indicate the location of the uterus in the mare. Record the location so that the transducer can be aimed at exactly the right place during the pregnancy check.

The Boveq has several beneficial features. First, it is used externally and is therefore less invasive than the other types of ultrasound machines. This also makes it easier to use for the inexperienced person. Second, this type of ultrasound device is about one fourth as expensive as the B-type scanners and therefore more affordable to breeding operations and practitioners that do not have large numbers of mares with which to work. It is also possible that with practice and study, the Boveq may aid in the preliminary diagnosis of pathological conditions such as cysts, scar tissue or uterine infections. Further research is needed to more clearly define its applications.

As with all of these pregnancy detection devices, the Boveq requires skill, practice and a knowledge of anatomy to operate effectively. The transducer must be aimed at the uterus to obtain an accurate reading. Any inaccuracy is caused by human error. The cost of the Boveq ($3495) may be prohibitive to the owner of a small breeding operation, depending on how much time is allowed for a complete return on the investment.

B-Type Scanners

These devices are the top of the line in early pregnancy detection equipment in both price and performance. They range in price from just under $14,000 to $35,000. They also range in size and sophistication from small, portable machines to large, stationary machines for clinic use. The portable
scanners that can be used on the farm will be the focus of this discussion.

These scanners are also called "real time ultrasound". Real time means that what the operator sees is a moving picture. To use this device, a transducer is inserted into the mare's rectum and placed over the uterus. Small crystals (piezoelectric crystals) are arranged in a linear pattern along the head of the transducer. When a current is applied to these crystals, they expand. When the current is removed, they contract. This cycle is repeated millions of times per second (megahertz) and results in the formation of ultrasound waves. The current is applied to the crystals consecutively which creates a moving picture. The echoes from the tissues return to the transducer and are converted back into electrical signals. A computer then converts the electronic signals into a picture. Dense tissues show up as almost white while thinner or more porous tissues are varying shades of gray. Fluids are barely reflected, so they show up as black on the screen.

An embryo at 15 to 17 days of gestation appears as a black circle with a dense white line on one edge (figure 6). The black circle is a fluid pocket known as the embryonic vesicle and the white line is the embryonic disc, which is the actual embryo. By approximately 25 days of gestation, the embryo appears to be a small, grayish "blob" in the middle of the vesicle. At this point the primitive, embryonic "heartbeat" can usually be detected. These scanners can also detect twin embryos at 15 to 17 days. Often, one of these is resorbed by the mare by 30 days of gestation.

The portable real time ultrasound machines on the market now are the Bion Equiscan 4100 and 8100®. The 4100 model is the basic unit. It sells for $13,900. It consists of a transducer which is attached by cable to an electronic module carried by the operator. The module is attached to the base unit which consists of a screen, adjustment knobs and a numerical identification coder. The 4100 has the ability to "freeze" a picture on the screen and is set up so that a photograph can be taken of the embryo. It also has a set of electronic calipers that can measure the diameter of the vesicle or the length of the embryo itself during later stages of development.

The 8100 model ($14,500) has all of the features of the 4100. It can also operate on two different frequencies. The lower frequency is 3 megahertz. This is adequate for finding a 15 day embryo. The lower frequency has the advantage of penetrating deeper into body tissues than the higher frequency waves. The higher frequency (5 megahertz) offers greater resolution. In other words, it makes a clearer picture. Research is being conducted to determine the ability of this device to aid in the diagnosis of various reproductive disorders. The multifrequency capability increases this potential. The 8100 also has full alpha-numeric capability for identification purposes and a larger monitor than the 4100. An optional battery pack is also available.

®Bion Corporation, Denver, Co.
Real time ultrasound machines have been proven to be accurate and reliable. Since pregnancy can be detected at approximately 15 days, mares are confirmed to be in foal do not need to be teased during that estrus. Some insurance companies accept ultrasound pictures as proof for in-utero insurance policies. These machines have been proven safe to use. They also have potential as diagnostic tools for detecting other reproductive conditions and disorders.

The cost of the B-type scanners places them way out of reach for most breeders. Large breeding operations and veterinarians with large breeding farm practices are the only ones who can realistically afford such a device. Veterinarians with these ultrasound machines usually charge more to use them than to test mares for pregnancy by palpation. This device also requires considerable skill and practice to use. An inexperienced operator may confuse uterine cysts or even follicles on the ovary for embryos.

As with any technology, too much emphasis can be placed on these devices. Mares should be checked for pregnancy several times after the initial test to make sure abortions or resorption has not taken place.

Summary

None of the breeding aids discussed here will work all of the time on all mares. When compared to other species of domestic animals, the mare exhibits the greatest variability in her estrus cycle. It is unlikely, therefore, that any treatment or device will be 100% accurate or effective.

It must be emphasized here that no breeding aid or new technology can replace sound breeding management. And if abused, some of this new technology may become detrimental to the reproductive efficiency of a breeding operation. Good estrus detection, records, sanitation and animal handling practices can be supplemented but not replaced by technological advances.

The author wishes to thank Dr. E. L. Squires of CSU’s Animal Reproduction Laboratory, Grant Gillig and Ed Tucker of Bion Corporation and Kevin Mayer of Ideal Instruments for their assistance in the preparation of this article.
REFERENCES


FIGURE 1: EFFECT OF PROGESTIN THERAPY ON PREGNANCY MAINTENANCE IN OVARIECTOMIZED MARES

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. of Mares</th>
<th>No. of Mares Maintained Pregnancy</th>
<th>% of Mares Maintained Pregnancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Treatment</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>250 mg progesterone in oil every other day</td>
<td>8</td>
<td>5</td>
<td>62.5</td>
</tr>
<tr>
<td>500 mg repositol progesterone every 4 days</td>
<td>8</td>
<td>1</td>
<td>12.5</td>
</tr>
<tr>
<td>1000 mg repositol progesterone every 4 days</td>
<td>8</td>
<td>8</td>
<td>100.0</td>
</tr>
<tr>
<td>22 mg altrenogest daily</td>
<td>8</td>
<td>7</td>
<td>87.5</td>
</tr>
<tr>
<td>44 mg altrenogest daily</td>
<td>8</td>
<td>7</td>
<td>87.5</td>
</tr>
</tbody>
</table>

a Mares ovariecomized at day 34 or 35 of pregnancy
Adapted from Squires et al. 1983. The Quarter Horse Journal, Vol. 35:7 p. 266
FIGURE 2: THEORETICAL RELATIONSHIP BETWEEN PLASMA ESTRADIOL CONCENTRATION AND OVASCAN READINGS DURING ESTRUS

estradiol concentration
Ovascan reading

Day of Estrus

FIGURE 3: EXAMPLES OF OVASCAN PATTERNS FOR MARES DURING ESTRUS

Probe Reading

Mare 1

Day of Estrus

Mare 2
FIGURE 4: TYPICAL PATTERN FOR OPEN MARE AS SEEN WITH THE BOVEQ ULTRASOUND SCANNER

FIGURE 5: TYPICAL PATTERN FOR MARE IN EARLY PREGNANCY AS SEEN WITH THE BOVEQ ULTRASOUND SCANNER
WHY YOU NEED AN AGENT
by Tyson Gilpin

Greetings

If you know how to buy, sell, breed, race, import, export and raise horses then, like me, you probably grew up with one leg in the saddle and the other in the crib. It's also a good bet that you are very knowledgeable about stallion services, know when and where to buy or sell your horses, and are familiar with current market values. If this describes you, then you might as well stop reading, line your bird cage with this booklet, and go take care of your horses.

However, if you're a newcomer to the thoroughbred industry, or, like some 70% of all horse owners are just too busy to stay up on all aspects of the horse business, then you need us, the professional agents.

When it comes to buying, selling and breeding horses one mistake or one oversight can cost you a fortune. That's why those details are best left to professionals. A good agent has more marketing sense than most owners from constant involvement because this keeps him abreast of market trends.

I'm going to show you some of the things you should look for in an agent, some of the areas of expertise in which he should be advising you, and the kinds of things he will do for you. By no means will I attempt to cover all the services provided by a good agent, but I hope to familiarize you enough to spot a good agency from a bad one.

Dollar for dollar, it pays to bank on the years of experience your agency brings into your thoroughbred business. The reasons are
completely bound up in what they do, should do and can do based on their experience and their knowledge of thoroughbreds. A good agency will save you money...a bad one will cost you. I'll leave it to you to decide!

**Buying a Horse**

Do you want to own a derby winner? Are you prepared to put out the enormous amount of time, effort and money necessary to have even a remote shot at breeding a champion? Then you'll need some good breeding stock!

Your first contact with an agent will probably come during the buying process in your search for a quality broodmare. He will need to know what you have in mind in order to advise you accordingly, and will then undertake to make you an owner, and to buy within the limits of your ability, interest and finances.

If you've contracted with your agent at a time when there isn't an auction scheduled, he'll begin by making private inquiries with owners who might have broodmares up for sale. He knows who they are because of his daily contact with the horse community. Many owners try to sell their thoroughbreds privately in order to save costs inherent in auction sales. Though it's not often that a really good buy comes available privately, it does happen.

Generally, private owners tend to overprice their stock either through optimism, or a reluctance to face the marketing facts of life. It may take them an auction experience, when they are faced with the prospect of taking their thoroughbred back home with them, to learn that the value of their mare is about what was bid for it. Even so, many private sellers continue to overprice themselves out of the market.
Should your agent find you a bargain at private treaty, be ready to grab it. Before the deal is finalized, however, your agent will look at the mare the same way he would at an auction, including traveling to where she is stabled.

A mare will be examined for breeding soundness. If she is a "crigger" think it over carefully. If she is a "weaver", your agent will know it by examining her stall. A "weaver" will mess up her stall. He'll also take a look and see if the horse is high strung, particularly mean, or has any significant faults against her.

Your agent will also examine her breeding record. Does she get in foal every year? Does she carry the foal about the right time period...11 months and a few days? Remember, there are some mares that will go a whole year which can put your selling time-table off schedule for auctioning her offspring.

Above all, the mare's pregnancy status must be confirmed. If she is barren, has she been barren more than just this year? If she has slipped, what are the circumstances? If possible, the agent should get a guarantee from the owner that she's not carrying twins, and have the mare vetted. You need medical verification that she's in excellent health.

After your agent has found the mare to be a suitable prospect, he will try to have a look at one of her foals, yearlings or race horses. This will tell him more about the mare and consequently help him help you buy well. Sometimes a good buy is lost because of a hasty decision not to buy a broodmare with some physical defect. For instance, a crooked mare that produces a straight foal is still an excellent prospect. Without seeing a foal there is no way of
knowing what kind of offspring she's going to get. A closer look just might turn up a good bargain that otherwise would have been passed up.

Let's say you now decide to have your agent go ahead and buy the mare if the price is right. Your agent will then calculate her value on the market by who she's in foal to, etc. He will look at foals by that sire, the sire's yearling average, and the prospects of that sire to improve. He should also ensure that you don't get a mare with a late foaling date. That will cut the price of the horse you're going to sell once the broodmare produces. Late foals are backward, they look backward and they don't have the strength and presence that earlier foals do. Therefore, late foals are discounted by prospective buyers all the way down to the two-year-olds in training sales.

If everything checks out, your agent will advise you to buy. When the check clears the bank, you're officially a thoroughbred owner. But one step remains. You must ensure your broodmare is kept at a farm with the proper facilities, and staff to take good care of your baby and mother. Although the boarding rates are not the primary factor, your agent will measure them against the care provided to ensure you will be getting a good value for your dollar. If you can't afford the best of care for your new broodmare and foal, you're in the wrong ball game and you've wasted your agent's time (and your own).

Breeding Your Thoroughbred

Once you've settled on where you're going to board your horse, you then go to work selecting next year's mate. Your agent will look around for just the right stallion. You don't want to
overbreed (pay too much stud fee compared to her value), or underbreed (breed to something too cheap for her value) your mare. You have to be very selective.

I think that a basic, yet valuable, rule of thumb that should be followed is to breed an unmade mare to a made stallion, and an unmade stallion to a made mare. That seems simple, but many agents don't advise this and seldom do people do it.

If you breed your made mare to an unmade stallion and the foal doesn't run you know it's the stallion's fault. If you breed an unmade mare to a made stallion and the foal doesn't succeed, it probably tells you something about your mare.

If that made stallion doesn't do it, you might give your mare another chance with another made stallion. If that doesn't do it either, I'd suggest you bail out and sell your broodmare. That's going to save you time and money, and time is money.

Your agent should look for a stallion that is coming on and improving. That's hard to do, but that's what you're paying your agent to do. A good agent knows his stallions!

He should also know about the science of mating horses. He must know what to breed to, how to cross a mare with a stallion and what type of stallion a certain type of mare needs. For instance, if you have a "plodder", you need something with some speed. If you're going to sell your offspring, you'll want something physically characteristic of a sales horse. You don't want to breed large to large, or peanuts to peanuts. You want a combination that will produce a horse somewhere between 15 and 16 hands. Anything outside those parameters normally doesn't sell well.
You should also be careful how much you inbreed. You don't want to overdo it because you begin to emphasize any pedigree or personality faults. You also emphasize the physical traits, and if you have a bad trait you can't afford to overemphasize or increase it.

A good agent will have spent years of breeding, watching what happens, and sharpening his eye on how his choices came out. He will be up on the trends in prices and values, and over the years will have developed a keen eye for quality horseflesh.

Selling Your Champion

When and if you decide to sell your foal or yearling, you must first decide where to sell it. A regional horse, something by a local sire that's well known in a particular area, will sell best in that area. Some horses usually sell well in Florida and New York bred's sell better in their home state where people are looking for them.

If you have a good candidate and want to sell to the English, French and Arab buyers, take it to the Keeneland Summer, Saratoga Summer and Fasig-Tipton Kentucky July sales which attract international buyers. For weanlings, the Fasig-Tipton Select or the Keeneland Breeding Stock sales, both in November, provide a fertile market—that's where the buyers expect to see weanlings.

Foreign buyers also frequent the January Two-Year-Olds in Training sales for Florida bred's in Miami and the Florida Open Two-Year-Olds in Training sales in February and March. Those sales have a distinctive international flavor. They are expensive to prepare for, however, and you must have a horse that is worth well over $25,000 to justify saving it for those particular sales.
Now that you have bought and bred the mare, and sold the offspring, when do you sell the mare? As agents, we advise our clients to keep her for at least two years, which is the capital gains period for livestock. We have learned from experience, just when to hold them, when and where to fold them and how to maximize after-tax income. If you see us start to run away...TAKE COVER.

There is a right time and place to sell your horse. Timing is important. You want to sell a $10,000 horse in a $10,000 sale. It doesn't help you to sell a $10,000 horse right between two $100,000 horses, because he will be ignored. Try to sell your horse, but don't give it away. You need to have enough capital backing to protect yourself from ridiculous prices. That may mean keeping the mare, having the foal, selling the foal and starting over a year later. Your agent can help you select the market and the strategy. If he has been in the business long enough, and is established and reputable (if he isn't, he won't last long anyway), you would do well to follow his advice. You will save money in the long run.

Once you have settled on a particular market, your agents will set about putting together the auction sale. For them, the real work will begin several months prior to the sale as they begin analyzing pedigree information and compiling family statistics on the horse, completing nomination, entry and contract forms, making early closing stake nominations, organizing their sales crew, editing pedigree proofs for the sales catalog and initiating early public relations with potential buyers. They will also obtain and file any necessary certificates, purchase sale halters, produce
stall cards, arrange transportation to the sale and research any late family improvements.

An agency's reputation alone will draw many buyers to its auction sales barn to see the consignment. Its reputation was earned by effectively promoting your thoroughbreds through personal contact, advertising in the leading trade publications, letter writing, and attending the major races, farms and sales.

Two or three months before the sale your agency will advise you how to prepare your horse and monitor his progress. Buyers look for well-rounded, strong and healthy individuals.

By the time the sale is just around the corner, your agency should have a fair idea of your horse's value. A professional and realistic appraisal, favorable or otherwise, is one of the most valuable contributions we can make. Depending on how the sales progress, you may need to revise your figures up or down. There are such things as "strong" and "weak" sales, or even sections thereof! Remember, nothing raises the value of a horse like owning it!

A good agency performs the followup that is so important to the new owner. They'll stick around until the next day. They won't take the buckets, straw or hay, remove the lock off the door, substitute an old halter, get in their pickups and leave town. They will have the vet, immunization, worming, shoeing and history records all neatly typed up to send with a note to the new owner thanking him for his purchase. As a result of the sale, you have profited, the buyer is happy, the agency is satisfied, and you are both ready to start the process all over again.
When pay-off time draws near, your agency should be in the position to follow up on your settlement to ensure that there are not complications or lacking documentation to slow up settlement.

A Final Word

By no means is this a manual on agents. I've merely presented you with some of the kinds of things your agency should be doing for you, to help you better recognize the good from the bad.

Most agents are reputable and honest. Not all of them, however, are knowledgeable and experienced. From someone who has been in the thoroughbred business since the 1940's, I can tell you that I have seen some slipshod operations and many inexperienced (self-proclaimed) agents stumbling around the marketplace. In the end it's you, the client, who will suffer the losses.

Your agent should have the integrity and the years behind him to attest to the quality of his service to the thoroughbred community. He should have already made the mistakes and passed through the pitfalls common to the industry.

The number of buyers and sellers turning to agents increases every year as evidenced by the fact that 70% of all horses changing hands last year did so with the help of agencies.

So shop around when you are choosing an agent. Mention his name at the sales and find out what his peers think of him. Then back him with your trust and confidence, and give him the authority he will need to make quality decisions on your behalf.

For you, a good agency is money in the bank!
With the increasing number of horses and horse owners, buying and selling horses has become a more serious business. This accounts for the increased use of Auctions as a means of marketing or purchasing horses.

Auctions are a convenient way to buy or sell horses if you understand how they operate. Whether you are a potential buyer or seller it is necessary to select a sale. The primary places to look are the breed or special interest publications that deal with the type of horse you have to sell or would like to buy. Sale ads can also be found in all-breed publications, State Association Newsletters and local newspapers. When you find an ad that interests you contact the sale manager or ask to be placed on their mailing list.

There are several types of sales including dispersals, production and consignment sales.

A complete dispersal indicates that the owner is selling all of the horses in this program. A near dispersal would indicate that most of the horses would be sold. These sales are usually brought about due to illness or death of the owner, other business obligations, financial difficulties or changes of interest. If a sale advertises that the horses will be sold without reserve or at absolute auction, then all horses must be sold to a new owner.

Production sales are used by breeders to market their produce. The reputation of the sale and the quality of stock are important because the breeder must depend on repeat business and a growing number of new customers to provide a decent income from the program.

Dispersal and production sales are popular with buyers because they feel they are given an opportunity to select from the best of a program and that the stock will be represented honestly.

A consignment sale is any sale where horses are consigned by a number of different sellers to a sale manager or sales management company. These sales provide a market place for many people who do not have a program large enough to have their own sale. Small breeders, families, individuals, and dealers use these sales to market horses where they have the benefit of extensive promotion and exposure to a large number of people. Consignment sales may sometimes feature small dispersal and production sales.

Many consignment sales are open to all types of horses within a breed. Some are open only to certain type or age group and others are open to horses of several related breeds or all breeds.

Most purebred horse consignment sales are "catalog sales" where a catalog is available with information on the horses. In other sales horses are presented in the ring at sale time and the information is read from the auction box.

Whether you are a potential buyer or seller you should find out about the reputation and quality of a sale. In most cases a sale or sales management company that has been around for a number of years must be doing a decent job for its customers.
The quality of the advertising and promotional material also gives an indication of the overall quality of a sale. Talking to people who have attended sales and have conducted business with them, will provide a good picture of the sale.

I am not going to tell you that auctions are the only good way to sell a horse. However, auctions can be a very effective means of marketing horses, if used properly.

Many people feel that the auction market is a depressed market and that horses will not bring as much as they would if sold privately. This is not the case with the well promoted sales across the country. A good auction actually reflects the "real market value", this is what a horse is worth TODAY, not what he may be worth if you hold him for six months or a year waiting for the "Right" customer to come along.

Auctions offer the opportunity for you to get more for your horse than you might take at home. This does happen more often than you think. When a good horse in excellent condition is offered, there is a good chance that two or more people may want the horse enough to drive the price beyond what you expected. One might study the Thoroughbred Horse market. For years they have offered their best horses for sale at public auction because they felt the exposure and competition for ownership would produce the best prices. World Record prices for Thoroughbreds are often established at auctions.

There are several important considerations when you intend to sell a horse. The first is to expose this horse to as many potential customers as possible. Then you must develop the proper atmosphere, in which to turn one of these potential customers into a buyer for your horse. This atmosphere can be affected by the condition of your horse, the quality of the facility where your horse is seen and the way customers are treated during the transaction.

A well managed auction can provide the exposure, attractive facilities, and an experienced, sales-oriented staff that can help market horses. These services, plus the seller's ability to fit his horse and show it to potential customers, should develop the conditions for a horse to bring "Top Dollar!".

When selecting a sale in which to sell a horse, you should consider many of the same things as the potential buyer. These include the quality of the advertising, facilities, the experience of the staff and the reputation of the management.

The quality of the advertising is a reflection of the quality of the sale. This is a major part of exposing your horse to a large number of potential buyers. Easy to see ads in prominent publications are essential to an effective advertising program. Good quality catalogs or flyers, which are widely distributed by direct mail, are also important to promotion.

If you are on the mailing list of several auction companies, you will probably receive notices by mail of upcoming sales. If not, you will have to watch magazines for ads. Notices or ads should appear from three (3) to six (6) months prior to the sale date. This will allow the sale's management to receive entries in time to prepare ads, catalogs and flyers to distribute them effectively before the sale.
At this point, it should be explained that the sales company acts as a Commission Agent to assist you with the sale of your horse. Most horse and livestock auction companies should be registered and bonded with Packers and Stockyards, an agency of the United States Department of Agriculture. Some states require additional licensing procedures. With this affiliation, and a good contract, you can feel that you are doing business with a firm that is regulated by the standards of the industry.

Take note of the consignment or entry deadline and make plans to enter as early as possible. There are advantages to being early. Your horse could be included in advertising and some sale companies determine the order of sale by the order in which entries are received.

The first step in selling a horse at auction is to obtain an entry form or consignment contract. You should write or call the sale company and ask that enough entry forms be sent to you for the number of horses you wish to sell. This is the "Contract" by which you consign your horse to the sale of your choice. It will explain the consignment fee, commission, withdrawal penalty, health requirements, and method of payment to consignor. This is an important agreement because it defines the responsibilities between the seller and the sale company. If you have any questions after you have read the consignment contract, call the sale manager. He should be happy to answer any questions you might have.

The cost of selling a horse at auction is figured in terms of the consignment fee and the commission. The consignment fee should cover cataloging, advertising, your stall and bedding. Some companies may charge extra for some of these services. If the contract is not clear on this, ask the sale manager. Consignment fees will generally range from $75.00 to $250.00. The old adage that "you get what you pay for" is also true for horse sales. Sales that charge a higher fee, will probably be able to do more promotion and reach more potential customers for your horse. Commissions are usually charged in addition to the consignment fee and generally range from five percent (5%) to ten percent (10%) of the sale price or last bid on your horse. Some sales companies charge a commission on the last bid whether or not the horse is sold, while others charge only if the horse actually sells. Some companies will charge a flat "no-sale" or "pass-out" fee on horses that are not sold which allows them some income but does not add excessive cost to horses that are not sold.

Most sale companies will charge a withdrawal penalty or fee on horses that are withdrawn for any reason other than a medical excuse. This is primarily to discourage the selling of consigned horses prior to the sale date. There are several reasons why you should not sell a horse prior to the sale. It damages the credibility of the seller as well as the Sale company. There may be people who traveled a great distance to the sale for a particular horse only to find they will not even have the opportunity to bid on it. Another reason is that the horse might have brought more money at the auction, but..you will never know.

Please pay particular attention to the method of payment to the consignor. The contract should give specific dates for payment such as "not less that 15 nor more than 30 days after the date of the sale."
Be careful to notice if no final date for payment is given, which may read that "payment to consignors will be made not earlier than 21 banking days after the sale," or even stated as simply as "consignor's will be paid when purchaser's checks have cleared." In this case, you should ask the sale manager to be more specific about when you should expect payment. Most contracts will cover certain exceptions to the standard method of payment. If you have any questions about these, again, ask the sale manager. In some instances, consignors will be paid on sale date, which is very convenient for the seller. However, you should check to see if this company is bonded sufficiently for the amount of money it handles and study your check to see that your account was figured correctly. It is difficult to do a large number of accounts so quickly.

Consignment contracts should specify what health records are required for a sale. In most cases, it will be a negative Coggins report and an Interstate Health Certificate. Some sale companies may also require a veterinarian's statement certifying pregnancy in broodmares or soundness in riding horses.

Most contracts will specify how you "no sale" a horse, or keep it if the price does not suit you. Some sales will use the "No Sale or Pass Out" method, where the Auctioneer will get the highest price he can, then call the horse sold. After the fall of the gavel and BEFORE the horse leaves the sale ring, the owner has the right to tell the Auctioneer "no sale" and the horse is passed from the ring as unsold. This method is probably the most straightforward and the easiest to understand for people who do not deal in auctions regularly. The other method that is widely used is where the consignor has the responsibility of protecting the price of his own horse. In this method "no sales" are not announced, but if the owner wishes to keep a horse, he or his agent must have the last bid on the horse. Some auction companies will allow the consignor to place a "reserve bid" or minimum acceptable bid on a horse. This may be done by filling out a form in the sale company office or giving the information directly to the Auctioneer or Sale Manager. If this service is not available, then it becomes the consignor's responsibility to protect the price. Most buyers are turned off when they see the owner of a horse bidding against them. It is wise to have someone bid for you if you wish to protect the price of your horse. It is best to use someone who has some experience at auctions and who will watch you for instructions in case you have a last minute change of mind on price. In either case, if you need assistance, contact the Sale Manager who will be able to handle it for you or help you find someone who can.

The consignment contract will also have a form for the information on your horse, such as name, registration number, age, sex, color, pedigree and a footnote. Most sale companies have the ability to complete pedigrees if you do not already have an extended pedigree. The footnote or catalog note is actually your written "sales pitch" to potential buyers. It should include things like show or produce records, special awards, special training, potential for show or breeding, disposition or anything else you think might interest someone in your horse.

Now that you have completed the consignment form and sent it to the sale company, the next major consideration is the condition
of your horse. An old horse dealer once told me that "fat and slick was the best color for a horse at an auction." It stands to reason that people will like a horse that is fat, slick, shiny, well trimmed and in good condition more than the one that is skinny, with long dull hair and shows a general lack of attention. How many times have you spent weeks or maybe months preparing the horse shows where you compete for "ribbons?" You should really do a better job for an auction because you are going for all the money, time and effort that you have put into this horse. If you are not experienced with preparing horses for show or sale, contact the sale manager who may give you some pointers on how to do it yourself or he can refer you to someone who could condition the horse for you. It is strongly recommended that you have the farrier work on your horse two or three weeks before the sale. This will not allow too much hoof growth, but more importantly if the horse should be quicked or trimmed too short, there will be time for the foot to heal. You should also do all of your clipping and trimming before you leave home. Some horses will tend to be harder to work with in strange surroundings where there is a lot of activity. You do not need to be clipping while customers are looking at your horse.

Another important consideration is how to price your horse. If you are trying to make a profit, then you will know what you have invested and a good idea of what you want. In other instances you may want to recover as much of your investment as possible. Some people just need to sell their horses, for whatever they bring, to generate some cash. Horses do not appreciate or depreciate automatically in value. The price you get for your horse depends on many things, including their condition, if they have a show or race record, if offspring are shown, and the age of the horse. If you have paid too much for a horse, it will be hard to get out no matter where or how you try to sell it. There is no formula that tells what a horse is worth. The only way to develop a value judgement of horses is to go to a lot of auctions or dealer's stables and to price horses wherever you go. If you do not have the opportunity to do that then ask the Sale Manager to give you an idea of what your horse might be worth. It will be hard to say exactly what one is worth but you can get an idea or an approximate price range. When you start asking for advice on what you horse is worth, you will probably get a lot of it. Be careful to consider the source. People who do not deal with selling horses on a regular basis will tend to have an exaggerated idea of what horses are worth.

When the time comes to leave for the sale, make sure you have everything you need. Be sure to bring feed, hay, buckets, grooming equipment and the halters, bridles, saddles and gear needed to show your horse to those customers. You should plan to arrive early for the sale. If you have to travel a great distance or even if you live close, it is advisable to get in the day before the sale. This will give the horse time to rest and fill up after the trip and get used to the new surroundings and activity. It is also a good idea to start early with the horses that have never traveled. A short trip with a nervous horse, that might have been through a fight to load, may
leave it as tired and irritable as one that has traveled hundreds of miles. You want your horse to be fresh, alert, and looking good on Sale day when the first lookers come by. The same is true for you. Surely, you are not going to feel very fresh if you drive all night, and then try to be sharp and pleasant to customers all day. You and your horse need to be fresh and alert on Sale day, because you will be dealing with a large number of people in a short period of time.

When you arrive, check with the Sales office or barn manager to locate your stall. Once you have settled your horse in the barn, you should take any paperwork or health certificates that are needed to the Sales office. This is a good time to notify the Sale Manager of any additions or corrections to the information printed in the catalog. It is also a good time to discuss any defects or blemishes on your horse that should be announced when it is sold. Some things that do not bother you, may alarm a new buyer. The Sale Manager can advise you of the best way to handle these. If you have any other questions about the sale procedure, the value of your horse or anything else pertinent to the sale, this is the best time to get the answers.

The topic of "Salesmanship" is very important. You will have to handle most of the personal contact with the potential customers for your horse. You need to present your horse in such a manner that customers will want to stop and look. On Sale day, you need to get an early start. By the time the first customer arrives, you should have your horse fed and groomed, your good clothes on, and your stall display ready. A stall display is a good way to draw attention to your horse. It can be a poster with more information, pictures or show records, or maybe a table display with trophies and ribbons. Try to stay close to your horse, so you do not miss any serious lookers. Be courteous and cheerful, and above all be honest with your customers.

If your horse is broke to ride, by all means, be prepared to ride it on Sale day. You could spend all day telling someone how well your horse rides, but it would not mean as much as riding it for ten minutes. Most Sales that are geared to Show and Pleasure horses will have a prescribed time to demonstrate horses under saddle. If you are going to a Sale that does not have a formal demonstration, then set a time when you will ride and tell the people who look at your horse when it is. This saves having to saddle and ride a horse five or six times in a day, which would be hard on your horse's disposition, as well as yours. If you have a horse that is broke, but you are unable to show it or bring someone with you who can, let the Sale Manager know in advance, so that he might be able to arrange for someone to help you.

It would be helpful to the Sale staff if you can remember who are some of the more serious customers for your horse. You should point these people out to the Sale Manager, Auctioneer, or the Bid Spotters. It will mean more money to everyone, if the Sale Staff can effectively work the serious customers.

Sale time is drawing near. Be sure to listen for announcements in the barn as to when you should take your horse to the Sale ring area. Some companies sell horses in the order they are
catalogued, while others draw for sale position on sale day. In either case know when your horse sells and plan to be in the holding area at least five or six horses before your sell. A lot of people like to come out and take one last look before they bid.

Some Sale companies have handlers that will take your horse into the sale ring. When this service is available, it is still your responsibility to bring your horse up to the sale ring. This will allow you to watch while your horse is being sold. Also, if the Sale Manager or Auctioneer need to ask any questions you will be available.

Now..., your horse is in the sale ring and the Auctioneer starts his chant. All that you have worked for these last few months will culminate in two or three minutes of hard selling by the Auction Staff. If everyone has done their part properly, the results should be very rewarding.