THE PROCEEDINGS
OF THE
HORSEMEN'S SEMINAR

March 15-17, 1974
Ramada Inn
Charlottesville, Va.

Sponsored By

VIRGINIA HORSE COUNCIL

in cooperation with

VPI&SU Extension Division and Animal Science Department
and
VHC Member Associations and The Industry

Prepared By

Dr. Arden N. Huff
Extension Specialist, Animal Science
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061

TABLE OF CONTENTS

NOTE: Presentations not included were not available for publication. Please contact the speaker for copy if available.

VIRGINIA HORSE COUNCIL

by
Dr. Arden N. Huff
Extension Specialist, Animal Science
VPI&SU
Blacksburg, Virginia 24061

The newly formed Virginia Horse Council, Inc. has initiated a broad base of educational programs to serve the entire Virginia Horse Industry. The Council is a non-profit organization organized by Virginia horsemen for Virginia horsemen. Mr. L. Clay Camp, Keswick, Virginia is the current President, and Mr. Herbert Stuart, Batesville, Virginia, is serving as the Vice-President. The Council membership and Board of Directors represent all breed groups, horsemen, and related groups and industries in the state.

The general purpose of the Council is to promote the common interests of the entire Virginia Horse Industry. More specifically, the Council promotes such activities, educational programs, research, legislation and marketing programs as will benefit the overall horse industry. Action committees of the Council are currently active in marketing, education, membership, legislation, and health programs. The Council sponsors educational programs and seminars.

Virginia has a growing horse industry with a history for quality horses and an unlimited future especially in the areas of production, recreation, sport, and youth programs. The Council will promote Virginia as "Horse Country" and assist in the development and expansion of the industry. Virginia has approximately 60,000 owners and 125,000 horses. The industry contributes approximately 100 million dollars each year to the economy of the state and plays an important role in recreation, as a spectator sport, and as a family oriented fun porject. The industry provides employment for approximately 20,000 citizens. Virginia produces quality champions of all breeds and has one of the most outstanding horse development program in

the nation including breeding farms, large quality shows and sales, riding schools, hunts, training farms, and youth and University Extension educational programs.

The Horse Council is designed to unite all horsemen, assist in industry development, provide a forum for exchange of ideas and problem solving, and to be the voice of the Virginia horse country. The Council publishes newsletters which feature the story and development of all breeds, youth groups, and the total industry. All horsemen and related industry representatives are eligible to unite and support the Council.

The Council is currently initiating a membership drive with 100 local or county chairmen to unite all horsemen with a membership goal of 20,000 members. Mr. Herbert W. Stuart, Vice-President, ARARAT, Batesville, Va. 22924 is serving as chairman of the membership drive and notes that membership is open to all horsemen, adult and youth, and related industries such as shows, sales, hunts, local horsemen's groups, tack shops, feed stores, etc. A new youth membership is available in addition to regular, sponsor, and farm memberships. The Council especially wants thousands of regular memberships at the "grass roots" or pleasure horse owner level in addition to farm and sponsor memberships. Thus, Virginia horsemen can unite and form a vital educational program, present the "voice of the horse country", and promote and develop the entire industry. Mr. Stuart notes that, "if all Virginia horsemen support and join the Council, The Virginia Horse Council could become one of the largest educational and agricultural service organizations in the state. Memberships may be sent to Mr. Stuart or to The Virginia Horse Council, P.O. Box 72, Riner, Va. 24149. Mrs. Richard Alley, Rt. 3, Riner, Va. 24149 is serving as the VHC membership and corresponding secretary."

HORSE PROGRAMS AT VIRGINIA TECH

By M. B. Wise, Head
Animal Science Department, V.P.I. & S.U., Blacksburg

Horse programs at Virginia Tech are designed to serve our viable and rapidly growing horse industry. We are interested in lending a helping hand to the entire horse industry, ranging from the youngster with a single horse kept on a small plot to the extensive stables with millions of dollars invested in the business. As is the case with other Animal Science endeavours, our purposes are accomplished through coordinated efforts in teaching, research, and extension programs. Each area will be outlined separately.

Teaching Program

A limited introduction to the horse industry is offered to the student in our initial course in animal production. In addition, the department offers 12 courses devoted, in part, or entirely to the study of various aspects of equine science. These courses may be listed as follows:

(1) Fundamentals of Animal Nutrition
(2) Applied Animal Nutrition
(3) Animal Genetics
(4) Animal Physiology, General
(5) Physiology of Reproduction in Domestic Animals
(6) Diseases of Domestic Animals
(7) Parasites of Domestic Animals
(8) Horses (For non-majors)
(9) Horse Production and Management
(10) Equitation
    (a) Introductory
    (b) Intermediate (297)
    (c) Advanced (497)

Studies dealing with horses are very popular among our students at Virginia Tech. Many attend Tech primarily because of their love for horses. A highly active Equestrian Club has been formed and meetings are well attended by the students. Dr. T. N. Meacham and Dr. Arden Huff are co-advisors for this extra-curricular activity.

Research Program

Due to a lack of financial support our equine research is limited, however, grants-in-aid from the Virginia Agricultural Foundation and some Thoroughbred Stables enable us to conduct a modest research program in equine nutrition. Studies have been conducted and are presently in progress concerning the adequacy of calcium and phosphorus nutrition among Virginia horses. A study is presently being initiated to study the availability of phosphorus from various feedstuffs. Under the direction of Dr. J. P. Fontenot, one graduate student recently obtained an M.S. degree in equine nutrition and another is presently working toward the masters degree.

Extension Program

The Extension Horse Program is expanding at a rapid rate and may be divided into two areas: adult work and the 4-H youth program. The educational program focuses on problem solving work in cooperation with the horsemen across the state. The bulk of the program is conducted by Extension Agents located in all counties and several cities in cooperation with adult volunteer leaders. The state program, originating from field problems is built around an interdisciplinary team involving the Animal Science, Agronomy, Agricultural Engineering, Veterinary Science, Entomology, and Agricultural Economics Departments and the State 4-H Club Staff. The Animal Science Department employs one full time Extension Specialist, Dr. Arden N. Huff, to serve as subject matter specialist for the adult and youth programs, chairman of the state interdisciplinary team, resource person for Extension Agents, coordinator of programs, and educational advisor for the Virginia Horse Council.

The adult program involves a continuous role in routine problem solving situations on a request basis such as nutritional problems, constructing facilities, etc. The Extension program initiated five horse science schools across the state this year (one night per school for eight weeks); approximately 350 horsemen have enrolled in this intensive program. The state team has also developed a sizeable literature package pertaining to nutrition, facilities, parasites, and management. Several of these publications have attracted national acclaim. Other work includes cooperative programs with schools, apprentice programs, shows, events, and field days.

Educational work with VHC includes this seminar, a monthly newsletter, news articles, and programs on a request basis. The Council has been active in educational, legislative, and recreational programs during 1973-74. Special emphasis has been placed on including all breed groups and a membership drive. Extension has assisted VHC in developing a statewide communication system involving 55 area advisors for VHC.

The youth program involves over 6,000 members in a comprehensive educational and recreational program. A new graded 4-H project literature series was introduced during 1973. The basic program is focused on learning and fun at the local level conducted by a great group of dedicated volunteer leaders. The program has been greatly expanded to include all phases of horsemanship. In addition to project work, demonstrations (county, district, and state level events), and achievement programs, a vast array of educational events are also operational. These include six district shows, one of the largest and best state shows in the nation, a state endurance ride, a western horsemanship clinic, two youth Arabian judging contests, a new state camping and packing trip, a Morgan horse clinic, and pilot programs for providing riding lessons for handicapped youth. Two new projects, Horses Are Fun, and Mare and Foal, will be introduced in the months ahead. Many of these programs include work at county, district, and state levels. The 4-H horse judging program involves thousands of youth and the Virginia program has produced two national champion judging teams within the past two years. The youth program is designed to develop young people with emphasis upon learning, fun, and sportsmanship. The new literature series also should graduate 4-H horsemasters capable of productive service within the industry.

Challenges and Plans

Interest is not lacking - funds are. Our Animal Science student enrollment has doubled and almost tripled in the past three years. As mentioned previously, more students are interested in horses than any other single species of livestock. Regrettably, Virginia Tech has limited facilities and animals to carry out a horse program. The equitation program is accomplished with a private stable. Our teaching and research programs must be "bootlegged' from a short supply of funds which is rapidly being eroded by inflation and the disenchantment of legislatures with programs of higher education.

The Animal Science Department has plans for considerable expansion in the area of equine science as funds become available. For example in the area of research we plan to conduct studies in the following areas:

I. Equine Nutrition

1. Mineral requirements and interrelationships
2. Vitamin nutrition
3. Effect of exercise on nutrient requirements
4. Protein requirement of growing horses
5. Synthesis and absorption of vitamins and amino acids in the digestive tract
6. Importance of protein quality in horses of various ages and at different levels of production

II. Equine Reproduction

1. Control of ovulation; inhibition, stimulation
2. Development of basic hormone levels in the mare
3. Interrelationships between nutrition and reproduction
4. Influence of social, neural and environmental stress on reproduction

In order to conduct research projects as outlined above the necessary land and facilities along with their estimated costs would be as follows:

Land (150 acres)	$ 75,000
Research barn	50,000
12 individual stalls	
6 metabolism stalls	
2 foaling stalls	
Field office & laboratory	
16 "tie" stalls	
Working chute	
Scales	
Feed storage	
Open sheds (2)	25,000
Stallion barn & paddock	5,000
Truck & trailer	6,000
Fencing	6,000
Total	$167,000[a]

[a]Assumed $67,000 from grant funds and $100,000 from appropriated funds.

Personnel to conduct such a program would include an equine research specialist (nutrition and physiology), three support personnel and two graduate students. Operation funds in addition to salaries are estimated at $30,000 annually.

Will the state of Virginia have a horse research program as outlined in the near future? The answer to this question is, "The horse industry can cause it to happen if it wants the program enough to work hard for it."

BASIC EQUINE GENETICS

By
Dr. Charles R. Cooper
Extension Specialist, Animal Science
VPI&SU
Blacksburg, Virginia 24061

A good approach to beginning to understand genetics (the laws of inheritance) is to consider some of the traits inherited in a simple manner. Gregor Mendel is considered the father of modern genetics for having discovered traits that were inherited in a simple manner. As an example, let's consider the inheritance of black and red coat color in Angus cattle. In this case, only one gene needs to be considered and can be labeled *B* for Black and *b* for red. In this case, *B* is called dominant to *b*. Each animal inherits one gene for coat color from each parent either *B* or *b* depending, of course, on which genes the parent carries. If an animal receives a *B* gene, it will be black since black is dominant to *b* (red). The following shows how black/red is inherited in Angus cattle:

Black Parents
B/B X *B/b*

Female Parent

	B	*b*
Male *B*	*B/B*	*B/b*
Parent *B*	*B/B*	*B/b*

All offspring are black

Black Parents
B/b X *B/b*

Female Parent

	B	*b*
Male *B*	*B/B*	*B/b*
Parent *b*	*B/b*	*b/b* (red)

1/4 of offspring are red

Red Parents
b/b X *b/b*

All red offspring and all black offspring from *B/B* X *B/B*

Parents

Black *B/B* X Red *b/b*

	b	*b*
B	*B/b*	*B/b*
B	*B/b*	*B/b*

All offspring are black

Parents

Black *B/b* X Red *b/b*

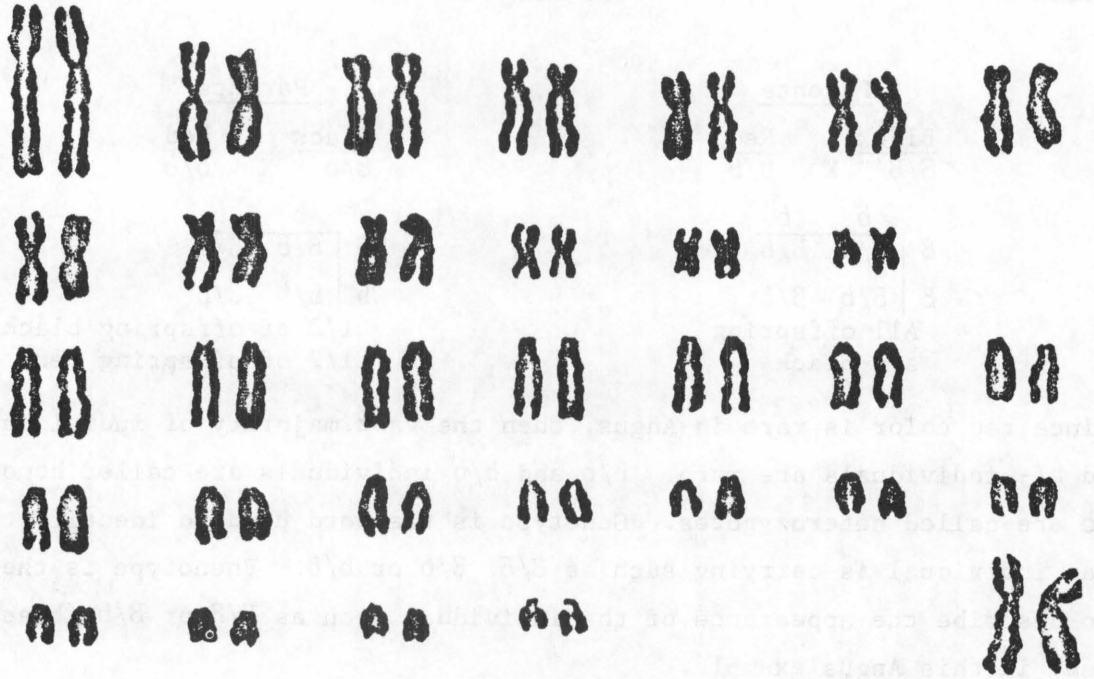
	b	*b*
B	*B/b*	*B/b*
b	*b/b*	*b/b*

1/2 of offspring black
1/2 of offspring red

Since red color is rare in Angus, then the vast majority of individuals are *B/B* and *b/-* individuals are rare. *B/b* and *b/b* individuals are called homozygotes and *B/b* are called heterozygotes. Genotype is the word used to identify the two genes an individual is carrying such as *B/B*, *B/b* or *b/b*. Phenotype is the word used to describe the appearance of the individual such as *B/B* or *B/b* (black) or *b/b* (red) in this Angus example.

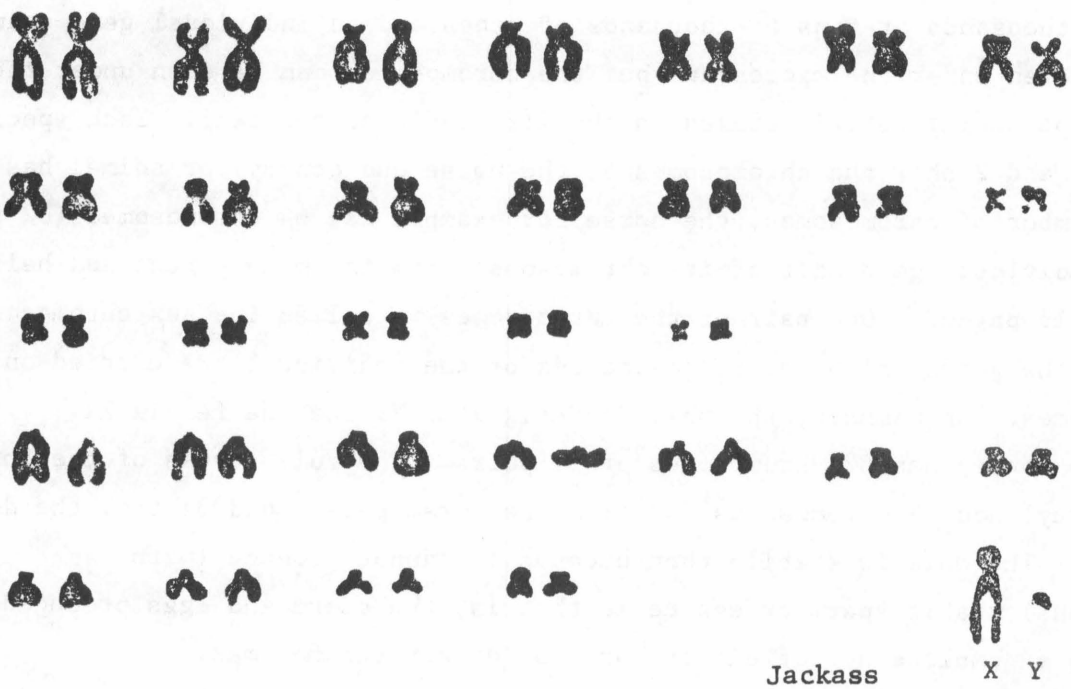
TABLE 1. CHROMOSOMES OF THE HORSE

Stallion X Y

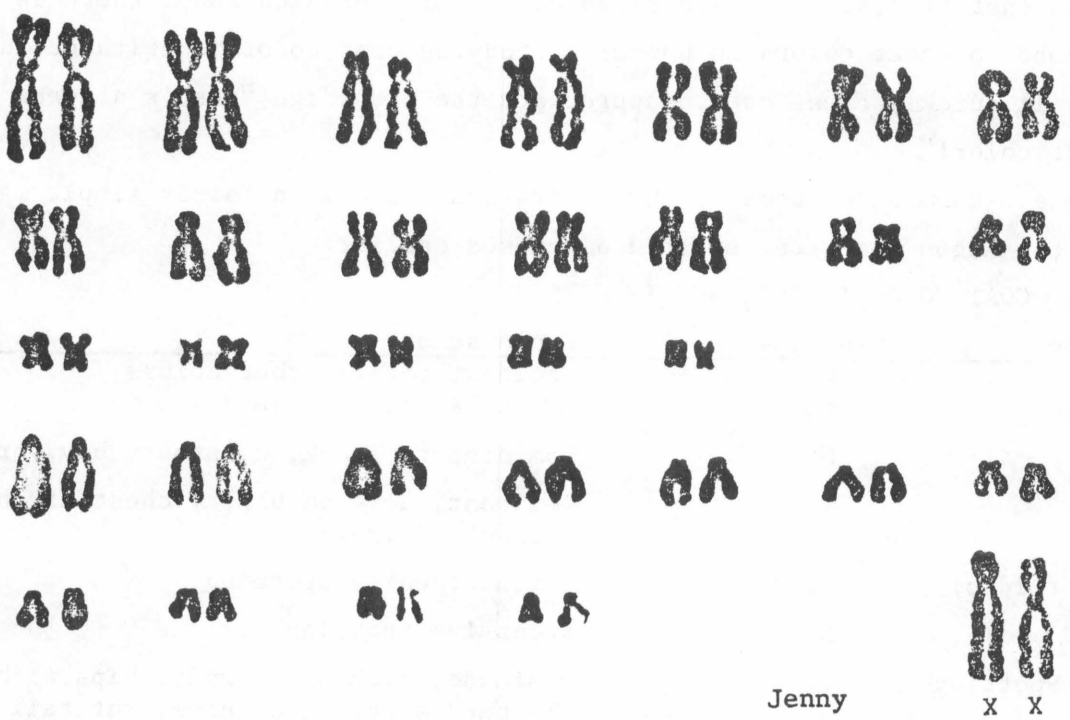


Mare X X

TABLE 2. CHROMOSOMES OF THE DONKEY



Jackass X Y



Jenny X X

Once the above rather simple rule is mastered, one is well on the way to understanding basic inheritance. Genes determine the characteristics of living things.

Where are the genes located? The genes are located on the chromosomes which are contained in practically every cell of the body. The chromosomes contain thousands or tens of thousands of genes and an individual gene cannot be seen even under the microscope but the chromosomes can be seen under the microscope during certain stages in the life cycle of the cell. Each species (Table 1 and 2 show the chromosomes of the horse and donkey) or animal has a given number of chromosomes, the horse for example has 64 chromosomes (32 pairs). Every individual gets half of its chromosomes from the male parent and half from the female parent. One pair of the chromosomes is called the sex chromosomes because the genes which determine the sex of the individual are carried on these chromosomes. In mammals, the male is designated XY and the female XX.

The donkey has 62 chromosomes or 31 pairs. The mule (cross of the horse and donkey) has 63 chromosomes (32 from the horse parent and 31 from the donkey parent). The mule is sterile then because it cannot produce (with rare exceptions) viable sperm or egg cells that is, the sperm and eggs produced do not have a complete set of either horse or donkey chromosomes.

One of the most intriguing and interesting aspects of inheritance in horses is that of coat color inheritance. As all horsemen know, there is a very large number of coat colors in horses. Studying coat color inheritance in horses will quickly cause one to appreciate the old adage "that's a horse of a different color!"

Table 3 summarizes some of the colors inherited in a fairly simple manner such as the Angus black/red example discussed earlier:

TABLE 3. COAT COLOR INHERITANCE IN HORSES

Phenotype	Genotype	Explanation
White	*WW* *Ww*	Dominant to all other colors *WW* is lethal
Grey	*Gr*	Dominant to black, chestnut, bay, brown
Roan	*R*	Dominant, acts on black, chestnut, bay, brown and gray
Piebald (Pinto)	*S*	Dominant white spotting
Skewbald	*S*	Recessive spotting
Leopard Spotting	*L*	Dominant, dark body, white hips with leopard spotting on hips, rat tail
Appaloosa White mane & tail	*mm*	Recessive
Star, blaze, white stockings	-	Probably recessive not proven experimentally

The genetics of the inheritance of bay, chestnut, brown, black, dun, buckskin palomino, etc. is not so simple as those colors summarized in Table 3, because there are four different genes involved, two of which have more than one mutant form. These genes are designated by *A*, *B*, *C*, and *E* having the following effects on coat color:

A gene - Causes a band of yellow color near the tip of a black or brown hair and designates the wild color also called agouti. For example, wild rabbits are basically brown with yellow color in the brown hair tips caused by the *A* gene. The mixture of brown and yellow results in the wild color. Rabbits which do not have the *A* gene but have *a* produce no yellow tip on the hair and is solid color. The same is true in the horse that has the *a* and no *A* genes. These horses are recessive blacks. For example, horses with *A* & *B* are bay or wild color as is the rabbit with the *A* & *B* genes. A recessive black horse or rabbit is a *B*.

B gene - Produces the black color while *b* produces brown but black is dominant. There are only two *B* color genes in horses *B* & *b*.

C gene - This gene determines whether any color is produced. The *c* form is not known to exist in horses since there has never been a true (pink eyed) albino horse. The mutant form in horses is c^{cr}, the *cr* indicating cream color as in buckskins and palominos.

E gene - Produces dark color in parts of the body such as the black mane and tail in the bay horse. The recessive form *e* limits the areas of the coat where the dark colors may appear and produces yellowish-red in the horse.

Table 4 summarizes the coat colors determined by the *A*, *B*, *C*, and *E* series of genes. The question marks by some colors in the table are those which are not definitely proven. There may be no practical use for a knowledge of coat color inheritance in horses unless one color might have a higher economic value as the palomino once did. However, this knowledge can be used to predict the possible color of offspring from various matings. For example, breeding a cremello stallion to sorrel mares will produce all palomino offspring. Also, this knowledge in some instances could be used to disprove parentage similar to the use of blood types in humans.

TABLE 4. SUMMARY OF HORSE COAT COLORS

(MODIFICATION OF CASTLE AND SINGLETON)

No dilution gene		With dilution gene c^{cr}	
Genotype	Phenotype	Genotype	Phenotype
A+ B C E	Ancestral bay	A+ B C/c^{cr}	Dun presumably
A B C E	Dark or mealy bay	A B C/c^{cr} E	Dun, sooty, dorsal stripe
A B C e/e	Red-bodied bay	A B C/c^{cr} e/e	Buckskin
a^t B C E	Seal brown	a^t C/c^{cr} B E	Seal brown
a^t B C e/e	Seal brown, light areas conspicuous	a^t B C/c^{cr} e/e	Seal brown
a/a B C E	Recessive black, uniform	a/a B C/c^{cr} E	* Black (mouse?)
a/a B C e/e	Recessive black, mane and tail darker than body	a/a B C/c^{cr} e/e	* Black (mouse? Grullo?)
A b/b C E	Chestnut	A b/b C/c^{cr} E	Palomino, sooty body
A b/b C e/e	Chestnut, sorrel light mane, tail	A b/b C/c^{cr} e/e	Palomino, body clear golden
a^t b/b C E	Claybank dun?	a^t b/b C/c^{cr} E	Claybank?
a^t b/b C e/e	Claybank dun?	a^t b/b C/c^{cr} e/e	Claybank?
a/a b/b C E	Liver chestnut	a/a b/b C/c^{cr} E	Liver chestnut
a/a b/b C e/e	Sorrel uniform	a/a b/b C/c^{cr} e/e	Sorrel uniform
A B C E^D	Dominant black, intense uniform jet black	A B C/c^{cr} E^D	Dominant black
		A B c^{cr}/c^{cr} E	Albino type B =
		A B c^{cr}/c^{cr} e/e	(perlino)
		A b/b c^{cr}/c^{cr} E	Albino type A =
		Ab/b c^{cr}/c^{cr} e/e	(cremello)

TO PRODUCE ALL PALOMINO OFFSPRING MATE:

AA b/b C e/e (Sorrell light mane and Tail) to A b/b c^{cr}/c^{cr} e/e (or E) (Cremello)

*Kownacki, M. 1970 concludes that the mousy color is indeed determined by the c^{cr} gene in Polish Konik horses.
Reference: Animal Breeding Abstracts, Vol. 39, 1971, No. 61

From a practical use point of view, the usefulness of genetics in livestock production comes from a knowledge of the mode of inheritance of production or performance traits such as growth rate, body or leg length, speed, endurance, muscling, etc. These traits are determined by many genes each with an effect too small to be measured. However, the combined effect of these genes can be measured by weighing, etc. and genetic differences calculated mathematically to arrive at an estimate of the extent to which a trait is inherited. This value is called heritability (h^2). Genes and environment are the two factors which determine the make-up of an individual. A heritability of 30% basically means that 30 percent of the differences among individuals are due to the effect of the genes and 70% is due to environmental effects such as amount of food, temperature, etc.

Very few heritability estimates have been made for performance traits, body conformation, etc. in horses. Some of the few reported are as shown in Table 5.

TABLE 5. HERITABILITIES OF TRAITS IN HORSES

Trait	Breed	h^2	Source
Speed	Thoroughbred (Russia)	Up to .87 (high)	ABA Vol. 38, 1970
Speed (Timing)	Thoroughbred (Japan)	.116 (low)	ABA Vol. 38, 1970
Conformation	Thoroughbred (E. Germany Czechoslovakia)	.35 (high)	ABA Vol. 39, 1971
Conformation Height at withers	Friesian	.61	ABA Vol. 38, 1970
Conformation	Dutch Fjord Ponies	.74	
Pace Length	Hanover		
w/sulky 1 Km		.612	ABA
w/sulky, trotting 2 Km		.634	Vol. 39, 1971
riding at gallop 4 Km		.673	
pace with sulky		.09	
pace at gallop		.692	

Heritabilities are useful in predicting the expected progress from selecting to improve a trait. If the h^2 estimate is 30% or higher, it means that the rate of improvement will be high enough to justify selection for that trait. This is the principle that has been used to improve production and carcass traits in dairy and beef cattle, swine, poultry, and other livestock.

REFERENCES: Comparative Genetics of Coat Color in Mammals - A. G. Searle 1968. Academic Press, New York

Castle, W. E. and W. R. Singleton. The Palomino Horse, Genetics 46:1143-1150. 1961.

Singleton, W. R. and Q. C. Bond. A Allele Necessary for Dilute Coat Color in Horses. J. Heredity. 57:75-77. 1966.

BASIC PHYSIOLOGY OF EQUINE REPRODUCTION

Thomas N. Meacham
Animal Science Department
V.P.I. & S.U.

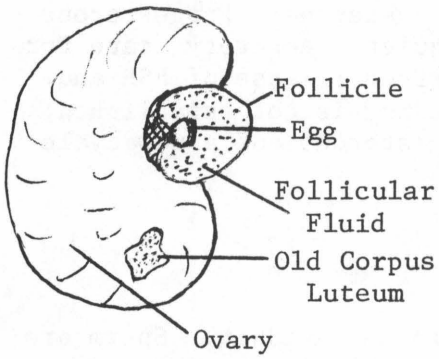
Compared with the reproductive performance of other farm animals, that of the horse is quite poor. The nationally average has been estimated at 60% foaled and 50% weaned. This means that out of every 100 mares bred, 50 of them weaned a foal.Figures from a survey of breeding farms in Virginia a couple of years ago indicate that we are doing a little better; 80% conceived, 74% foaled and 71% weaned. Those figures were from some of the better farms. State average is probably closer to 60% weaned.

I. Patterns of Reproduction in Horses

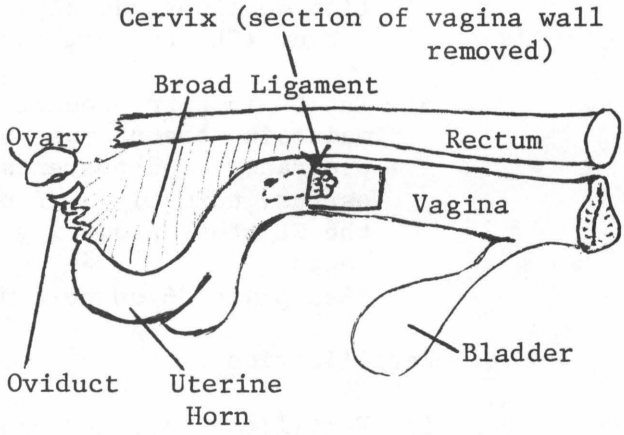
A. Female

1. Anatomy

OVARY OF THE MARE



MARE REPRODUCTIVE TRACK



2. Physiology

a. Puberty is around 18-24 months of age. Quite variable. Usually reached in spring of second year.

b. Breeding season. Definite seasonal effect. Peak period of breeding efficiency is from mid April-July. Many tend to be in anestrous during winter.

c. Estrous cycles

1) Cycle length 18-24 days, avg.=21. Estrous period averages 6 days with a range of 2-7. Longer, more irregular estrous periods early and late in the breeding season.

2) There are four phases: proestrus (2 days), estrus (6 days), metestrus (2 days), and diestrus (12-13 days). Heat and ovulation take place during the 6 day estrus period.

d. The cycle is controlled by several hormones, two from the pituitary and two from the ovary.

1) The follicle-stimulating-hormone (FSH) is released from the pituitary. It stimulates follicular growth in the ovary and estrogen production from the developing follicles. (Figure 1).

2) When the level of estrogen in the blood reaches a certain point, the behavioral pattern of estrus or heat are exhibited. Also, the uterus is preparing for a pregnancy under this estrogen environment. Uterine glands and blood vessels grow rapidly, fluid accumulates.

3) The high blood levels of estrogen act on the pituitary to bring about a sudden increase in the luteinizing hormone (LH) that is being released from the pituitary.

4) The surge of LH acts on the ripened follicle and causes it to break or ovulate and release the egg or ovum. This normally occurs during the last 1-2 days of the heat period. When the follicle breaks estrogen production declines rapidly. LH then causes the corpus luteum (CL) to form in the ovary.

5) The CL in turn produces progesterone. Progesterone maintains the uterus in a quiet, secretory state for pregnancy, and prevents further release of FSH and estrus, normally. If pregnancy is not established, the CL stops producing progesterone and a new cycle begins.
*See plate 36 on next page.

e. Fertilization

1) Fertilization takes place in the oviduct. Sperm are present in the oviduct when ovulation occurs, so fertilization is almost immediate.

2) Conception rates are reduced if sperm are not present when ovulation occurs. Ovum are viable for 6-12 hours and sperm about 24 hours. Must breed at the right time, just prior to ovulation.

3) Twin ovulations and fertilization occurs about 4-5% of the time. Few twins are born alive and normal.

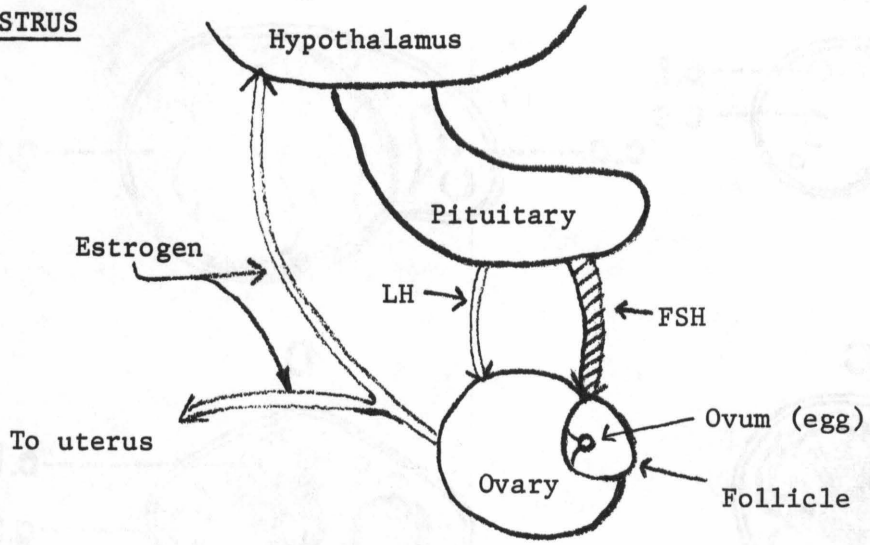
f. Implantation

1) Fertilized ovum, the embryo, migrates to the horn of the uterus in 4-6 days.

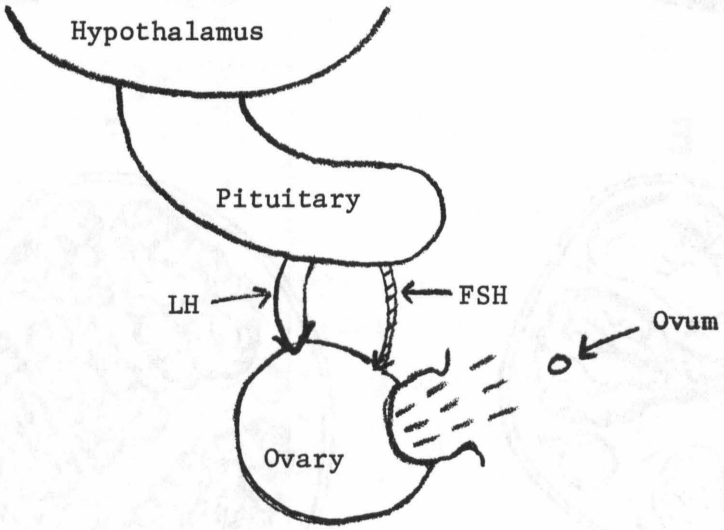
2) Embryo remains free in the lumen of the uterus for about 6 weeks--held in position by fluid pressure. At about 6 weeks of pregnancy the diffusion type of fetal nutrition begins to change to a fetal-capillary type (Chorio-

FIGURE 1: HORMONE CONTROL OF THE OVARY

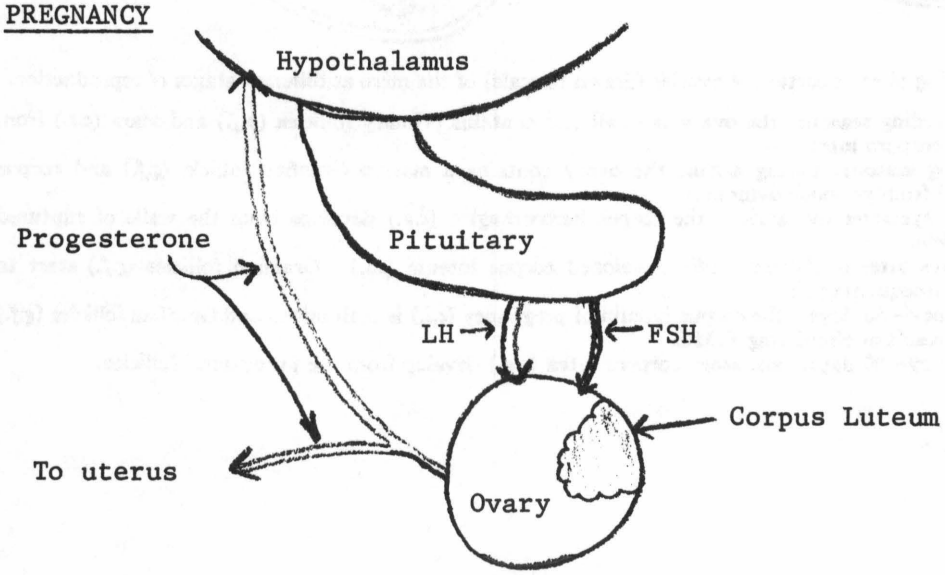
A. ESTRUS

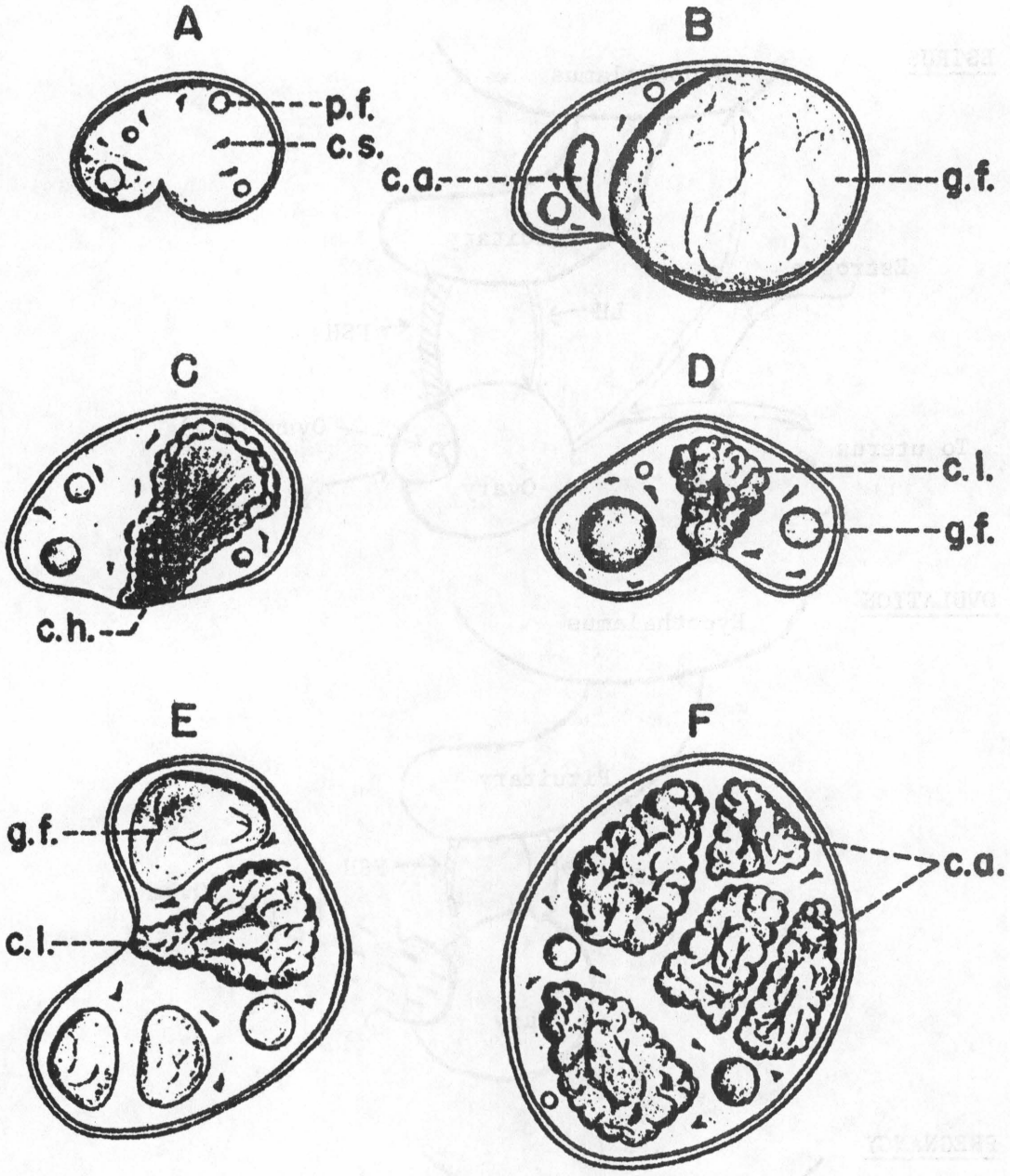


B. OVULATION



C. PREGNANCY





Microdrawing of cross section of ovaries (drawn to scale) of the mare at different stages of reproduction.

A, Non-breeding season: the ovary is small and contains primary follicles (*p.f.*) and scars (*c.s.*) from degenerating corpora lutea.

B, Breeding season: during estrus, the ovary contains a mature Graafian follicle (*g.f.*) and corpus albicans (*c.a.*) from previous ovulation.

C, Three days after ovulation: the corpus hemorrhagica (*c.h.*) develops from the walls of ruptured Graafian follicle.

D, Ten days after ovulation: fully developed corpus luteum (*c.l.*). Graafian follicles (*g.f.*) start to develop for subsequent cycle.

E, Pregnancy—60 days: the corpus luteum of pregnancy (*c.l.*) is maintained and Graafian follicles (*g.f.*) develop as a result of circulating P.M.S.

F, Pregnancy—80 days: accessory corpora lutea (*c.a.*) develop from the unruptured follicles.

allantoic type). (This is when embryo is most likely to slip.) Attachment to the uterine wall is complete at about 100 days (14 weeks).

3) Around 45 days the uterus of the pregnant mare begins to produce the hormone called pregnant mare serum (PMS) which stimulates the development of accessory CL on the ovary. These provide additional progesterone to supplement the original CL until the placenta is formed and takes over the job of producing progesterone for the remainder of pregnancy.
*See plate 36.

4) During this period the embryo is nourished by secretions from the uterine glands (uterine milk).

g. Pregnancy Tests

1) Rectal palpation - an examination of the uterus through the rectal wall. Easiest, most rapid, most informative, and as accurate as other method.

a. Follow uterine horn from ovary down

1) 30 days - small, hard noticeable bulge size of walnut in lower third of horn of uterus

2) 40 days - bulge about size of orange and spherical in shape

3) 50 days - oval and size of grapefruit - starts to enter the body of uterus.

4) 60 days - size of small football, 1/2 is in body of uterus

5) 90 days - whole uterus is enlarged and is abdominal and cannot be reached

2) Pregnant Mare Serum Test

a. 95% accurate between 45-100 days of pregnancy

1) Inject 1 ml of mare's serum into immature female rat

2) 96 hours later the reproductive tract of the rat is examined. Enlargement of the ovary and uterus indicates pregnancy.

h. Placentation and Gestation

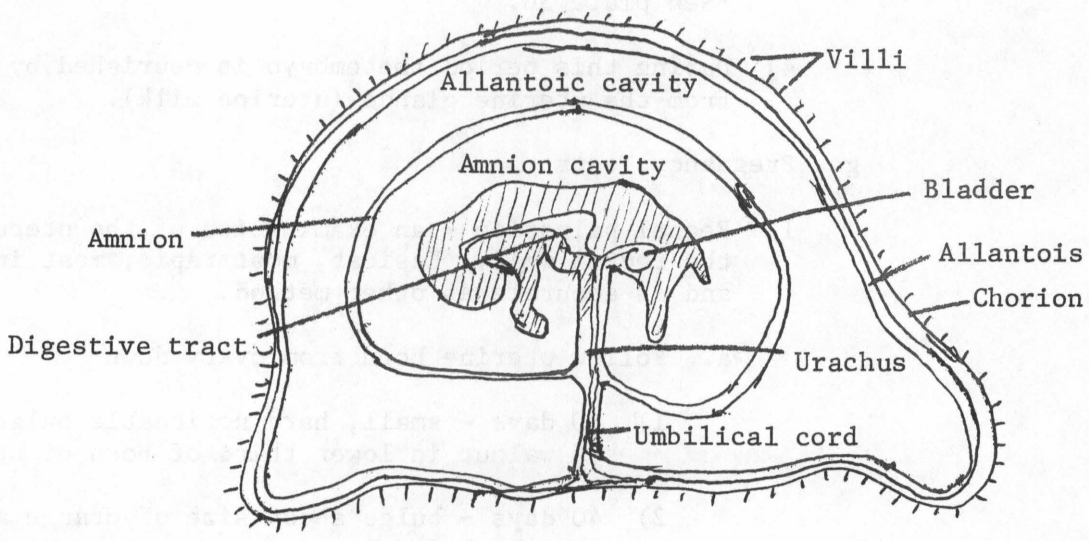
1) The placenta consists of 3 membranes

a. Amnion - surrounds the fetus and is filled with fluid. This protects and cushions the fetus.

b. Allantois - fetal waste receptical, fused with the chorion

c. Chorion - outer most layer and contains the vascular system of the fetus. Arteries and veins from the fetus extend out through the embilical cord and branch through the chorion.

Fetus of horse within the placenta



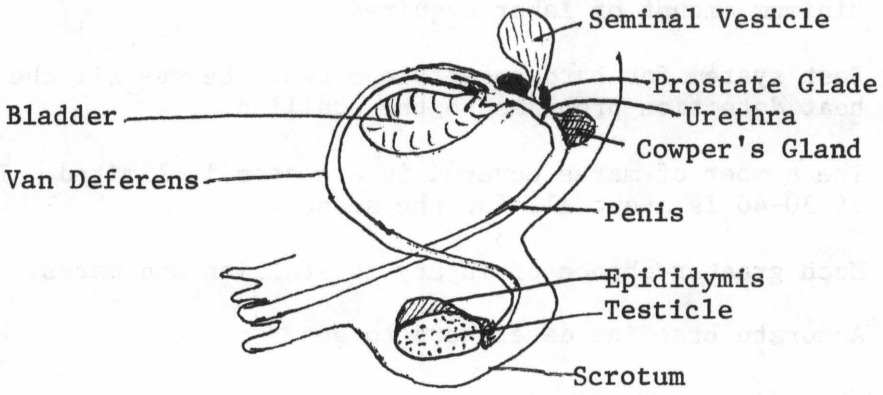
2) Placentation is complete and attachment to uterus has occurred at approximately 100 days. Small villi projections on the surface of the chorion penetrate into crypts of the uterine lining. Capillaries of maternal circulation and those of the fetal circulation are located adjacent in these crypts. The exchange of nutrients and waste products take place at this point. The two systems are not connected but diffuse from one to the other during gestation.

3) Gestation period lasts about 11 months (320-360 days). Considerable variation.

B. Male

1. Anatomy

STALLION REPRODUCTIVE TRACK



2. Physiology

a. Puberty, the age when the colt is capable of reproduction, is around 18-24 months. This is quite variable.

b. Sexual maturity does not occur until 3-4 years of age.

c. Spermatogenesis takes place in the semeniferous tubules of the teste. This process is stimulated by a gonadotrophic hormone (FSH) from the pituitary gland. Testosterone, a hormone produced by the testes is also needed for spermatogenesis. This process is initiated at the time of puberty.

d. Sperm are stored in the epididymis, the vas deferens and ampulla for ejaculation.

e. The pituitary also secretes a hormone (LH) which stimulates the Leydig cells in the teste to produce testosterone. Testosterone is responsible for the secondary sex characteristics, libido, etc. causes the secondary sex glands (seminal vesicles and prostate) to secrete the fluid portion of the semen.

f. Semen production and libido are continuous once puberty is reached. Some variation in semen production, lower during winter months. Average ejaculate is 125 ml and contains 8 billion sperm.

II. Breeding Management

A. Breeding systems

1. Pasture breeding

   a. Stallion turned out with group of mares.

   b. Most efficient in terms of pregnancy rates.

   c. Minimum amount of labor required.

   d. Best system for hard-to-settle mares. Leaves all the heat detection problems to the stallion.

   e. The number of mares covered in a season is limited. Band of 30-40 is about all for the season.

   f. Much greater chance of injury to stallion and mares.

   g. Accurate breeding dates hard to get.

2. Hand breeding

   a. Mares teased and brought to the stallion for mating under controlled conditions.

   b. Can breed more mares in a season - 50-100.

   c. Can take precautions to protect mare and stallion from injury.

   d. Increases labor and time needed to check mares and get them bred.

   e. Greater chance for personnel injuries.

   f. Requires well qualified help.

   g. Can accommodate "outside" mares easily.

3. Artificial insemination

   a. Greatest efficiency in terms of numbers of mares bred/ stallion.

   b. Little danger of injuries.

   c. Can reduce spread of disease.

   d. Breed associations vary in their rules on registering A.I. sired foals. These rules may change.

   e. With the use of frozen semen, A.I. offers quite a bit to the horse breeder who is not concerned with registered horses.

BASIC HORSE NUTRITION

By
Dr. H. J. Gerken, Jr.
Extension Specialist, Animal Science
VPI&SU
Blacksburg, Virginia

I. Introduction

Nutrition is the science that deals with food and the nutrients it contains in relation to the health of man and and animals. Nutrition is especially important to the horseman because the horse is essentially an athlete that is expected to perform at peak efficiency for a long period of time. Adequate nutrition is required to achieve this desired result. Poor nutrition can lead to disease, limited performance, injury, poor growth, reproductive failure and economic loss.

An understanding of nutrition requires knowledge of the amounts and kinds of nutrients required by the animal as well as their availability in usually available feeds. A nutrient may be defined as a food substance or group of substances of similar chemical composition which aid in the support of animal life. These may be grouped as energy sources (carbohydrates and fats), protein, vitamins, minerals, water and oxygen.

Carbohydrates are organic compounds containing carbon, hydrogen and oxygen. These are the main compounds found in plants, making up 50-75% of the dry matter in livestock feeds. Carbohydrates are the basic products of photosynthesis being formed in plants from water from the soil and carbon dioxide from the air as well as energy trapped from the sun. Carbohydrates are the major source of energy for horses but are present in only small amounts (about 1%) in the animal body as glucose or glycogen.

Carbohydrates are classified according to the complexity of their chemical structure. Monosaccharides or simple sugars are relatively simple organic molecules containing five or six carbon atoms. Examples are glucose, a key energy compound for plants and animals and fructose or the sugar found in many fruits. Disaccharides are combinations of two simple sugars. An example is table sugar which is a combination of glucose and fructose and is very sweet. Lactose or milk sugar is a combination of glucose and galactose. Trisachaharides are combinations of three simple sugars.

More complex carbohydrates called polysaccharides are made up of large numbers of simple sugars. Starch is a polysaccharide and is the main component in cereal grains such as corn, oats and barley. Starch is highly digestible and rich in energy which explains the importance of cereal grains in feeds. Many starches are made up of large numbers of glucose units. Glycogen, a storage form of glucose in liver and muscle cells has been called "animal starch".

Cellulose is a major carbohydrate component of forages such as hay or pasture. Cellulose is also a combination of glucose units but is digested only by microorganisms present in the digestive tract. The products of this digestion yield energy to the animal while cellulose itself adds bulk and aids in maintaining muscle tone in the digestive tract.

Lipids, commonly called fats, include a group of compounds made up of oils, waxes and other compounds. Fats are also made up of carbon, hydrogen and oxygen but have 2.25 times the energy value of carbohydrates. These high-energy compounds may be classified as simple lipids, compound lipids and derived lipids. Most fats or simple lipids are esters of three fatty acids and glycerol. Fats may be a solid or an oil depending on temperature and chemical structure. Simple lipids supply energy and are a source of essential fatty acids.

Compound lipids are similar to simple lipids but contain additional groups on the molecule. For example, phospholipids such as lecithin contain a phosphorus group and are important in fat transport in the blood-stream. Derived lipids include such special compounds as cholesterol and vitamin D. Simple and complex fats are found in relatively small amounts in forages and grains and are also synthesized by the animal.

Proteins are complex organic compounds containing carbon, hydrogen, oxygen and nitrogen in rather characteristic proportions. Protein may also contain sulfur and other elements. The structure of protein is made up of smaller molecules called amino acids. There are many kinds of proteins; the basic difference between them is the amino acid composition. The highest quality protein for feeding purposes has an amino acid composition similar to animal protein as, for example, egg protein, meat scraps or soybean meal. Feed sources high in protein are the protein supplements such as soybean meal, linseed meal or peanut meal. They must be added to rations when the protein content of grain or hay are not high enough to meet the needs of the horse. Protein supplements of animal origin such as dried skim milk, fish meal or meat scraps, though of top quality, one not usually fed to horses because of the expense but may be used in feeds for foals.

Vitamins are specific, complex organic compounds essential for normal growth and maintenance of animal life. Effective in very small amounts, they function primarily as metabolic regulators in various chemical reactions within the animal. Vitamins are classified as either fat-soluble or water-soluble. The fat soluble vitamins include vitamins A, D, E and K. Water-soluble vitamins are vitamin C and the B-complex vitamins such as thiamine, riboflavin, pyridoxine, niacin, etc. The vitamin requirements of the horse are usually met by high quality feeds or they are synthesized within the animal. In some situations supplementation, particularly of vitamins A and D, is required.

Minerals are chemical elements that fulfill specific metabolic and structural roles within the animal body. Primary minerals and related functions include calcium and phosphorus in bone, iron in hemoglobin for oxygen transport in the blood, magnesium, copper and zinc for enzyme function and sodium and chlorine for acid-base balance. Potassium is needed in osmotic relationships and for muscle function and iodine is required in the metabolism-regulating thyroid hormone. Essential minerals can be grouped in two categories; major minerals or those required in relatively large amounts and minor minerals or those that are required in only small or trace amounts. The first group includes calcium, phosphorus, magnesium, sodium, chlorine and potassium. Trace minerals include iron, copper, cobalt, manganese, zinc, iodine and possibly fluorine, molybdenum, and selenium.

Water is an essential component in animal nutrition since it is needed in large amounts for the performance of essential body functions. Finally, oxygen is essential for all body processes.

Proper nutrition of the horse is accomplished by providing a balanced ration of the nutrients required for body maintenance, growth, reproduction and work. Some principles to keep in mind are: (1) Horses differ considerably in the amount of energy they use. Feed to maintain the desired body condition of each animal. (2) Voluntary feed consumption of mature animals will be 1.5 to 2.5 percent of body weight; growing foals and lactating mares may eat up to 3 percent of their body weight daily, (3) The amount of protein needed in a horse's ration depends on the age of the horse and the quality of the forage consumed. Growing foals or lactating mares need more protein than do mature horses at work or in the breeding herd. (4) The need for vitamins depends on the forage fed. Vitamin A and D requirements will increase when poor quality, badly weathered or over-mature hay is fed. (5) Good pasture and free choice minerals usually meet the nutrient requirements of mature horses. (6) Salt is usually included in mineral mixtures to increase animal acceptability. Additional trace mineralized salt should also be provided at all times.

II. Anatomy and Physiology

The beginning of the alimentary canal starts with the lips which have a high degree of sensitivity and are well adapted for selection of feed and its retention in the mouth during mastication. The teeth are hard, bony organs of great importance for cutting, bruising and breaking down food. Periodic inspection of the teeth is necessary to assure that improper wear does not result in difficulties in mastication. Salivary glands moisten dry feed with saliva preparing it for swallowing and initiating the process of digestion. The pharynx is a muscular sac connecting the mouth with the esophagus; the esophagus is a muscular tube about 3 feet in length extending from the pharynx to the stomach.

The stomach of the horse is a J-shaped muscular sac with a capacity of about 4 gallons. It has four distinct regions determined by structure and glandular characteristics. Digestion in the horse begins with the secretion of hydrochloric acid and enzymes in the stomach. The stomach serves as a reservoir and mixing area but because of its relatively small capacity, food remains in the stomach only a relatively short time.

The small intestine is a tube about 70 feet in length extending from the stomach to the large intestine. It is about 1 1/2 inches in diameter and is divided into regions known as the duodenum, jejunum and ilium. The interior surface is lined with mucous membrane which has a velvety or pile-like appearance. This is due to the immense number of projections called villi between which are glands which secrete digestive juices. The pancreas and liver deliver their digestive secretions into the small intestine.

Most digestion and absorption of nutrients takes place in the small intestine. A rich capillary blood supply and a network of lymph vessels called lacteals which extend into the villi provide a means for the absorption of nutrients from the small intestine into the bloodstream.

The large intestine of the horse consists of the caecum, great colon, small colon, rectum and anus with a total length of about 26 feet. The caecum is of particular interest because of the bacterial fermentation occurring within this part of the tract. The caecum is about 4 feet long and has a capacity of about 8 gallons. Digestion of fiber (cellulose) by microorganisms occurs mainly in the caecum and great colon. Vitamin and amino acid synthesis occurs as a result of microbial action. The B-vitamins and vitamin K are synthesized and are available to the animal. There is some doubt as to the value of microbial protein synthesis in the horse when compared to its value in ruminants since the means for digestion and absorption are lacking at the posterior end of the alimentary canal.

III. Digestion, Absorption and the Role of Nutrients in the Body

Digestion consists of all the physical and chemical changes that take place in the preparation of feed for absorption. In this sense, mastication and ensalivation are the first steps in the digestive process. Physical mixing of the feed ingested with digestive enzymes including those secreted by the liver and pancreas is brought about by the muscular contractions of the digestive tract. These contractions are called peristalsis and are important to the health of the animal. Sufficient bulk or roughage in the ration is conducive to good intestinal muscular activity.

Starch is the most important energy source for monogastric or simple stomached animals such as the horse. Starch is digested in the small intestine by the action of the pancreatic enzyme amylase which breaks the starch molecule into the disaccharide,maltose.. Maltose and other disaccharides are further broken down into simple sugars by enzymes produced by glands in the small intestine.

In the first three compartments of the ruminant stomach and in the large intestine and caecum of the horse, microorganisms attack cellulose and break it down into volatile fatty acids mainly, acetic, propionic and butyric acid. These acids are absorbed into the bloodstream where they can be metabolized as energy sources and for the synthesis of certain other molecules including amino acids.

Fats are broken down by digestive enzymes called lipases. They break fat into its constituent alcohol and fatty acid components. For example, a typical triglyceride would be split into three fatty acid molecules and glycerol. Bile salts produced in the liver aid in fat digestion by their emulsifying action.

Protein digestion is also an enzyme - directed process. Enzymes aided by the hydrochloric acid (H+) ions secreted in the stomach proceed with the breakdown of protein until free amino acids are produced. Protein digestion which is well started in the stomach is further carried out in the small intestine where specific enzymes produced by the pancreas play essential roles.

Minerals are dissolved from foods by the action the hydrochloric acid secretions of the stomach or are released from organic compounds broken down by enzymes. Little is known about the digestion of vitamins, but they can

probably be used without conversion to simpler compounds. Carotene, a precursor of vitamin A, is believed to be converted to the vitamin in the small intestine although this conversion can also take place in the body cells after absorption as carotene.

Absorption is the transfer of nutrients from the intestine to the bloodstream. Most absorption takes place in the small intestine. Carbohydrates are absorbed as simple sugars by simple diffusion and by a process called phosphorylation which results in the active transport of simple sugars across membrane of intestinal cells into the blood capillaries which supply the villi of the small intestine.

Some fat is absorbed directly but most is broken down into glycerol and fatty acids and then recombined into neutral fat in the intestinal wall. Fat is transported in the lymph system to the thoracic duct where it enters the bloodstream. It may then go to the liver or to stores of body fat. Fat absorption is not very efficient in horses.

Protein is absorbed as amino acids by a diffusion process into the capillaries associated with the villi of the small intestine. They may then go to the liver or to the cells of other tissues for resynthesis into protein. Intact proteins are usually not absorbed across the intestinal wall except in the newborn animal. In that particular instance, however, the transfer of antibodies found in the "first milk" or colostrum of the mother does occur.

Fats promote the absorption of vitamin A and its precursor, carotene and probably enhance the absorption of other fat-soluble vitamins as well. Water-soluble vitamins are absorbed from the small intestine and from the caecum and large intestine where they are synthesized by micoorganisms. Most minerals are absorbed quite readily from the small intestine. Vitamin D plays a significant role in the absorption of calcium and phosphorus. In some instances, high levels of one mineral element may interfer with the absorption of certain other minerals.

In summation of the role played by specific nutrients, it can be said that carbohydrates supply energy for body processed. Surpluses are converted to fats which then become potential energy sources. Though sometimes overlooked in our concern about protein, minerals and vitamins, energy sources make up the largest proportion of the feeds given to horses and thus our greatest expense in feeding the horse is for energy. As pointed out earlier, fats are rich sources of energy and are necessary to supply essential fatty acids (linoleic, linolenic, arachidonic). Body fat is a reserve of energy and serves to cushion and protect vital organs.

The functions of protein in the animal body include (1) repair of tissue, (2) growth of new tissue, (3) metabolism for energy, (4) manufacture of antibodies, (5) enzyme synthesis and (6) hormone production.

Vitamins are regulators of metabolism and have thus been called "organic catalysts". Vitamins play essential roles in digestion, absorption and metabolism of nutrients, growth and reproduction and in the maintenance of general health.

Minerals play a variety of roles in the animal body and as such make up 3 to 5 percent of body weight. Deficiency symptoms are often unrecognized until effects are extreme, so proper supplementation is important.

IV. Nutritional Requirements of the Horse

The maintenance requirement of a horse is that amount of energy required to sustain zero body-weight change in a mature horse undergoing normal non-working activity. This is best judged by observing the animal's condition. High quality hay and farm grains or good pasture supply adequate protein and other nutrients for maintenance.

The energy requirement for work is greatly influenced by the type of work, the condition and training of the animal, the ability of the rider or driver, fatigue, environmental temperature and the constituents of the diet. For example, the energy requirement for a horse moving at the walk is about one-tenth that of a horse trotting with occasional cantering. More strenuous effort rapidly increases energy needs. Protein requirements are not measurably increased by muscular activity. Feeding greater amounts of the maintenance ration to supply the extra energy needed for work will supply sufficient protein to cover the protein requirement for work. When horses are under the stress of performance, racing or show, B-vitamins may well be added to the ration to insure adequate intake.

The question of just how fast a horse should grow is unresolved but most owners strive for rapid growth which of necessity implies adequate supplies of all nutrients. A shortage of energy in the growing horse results in poor condition and eventually in weight loss. Young horses require more protein in their rations than do mature horses. When expressed as a percentage of ration dry matter, a young foal requires about 19% protein, a yearling needs about 12% and a mature horse can do well on about 10%.

In the early stages of gestation the nutritional requirements of the mare are not greatly different from maintenance needs. In the last 90 days of pregnancy, energy and protein needs increase appreciably and need to be met with increased levels of feeding. The products of gestation will equal about 10 - 12% of the mare's bodyweight. The pregnant mare in the last 90 days of pregnancy should receive 11.5% protein on a ration dry matter basis.

The nutritional requirements during lactation are higher than during pregnancy. For example, the energy needs at peak lactation are about 160% of the maintenance requirement. The protein level of the lactating mare should be increased to 13% of the ration's dry matter to provide for both maintenance and milk production. Otherwise, the mare will produce milk at the expense of body tissues.

The young, growing horse and the pregnant or lactating female have increased vitamin and mineral requirements which need to be considered.

APPLIED NUTRITION AND LABOR SAVING TECHNIQUES

Thomas W. Tuggle, Manager
Specialty Feed Services
Southern States Coop., Inc.

Nutrition may be defined as the science of food and the nutrients in food and their relation to health. Basic nutrition is the application of biochemical and physiological knowledge to animal production and maintenance experiments. Applied nutrition, simply stated, is the what, when, and how an animal is fed. Applied nutrition recommendations should be based on the results of production and maintenance experiments.

It is true that equine nutrition is many years behind the nutritional data for almost every other specie of animal and that many questions in this field go unanswered today; however, considerable progress has been and is being made which is too frequently not recognized by too many of our good horse people. Many of the rations fed to horses today are the desires of horse people rather than horses. The misconceptions, mysticisms, and old wives tales of feeding horses remain with us and seldom will we find any five good horsemen in agreement on rations.

We must treat the horse like the athlete he is, and if he is to perform properly he must be healthy which means he must be fed properly. Feeding should be kept as simple as possible as long as it is adequate. Horses can and do subsist on hay and oats which may be nutritionally adequate for the mature idle horse, particularly if the hay is a top quality hay. More credit has been given to a horse's ability to handle low quality feed than is actually due.

A feed salesman or a nutritionist cannot or should not attempt to recommend grain rations without the knowledge of the forage being fed. The total feeding program should be built around the forage program in order to have an economical and a nutritionally sound program.

A knowledge of the digestive system and the essential nutrients required by the horse will better equip horsemen to utilize and apply better feeding methods. The essential nutrients, water, protein, carbohydrates, fats, vitamins and minerals are needed in various amounts depending on the: (1) age (2) size (3) condition (4) performance expected (5) reproductive status and (6) climate.

(A series of slides to be used in a brief discussion of the digestive system and essential nutrients.)

Protein and energy content of rations are the main variables we are concerned with in feeding horses.

1. Foals - 7 days to six months - 18% crude protein.
2. Weanling - up to twelve months - 16 to 18% crude protein.
3. Yearling and 2 year old - 13% crude protein.
4. Gestating and lactating mares and stallions - 15% crude protein.
5. Performance Horses - 11 to 13% crude protein.
6. Idle mature horses - 10 to 11% crude protein.

With good quality hay, legume or part legume, fed at the rate of 1 to 1 1/2 lbs. per one hundred pounds of body weight along with good quality grain at the rate of one lb. per hundred pounds of body weight horses should grow, reproduce and perform well. The above should be considered as a "thumb rule" since the eye of the feeder plays an important role. The "art" of feeding horses will always remain important; however, we must begin to use the "science" along with it if we are to expect the maximum bred in potential. The amount of energy supplied will determine level of performance and condition. The caloric requirement is probably 16,000 to 20,000 K Cal per mature horse daily.

It should be remembered that a horse is a creature of habit and should be fed regularly and at the same time each day. If this is not done digestive disturbances may occur. If feeding habits are changed, do so gradually.

LABOR SAVING TECHNIQUES

1. PELLETED FEEDS.
2. COMPLETE FEEDS (WITH FORAGE).
3. BULK FEEDS.
4. CREEP FEEDERS.
5. AUTOMATIC FEEDERS.
6. PASTURE AND PADDOCK (VS STALLS).
7. GROUP FEEDING.
8. AUTOMATIC WATERERS.
9. AUTOMATIC WALKERS.
10. OPEN SHEDS.

Pelleted feeds are becoming more popular with horsemen and will be more widely used in the future in order to save labor.

Complete feeds with forage built in can assure the horseman of a good quality roughage and save labor; however, under many conditions hay is essential for proper management of horses.

Creep feeding is becoming very popular and is a practical method of caring for foals to the yearling age in order to save labor. Foals that are started at seven days of age on feed seldom over eat. Many horsemen will not want to substitute individual feeding; however, we see more interest in creep and group feeding, particularly on large farms.

NUTRITIONAL DISEASES OF HORSES

By J. P. Fontenot, Professor

Virginia Polytechnic Institute & State University

Blacksburg, Va. 24061

These may be caused by deficiencies, excesses or imbalances of nutrients.

Malnutrition (Inanition)

This is a condition which usually occurs in horses which are generally undernourished. In many cases most or all of the nutrients required by the horse are inadequate.

The symptoms would be: 1) horse would be thin and dehydrated, 2) weak and incoordinated gait, 3) abdomen is frequently filled with fluid, especially if protein is deficient, 4) accumulation of fluid in the legs, 5) reduced sexual desire in mares and stallions.

The cause may be due to starvation, poor teeth, lameness or extreme parasitism.

Water Starvation

Horses worked hard on hot days without access to water may suffer from heat exhaustion. This may be referred to as water starvation.

The symptoms are: 1) profuse sweating, 2) restlessness and a stumbling gait, 3) body temperature will rise up to 108°F or more, 4) accelerated pulse and respiration rate, 4) if not treated comatose and death will follow.

In order to prevent this disease, a horse at hard work in hot weather should be watered frequently. However, caution should be used not to let the horse overindulge with water at any one time, or

founder may result.

The treatment should be designed to reduce the feaver and to reverse dehydration. The horse should be hosed off with cold water, ice packs should be applied especially on the head and intravenous injections of 5% dextrose or isotonic salt solutions should be administered.

Salt Deficiency

This will usually occur in a working horse shipped from a temperate to a hot humid area, since, of course, the horse will sweat profusely. For treatment, intravenous injections of isotonic salt solution are helpful.

B-vitamin Deficiencies

The B-complex vitamins are synthesized in the cecum and colon of the horse. However, the amount of these synthesized or the amounts absorbed may not be adequate to meet the requirements. If low quality feeds are used, deficiencies of certain of these may arise. However, if good quality feeds are fed, the amounts of vitamins synthesized plus the amounts supplied by the feeds will usually supply sufficient quantities of the B-vitamins to meet the requirement.

Vitamin K

Vitamin K is essential for the production of prothrombin, which is an important part of the blood clotting mechanism. Vitamin K is synthesized in the cecum and colon. Usually, the amount synthesized plus the amounts in certain feeds are sufficient to meet the requirement.

Moldy sweet clover contains dicoumerin which interferes with vitamin K utilization. Feeding such feeds may result in excessive bleeding from injuries and internal hemorrhages.

Annemia

Annemia may result from deficiencies of certain trace minerals such as iron, copper and cobalt. If a deficiency of any of these is suspected the horses should be provided with a trace mineral premix or trace mineralized salt.

Azoturia and the Tying-Up Syndrome

This is sometimes referred to as the Monday morning disease. It is associated with overfeeding the horses at rest. The gait is usually choppy or stiff and the horse is restless. It can be prevented by reducing the intake of concentrates during idle periods.

Eclampsia (Lactation Tetany)

Eclampsia is an acute deficiency of blood calcium. Lactating mares are most susceptible. They develop the disease during foal heat when milk production is high. Prolonged shipping may predispose the horse to this condition. Treatment consists of intravenous injection of calcium salts.

Vitamin A Deficiency

The symptoms of vitamin A deficiency are 1) secondary respiratory problems, 2) diarrhea, 3) watery eyes or "pink eye" appearance, 4) impaired reproduction in mares and stallions. In order to prevent a vitamin A deficiency adequate carotene or vitamin A should be fed.

Rickets, Osteodystrophy Fibrosa and Osteomalacia

These may result from a deficiency of calcium, phosphorus or vitamin D or an imbalance of calcium and phosphorus.

Rickets is the term for the disease in foals. The fetlocks, knees and hocks are enlarged and painful. Bog spavins and splints are common. The long bones will become bowed and will be easily fractured.

Osteodystrophy fibrosa is the term given the condition in horses from weanling to 2-years of age. This condition usually occurs in young working horses or race horses in training. The symptoms are lameness and softening of the long bones, fetlock or pastern bones.

Osteomalacia develops in older horses. There is decalcification and increased porosity of the bones. Symptoms are stiff gaits, enlarged joints, spavins and fractures.

In order to prevent these diseases, adequate levels of calcium and phosphorus must be provided and these must be in the proper ratio. It is especially important that the phosphorus level not exceed the calcium level. If the horses do not have access to sunlight or are not fed suncured hay, supplemental vitamin D should be fed. On the other hand, caution should be exercised not to overfeed vitamin D since this could be toxic.

HORSE NUTRITION RESEARCH IN VIRGINIA[1]

J. P. Fontenot, K. E. Webb, Jr., Janie Carle, T. M. Leonard and G. A. Morrow

Department of Animal Science

Virginia Polytechnic Institute and State University

Blacksburg, Virginia 24061

The horse industry is plagued with problems of keeping the horses sound and functional. Many horses are lost or wasted due to bone problems. Another major problem confronting the horse industry is poor reproductive efficiency. The nutritional status of the horse is important in both of these problems. Most of the nutritional requirements and recommendations for light horses have been based on research with draft horses and cattle. These recommendations may not be accurate since draft horses are used for a different purpose and cattle have a different type of digestive system than horses.

Persons from the Virginia horse industry and practicing veterinarians working with horses requested that research in nutrition be initiated. The first experiment was a field study to evaluate the current nutritional status of horses in Virginia. This research was conducted in cooperation with three thoroughbred farms, Keswick Stables, Cobham; Little Hawk Farm, Crozier; and Meadow Stud, Inc., Doswell, Va. This initial study was supported in part by grants-in-aid from the three cooperating thoroughbred farms.

---

[1]Supported in part by grants-in-aid from the Virginia Agricultural Foundation, Keswick Stables, Cobham, Va., Little Hawk Farm, Crozier, Va., Meadow Stud, Inc., Doswell, Va. and Verulam Farm, Charlottesville, Va. The farms also made available horses and facilities for the studies. Dr. Daniel Flynn, Charlottesville and Dr. Olive Britt, Ashland cooperated and obtained the blood samples.

A total of 30 thoroughbred horses, 10 from each farm, were sampled. Five mares and five yearlings were used on two farms and seven mares and three yearlings were used from the other farm. All horses were fed and handled on the individual farms in the usual manner and were allowed water and salt ad libitum. Feed and blood samples were taken every 3 months for a period of 1 year. The samples were obtained in the summer, fall, winter and spring. For these corresponding times the sampling was in July, October, January and April, except the last samples were obtained in March on one of the farms. The horses were weighed at each sampling time. At the time blood samples were taken, samples of feed and pasture forage, if available for grazing, were obtained.

The blood samples were analyzed for hemoglobin, hematocrit, blood glucose and blood urea; blood serum was analyzed for protein, calcium, magnesium, inorganic phosphorus, copper and iron; and blood plasma was analyzed for carotene and vitamin A. The feed and pasture samples were analyzed for crude protein, crude fiber, ether extract, ash, moisture, calcium, phosphorus, magnesium, copper, iron and carotene.

The hematocrit values were higher for the mares than the yearlings, indicating a relatively higher percentage of red blood cells in the blood (table 1). Hemoglobin values also tended to be higher for the mares than for the yearlings. The blood glucose levels were usually in the normal range for horses and tended to fluctuate with the energy levels in the ration. Generally, the values were lower for the mares than for the yearlings.

The blood serum protein levels were similar for the mares and yearlings and did not vary substantially among the horses from the three farms. The serum protein levels were lower for the fall sampling

(October) than for any of the other sampling periods for both mares and yearlings (table 1). This might indicate that protein nutrition may have been sub-normal at that time. The blood urea levels, which should be an indication of protein intake, were also lower for the October sampling.

The blood serum calcium levels were not consistently different between mares and yearlings (table 2). These were in the ranges usually considered normal for horses. Inorganic phosphorus levels in the blood serum were generally lower for mares than for yearlings. Serum phosphorus is normally expected to be higher in young horses than in older ones. The serum inorganic phosphorus levels were generally lower than what has usually been considered normal for horses. However, there are not that many normal values available in the literature. Frequently the values were quite low. In fact, quite a number of the mares showed blood serum inorganic phosphorus levels of less than 3 mg. per 100 ml. This may indicate a critical area of nutrition.

Blood serum magnesium levels were usually below 2 mg. per 100 ml. The importance of serum magnesium in horses is not completely understood. In beef cows a level of 2 mg. per 100 ml. of blood serum is considered the minimum level needed to ensure against hypomagnesemic tetany.

The blood serum iron and copper values did not indicate any deficiency of these two minerals. This, coupled with the normal values for hemoglobin and hematocrit, were indications that levels of these trace minerals were adequate.

It is difficult to find published normal values for blood plasma carotene and vitamin A in horses. As shown in table 2, the vitamin A values were not consistently affected by type of horse (mares vs. yearlings). The plasma level of vitamin A, except for the October bleeding, which approached 40 µg. per 100 ml.,were generally around 20 µg per 100 ml. or lower.

From the results of the first year's work, it appeared that certain critical areas needed to be explored further. Since it appeared that blood serum inorganic phosphorus levels were borderline and since phosphorus is important for normal reproduction and for proper bone development and maintenance, it was decided to study the effect of phosphorus supplementation.

During a 2-year period an experiment was conducted in cooperation with four thoroughbred horse farms. The four farms were Keswick Stables, Cobham; Little Hawk Farm, Crozier; Meadow Stud, Doswell; and Verulam Farm, Charlottesville. The project was supported by Virginia Polytechnic Institute and State University, grants-in-aid from the cooperating horse farms mentioned above and a grant-in-aid from the Virginia Agricultural Foundation.

A total of 117 horses were used during the study,including 2 stallions, 54 mares, 14 yearlings and 47 weanlings. Prior to the beginning of the experiment each year the horses at a given farm were allotted at random to the following two treatments on the basis of kind of horse, age, weight, sex of weanlings and yearlings and expected foaling date of the mares: 1) Control and 2) Phosphorus supplemented.

The horses on each farm were fed and managed in the usual manner for that farm. The experimental period was from November to March.

The horses were fed hay and concentrate in stalls and were turned out for exercise during the day. The amounts of hay and concentrate fed were recorded daily for each horse. The supplemental phosphorus consisted of defluorinated rock phosphate for the first year. For the second year dicalcium phosphate was used for the horses on three farms and monosodium phosphate for those on the other farm. The amounts of supplemental phosphorus fed, calculated to supply one-half of the National Research Council requirements of the horse, were as follows:

Year	Kind of supplement	Grams per head per day		
		Mares & stallion	Yearlings	Weanlings
1	Defluorinated phosphate	50	50	50
2	Dicalcium phosphate	65	86	86
	Monosodium phosphate	47	62	62

The amounts of phosphorus supplements to be fed per feeding were weighed at Blacksburg in small plastic bags. At each of two feedings per day the phosphorus supplements were added to the concentrate part of the ration.

During both years, prior to the beginning of the experimental period and at monthly intervals during the time the horses were on test, blood samples were obtained from each horse and samples of all feeds were taken. During the second year hair samples were taken by clipping a rectangular area on the underside of the horses. The feed samples were analyzed for dry matter, crude protein, crude fiber, ether extract, ash, calcium, phosphorus, magnesium, copper and iron. The blood serum was analyzed for protein, calcium, inorganic phosphorus, magnesium, iron and copper and the blood plasma for carotene and vitamin A. Hair samples were analyzed for calcium, phosphorus, magnesium, iron and copper.

Supplementing with phosphorus did not consistently affect the serum inorganic phosphorus levels in mares, yearlings or weanlings during the first year. The average values were 3.4 mg. per 100 ml for the mares, 4.4 mg. per 100 ml for the yearlings and 4.9 mg. per 100 ml for the weanlings. As observed in the other phase of the research, serum inorganic phosphorus levels decreased with the age of the horses.

During the second year's research, phosphorus supplementation resulted in increases in serum inorganic phosphorus in the mares and yearlings. The response in the mares was most dramatic on the farm in which the ration was borderline in phosphorus content. The average response to phosphorus supplementation for the four farms was 0.22 mg. per 100 ml., but in the mares on the farm where the ration was borderline in phosphorus content the average response was 0.69 mg. per 100 ml (2.50 vs. 3.19). The increase in serum inorganic phosphorus in yearlings from supplementation was substantial during the second year (4.42 vs. 5.61 mg. per 100 ml). Phosphorus content of hair was not substantially different between the mares and yearlings fed supplemental phosphorus and those fed the control rations.

Supplementing phosphorus resulted in large increases in phosphorus content of hair in weanlings. The values were 380 ppm for the unsupplemented animals and 458 ppm for those fed supplemental phosphorus. Serum inorganic phosphorus in weanlings was not substantially altered by phosphorus supplementation. Thus, it would appear that the hair may be a good index of phosphorus nutrition of young horses. In older horses, it appears that the hair content is not a reliable index.

Research currently in progress includes cooperative work with thoroughbred farms and a study in Blacksburg on phosphorus utilization from different feedstuffs. The cooperative work consists of monitoring the nutritional status of horses during the year and the effect of calcium and phosphorus supplementation on bone development and prevention of epiphysitis in foals. At Blacksburg, 10 ponies have been acquired for the study of phosphorus utilization from different feeds. Initially, phosphorus availability from two sources of alfalfa hay and one source of each of corn and oats will be determined.

It is hoped that sufficient support will be forthcoming for the development of a strong horse research program.

TABLE 1. MEAN BLOOD AND BLOOD SERUM COMPOSITION FOR ALL MARES AND YEARLINGS SAMPLED

Sampling period	Type of horse	Blood				Blood serum protein
		Hematocrit	Hemoglobin	Glucose	Urea	
		%	g/100 ml	mg/100 ml	mg/100 ml	g/100 ml
July	Mares	40.82	15.58	54.94	17.82	7.06
	Yearlings	35.34	13.70	86.65	15.17	6.79
October	Mares	41.34	14.38	65.36	9.07	5.80
	Yearlings	39.76	14.78	79.27	10.39	5.06
January	Mares	39.26	21.64	57.57	34.51	7.05
	Yearlings	36.53	16.69	54.43	31.07	7.03
April	Mares	47.59	18.38	49.72	39.38	8.92
	Yearlings	40.90	15.33	60.64	33.02	7.95

TABLE 2 . MEAN BLOOD SERUM MINERALS AND PLASMA VITAMIN A COMPOSITION FOR MARES AND YEARLINGS

Sampling period	Type of horse	Blood serum					Blood plasma	
		Calcium	Inor. phos.	Magnesium	Copper	Iron	Carotene	Vitamin A
		mg/100 ml	mg/100 ml	mg/100 ml	µg/100 ml	µg/100 ml	µg/100 ml	µg/100 ml
July	Mares	12.56	3.49	1.94	70.87	277.9	27.70	26.70
	Yearlings	12.78	6.06	1.98	84.48	171.3	27.06	19.62
October	Mares	12.23	3.25	1.83	56.45	264.8	28.60	38.61
	Yearlings	12.31	4.51	1.73	52.74	151.0	24.88	38.85
January	Mares	10.85	3.94	1.82	48.87	237.0	51.77	20.53
	Yearlings	10.63	5.61	1.74	50.73	303.8	26.98	19.11
April	Mares	11.92	3.20	2.31	76.79	266.7	109.72	17.59
	Yearlings	11.47	5.17	2.00	73.77	217.3	69.13	24.70

MANAGEMENT, CARE, AND PROBLEMS WITH PASTURES

John W. Mayhugh, Area Consultant
Brookside Farms Laboratory Assn., Inc.
P. O. Box 71
Warrenton, Virginia 22186

Good horsemen, good pastures, and good horses go hand in hand. It has often been said that good pasture is the cornerstone of successful horse production. Needless to say, the great horse breeding centers of the world are characterized by luxurious pastures produced on fertile soils. In season there is no finer forage for horses.

Pastures on highly fertile, well balanced soils help provide needed proteins, energy, minerals, and vitamins for horses. In addition pastures provide horses invaluable exercise on natural footing with plenty of sunshine and fresh air. A lower feeding cost per animal is an added virtue.

The climate in Virginia furnishes a long pasture season and is favorable for growing mixtures of grasses and legumes that are of excellent nutritional quality if properly treated and managed. Also. these pastures are highly palatable for horses throughout our pasture season. In the spring, good quality green pasture feed is considered to be the "cure-all" for the animal subjected to the deficiences that may arise during winter feed.

The qualities of good pasture that I want to discuss with you are the soil, the fertilization, grass species, and clipping. Now each of us has a different situation but let us cover the general characteristics. Horse pastures should be well drained and not too rough or stony and all dangerous places such as pits, stumps, poles or tanks guarded. Shade, water, and salt should be available in all pastures.

We then need to start with the soil. Plant life is immobile. Plants cannot move for they are firmly rooted in the soil where they live out their complete cycle of life. Nor does a plant possess a stomach or any kind of digestion apparatus. The soil serves as the plant's stomach. Therefore, we must establish the proper "Balance" of mineral ingredients in the soil for high quality pastures. Balance does not refer to a random combination of mineral ingredients but a combination best suited for the grasses generally found in horse pastures. While no two fields will be alike in their chemical composition, there will exist an approximate relationship between the values that may be accepted as ideal for horse pastures. The following base saturation of the soil's colloidal system is suggested:

60-70% Calcium (Ca)
10-20% Magnesium (Mg)
2-5% Potassium (K)
10-15% Hydrogen (H)

and about 5% other bases, including Sodium and many of the trace elements

The negatively charged acid elements, important for good pasture, which are held principally in the soil solution where plants absorb them through their root hairs from the soil are nitrogen, phosphorus, and sulfur. Suggested levels are:

Nitrogen (Discussed later)
Phosphate (P_2O_5) = 250+ lbs. per acre
Sulphates = 750+ lbs. per acre
Ideal pH = 6.2-6.5

The above type of information is available through quantitative soil analysis of commercial laboratories and some universities in this country. I urge you to test your soils and demand information beyond readings such as High, Medium, and Low. An understanding of this broader concept of soil-plant relationship will help you deal with excessive as well as depleted elements in taking the necessary corrective measures to bring your soils to a proper balance of nutrients for good pastures.

The timing and application of fertilizers are important. When seeding a new pasture, all fertilizer ingredients give the most response when disked down instead of being plowed under. Much more mixing action takes place with disking. For major soil corrective treatment, application of ingredients can be made at any convenient time of the year. Horses should be removed until a good rain has washed the material from the grass. Maintenance fertilizer applications are best done in the Fall on heavy soils and early Spring on light soils. The horses may or may not remain on the pasture for this application. It depends on the kind of material, particle size, and the amount applied. If in doubt, then the safest thing is to remove the animals from the pasture.

What about Nitrogen? Purposely, I have not mentioned this fertilizing ingredient. Yes, nitrogen is a most essential plant food but when applied in excess may cause detrimental after effects. It is needed with new seedings ....about 30 to 50 lbs. per acre. However, beware of its use on other pastures. If organic matter exceeds 4%, then I would not use it. I do not want to condemn Nitrogen but its use must be handled with care and understanding. If there is a question in your mind, then you would do best to leave it off except when seeding (30 to 50 lbs. per acre.) Remember, Nitrogen increases protein and builds flesh; whereas calcium, phosphorus, and magnesium build bones.

The species of grasses which are desirable for Virginia Horse Pastures are as follows:

Kentucky Bluegrass ranks first as a pasture grass. It flourishes well in well drained fertile soils but will not grow well in wet areas and may die out entirely in dry areas. Bluegrass if not allowed to head out has a high protein content as compared with other grasses and maintains this high protein level late in the season on high fertility soils. It does become dormant in the hot weather of midsummer; therefore, it should be seeded in combination with a legume which will provide pasture feed during the dormant stage.

Alfalfa is used for both pasture grazing and hay production. It is usually used in combination with other grasses for pasture such as orchard grass or bluegrass. The latter being my favorite combination ....Bluegrass and Alfalfa.

Clovers ---Several varieties of clover are used in combination with other

grasses as pastures for horses. Red Clover is common to Virginia but does not stand drought conditions as well as alfalfa. As a second choice to alfalfa, I like to seed this legume with Bluegrass in new seedings. Ladino Clover is often found in grass and legume mixtures. However, it really thrives in wet conditions and is hard to keep under control; therefore, I do not recommend it for horse pastures. White Clover is found throughout Virginia. It, too, flourishes on heavy moist soil in a relatively cool season. It is low growing and often grown in combination with Kentucky Bluegrass. This clover will reseed itself even under close grazing conditions and normally will come into pastures under wet conditions. Therefore, I do not recommend it in new seedings.

Fescue ---Kentucky 31 Fescue, a tall fescue, is a very coarse grass but not as palatable as other grasses. Because of its wide moisture and temperature adaptation, it tends to crowd out clovers and other grasses. I do not normally recommend Fescue as a grass for horse pastures; however, under some limited conditions it may be a grass to consider.

Orchard Grass is a good grass for horses. However, it is very aggressive in the early spring and must be kept clipped. It blends well with bluegrass and provides pasture during the dormancy of bluegrass. It establishes much quicker than bluegrass; therefore, it can shorten the period of sod establishment and aid in competing with weeds.

Problems

Establishment of New Seedings - Suggested Outline

Soil Analysis - Time of year for seeding, either early Spring or Mid-August to Early September

Tillage - Either plow or use repeated diskings
Apply corrective treatment based on soil analysis
Get a good smooth seed bed (remember you will be clipping these pastures for years to come.)

A good Seed Mixture:

Kentucky Bluegrass - 50 #/A (Minimum)
Alfalfa or Red Clover - 10 #/A
Orchard Grass - 2 #/A (Optional)
White Dutch Clover - $\frac{1}{2}$ #/A (Optional)

Covering the seed $\frac{1}{4}$" by rolling improves germination and speeds up establishment.

What about weeds? The best weed control is the heavy seeding of grass mixtures. If broadleaves come in, then an application of Butyrac (2-4, D-B) @ $1\frac{1}{2}$ quarts in 10 gallons of water per acre should be applied when seedling weeds are no more than 3" high in 60° temperature. Do not graze for 60 days.

Degenerated Pastures - These are weedy sods with sparse stands of desirable grasses. Generally, they can be improved without a complete reseeding. I suggest you begin with improving the fertility by fertilizing in September after summer weeds grow slowly because of cooler temperatures. Disk lightly and introduce additional Bluegrass @ 10-15 lbs. per acre, Alfalfa or Red Clover @ 5 lbs. per acre and optional Orchard Grass @ 2 lbs. per acre. Keep

animals off if possible and allow the new grass to get started. Repeat the following Fall if necessary.

Heavy Fall and Winter Use Pastures - In other words, these are pastures which have been overgrazed during this period. I suggest you disk or drill in a grass and clover mixture during the early Spring. A layer of phosphorus just below the seed will stimulate quick growth.....about 200 #/A of 46% Triple Super Phosphate.

Bare Spots At Gates - Heavy traffic areas cause compaction and eliminate desirable grass. I suggest you loosen the soil and overseed annually with 10 lbs. per acre of Rye Grass.

Maintaining Grass and Clover Balance - This is very difficult in wet years because White Clover comes in. This White Clover then supplies nitrogen which will in turn stimulate the other grasses the following year causing them to be competitive. The White Clover then declines in the pasture unless it remains very wet.

Care Of Pastures

Clipping is very important. When the pasture is under continuous grazing by light stocking with horses, the horses keep grazing the short pastures shorter or closer because it is highly nutritious. This short grass is high in protein, minerals, and digestibility as compared with the taller ungrazed areas. Clipping at 4" helps to alleviate this condition. Also, the use of cattle makes for a more even looking pasture. Four to six inch clipping is normal; however, this height should be on the high side during dry weather.

Rotation of pastures is important. I know this is not always possible, but it is important. Several months rest each year is desirable. It allows the pasture to even out and the grasses to build up a good root reserve of food.

The construction of small paddocks of one-half acre or less present problems in maintaining quality grass. Compaction becomes a problem. They are also difficult to clip and fertilize properly. In wet weather they take severe punishment and a good grass cover can be ruined completely. Therefore, if possible, avoid putting horses in wet pastures during very wet periods regardless of size.

Fertilization is important and should be done under the guidelines outlined earlier in this presentation. Since the soil represents the basis of all agricultural production, we consider its proper use and management of foremost importance.

In summary, good quality pastures are an asset to any farming enterprise. The wise horseman will regard his soil and grass with the same tender care as he bestows upon a prize yearling or broodmare or any other valued possession. Laboratory techniques applied to your specific problems will help bring positive answers, dispel doubt, and replace confusion with confidence.

KNOW WHAT TO LOOK FOR IN HAY QUALITY!

By
Dr. Harlan E. White
Extension Specialist, Forages
VPI&SU
Blacksburg, Virginia

As everyone knows who has attempted to produce or buy hay, high quality is often elusive and difficult to obtain. There are so many variables involved in producing hay that it is not surprising that such a wide range in quality exists. Understanding the factors involved in producing hay and knowing how to evaluate it will help you to provide high quality hay for your animals.

GENERAL PRODUCTION FACTORS AFFECTING HAY QUALITY--

1. Species of Plants Cured for Hay - Legume hay such as alfalfa is generally higher in protein and minerals than grass hay. Red clover is another legume commonly used for hay but is often dustier than alfalfa and lacks alfalfa's green color. Grasses such as orchardgrass and timothy also make high quality hay. A mixture of legumes and grass is often used. Most of the commonly grown domestic leafy grasses and legumes make high quality hay.

   Weeds, or undesirable plants, lower hay quality by adding woody material low in acceptability and digestibility, as well as contributing bad tastes or odors.

2. Growing Conditions - Hay grown during a drought may be stunted and less leafy than that grown with adequate moisture. Excessive moisture, on the other hand, often produces diseases which attack the leaves and may reduce leafiness. Plants grown under adequate fertility have a higher nutrient content and are more leafy and lower in fiber than those grown under low fertility.

3. Stage of Plant Growth at the Time of Harvest - As grasses and legumes advance from the vegetative to the reproductive stage, they become progressively lower in protein content, digestibility, and acceptability to livestock. This is the direct result of increased stemminess and fewer leaves, resulting in a higher fiber content.

4. Curing Conditions - If the hay is allowed to dry or "cure" in the field, rains and sunlight often reduce quality. Rains beat leaves from the legumes, leach nutrients from the leaves and pack down mowed material to prevent proper drying. The crop thus soaked often begins to deteriorate before drying occurs. The sun further bleaches the leaves, resulting in losses of Vitamin A and in the "bleached" appearance of such material.

5. Harvesting Procedures - Hay allowed to completely dry in the field before raking into windrows for baling loses many brittle leaves in the raking process. Ideally, the stems should be crushed or "conditioned" at the time of mowing for more rapid drying and left in the windrow for drying. This avoids the necessity for raking which often shatters many leaves and mixes dust and dirt with the hay.

FACTORS TO LOOK FOR IN HIGH QUALITY HAY--

1. Stage of Maturity of the Plants When Cut. No mature seed should be present. Legumes should not be in full bloom.

2. Percentage of Leaves Present. Leaves are the part of the plant of highest quality, so high quality hay should contain a high proportion of leaves relative to stems.

3. Percentage of Green Color Present. A bright green color indicates a minimum of bleaching and leaching losses of vitamins and nutrients.

4. Aroma and Fragrance. Moldy, dusty smells are undesirable. Should have clean, "crop" odor.

5. Stemminess. Large and numerous stems are low in acceptability and quality.

6. Amount of Foreign Material Present. Such items as stubble, weeds, sticks, dirt, etc.

HAVE YOUR HAY ANALYZED!

A great deal can be learned about the quality of hay by physically evaluating it on the basis of the above six factors. However, the only sure way to know its actual feed value and how much hay you need to feed your animals is to have it tested chemically to determine its nutrient content.

The VPI&SU Forage Testing Program is a free service which you are encouraged to take full advantage of. The VPI Leaflet, MA 15, describes the procedure for sampling and mailing samples to the laboratory.

BEEF CATTLE SYSTEMS FOR HORSE FARMS

By
Dr. A. L. Eller, Jr.
Extension Specialist, Animal Science
VPI&SU
Blacksburg, Virginia

My approach to owners and managers of beef cattle operations in Virginia when talking about systems, is that PROFIT is the name of the game. When a horseman contemplates the possibility of beef cattle on his farm I think the profit motive needs to be high in priority also. None of you would get very excited about cattle if their addition would be a cost rather than a return. There are some other good reasons to consider beef cattle on horse farms but these simply fit because they're part of the opportunity to enhance the PROFIT picture. These are:

(1) Better utilization of labor. Full utilization of your labor force is mandatory. Admittedly most beef enterprises are not big labor users but certain beef enterprises can fit in rather nicely with the horse enterprise and other farm operations to level out labor requirements and make labor more productive.

(2) Better utilization of pasture. Cattle and horses are almost always compatible with one another and actually complement one another. Select the kind of cattle you need depending on what your presently wasted pasture or crop residue is. On many farms cattle can simply utilize acreage that horses can't utilize well at all. Brush and rough land is no problem.

(3) Improve pasture management. Cattle can be stocked on a flexible basis so that all pastures can be grazed when excesses are expected. Cattle can make good utilization of pasture that may be unfit for the needs of horses and vice versa. Since cattle graze high and horses graze low, improvement in pasture productively and pasture species balance is a definite plus.

(4) Utilization of weather damaged and moldy hay. If you make hay, you'll always have some of this kind. Horses can't use it but cattle sure can. Yearling and older cattle can better utilize any poorer quality roughage than can calves.

(5) Level out cash flow. If cash flow balancing is of importance, you can probably select a cattle enterprise that will fit in to return income at a time when horses or other enterprises on the farm do not.

(6) Tax advantage. Capital gains may be used to advantage only with a beef breeding herd, not a steer operation.

On some farms where horses are intensively managed, there may be no place for cattle but on perhaps a majority of horse farms, beef cattle are a natural supplementary enterprise. On the farms of lots of horse owners in Virginia, beef cattle are a major enterprise and horses are viewed as supplementary. In either case the right beef cattle system should be selected. Let's look at and discuss several basic systems:

1. Cow-calf - The cow-calf enterprise will fit best where cattle are the major farm enterprise or on large horse farms with a significant acreage of pasture that may be of low quality or located in inexcessable areas where utilization by horses may not be practical. Cows take minimum management and buildings and do not require annual financing. Cows, however, are usually not as flexible as are steers. You simply don't buy and sell.

   Purebred herds may be advantageous over commercials in that they are generally of greater value. Marketing of purebreds and the more exacting records that must be kept are worthy of consideration. Commercial calves should be sold at weaning. The best outlet is the organized feeder calf sales.

Cows are great users of coarse pasture, crop residues, and waste forages.

2. Stocker-feeder - We're usually talking about steers although heifers may fit as well but need to be bought at about 80% of the steer price to make as much profit. Steers gain faster and don't come in heat. Either will serve your purpose. There are two classes of stocker-feeders:
   (1) Winter and graze - This entails buying calves in the fall, wintering them to gain 3/4 to 1 pound a day and grazing the next summer for sale in late summer or fall. If you can winter calves I would suggest that they be bought in October to December weighing 400 - 550 pounds. If you winter calves you will need some good quality feed such as silage, legume hay, and some supplementary protein. These kinds of cattle usually will gain 100 - 150 pounds in the winter and 200 to 250 pounds the next summer. If pasture becomes short, sell in late summer. If pasture is plentiful, sell in October.
3. Buy in the Fall and Sell in the Spring - For this system, you should buy the same kind of calves but you would winter them to gain 200 pounds or more and they would be either sold in April or June. If you elect this program, you obviously have some high quality feed and plenty of it for sale through cattle. This system won't fit many horse farms but will work wonderfully for some. If there's early spring grass in abundance to be grazed, a combination system where part are sold in June or July and the balance are grazed on to fall can be used.
4. Buy in the Spring, Graze, and Sell in the Fall - For many a horse farm, this system will actually fit best because it is flexible. This system simply helps to utilize forage that would otherwise be wasted.

The steers to be bought should be rather thin yearlings. Lay them in

in April or before. Worm them, implant them with Ralgro, Synovex or Stilbestrol, and turn them out. They can be moved into and out of pastures and can be moved around to sort of act as scavengers. If it gets dry, some can be sold early. If not, plan to sell in the organized yearling feeder sales in September or October.

There are many other systems that are really variations of the above. Select the one or ones that fit your needs.

Remember, you don't have to be a cowboy and ride a cutting horse to be successful with cattle. The right cattle enterprise is a natural with most horse operations. May I suggest you choose the right one for yours.

CONDITIONING YEARLINGS

By
George Comer
Manager
Verulam Farm
Charlottesville, Virginia

What determines the price of a yearling when sold at public auction? There are many factors, and these factors are so complexly interwoven, that there is no apparent pattern one may use to weigh these factors.

What are some of the factors which determine the price of a good yearling?

1) The pedigree as it appears in the sales catalog. It is advisable to have sound blood lines. For an example - the yearling should be by a fashionable sire or a proven sire, and out of a good race mare or a proven producer. A poor pedigree manuscript is most undesirable.

2) A hot sire, for instance, Guarkstark, Prince John, Vaguely Noble, Bold Ruler, First Landing, and lots of other good sires to choose from, but always bare in mind you have got to have a good mare with some good blood line to go with her. If you are not keyed in on blood lines, ask some knowledgeable person, don't be too backward or ashamed to ask.

3) The yearling should be a close relative to a horse winning a stakes race or placing in a stake, or from a good stake family, or even a close relative to a good allowance winner prior to the sale.

4) The reputation and past record of the consignor will count. This includes both previous sale results and race results.

5) The promotional activities of the consignor will be an important factor. This means advertising and personal contact.

6) The yearling's position in the sale is important, this applies not only to the day of the sale, but also to the position in a particular sale session. The first few yearlings or the last few sold takes the worst of it. It has been said that a good yearling will sell anywhere, but this is not true of an average yearling.

7) The size of attendance effects the bidding. The weather, for instance may affect a good sale.

8) It is necessary to have a number of buyers desiring to purchase a yearling, for one buyer is not enough, it takes at least two.

9) An important national event right on top of a sale session, for example, a sudden turn in the market, will make a difference.

10) A local event, such as an athletic contest, cocktail party, etc. will help, usually.

There are other factors which could influence the selling price and no doubt each of you could name at least one I have failed to mention.

11) We must include the physical appearance of the yearling. This last point or factor should be further considered from the following angles:

a) The size for the July and August sale yearlings should be some what larger than average. The small yearling is always sold to a better advantage at a later date.

b) The degree of maturity is important. The more mature looking the better. Again, give the backward yearling time to grow and develop.

c) Soundness is a must, and obviously the sounder the better.

d) Cleanness, in my opinion this differs from soundness. Included under this heading should be the absence of minor blemishes, such as scars, and wounds which could hurt the horses appearance.

e) The finished yearling should be well groomed and well mannered.

The big problem in selling horses, as in selling any commodity, is that you must give the buyer what he wants if you are at all interested in realizing the <u>High Dollar</u> for your product.

This brings up the question,do the yearling buyers, as a whole, really know what they want or do they recognize what they want when they see it. I am sure the buyer will want to buy a yearling that will win races, and if fortune smiles on their purchase, maybe even win a stakes race. But, the buyer, again I am referring to the collective buyer, behave in the strangest ways. They usually pay the most money for the least likely racing prospect, for some reason they fail to appreciate a clean, hard, sound, sunburned, natural yearling. They much prefer the sleek and polished yearling which in turn deprives the yearling of soundness for racing. We all know that a natural upbringing, with our supplementing scientifically the things that "fenced in" nature cannot supply, will produce the most likely racing prospect. We know how valuable sunshine is in their development. We also know the value of horses playing together, when they are young, learning to gain quickly their balance. Yet entering the rugged looking yearling in the sales arena, you may not receive the price you deserve, but will probably receive press notice in the future years as having bred a champion.

Buyers swear they want a "natural yearling", trainers deplore the fat yearling since it takes lots of time to take that fat off, it's slow hard word. But at the sales, the natural yearling has little eye appeal and it is the sleek, well groomed, well mannered ones that really excites the bidding.

The big problem is how close can the market breeder follow the accepted logical program of raising and developing a sound yearling that will sell and withstand training. It is strange indeed that as a rule the more the breeder offers in the way of soundness the less he is likely to receive for his yearling. Perhaps, this needs a bit of explanation - let us go

back to our childhood, what are the best athletes? Are they closed behind doors, fed a lot of rich food and made fat, and allowed no exercising at all? No. In short, the top athlete must be highly trained and physically fit competitor, all of which starts at an early age.

So in my opinion to have a healthy yearling that will bring a fair price at the sales and later compete successfully at the track, one must follow certain steps:

1) You must have good fields that are clean and safe, plenty of fresh water at all times.

2) Now to the all important matter of feeding, it is hard to make a definite statement and it is impossible to set down a concrete feeding program or schedule. All I can say here at this time is you have got to consider each individual. You cannot have a blanket feeding program. Never get in a hurry at feeding time, take time to weigh the feed that each horse gets. Generally speaking, it is advisable to feed three times a day and four times if you have a bad doer. Your feeding program should have as one of its chief objectives - a uniform group of yearlings-if you decide to have a fat yearling then have them all equally fat. It may be necessary to feed different quantities and a different ration to different yearling. One of the most important feeds are good hays. Be sure it is a good top grade. I prefer clover, but be sure it is free of mold. Alfalfa is a good hay for yearlings. I also like a good mixed hay. I, for one, feel that protein is very important when feeding yearlings.

3) One final point on feeding, it is necessary to have your yearlings in top shape at sale time, not two weeks after and three weeks before. This is very important. Feeding is a very extremely nebulous thing. Actually, it is the eye of the feeder that fattens the horse.

4) Grooming of the sale yearling is very important. A fine genuine coat of hair requires daily grooming. You must have good grooms. If he is a good groom, it is equivalent to an extra feed a day.

5) The yearlings will need the proper schooling prior to sales. The schooling should teach them how to walk, stand, and trot, without braking into a gallop. All this is important when conditioning a yearling, the use of a chiffney that snaps on the halter is a big help.

6) In moving your yearlings from the farm, have plenty of men, use good transportation, and if going a distance oil the yearling. It is foolish to cut corners when you have got a good group of yearlings. It will help create a favorable impression on buyers if the men are clean and well groomed and polite. Be sure to have plenty of help, so you can have your yearlings groomed and ready when the buyers come to the barn to see them.

I hope that the foregoing remarks may be helpful. I would like to close with thought that in a final analysis - the appearance of your yearling on the printed page of the catalog is just as important as the physical appearance of your yearling in the sale ring. It costs just as much money

and takes just as much time to prepare a yearling with poor or inadequate pedigree credentials as it does a colt by Bold Ruler out of Something Royal.

Selling yearlings at public auction is tough and highly competitive business. It is also fascinating and exciting and it can be a profitable business if you offer well grown, sound, and well prepared stock with good pedigrees. And, it can be extremely unprofitable if you offer poorly prepared stock with poor pedigrees.

FAMILY OR GROUP CAMPING AND PACKING IN THE HIGH COUNTRY

The James L. McDonalds
Extension Agent and Family, Tazewell, Virginia

Family or Group Camping and Packing with horses can serve as a healthful recreation and learning experiences for all family members. A well managed camp will treat the whole person, body, and soul. The out of doors opens and cleanses man's senses.

A successful trip must be well planned. First you must decide where you want to go and what you want to do. Second find out all you can about what the trip will involve - equipment, travel arrangements, reservations, and conditions. These things you need to know before you start out.

The persons involved must be congenial and willing to work. There has to be a leader who will delegate responsibilities and supervise the group.

Now let's look at the things to consider when camping and packing with horses.

Horses and Mules:

Individual saddle horses need to be well mannered and trained. They should be in good thrifty condition and well shod about a week before the trip is planned.

Horses and mules can be used for packing. Mules are the most desirable as they utilize food to the best advantage and are sure-footed. Horses should be in the neighborhood of fourteen hands high, heavy muscled, short back, and well cared for.

One important thing to remember is that the pack on a horse is actually dead weight, therefore, it is more difficult for the horse to carry and handle than a rider, where his live weight helps the horse as he goes.

The total load on each animal should not exceed 12 to 15% of body weight and range from 150 to 200 pounds depending on the size of the pack animal.

Stallions should not be permitted as they create problems.

Packing Equipment:

A pack saddle, a good thick pad, hobbles, a stout rope halter with a lead rope at least 10 feet long, lash cinch with 35-40 feet of lash rope, a pack cover or mantie, and paniers are needed for each animal.

Horse Care and Feed:

All animals need to be in a good thrifty condition. Whenever possible utilize pasture at night or during the day. If hay is needed it should be taken to the camping areas and stored prior to the packing trip. Hay is difficult to pack along with other equipment.

One grain mixture for all animals makes for simpler feeding. When packing provide 3 to 5 lbs. of grain for each animal per day.

Remember - hungry horses are difficult to handle.

Pack animals are last to be loaded and first unloaded and cared for.

Equipment for Horses:

Individual: Saddle and bridle in good condition, good saddle pad, stout halter and lead shank, set of hobbles, and saddle bags.

All Animals: Hoof pick, curry comb, brushes - rags
Horse or mule shoes - 1 of each size that animals are wearing
Shoeing hammer, nails and rasp.
Fly and insect repellent-
First aid kit for animals -

Individual Clothing and Equipment:

Use sturdy camping clothes that you can ride, work, and walk in. (Change of clothing needs to be rolled).
Low heeled work or hunting shoes or boots.
Poncho or raingear - jacket for nights or cool weather
Work gloves, billed cap
Toilet articles (many can be shared).
Washcloth, tissue packets, safety pins, wash pan made out of the base of a plastic jug
Canteen - flashlight - insect repellent
First aid kit - one good kit that can be used by group
Sleeping bag in plastic bag and air mattress with cover or ground sheet
Personal medicine must be taken care of by the individual
Needle and thread carried by at least one person
One set of binoculars may be useful

Shelter and Camp Site:

Needs to be located fairly close to water and pasture for animals.

Utilize existing shelters whenever possible. Prior preparation and planning can reduce time needed to set up camp.

Tents can be used when adequate shelter is not available. Saddles need to be stored out of rain and weather. Wet equipment is hard to handle and adjust.

One axe and shovel that can be covered are useful. A gas lantern for the cook area is helpful. Cover for the cook area is often needed, a strand of plastic clothes line may be used by the entire group.

Food: Meals should be simple, nutritious

Plan menus several weeks ahead of time to include needs and likes of the group. Keep in mind foods that are easy to prepare and are light in weight and will pack easily. When individuals are picky concerning food likes this makes group

meals difficult. Plan to pack foods and utensils separate from other needed gear. Box panniers seem to work best for food items. One dish meals such as stews and spaghetti make preparation easier. Liquid food itmes should be bought or packed in plastic containers. Premeasure and mix ingredients when possible to cut down on preparation time at camp site. These can be stored in plastic bags. Do not plan for many snack foods as these often spoil appetites and can lead to upset stomachs. Each meal should have staying qualities so the group is not tempted to snack. Quick cook foods are most desirable.

Utensils and equipment that are helpful are gallon plastic pitchers, large, light weight cooking pots, dutch oven skillets - cast iron is good but adds to the weight - coffee pot rack to place over open fire - long handled forks, turners and spoons. Plastic mixing bowls. Mit-type pot holders or gloves, good can opener, box of long wooden matches wrapped in plastic, paper plates and cups may be used at hurried meals when you do not want to plan on doing dishes.

Metal or plastic bowls and plates pack and carry well. Aluminum pie pans may be used. Aluminum foil may be shaped to serve many purposes in cooking. Salt, pepper, sugar, and other dry ingredients need to be wrapped in plastic.

A sturdy breakfast - sufficient lunch and a hot supper is often the order of the day. Weather conditions should determine your best traveling time and will, therefore determine your cooking time. Very hot hours are hard on the animals and must be considered when planning your meals.

If midday is not too warm you may want to pack lunches that each individual will carry for himself. The zip lock plastic bags carry food well when stored in saddle bags.

Source of Heat: Fireplace - Open fire with rocks o: logs enclosing it, stoves or canned heat. Cooking methods: - Frying, broiling, baking, and stewing or boiling -

FOOD SUGGESTIONS

BREAKFAST

Meats - bacon, sausage (country cured meats keep well)
Cereals: Oatmeal (with dates, cinnamon, and sugar, raisin or brown sugar)
Grits (sugar and cream, butter or red eye gravy).
Cream of wheat, Rice Wheatina, Cream of Rice, Hominy. Dry cereals, (varied and abundant)
Eggs - Cooked in un-liminted ways
Breads - Toast (varied kinds) Pancakes, biscuits

LUNCH

Sandwiches - meats, cooked and frozen 1st. few days, canned meats - Spam, Treet, Vienna Sausage, Bar B. Que, Sloppy Joe
Cheese - many types
Vegetables - (raw) celery, carrots, turnips
Fruits - (raw) - apples and mellons, individual cans of fruit salads
Breads - buns, sliced bread, crackers
Desserts - Cookies, small cakes
Beverages - Packaged mixes - varied flavors, canned drinks

SUPPER

Meats - Beef Stew, salmon, chicken, tuna, corn beef, soybean products, dried beef
Protein - Casserole dishes with noodles, rice, spaghetti
Soups - varied
Vegetables - Fresh 1st day, Canned - varied beans, greens, dehydrated potatoes onions, root vege-tables
Fruits - fresh,

BREAKFAST	LUNCH	SUPPER
sweet rolls Fruits - Fresh, canned juice Beverages - Coffee, Tang, (varied flavors) Instant Cocoa, hot tea		dried, canned Breads - rolls, corn meal cakes, hush puppies Desserts - Puddings (varied flavors) Baked desserts Beverages - Tea - Instant Russian Tea

Most foods may easily be switched to different meals depending on personal choice and preparation time.

Dishwashing: Two plastic dish pans are helpful - they are light weight and can easily fit in panniers with other items stored inside of them. Liquid soap is easily carried - sturdy dish cloths are a must. A small amount of chlorine solution to the rinse water cuts down on germs. Plastic scrubbers and steel wool soap pads are often needed. Very hot rinse water and paper towels make drying of utensils easy.

All waste materials should be buried or carried out far from the trail and camp-sites. If containers were carried in full they can certainly be carried out empty. All traveled areas should be left in better condition than you found them.

"GOOD LUCK ON YOUR NEXT OUTING"

HORSE FACILITIES[1/]

by

H. A. Hughes
Department of Agricultural Engineering
Virginia Polytechnic Institute and State University
Blacksburg, Virginia

Agricultural engineers have, for many years, been very active in the design of production systems, material handling equipment, environmental control facilities and structures for animal industries such as dairy, beef, poultry, and swine. But to date, this activity has not been extended in any sizeable way to horse production systems. Horse production has evolved under the guidance of the people running individual operations. Facilities and equipment have been developed by the sampe people. Changes, based on research findings and applied through the medium of engineering judgment, have been very scarce.

Two factors can be identified which may modify this situation. (1) There is an every increasing interest in keeping horses for pleasure purposes, as well as business. These horses are being kept in a wide variety of areas ranging from urban to rural. (2) The investment, even in a modest size horse farm, can be substantial. Owners of these operations want to be sure that structures are well designed and safe, that feed handling and other labor consuming parts of the system are efficient, and that the waste is handled in a fashion that complies with legal requirements and which does not detract from the attractiveness of the installation. All of these concerns are traditional areas of engineering activity.

SYSTEM PLANNING

The first area of concern is "system planning". System planning is the "big picture" view of the entire operation. System planning should take place before construction of the horse production system or whenever a modification of an existing setup is contemplated. Follow the procedure outlined in the next section or see a publication such as the Horseman's Handbook for advice.

Number of animals

Determine the number of animals of each type to be handled. Remember to consider all types. If you are planning a breeding farm, stallions, brood mares, and young stock must be housed as well as any horses kept for other purposes.

[1/] This paper was prepared specifically for the 1974 Virginia Horse Council Seminar Program, Charlottesville, Va., March 15-17, 1974.

Housing

Are the animals going to be handled and housed individually or in groups? Do you prefer box stalls or tie stalls? A few box stalls are nearly always needed. Perhaps the animals are to be kept on range. Consider range shelters or shades. Again, remember to include all kinds of animals that are to be kept on the farm.

Roofed Area

Roofed area is needed for stalls, walkways, feed alleys, feed storage and tack storage in nearly all systems. Other places that you may want to cover include areas for washing, breeding, showing, sales, training, riding, exercise, and equipment storage. You may want to include an office area. If not, allocate space in the feed room or tack room where office work can be done. If you anticipate many visitors, a lounge area may be appropriate. Also, if people are expected to live and work on the farm, include suitable living quarters.

Open Area

Open area is required for lanes and roads, outside lots, corrals, exercise areas, parking for trailers and other vehicles and equipment, special events, and distance between buildings for pleasing appearance, fire protection and future expansion.

Waste Handling

Plan how you are going to handle the manure. The physical and social aspects of collecting, handling, storing, transporting, and disposing of manure can be a major problem. Poor waste handling methods can allow contamination of water supplies and often are the cause of odors, flies, and other nuisances.

Check on local or state regulations for storage and disposal of manure. If such regulations exist, follow them. If such regulations do not exist, plan to dispose of manure daily when possible. Use ground disposal or composting. Provide temporary storage for manure that cannot be disposed of daily. Plan to empty the storage at least once a week during the summer fly breeding season. Provide for drainage away from the storage area, but do not allow any material which is polluted with animal waste to reach useable or public waters.

Feed and Water

Determine the amount of feed that should be stored for your operation. Allow adequate storage for this amount. It will usually be necessary to allow for storage of several kinds of feed. The amount to be stored will depend on the ration, time between re-supply and the size of the horses.

Zoning Regulations

Early on in the planning stage, check to find out the effect of various regulations and restrictions on your proposed project. Zoning regulations are usually limitations on the use to which property can be put. It is not uncommon to find, particularly within cities or towns, that animal housing is restricted. This restriction may take the form of an outright ban. More commonly, there will be statements about the density of population of animals, and the way in which the animals must be housed and handled.

Even if you do not have zoning regulations, it is often to your advantage to operate as if a typical set of regulations was in effect. This is particularly true if you have close neighbors. Don't allow horses to graze right up to the line fence. Keep the pasture fence 5 to 8 feet back from the property line. Locate barns and other structures at least 75 feet away from the property line. Have secure fences. Your neighbor may enjoy your horses on your place. He is not likely to enjoy your horses on his property!

Building Codes

Building codes set construction standards for all types of structures. Depending upon where your structure is to be located, it may or may not be classified as an agricultural structure. Agricultural structures can sometimes be built to somewhat lighter structural requirements than other types of structures. Check out the building code requirements with your local building inspector.

Building Style

Choose a style for barns and other buildings that fits in with the site and is in harmony with the surroundings. This is especially important if you are in an urban area, or an area which is likely to become urban in the near future. Close neighbors are much less likely to be offended by your horse operation if it has a clean, neat, and attractive appearance. A good operation can be an asset to the neighborhood. A poor operation is always a detraction from the neighborhood and can be expected to produce complaints from neighbors.

Site

Try to locate your operation on high ground if at all possible. Good drainage is necessary if the buildings, arenas, and other areas are to be dry and useful. Be aware that there will be some odors from your horse operation. Try to locate down wind (consider the prevailing winds) from concentrations of houses, apartments, or other places where there are going to be a lot of people.

Consider all aspects of the location which might be pertinent. A lot of traffic to and from your farm, particularly trucks, can be very irritating

to neighbors. Suburban housewives, with no objection to your horses, may not desire to have large feed trucks or livestock trucks traveling up and down the street leading to your operation.

Capital

Review your budget. Place priorities on necessities, conveniences, and overall desires. It may be necessary to build your operation on a step by step basis. If you do this, you may also want to grow into the operation which you plan to develop. It may be desirable to start with a restricted type of operation, or a smaller size operation, then the one which you ultimately hope to have on the site.

Frills

The definition of a frill varies from person to person. What one individual considers a necessity, another may consider to be an absolute unneeded frill. Also what may be a frill in one location will not be a frill in another location. For example, a building style which is very attractive and would fit into a suburban setting, might be considered a frill if it was placed in a very rural setting or on a farm where the rest of the buildings did not conform to the same style.

Do not be afraid to plan for a few frills in your operation, provided they are not excessively expensive. A frill can be a source of pride to the owner or the operator. As such it can increase the pleasure and the time which the individual spends at his operation and will often result in superior management of the system.

Barns

Horse barns, whether large or small, should be well planned, attractive and durable. Barns provide an environment that protects the horses from temperature extremes, keeps them dry and out of the wind, eliminates drafts, provides fresh air in winter and summer, protects them from injury, and is easy for the operator to work in and around. Provide ample space in the barn, based on established space requirements that you can find in many publications, for the well being of the animals and the convenience and safety of the people caring for them.

Barn Styles

Barn styles are usually classified by the destinctive shape of the roof. Most new barns use a shed roof, gable roof, or an offset gable. Gambrel, gothic and monitor roofs which were once very popular are only occasionally used now. The trend in barns is toward the use of a single story structure with clear span or post and beam supported roofs. The use of single floor construction permits lighter, less costly buildings. Clear span roofs add flexibility to buildings by making them more adaptable to other purposes.

The shed roof structure has a single slope roof. It may be an open front or fully enclosed free standing structure, may be attached to other structures or a small movable building. It is relatively low in cost, provides good headroom, and is simple to build and insulate.

The gable roof is the most widely used for new structures today. It is applicable to both open front or closed buildings and for other facilities such as riding arenas.

The gable roof has a triangular shape with two equal pitches which meet at a line in the center of the building. It has a pleasing appearance, is fairly simple to construct and insulate and is about medium in cost. Clear span construction can be obtained in widths as large as 100 feet, by the use of readily available wood or steel trusses. The offset gable roof is similar to the gable except that the two parts of the roof are of unequal length.

Open Front Buildings

Provide free choice shelter for horses which are kept outside. An open front shed will usually provide adequate protection. You should allow 60 to 80 square feet of floor space per 1,000 pounds of animal weight in the shelter. The building should be at least 32 feet wide for moderate climates. Provide additional room if you intend to use the shelter for a hay and bedding storage or any other purposes.

The open side of the building should be faced away from the prevailing winds. In Virginia this usually means that the building should face to the south or southeast. The open front of the building should be at least 10 feet high. The building should include ridge vents an adjustable panels in the back wall for summer and winter ventilation.

Headroom

Provide plenty of headroom for the horse and the rider, if any riding is to be done in the area. Eight feet of headroom is the minimum that is acceptable for an average horse. For a horse and rider, at least 12 feet are needed.

Ceiling height in stalls should be no less than 9 feet. Riding arena ceilings should be at least 14 feet high. If jumping events or training are to take place in the arena, the ceiling (or lower chord of the truss) should be at least 18 feet high.

Layout

Layouts of horse barns are variable. One, two or more rows of stalls can be used. Frequently stalls are arranged around two or three sides of a building leaving an open area in the center. The barn can provide for a covered riding and exercise area, or be just housing.

Decide on your own layout. If you want help, see an expert. Read books on housing. Study plans. Visit other farms and talk to the people in charge. But plan the building layout so that it is an easy building to work in and that is suitable for the stock being housed.

Box Stalls

All stalls should be free from sharp projecting corner objects. Stalls should be sturdy. Stall lining should be solid 4 to 7 feet above the floor. Bars or heavy wire can be used above that. Pressure treated lumber is most durable. Boards should be placed on posts so that the posts take the pressure, not the nails. Locate feeders, waterers and other stall equipment where the animal can't injure itself on them. Minimum stall size is 10 ft. by 10 ft. Most operators prefer larger stalls. Stalls for a broad mare and her colt should always be 12 ft. by 12 ft. or larger.

Doors

Sliding doors and hinged doors, both solid or dutch are used. If you use hinged doors, make sure that they can be latched open. This is also true of dutch doors. Both the top and bottom portions should be latchable in the open and closed positions.

Stall doors should be at least 4 feet wide. If you plan to ride through doors leading into the building, they should be about 12 feet wide. Doors which will accomodate trucks or other large equipment should be 16 feet wide.

Feed Room

The feed room is usually about the size of a box stall. It should be organized for convenience and easy house keeping. Plan the storage of feed materials, equipment, and tools to maximize the use of space and to be convenient for you, the operator. Keep the storage area as clean and dust free as possible.

Hay can be stored in an overhead loft or on the ground floor. Small rooms and narrow doors should be avoided, because they make it inconvenient to move hay into and out of storage. Grain feed should be stored in vermin proof bins or containers. Metal containers such as large garbage cans are excellent for limited feed storage. Hopper-bottom bins with mechanical unloading systems can be used for feed storage, particularly where a large number of horses are involved. A good rodent control program is essential.

Provide for feed storage on a rule of thumb basis. Allow for 1 3/4 pounds of hay and one pound of grain per day for each 100 lb. horse weight. Baled hay weighs approximately 10 pounds per cubic foot and a ton occupies about 200 cubic feet. Oats weigh approximately 26 pounds per cubic foot, ear corn about 28 pounds per cubic foot, and bulk feed about 40 pounds per cubic foot.

The amount of storage space which you should provide will depend upon the number of animals, their total weight, and how often the feed supply is to be replenished.

Windows

A small window in each box stall provides light and ventilation. However, if other methods are provided for lighting and ventilating the building, windows are not essential. If used, locate the windows near the top of the wall. They should be at least 6 feet above the stall floor and protected by heavy screening if they can be reached by the horses.

Translucent roof panels and wall panels are used to admit daylight into some animal shelters. In the summer, however, they allow extra heat loading on the building. They are also subject to severe moisture condensation and frosting in cold weather.

Windows add to building cost. Summer ventilation can be better provided by solid adjustable ventilation doors near the top of outside walls instead of windows.

Floor

Packed or puddled clay on a well drained base makes one of the best floors for horses. It is usually easy to obtain, however, it may have to be hauled to a location. It is also difficult to keep clean and has to be renewed from time to time. Wood planked stall floors or wood floors on concrete or asphalt have been used by some horse owners. These floors are usually difficult to keep dry and free from odors. If concrete floors are used, a considerable amount of bedding such as sawdust is needed or the horses may get stiff. Artificial turf has been used by some operators for stall floors and alleys.

To insure adequate drainage, the top of the floor should be elevated 8 to 12 inches above the outside ground level. Concrete makes a good floor material for a wash area, feed room, feed alleys, and tack room. Avoid slick floor finishes. Use brush or broomed concrete surfaces.

Lighting

Good illumination is important for the convenience and safety of both the horse and the attendant. In particular, light should be provided for general illumination of alleys and pathways, specific illumination of stalls, storage areas and speciality areas, and illumination of outside approach and service areas.

Electric wiring and fixtures must comply with applicable state and national electric codes.

Water

A healthy horse needs an adequate supply of clean fresh water. A mature horse will use 8 to 12 gallons per day. It is difficult to supply this much water by carrying it in pails, especially if a number of horses are to be watered. You may want to consider the use of an electrically heated watering bowl. One unit can serve two stalls or 8 to 10 horses in a lot. If the horses are confined in tie stalls and several are released at once for watering, a small frost free watering tank is preferrable. If the horses are watered in their stalls, the watering device should be located where spillage can drain or out of the stall.

Ventilation

Moisture is one of the biggest problems in all types of livestock housing. All animals produce both heat and moisture. The moisture must be removed from the building to prevent condensation and odor buildup. Ventilation is the most commonly used technique for removal of moisture and odors in temperature control. A number of publications are available on the topic of ventilation from the Extension Service. If you need more help or more information, contact your county agent or your extension ag engineer.

Fences

Traditionally fences for horses have been made of wood. Wood is the most widely used material for fencing roadways, paddocks, exercise lots, etc. However, pipe or 4-inch diamond woven wire fence are also satisfactory. If wire fencing is used, select a mesh that a colt cannot get his feet through. Use a protective board on top of the fence. Use pressure treated 5-inch diameter wood post or their equivalent.

Wood fences are normally made of 1 x 6 or 1 x 8 rough-sawed native lumber. The bottom board is located 9 to 12 inches above the ground, and other boards are spaced about 8 inches apart to obtain the desired fence height. If a higher and more rugged fence is desired use 2-inch thick fence boards and 6-inch diameter posts.

The fence should be free of sharp projections such as nails, bolts, and latches. Do not use barbed wire fences. Planks may be pressure treated, sprayed or brushed with pentachlorophenol for durability and long life. For appearance use a penetrating stain or lead-free paint.

Gates

Use positive locking devices on all gates, such as chain and snap locks or slide locks which require more than one motion to unlock and open. Horses often learn to open gates or doors equipped with conventional locks.

CONDITIONING FOR AND RIDING AN ENDURANCE RIDE

by
Harry Disston
Hidden Hill Farm
Keswick, Virginia 22947

A. What is an "Endurance Ride"?

B. Why participate?

C. Objective

D. Preparation

1. A suitable horse
   (breed, height, weight, age, sex, movement, and temperament)
2. Overall time required
3. Facilities and training aids
4. Equipment
5. Feeding
6. Veterinary attention
7. Shoeing
8. Things to keep in mind
9. Conditioning
   a. Objective
   b. Assumptions - 8 weeks - 6 days - 2 hours
   c. Training basics
   d. Exercise units
   e. Weekly schedules
   f. Special conditioning of back
   g. Special conditioning of legs
   h. Hoof care
10. Transportation and help

E. On the Ride

1. A ride plan (gait, pace, time, distance)
2. What to take along
3. What to wear
4. Your watch
5. Drinking water
6. Pauses and rest periods
7. The last 2 miles
8. Courtesy and attitude

A Suitable Horse

1. Any height, weight, sex and breed.

2. Age: Not younger than 4 - better 5 to 7
   As old as good health and condition will permit - 20 or older

3. Movement:
   a. A long, free, fast and regular stride at the WALK - 4 to 5 1/2 miles per hour
   b. A long, easy, smooth, rhythmic and rapid TROT - 9 to 10 miles per hour

4. Conformation:
   a. Short back
   b. Medium to broad chest and good girth
   c. Moderately sloping pasterns
   d. Relatively short cannon and long forearm
   e. Sound in wind and limb

5. Temperament
   a. Calm, with a kind disposition
      (Does not pull, gig, stumble or toss its head)
   b. Loads and unloads easily
   c. Is a "good keeper" (eats well)
   d. Makes itself at home in a strange stable and strange surroundings

Facilities and Training Aids

1. A "Course" - trails, paths, roads, streams - A few miles with good footing over as large a variety of countryside as practical - especially: (other than wooded trails and country roads).
   a. Stream crossings
   b. A bridge
   c. Steep slopes or hills (or soft footing, a beach)

2. A "Pacing Strip"
   Fairly accurately measured mile or 1/2 mile on reasonably level ground. To determine at what speed your horse walks and trots - and to measure progress in training it to lengthen its stride and increase its pace. Use:
   a. Miles per hour (Walk 4-5 mph. Trot 9-10 mph.)
   b. Minutes to cover a mile (12-15 minutes at the walk. 6 2/3-6 minutes at the trot.)

Things To Keep In Mind

1. You will ride at a walk and trot nearly all of the way - seldom canter (only to relieve monotony).

2. Your saddle needs to fit well and the girth should be tight - to avoid chafing and a sore back.

3. You will have to sit right and ride well.

4. If you and your horse are NOT in good condition, both of you:
   a. Will become tired - maybe exhausted
   b. Will become irritable and uneasy
   c. Are apt to develop sores, raw spots, chafes and blisters.

5. Properly trimmed hoofs and new shoes - about a week before the ride are essential.

6. A good atitude, courtesy and the spirit of having fun will pay off. Be calm and relaxed.

Training Basics

1. Objectives:
   a. Improve your horse's ability to move along actively and freely at the walk at a pace of 4 to 5 miles per hour (A mile in 12 to 15 minutes).
   b. Improve your horse's ability to trot for long periods substantial distances up and down long grades with a big easy, regular stride.
   c. Develop your horse's motor muscles and wind.
   d. Develop your horses back muscles and toughen the hide in its back so that it can carry you for a long time in the saddle - 4 to 6 hours - without causing a sore or tender back.
   e. Develop in your horse the ability to do 40 miles a day - up and down steep grades - for two or three days in succession and remain in good condition.

2. Procedures:
   a. You need only ride 40 miles in a day once prior to the event - about 10 days preceeding it.
   b. Nearly all of your training will be at the walk and trot, using combinations of one-hour "exercise units".
   c. Occasionally walk for one hour and trot 20 minutes without a break.
   d. Two or three days before the event, only walk your horse - an hour in the morning, an hour in the evening.
   e. Progress in the amount of training time and the distance covered at various gaits, depends on your horse's response to the training - his condition, his keenness and alertness, how well be eats and rests.
   f. Your horse's fitness should increase gradually to the date of the event - avoid to early a peak.
   g. Provide as much variety as practicable during your training - to avoid boring your horse and yourself.
   h. Where the footing is good - on fairly level ground - canter occasionally for a short distance to relieve the monotony.

Basic Exercise Units - First 4 Weeks

You need only ride 40 miles in a day once prior to the event—about 10 days preceding it.

First, measure a mile on reasonably level ground and train your horse to *walk* 4 or a little over 4 miles per hour—a mile in 15 minutes or a little less and to *trot* 9 miles an hour—a mile in 6⅔ minutes.

Next work out one hour "exercise units" along the following lines, each succeeding "unit" increasing the time—and therefore the distance—trotted within the hour.

Exercise Units

	Mins.	*Miles*
A. Walk	10	.7
Trot 6 Walk 4 (3 times)	30	3.5
Trot	5	.8
Walk	15	1.0
	60	6
B. Walk	10	.7
Trot 7 Walk 3 (3)	30	3.9
Trot	8	1.2
Walk	12	.8
	60	6.6
C. Walk	10	.7
Trot 8 Walk 2 (3)	30	4.1
Trot 8	8	1.2
Walk	12	.8
	60	6.8
D. Walk	10	.7
Trot	15	2.3
Walk	5	.3
Trot	20	3.0
Walk	10	.7
	60	7.0

Weekly Schedule and Additional Exercise Units

Assuming your horse has been working an average of an hour or two a day, and that your training will consume 8 weeks: Work 6 days every week—one day complete rest.

1st week:	Alternate	2 "A"s (12 miles, 2 hours)
	and	1 A and 1 B (12.6 miles, 2 hours)
2nd week:	2 As	two days
	1 A and 1 B	two days
	1 B and 1 C	two days
3rd week:	1 B and 1 C	two days
	1 C and 1 D	one day
	1 A and 1 B	one day
	1 C and 1 D	one day
	2 Ds	one day
4th week:	1 C and 1 D	one day
	2 Ds	two days
	1 C and 1 D	one day
	2 Ds	two days

Now develop two additional exercise units "E," 8⅓ miles in 1 hr. 10 min. and "F" 11 miles in 1½ hours along these lines:

Additional Exercise Units

	Mins.	*Miles*	
E. Walk	10	.7	
Trot 8 walk 2 (3)	30	4.1	
Canter 6 Walk 4	10	1.5	
Trot	8	1.2	
Walk	12	.8	
	70	8.3	(7.2 mph)
F. Walk	10	.7	
Trot 8 Walk 2 (3)	30	4.1	
Canter 6 Walk 4	10	1.5	
Trot 8 Walk 2 (3)	30	4.1	
Walk	10	.7	
	90	11.1	(7.5 mph)

During the next four weeks use exercise units "E" and "F" in combination with exercise units "A," "B", "C" and "D" to train 2 to 3½ hours 6 days each week covering 12 to 24 miles.

Occasionally *walk* for one hour and trot 20 minutes without a break.

What To Take Along

A. Be prepared for cold, heat, rain, snow, accidents.

B. Stable equipment. (In addition to bridle and saddle).
   1. Sheet, blanket, halter, shank, tie rope
   2. Pitch fork, shovel, rake, manure basket
   3. Water bucket, feed tub, feed measure
   4. Grooming equipment, leather and metal cleaning equipment - bridle cleaning hook, portable saddle rack.
   5. Extra stirrup leathers, girth and lip strap
   6. Basic first aid (for horses) items.

C. Personal equipment.
   1. A "Boy Scout" or "Swiss Army" knife; it contains a variety of tools as well as cutting blades.
   2. A hoof pick.
   3. A two foot length of rawhide and a three foot length of stout cord.
   4. A couple of safety pins.
   5. Some band-aids and a small bottle of merthiolate.

EQUINE IMMUNIZATIONS

by
Reynolds Cowles, D.V.M.
Georgetown Veterinary Hospital, Inc., Charlottesville, Virginia 22901

The role of vaccinations in the overall program of equine management cannot be overemphasized. Preventive medicine is the name of the game in today's spiral of rising costs of raising and maintaining equine athletes.

Most of you are quite familiar with the routine vaccination programs in use today and much of what we will cover is old hat, but possibly there are some aspects which will refresh your basic knowledge and add a few new ideas.

It goes without saying that most of our vaccinations today are used in the prevention of infectious disease. Let's look at the diseases and vaccines available.

The first routine vaccination that comes to mind is for the prevention of tetanus.

Tetanus or "lockjaw" is the dread disease caused by bacterial organisms (Clostridum tetani) that follows introduction of the infection through a wound or possibly through the gastrointestinal tract in the young foal. It is an uncommon condition today due to the use of tetanus antitoxin and tetanus toxoid.

Tetanus antitoxin is prepared from the blood of horses repeatedly injected with large doses of the toxin.

We routinely administer this after an animal is noticeably wounded. This is usually adequate, but depends on one large factor - the owner noting and treating the wound.

The other avenue for prevention of tetanus is the use of tetanus toxoid. This vaccine produces a good immunity that lasts for some time - probably several years.

EQUINE IMMUNIZATIONS

It requires administration of two initial doses, four to eight weeks apart, followed by yearly boosters. In the case of injury, a booster is recommended unless the annual booster was given within the preceding three months. If a horse has had only one toxoid injection and receives an injury, then it should have a tetanus antitoxin injection.

We start this vaccination in foals as early as two weeks of age. The best program for the immunization of the foal is to booster the broodmare within two months previous to foaling. This allows passage of tetanus antibody through the colostrum to the foal and gives good immunity for the first three months of age. If the foal is born from an unvaccinated mare, then it should receive tetanus antitoxin at birth and be vaccinated with tetanus toxoid at an early age. If the young animal has not been vaccinated by weaning time, it is advisable to do so at this time.

The second common vaccination is that for Eastern and Western Encephalomyelitis, or Sleeping Sickness. In areas where this disease is present, this vaccine is a necessity. Most of Virginia contains the potential for this disease that is spread by mosquitoes. Certainly any horse that moves through endemic areas should be vaccinated. Your local veterinarian can advise you on the incidence in your particular region. The vaccination program consists of two injections annually.

These may be given as an intradermal injection, seven to fourteen days apart or as an intramuscular injection to be given thirty days apart.

This should be given in late winter or early spring before the mosquito season starts. This will produce sufficient immunity for ten to twelve months. It must be repeated every year.

EQUINE IMMUNIZATIONS

Several combinations are now available that allow vaccination for tetanus toxoid and Eastern and Western Equine Encephalomyelitis in one injection. These are quite handy if the timing fits your program.

Now we come to Equine Influenza - Flu, Racetrack Cough, etc.

This is a viral disease caused by A_1 and A_2 Equine Influenza Virus. It accounts for a good percentage of cough in our race and show horses. Most stables that use this vaccine are quite convinced of its efficacy. As you know, this disease can produce a very high fever and a cough which may render a horse useless for work for three to six weeks. Because of this, I believe it is foolish for a racehorse or a show horse not to be vaccinated for flu.

The vaccine must be given as two deep intramuscular injections four to twelve weeks apart followed by a yearly booster.

This vaccine often causes a local tissue reaction and should be given in the deep muscles of the hind quarter.

Everyone asks - "What about V.E.E.?"

Venezuelan Equine Encephalomyelitis is the tropical disease that invaded southern Texas in 1971. As you know, there were massive state and federal programs to vaccinate horses against this disease. The disease is no longer found in the United States, but can crop up at any time in those areas where it was found in 1971. It was predicted then that V.E.E. would eventually spread along the southern coastal areas. However, it has not materialized, due in part to the crash vaccination program implemented. It was thought that the original vaccine caused abortion in mares and many other ill effects in the equine. Certainly this vaccine had a number of side effects, the most common being a high fever for three to seven days after administration.

EQUINE IMMUNIZATIONS

The tissue culture vaccine in use today, in my experience, is freer of side effects with only an occasional fever noted.

V.E.E. vaccine is still not recommended for use in pregnant mares. Any horse that has not been vaccinated and is not pregnant should be vaccinated. Young stock should be at least six months old before vaccination. The drug company manufacturing the vaccine recommends an annual booster. However, studies indicate that the immunity lasts for at least four to five years in most horses. Recently the U.S.D.A. has recommended that horses be boostered every two years.

I advise the routine vaccination of all young stock as weanlings or yearlings. Boosters should be given for shows and track requirements.

I would now like to discuss the viral condition, Equine Rhinopneumonitis, caused by Equine Herpes Virus I. This is, in its purest form, a viral respiratory disease. It accounts for a lot of the fall nasal discharge seen in our sucklings and weanlings and accounts for about twenty percent of the cough complex seen in race and show horses. Probably the most dread form of the disease is that of viral abortion. In most cases, the mare goes through a subclinical case of respiratory disease and then aborts her fetus some time later.

This abortion syndrome may occur as an isolated mare on a farm or as an abortion storm with most mares slipping. Obviously this can be a costly disease.

The vaccination program that has been used in the prevention of the "virus abortion" due to E.H.V.$_1$ has been the use of a live virus spray. This year a new vaccine has been marketed that is a modified live virus grown in tissue culture that promises to be a better program of immunization. Let's discuss both programs taking the live virus first.

EQUINE IMMUNIZATIONS

This is the method that most large Thoroughbred farms have used in the past. It involves the vaccinating of all horses on the farm with a nasal spray. It is administered in two doses - July and October of each year. No mare should receive the first injection after her fifth month of pregnancy. This July date conforms to our Thoroughbred breeding season. The Standardbred program runs slightly different due to the earlier breeding season. All horses on the farm are sprayed and quarantined for twenty-one days. This includes foals and other young horses. This program can produce abortion as this vaccine is only slightly modified. Abortion has been seen in about 0.5-1.0% of the mares vaccinated. It also will produce a mild upper respiratory disease in sucklings that must be observed to prevent it from becoming more severe. The obvious disadvantages to this program can be noted. However, it is quite effective in reducing abortion in areas where E.H.V.$_1$ is a problem.

Use of this vaccine must be approved by the State Veterinarian's office and requires a thorough understanding of the possible consequences.

The new vaccine out this year is a tissue culture modified live virus that appears to be much safer than the previous program. I must state, that although the work done by the drug company on this vaccine looks quite good, it was field tested only last year and this is the first year of actual clinical usage. Your veterinarian may have his own opinion concerning its usage so you may want to discuss it with him. At this time, our experience indicates that this is a very good vaccine for prevention of both the respiratory and abortion syndromes.

The mare should be over sixty days pregnant before the initial dose is given. The second dose is given at the fifth to the seventh month of pregnancy. There is an annual booster of one injection given after the sixtieth day of pregnancy. We will be in a better situation to fully evaluate this vaccine

after this foaling season because many mares are presently in this program.

Its use in horses other than pregnant mares is to be highly recommended. As I stated earlier, the E.H.V.$_1$ makes up about twenty percent of our cough complex and if we can reduce cough in our race and show horses, then we are financially ahead. I recommend vaccination of all such animals. We give two injections, four to eight weeks apart and an annual booster.

Foals can be vaccinated any time after three months of age.

Another vaccine that is used by many farms is that used for strangles. Strangles is a bacterial respiratory disease that is common throughout the state. It varies from a mild, upper respiratory disease to full blown pneumonia and death. Unfortunately the vaccine causes a lot of local tissue reaction and this may be worse than the disease itself. It consists of three injections, each administered one week apart and must be repeated annually. It is useful on farms where strangles is a constant problem. It may be used in foals.

Other vaccines that may occasionally be used are the bacterins for Salmonella and Leptospirosis.

Salmonellosis is an acute enteric disease seen on some farms in certain localities and your veterinarian may administer these vaccines if you have a farm problem.

Leptospirosis is an uncommon cause of disease in the horse, although it is one of the causes of periodic opthalmia. Many veterinary pathologists state that Leptospirosis is not a cause of systmeic disease in the equine. Although the occasional situation may warrant its use, routine vaccination with Lepto bacterius is not recommended.

EQUINE IMMUNIZATIONS

I have put this information in chart form for you and I've broken it down as to the age group and use of the horses. I hope this has given you a refresher in your program for preventive medicine. I will open it up for questions.

IMMUNIZATION RECOMMENDATIONS

VACCINE	FOALS	YEARLINGS	BROODMARES	RACEHORSE	SHOW HORSE	STALLION
Tetanus Toxoid	Two shots, 4-8 weeks apart after two months of age.	Booster or orig. series if not before.	Original series followed by booster in the last two months of pregnancy.	Annual booster	Annual booster	Annual booster
Flu Vac	Two shots at weaning time, 4-12 weeks apart.	Booster - one shot.		Annual booster	Annual booster	Annual booster
Encephalomyelitis EEE & WEE	Vaccinate after two weeks of age in high endemic area.	Two injections early spring.	Vaccinate late winter or early spring or after foaling.	Annual vaccination - two shots.	Annual vaccination	Annual vaccination
VEE	One injection after six months of age.			Booster for requirements for racetrack or show.		
Rhinopneumonitis (Pneumabort - live virus)		All animals on farm - nasal spray		July and October.		
Rhinopneumonitis (Rhinomune)	After three months of age, two injections 4-8 weeks apart.	Original series or annual booster.	Original series First shot after 60 days pregnancy Second shot at 5-7 months preg. Annual booster.	Original series 4-8 weeks apart. Annual booster.	Original series 4-8 weeks apart. Annual booster.	Original series 4-8 weeks apart. Annual booster.

EXTERNAL PARASITES

by
Dr. James E. Roberts
Extension Specialist, Entomology
VPI&SU
Blacksburg, Virginia 24061

Two species of horse bot flies (nit flies) are serious pests in Virginia. These are the common bot fly and the throat bot fly. Bot flies have four life stages: adult, egg, larva (bot), and pupa. Adults have no mouth parts for feeding or biting. Their sole purpose in life is to reproduce. Adults may be active in Virginia from March until November.

Eggs can be found glued to hairs as soon as adults become active, and egg laying continues as long as adults are present. Viable eggs remain attached to the hair two months or longer after egg laying is completed.

During the larval stage, the bots develop inside the animal. The minute larvae develop into fat bodied internal parasites. Fully developed bots pass out of the animal and make shallow burrows into the soil. Pupation occurs in the soil and adults emerge in a few weeks.

Annoyance Factor - On warm, sunny days when bot flies are active, horses will fight the flies from morning until late afternoon. When the bot flies are present, horses will walk, run, bob their heads and seek shelter in the barn. Anyone handling horses while the flies are trying to lay eggs may be severely injured. Gentle, well broken animals may become uncontrollable, even in harness or under sadle.

Larval Damage to Mouthparts - Newly hatched bots cause severe irritation as they burrow into the animal's tongue, gums or lips. Animals may dip their lips in water or rub violently against hard surfaced objects to relieve pain and irritation.

Intestinal Damage - Bots attach themselves with spiny hooks to the lining of the animal's stomach or small intestine. This causes inflammation,

which interferes with digestion and can cause colic. As many as 1,000 bots have been found in the intestine of one animal.

BITING FLIES

There are several kinds of flies that suck blood from horses. The three most important are horn fly, horse fly, and stable fly.

The most effective way of treating horses for the various species of biting flies is by the use of sprays. However, if only a few animals are involved, it may be advantageous to sponge the animals with a "spray mixture". In addition, some horses are much too nervous to tolerate spraying. Wear rubber gloves when sponging animals with any insecticide. DO NOT TREAT SICK ANIMALS WITH INSECTICIDES. DO NOT TREAT ANIMALS LESS THAN THREE MONTHS OLD.

Horn Fly - Horn flies are small black flies about half the size of house flies and are usually found on the animal along the back or around the head or neck. They leave the host only for laying eggs in fresh cattle droppings, thus are easily controlled by spraying the animals. They begin their attack on animals with the first warm days of spring and usually reach their peak in June or July. If rainfall is plentiful, they may be abundant throughout the summer. Drought may reduce infestations by drying out the cattle droppings so that the maggots cannot mature.

Horse Flies and Deer Flies - Horse flies and deer flies are heavy blood suckers and may spread disease. They range from small to large and are brightly colored flies with a vicious bite. They breed in wet places such as weedy areas around ponds and streams. Eggs are laid on vegetation and the immature stages live in submerged or wet soil. Destroying vegetation

at the margins of ponds and streams is an important factor in reducing the problem. Horse flies are abundant throughout the summer.

Stable Fly - Horses are often attacked by stable flies. They may suck blood from the animal as well as spread disease. Stable flies breed in wet straw, or in a combination of manure and straw. This type mixture should be spread onto the field or pasture to prevent breeding of stable flies. They may be found feeding on the animals during most of the summer months. It is similar in appearance to the house fly but can be distinguished by its biting mouth parts.

Black Flies - Black flies are small, clearwinged, hump-backed, "chunky," blackish gnats. One species is known as buffalo gnats. Others are referred to by such names as "punkies" and "no-see-ums." They often appear in large numbers in the spring and converge on the animals to suck blood. They have a vicious bite. Because they are small, they are often overlooked.

MOSQUITOES

Mosquitoes breed in water. They may become a pest in any area during rainy seasons. Some species breed in pot-holes and become a pest in dry seasons. Females of all species suck blood. They will converge on horses in large numbers during periods of abundance.

HORSE LICE

Two kinds of lice, a bloodsucking species and a biting louse, are prevalent on horses. The bloodsucking lice are more injurious because heavy infestations mean a heavy loss of blood that may seriously weaken animals.

Lice occur in largest numbers in winter months when hair is long. Infestations spread from animal to animal in adjacent stalls and around mangers or at any time infested animals come in contact with those that are not infested.

Eggs or nits of lice are attached to hairs close to the skin. Eggs hatch in about two weeks. Young lice reach maturity about ten days later.

Sucking lice are usually found on the head, neck, back and inner surface of the thigh. Biting lice may be found anywhere on the body, although they seem to occur in greatest numbers around the withers and base of the tail. The biting lice feed on hair, scale and exudations from the skin.

HORSE MANGE

Mites cause contagious skin diseases known as mange, barn itch, scab and scabies. Three different species of mites may affect horses. Mites spend their entire life on the skin of the host animal. Transmission is by direct contact between healthy and infested animals or by means of "contaminated" curry combs, brushes, blankets, and equipment.

Horses seek relief by rubbing affected areas of the body against any available object. Blisters, bumps or ridges may develop. Skin may become swollen and inflamed. Constant rubbing will cause skin to rupture and discharge watery fluid. Symptoms usually appear first on the head, neck and shoulders.

Microscopic examination of skin scraping is absolutely necessary for positive diagnosis of mange.

TICKS

The lone star tick is the most common tick in some areas of Virginia. It has four stages in its life cycle: egg, larval or seed tick, nymphal tick, and adult. The adult female is brown with a prominent white spot on the back. Males are solid brown in color and smaller than the females. The larvae or seed ticks are solid in color, as are the nymphs or yearling ticks.

Adult ticks are abundant from very early spring until the last of June. Seed ticks are most abundant during July and August, and nymphal ticks are plentiful in the fall.

There are two species of winter ticks. These are most numerous during early winter. Winter ticks and the lone star tick will feed on horses.

Insect	When to Treat	Insecticide	Method of Application	Amount of Water 100 gals.	3 gals.	Precautions & Days Between Last Application & Slaughter*
Bots	30 days after first killing frost. Repeat 30 days later	Anthon horse wormer (trichlorofon)	Mix with a palatable (tasty) ground feed. Withdraw food 12 to 18 hrs. prior to treatment to assure complete ingestion. Do not offer additional food for 12 hrs. or until all medicated feed is consumed.	Use one 5-gram packet per 250 pounds of body weight.		Do not treat sick animals or colts under 4 months of age or mares in last month of pregnancy. Remove and destroy any food not consumed after 12 hrs.
Bots	December	Bathe or sponge with warm water (115-120°F)	Keep water warm. Wet sponge or cloth. Rub Firmly where eggs are present.			Firm rubbing is necessary to impart heat and moisture. Worms hatch and die when wet with warm water.
	(Clipping and destroying hairs infested with bot fly eggs should aid in control)					
Horn flies	When horn flies appear	**Co-Ral (coumaphos)	0.06% spray	2 lbs.25% WP	1 oz.25% WP	0 days
		**Co-Ral (coumaphos)	0.06% spray	2 qts.11.6% EC	2 oz.11.6% EC	0 days
		OR Malathion	4% dust	Rub 2-3 ozs. on the face, neck, shoulders and back of each animal.		10-14 days
Stable fly	At first sign of pest. Repeat as necessary.		2% spray	8 gals. 14.4% EC	1 qt.14.4 % EC	Do not use more than once each week.

Insect	When to Treat	Insecticide	Method of Application	Amount of Water 100 gals.	3 gals.	Precautions & Days Between Last Application & Slaughter*
Horse flies and deer flies (will also control horn fly and stable fly)	At first sign of pest. Repeat daily if problem persists.	Synergized pyrethrins plus a repellent***	0.1% mist spray or very light sponge application	Use 1 to 2 oz. per day per animal		No waiting period
Black flies & Mosquitoes	At first sign of pest. Repeat daily if problem persists.	Synergized pyrethrins plus a repellent***	0.1% mist spray or very light sponge application	Use 1 to 2 oz. per day per animal		No waiting period
Lice	When lice appear on animals	**Co-Ral (coumaphos)	0.06% spray	2lbs. 25% WP	1oz. 25% WP	0 days. Repeat in 2 weeks for maximum louse protection
		**Co-Ral (coumaphos)	0.06% spray	2qts. 11.6% EC	2oz. 11.6% EC	
		**Co-Ral (coumaphos)	5% dust	Rub throughly into coat		0 days
		OR				
		Malathion	0.5% spray	1gal. 57% EC	4 oz. 57% EC	Do not apply to sick animals or animals less than 3 months
		Malathion	4% dust	Rub 2-3 ozs. on the face, neck, shoulders, and back of each animal.		10-14 days.
Mange	As needed based on positive symptoms	Lindane	0.12% spray	4 lbs. 25% WP	10 TBS. 25% WP	30 days
		Lindane	0.12% spray	2 qts. 20% EC	4 TBS. 20% EC	30 days
						Do not overdose. Do not treat animals less than 3 mths.

Insect	When to Treat	Insecticide	Method of Application	Amount of Water 100 gals.	Amount of Water 3 gals.	Precautions & Days Between Lasp Application & Slaughter*
Ticks	When ticks are present	**Co-Ral (coumaphos)	0.12% spray	21bs. 25% WP	1 oz. 25% WP	0 days
		**Co-Ral (coumaphos)	0.12% spray	2 qts.14.4% EC	2 oz. 11.6% EC	0 days
		OR				
		Malathion	4% dust	Rub 2-3 ozs. on the face, neck, shoulders, and back of each animal.		10-14 days

* Even though horses are not usually considered meat animals, these restrictions should be kept in mind.

** Do not spray or dust animals in a confined, nonventilated area. Some formulation are accompanied by the following cautions:
Do not apply to sick, convalescent, or stressed animals or animals less than three months old.
Do not dip or spray animals for 10 days before or after shipping or weaning, or after exposure to contagious or infectious diseases.
Do not apply in conjunction with oral drenches or other internal medications, such as phenothiazine, or with natural or synthetic pyrethroids or their synergists, or other organic phosphates.

*** Synergized pyrethrin plus a repellent will substantially reduce the number of horse flies feeding on your animals.

REPRODUCTIVE PROBLEMS

Calvin E. Rofe,DVM
Meadowville Animal Hospital
Box 701
Warrenton, Virginia 22186

Reproductive problems seem to keep many of us occupied and preoccupied throughout every year. In spite of growing knowledge and experience and the development of new techniques we are still usually far from achieving 100% or, even 90%, foal crops from the average book of mares. I will discuss some of the situations that I seem to encounter more or less frequently in my practice along with some possible approaches to these problems keeping in mind that others, in different circumstances, may utilize other effective methods.

The economic pressure to produce early foals for yearling sales and two year old racing forces us to breed many mares in February and March when some of them are still only attempting to adjust themselves to their normal breeding cycles. Thus, we have created one class of "problem" mares which can best be treated with patience and restraint. To compound the problems for this class of mares or the stallion with a large book, we then lock the door to the breeding shed about halfway through the period of 5 or 6 months when mares and stallions are apt to be most fertile. Doubting that we will ever find a satisfactory solution to this situation, we must do our best to find ways to cope with it.

One consideration becomes extremely important and, hopefully, never poses a real "problem. To cope with any reproductive problem one of the most important aids can be a good working relationship among the people involved in the breeding program. Obviously, all parties concerned- the stallion manager, broodmare manager, grooms, and veterinarians must have mutual confidence and a cooperative attitude. The pressures of the breeding and foaling season can be, and usually are, intense upon all concerned. Mother Nature, in her versatility, can provide more than an ample supply of wrinkles for ironing out without human interference.

It is helpful, when considering reproductive problems, to divide the mares into different classes. Generally, we consider

1.Maiden
2.Barren
3.Foaling- mares as rather distinct groups with some reproductive problems in preponderance. However, there can be much intermingling among these groups and the same problems may afflict more than one of them.

I have previously alluded to seasonal variations in the reproductive activity and efficiency of mares. During February and March (some years it seems as if April may be included) many mares are simply unprepared to breed and are going through what is for them a normal period of adjustment. They are not cycling "according to the book" and can be very exasperating. Even if they are in otherwise good breeding condition their erratic activity can produce serious problems in management. We are usually dealing with maiden and barren mares at this time of year

and some of the more common complaints include:

1. Weak estrus--- which may be long or short in duration. Generally, affected mares show enough to the teaser to be tantalizing for breeding but either go out of season or fail to improve their performance when closely examined. Speculum examination usually reveals only weak signs of estrus. Follicular development, determined by periodic manual examination, may or may not be completed.

2. Prolonged estrus--- which may be strong or weak in nature. In some of these cases, very little ovarian activity can be detected. In some there is development of multiple, small follicles which seem to play a game of "after you". In others, a promising follicle develops but, there appears to be failure to mature and ovulate.

3. Prolonged anestrus (NO estrus)--- which may actually involve a state of true anestrus or of extremely weak estrus. In the latter case periodic speculum and manual examination may reveal the time of estrus.

4. "Split estrus"--- which may be a problem all season but seems to me to be more common among maiden and barren mares early in the season. They may be strong or weak but, in any event, the mare appears to have a "normal" estrus, shows out to the teaser for a day or two then proceeds to have another "normal" estrus. Usually, in these cases there is development of a second follicle and repeated breeding is not productive.

5. Long estrus--- There seems to be a tendency for all mares to have a longer period of estrus early in the season even if they are performing normally. If they are being observed carefully and being diligently examined to determine the optimum time to breed this causes little inconvenience. However, it can become an important consideration later in the season if we become accustomed to a mare staying in for 6 to 8 days then, early in May she ovulates during her third or fourth day of estrus and goes out without being bred.

Problems such as these must be handled on an individual and firsthand basis. Optimistically, many of these problems will take care of themselves as the season progresses if we use patience and restraint. Pessimistically, even if these mares are bred at what seems to be the optimum time, the conception rate is not likely to be as good as later in the spring. With many stallion contracts limiting the number of covers to five or six per year patience is definitely indicated. At the same time it is important to be observing and studying the activity of these mares even if they are not bred so we may be prepared to take action if natural progress doesn't occur.

A <u>good teaser</u>, properly utilized by knowledgable people, following a consistent program is one of the most important ingredients of a successful breeding program. He should be used:

1. On a regular basis--Usually, every other day is sufficient though some prefer to tease certain mares every day.

2. Preferably by the same personnel so they may become acquainted with the habits of individual mares.

3. In such a manner as not to cause undue excitement or

injury to the mares being teased or their foals. Foaling mares may be teased in the stall if adequate personnel are available to prevent injury to the foal. If they are teased at the board, it is my opinion that they are more consistent if their foal is in sight. If the foal is left in the stallthe door should be tightly closed and potentially injurious objects removed. Some mares seem to show well only when they are restrained with a twitch and some may show only after the teaser is led away so they should all be observed carefully at that time. A few supposedly anestrus mares mares show very nicely to other mares in the paddock so an occasional "problem" may be solved by daily observation in the field.

Even when only a small number of mares are involved, accurate and complete RECORDS are vital. They should be kept throughout the year and available from year to year. Ideally, both teasing records and the results of veterinary examinations should be maintained and easily available. Not infrequently, the same mares will demonstrate similar patterns from year to year and though they cannot be depended upon to always be consistent, it can be helpful to have informative records for comparison.

It is often helpful to periodically inspect anestrous mares or mares showing very weak estrus with a speculum. Twice a week is usually adequate until suspicious signs are detected. If a mare has an history of anestrus this might be started early in the season. All anestrus mares should be periodically examined if they have not started to come in by early April. If, after three to four weeks of diligent inspection, no signs of strong estrus have been detected several treatments may be considered. There are varying opinions concerning their effectiveness just as there are sometimes varying responses in the treated mares. Thus, they should be applied only after careful consideration of the individual case. They include, among others:

1. Saline douche which involves the infusion of a quantity of warm saline into the uterus with the objective of stimulating nerve receptors within the uterus and setting off a chain of hormonal actions. When successful, a mare in weak estrus may be stimulated to strong estrus and anestrus mares may come in within 3 to 10 days and may conceive if bred at the optimum time.

2. Estrogenic hormones such as stilbesterol and estradiol. Unfortunately this type of treatment frequently results in producing a "false" estrus without normal follicular development. It is essential that mares treated in this manner be closely examined to determine the optimum time to breed if and when it occurs.

3. Hormones which are aimed at stimulating follicular development and maturation including Human Chorionic Gonadotrophim, Pregnant Mare Serum Gonadotrophin, Follicle Stimulating Hormone of pituitary origin, and recently, Prostaglandins. They can be effective in selected cases but must be used only in conjunction with thorough and continuing examination to determine optimum breeding time.

4. Determination of hypothyroid or hyperthyroid activity and appropriate treatment may be helpful in selected cases; particularly involving abnormally obese or overactive mares.

5. Various vitamin supplements, especially including high levels of Vitamins A, C, or E are favored by some and, under certain circumstances may indeed be effective.

MAIDEN MARES as a group often present some special problems. It seems that some fillies conceive very easily immediately upon being retired from training or, even while still in training. In the long run, conception percentages are much better if they are permitted to let down and adjust to the change in routine for several weeks or even months before breeding. Some maiden mares are found to have underdeveloped reproductive organs with small and relatively inactive ovaries. Though they may cycle regularly they tend not to have normal estrus and it sometimes is impossible to determine an optimum time to breed. Periodic examination may reveal gradual improvement but very few of these mares benefit from repeated breeding or hormone therapy. Generally they improve dramatically by the next breeding season and, in many cases, it is preferable to lose the year rather than struggling with these juvenile mares and finally succeeding in starting their foal production with late May foals.

Even normally developed maiden mares seem to have a greater tendency than other groups to demonstrate prolonged estrus, either weak or strong; or to be anestrus for long periods of time. When they appear to be otherwise normal and healthy the previously described treatments may be applied. However, I think it is better to be more conservative in treating young mares and give them ample opportunity to adjust themselves.

BARREN MARES as a group, present our best opportunity to obtain early foals and "thin" out the book of mares early in the season. Most important, we have all summer, fall and winter to correct any detectable problems and should take full advantage of all this available time. Good records can often give helpful clues to their performance in previous years and, though it is still not always very productive to try too hard to force them to breed too early, we may be a little more vigorous in treating them than maiden mares. Use of arificial lights early in the winter to artificially lengthen the days may also be helpful in stimulating some of these mares .

FOALING MARES may be especially troublesome because of the shorter time available to prepare themselves for breeding. Late foaling dates, foaling injuries, retained placenta, difficult foaling, or lack of proper exercise or feed due to problems with her foal may practically eliminate the successful breeding of some foaling mares. Everything possible should be done to provide a clean environment for foaling. Mares which have been sutured should be resutured as soon after foaling as possible. Stretching, tearing, swelling, and an abundance of fluid and potential contaminants make this a critical period for introduction of infection. Reducing the time before the mare is resutured may be our simplest contribution to prevention of infection. Even if the

mare has not been sutured previously, I try to make it a rule to suture any mare which looks even a little bit as if she needs it.

"Ninth day breeding" is, at best, controversial; usually results in a poor rate of conception; and more often than not it is a misnomer. "Foal heat" is a better name because the optimum time to breed is at least as often the tenth, eleventh, or even as late as the twenty-first day after foaling. Even if the mare appears to be in good condition it is not really very productive to breed at the ninth day and, ideally, I think it is best avoided; especially early in the breeding season. I doubt that there is much validity to the old wives tale that mares will fail to come in season later if the foal heat is passed. Even if they are not bred foaling mares should be teased regularly and examined at the time of estrus for evidence of injury, infection, and ovarian activity. Routine culturing of mares during their foal heat may often produce evidence of infection which is insignificant but, if the slightest doubt exists it is best to culture and treat them.

If a foaling mare fails to come in at the expected time or, at least after 18 to 20 days it is wise to start periodic speculum examination to detect estrum. Some may be truly anestrus but many may be failing to show to the teaser for psychological reasons or due to weak estrus. Diligent examination of these mares can prevent at least a few from acquiring the reputation of being "every other year mares."

Some mares seem to acquire this bad habit due to age, numerous previous foals and resultant changes in their reproductive organs, and/or failure of the uterus to properly involute and return to a healthy state. The result may be failure to have normal estrus, failure to conceive, failure of the embryo to implant, or early fetal death, or even relatively late abortion. If infection has been successfully prevented or treated and there are no other inhibiting factors, about all that can be hoped for with these mares is enough time to repair themselves before the breeding season closes. In the meantime, our patience is again demanded because little is to be gained by indiscriminate breeding of these mares.

Two potential causes of anestrus are PREGNANCY and "false" or PSEUDOPREGNANCY. They can be and have been overlooked and must be eliminated before any treatment for anetrus ensues. There are chemical tests and hormone bioassays available to detect pregnancy in mares which are more or less accurate. However, time factors limit most of their usefulness and manual examination is still the most useful method during the breeding season. False pregnancy is not unheard of among mares and with experience, previous manual examination of the mares uterus, accurate records of the findings, and sometimes repeated examinations; the condition may usually be accurately diagnosed and the mare stimulated to return to estrus. Early pregnancy diagnoses are possible in many mares and, coupled with other signs of pregnancy, may help to allay fears of possible anestrus. Early pregnancy diagnoses should always be followed up at the normal time (usually 40-45 days). Even after a mare has been diagnosed as pregnant she should be teased regularly. Implantation does not occur in mares until

about the 25th day after conception and, for a variety of reasons, may fail thus negating many early pregnancy diagnoses. Even after 45 days as many as 5% or even 10% of pregnant mares may have unnoticed abortions due to early fetal death. If the breeding season has not ended they may again conceive if they are detected and bred. It is good practice also to reexamine all mares early in the fall and to undertake necessary treatment of any barren mares which may be discovered.

Some mares are presented with a history of TWINNING or are detected to be developing twin follicles. This subject has recently stirred some controversy but it is my feeling that by repeated frequent, manual examination; regression can sometimes be detected in one of the follicles and the mare may be confidently bred. On the other hand, I do not feel that they should be bred if there is any doubt and they should not be rebred during a short, "split estrus". Twin pregnancy must usually be detected before the 50th day by manual examination. Various techniques may be attempted to terminate one or both pregnancies. The results appear to me to be variable and the whole affair becomes cause for much soul searching among those concerned. The sad facts are that twin pregnancy in a mare is bad news, its management is debatable, and at least among Thoroughbred mares it appears to be becoming more prevalent.

A few mares are encountered every year who cycle every 10 to 14 days. Some may be afflicted by a hormonal imbalance and treatment with progesterone immediately after estrus has been suggested. In my experience, it has been more common to find that these mares are infected and suffering from chronic endometritis. Repeated uterine cultures or biopsy may be necessary to accurately diagnose these cases but, it is my opinion that this cause should be eliminated before hormonal therapy is attempted.

An occasional mare will appear to be normal in all respects but will be detected by manual examination to have failed to ovulate even a few days after she shows out or "going out" to the teaser. For this reason it is helpful to reexamine mares manually even after they have been bred and they seem to be going out. If this problem can be detected, hormonal treatment may be helpful in stimulating ovulation. Some mares appear to be developing a normal follicle but it fails to progress to ovulation or it may regress almost completely. These conditions usually cause erratic estrus cycles which may be weak, prolonged or split. Massage of the ovaries, hormonal treatment, or saline douche may be beneficial in selected cases.

Causes of reproductive problems in mares may also be broadly classified as 1. Infectious
2.Anatomical
3.Hormonal
4.Nutritional
5.Psychological

I have already considered most of the psychological and hormonal problems which are commonly encountered. Nutritional deprivation can have indirect effects on all causes of reproductive difficulty but, few specific problems are encountered.

Infectious and anatomical causes are often inter-related since many of the anatomical problems encountered predispose to infection and prevent successful treatment until they are corrected.

Bacterial infections are most common among the infectious causes of infertility. Occasionally a mare may become infected as a result of unclean breeding practices, lack of cleanliness when performing speculum examination, or unnecessarily manipulating the cervix before or after breeding. It is also predisposed to by foaling complications such as dystocia, abortion, or retained placenta. The single, most important cause is "windsucking" which causes the introduction into the vagina of air, dirt, and fecal material. Windsucking may be caused by numerous conditions and is usually easy to detect. Prevention and treatment of the condition is easily accomplished by suturing together the lips of the vulva to the level of the brim of the pelvis by the method made popular by Dr. Caslick. I cannot overstate the importance which I attach to this simple procedure and I advocate its use if there is even the slightest possibility that a mare needs it. Some mares only have the problem when they are in season and the vulvar tissue is swollen and relaxed. Others may have the problem only after repeated foaling or changes in their anatomy brought on by age. Tears of the vulva due to kicks, foaling injury, or breeding may also cause the problem. It seems that the vast majority of fillies in training are afflicted at least part of the time and many of them become infected at an early age. While suturing of the vulva may cause some minor inconveniences at the time of breeding, they are heavily outweighed by the advantages to be gained. In selected cases it may be found unnecessary to resuture a mare for a few years after she has had her first foal due to improvement in her conformation. Usually, it is wiser to keep them sutured anyway because a few days after foaling when the swelling subsides the situation often appears less optimistic. When properly performed, vulva suturing may be repeated over and over without seriously affecting the mare. The important consideration is that they be kept sutured low enough to totally prevent windsucking which may entail periodic repairs.

Vaginal infections permitted by windsucking eventually can pass by extension through the cervix to the uterus creating endometritis. I will not take time to enumerate the many organisms which may become established. Their detection and treatment require considerable effort and expense and, unfortunately, sometimes becomes impossible. Prevention of these infections is usually much more easily accomplished and is much to be preferred.

All barren, maiden, and at least the suspicious foaling mares should be cultured before breeding. Examination should be started as early in the year as possible to permit time to treat infected mares. It is preferable, due to some variables to have at least two consecutive negative cultures before breeding. Useful cervical or uterine fluid samples can only be collected during estrus when the cervix is dilated. It is most desirable that they be collected near the time of ovulation rather than early in the estrus.

Sometimes, even after a mare is presented with clean cultures, speculum examination may reveal suspicious signs of inflammation or abnormal discharge. Manual examination may reveal abnormal size or lack of tone in the uterus. Occasionally a mare will appear normal until after she has been covered by the stallion. Apparently in many such cases the normal body defenses have succeeded in partially controlling the infection which is present in one way or another. It may be necessary and informative in some of these cases to examine a small portion of the uterine lining which can be removed with a biopsy instrument by a relatively simple, painless and safe procedure. Interpretation of these samples is much more complex than that of bacterial cultures and requires more time in most cases.

During the breeding season when itme is at a premium I think it wise sometimes to treat any mare which even appears suspicious with a broad specturm antiseptic. In some cases it is even possible and helpful to treat and breed during the same estrus.

Most treatment for uterine infection is performed by infusing medication directly into the uterus. This can be performed only while the cervix is dilated during estrus. No attempt should be made to treat mares by infusion at any other time to prevent the possibility of trauma to the cervix and, possibly, causing extension of the infection which is already present with resulting adhesions in the cervix or even pyometra. This is not the only way that these conditions may develop as they may result from foaling or breeding injury, incomplete expulsion of the placenta, or chronic infection. Unfortunately, when they occur they are often incurable.

In some cases where repeated treatment is desired and the mare is closely sutured or difficult to manipulate for other reasons the use of an indwelling, bovine, uterine catheter is very satisfactory. With a bit of manipulation it may even be inserted through a speculum.

In some cases which a re refractory to the usual treatment curettage of the uterine lining with a specially constructed sharp instrument has proved successful. Combined with antibiotic or antiseptic therapy it may, in some cases, permit conception soon after it is performed.

Some conditions cannot be satisfactorily treated in the aisle of the barn. Rectovaginal fistulas, more or less severe tears permitting communication between the vagina and rectum, require extensive and often repeated surgical treatment and are usually difficult to repair. Ovarian tumors occur occasionally and their removal is best accomplished under hospital conditions. After their removal some mares conceive with little difficulty whereas others pose a real challenge.

Many old mares and foaling mares are found to have a pool of urine in the vagina when they are examined with the speculum. Due to chronic loss of tone or the weight of an incompletely involuted uterus, the cervix is pulled over the forward brim of the pelvis. The resulant space is filled with urine by gravity predisposing to inflammation and infection and reducing the chance of conception. It has been attempted to "swab" such mares with cotton before breeding to remove the accumulated urine. The risks involved in this procedures seem to me as undesirable as the condition being treated. Rest may succeed in relieving

the problem in some mares. For the others, a surgical reconstruction of the floor of the vagina in front of the urethral opening to form a barrier to the flow of urine forward appears much more promising.

This review of reproductive problems may be sketchy in places and many have been omitted. At least every year and usually more often something "new" occurs. I have ignored most of the things which can go wrong after the mare is in foal. These problems combined with proper care of the barren and maiden mares make broodmare management a year round job.