FARMING FOR PROFIT

LIVE STOCK AND DAIRY FARMING

FRANK D. GARDNER

TEAM OF PERCHERONS.[1]

This type of draft horse is noted for its great power, good action and intelligence. Its native country is France.

[1] Courtesy of "The Field. Illustrated." N. Y.

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LIVE STOCK
AND
DAIRY FARMING

A NON-TECHNICAL MANUAL FOR THE SUCCESSFUL BREEDING, CARE AND MANAGEMENT OF FARM ANIMALS, THE DAIRY HERD, AND THE ESSENTIALS OF DAIRY PRODUCTION

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PREFACE

This book is written for amateur as well as professional livestock and dairy farmers. It makes a popular appeal to all men engaged in animal and dairy husbandry.

Ages of farm experience have given us a vast store of practical knowledge on the raising of crops and animals. This knowledge is scattered through many volumes on different phases of the subject, in experiment station bulletins, agricultural journals and encyclopedias. The important facts on which the most successful livestock and dairy farming is based are here brought together in orderly and readable form. Not only are directions given for the management and care of farm animals but the business end of the problem is fully discussed, showing why some achieve success and why others fail.

The subject-matter is arranged in several parts of a number of chapters each, and by referring to the Table of Contents any subject may be quickly found. Each department has been prepared by a specialist in the subject presented. The name of the author appears at the beginning of each chapter. Those unacknowledged have been prepared by myself.

The illustrations have been secured from many sources. Due credit has been given these.

Special acknowledgment is due the publishers of this volume and the other volumes in the series for its conception, and for many helpful suggestions in the presentation of the subject-matter.

I wish also to especially acknowledge the valuable editorial assistance of my wife in the preparation of the manuscript.

FRANK D. GARDNER

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CHAPTER 1

Advantages and Disadvantages of Keeping Livestock

Without the aid of domestic animals as beasts of burden, man would have a sorry existence. The horse, ass and camel have been of great service in past ages in aiding man to conquer new regions, and by their aid he has been enabled to very materially increase his productive power.

Animals have also been a great aid to man as a source of food and clothing. Those countries that depend upon animals and animal products the most are, as a rule, the most productive and highly civilized. In North America animal products, such as meat, milk, butter, cheese, lard, eggs, etc., constitute fully one-half of the value of the products of human consumption.

A large part of the vegetation on the earth is unsuited for human consumption. Of this, such by-products as straw and stover are converted into milk, butter, cheese, meat and animal fats. It is estimated that 80 per cent of the corn produced in the United States is consumed by livestock in the county where produced. This conversion of crude farm products adds greatly to the quality of man's diet.

The essential characteristics of domesticated animals are: (1) their ability to convert food into energy and animal products for human use, (2) the readiness with which they become subject to the will of man, and (3) their prolificacy or ability to breed abundantly.

Value and Importance of Livestock.—The United States and Canada with 28,000,000 horses, 63,000,000 cattle, 51,000,000 sheep and more than 62,000,000 swine, is pre-eminently a livestock country. South America leads in the production of sheep with 115,000,000 and ranks third in cattle with 48,000,000. It falls to India to lead in cattle production, which, including the water buffalo, numbers 125,000,000 head. The United States, however, far outranks all other countries in its numbers of horses, mules and swine. It is second in production of cattle and sheep.

During the past half century, the livestock in the United States has increased about three times in numbers and about six times in value. While numbers have not quite kept pace with increase in population, the value per capita has steadily increased. This increase in value has been due chiefly to two factors: (1) the improvement in livestock, and (2) the increased value per unit of weight of animals and animal products. In 1850 the average fleece of a sheep weighed 2.4 pounds; in 1900 it had increased to 6.9 pounds. During the fifty years sheep nearly doubled in number, while the yield of wool increased five times. This increase was due chiefly to breeding rather than feeding. If statistics were available,

we would doubtless find that the increase per cow in milk, and particularly in butter-fat, would not be less striking.

Thirty-five years ago, the usual work-team in the corn belt consisted of two 1000-pound horses. Today, the prevailing team is three 1500-pound horses. This increase in the size of the team has been an important factor in increasing the man unit of production on the farm, and has undoubtedly been one of the factors instrumental in the increase in land values in that region. The following table gives the numbers, value per head and total value of the principal classes of livestock in the United States for 1880 and 1915, as reported by the Bureau of Statistics of the United States Department of Agriculture:

NUMBERS AND VALUE OF LIVESTOCK ON FARMS IN THE UNITED STATES IN 1915 AS COMPARED WITH 1880.

Class of Animals.	1880.			1915.		
	Number.	Value per Head.	Farm Value.	Number.	Value per Head.	Farm Value.
Horses	11,202,000	$54.75	$613,297,000	21,195,000	$103.33	$2,190,102,000
Mules	1,730,000	61.26	105,948,000	4,479,000	112.36	503,271,000
Cows	12,027,000	23.37	279,889,000	21,262,000	55.33	1,176,338,000
Other cattle	21,231,000	16.10	341,761,000	37,067,000	33.38	1,237,376,000
Sheep	40,766,000	2.21	90,231,000	49,956,000	4.50	224,687,000
Swine	34,034,000	4.28	145,782,000	64,618,000	9.87	637,479,000
Total			$1,576,908,000			$5,969,253,000

From the above table it will be noted that the total value of livestock in the United States increased from a little more than $1,500,000,000 in 1880 to nearly $6,000,000,000 in 1915. During that period, horses and mules doubled in number and quadrupled in value. The increase in numbers of cows and other cattle did not quite double, while the value per head of the former considerably more than doubled and the latter slightly more than doubled. The increase in numbers of sheep and swine was slightly less marked, but in both of these classes the value per head slightly more than doubled.

ADVANTAGES OF LIVESTOCK

Animals Furnish Food, Labor and Clothing.—Even when not profitable to rear anmals for market, the cost of living on farms may be greatly reduced by the judicious production of livestock and livestock products for the home food supply. The difference between the purchase price of animals and animal products and the price which the producer receives has materially increased during recent years. The value of these products to the farmer for his own consumption is equal, whether bought or produced on the farm. Furthermore, animals and animal products may be produced on a small scale on most farms on what otherwise would be wasted.

The acres of land cultivated by each horse depends on the size of the horse, character of farming, the type of soil and the topography of the land. In England, two horses are generally required for 80 acres of light, sandy soil or 60 acres of heavy, clay soil. In the United States, there is about one horse or mule of working age to each 30 acres of improved land. Formerly, many oxen were kept for work, but these have been largely replaced by the horse and mule because of their more rapid movements and consequent greater efficiency. The draft of the ox is larger in proportion to his weight, but his slowness has caused his displacement with the increase in the value of human labor.

With the introduction of cotton and silk, the value of animal products as sources of clothing decreased relatively. The value of leather, wool and

UTILIZING WOODLAND FOR PASTURE.[1]

hair is very large, however, and plays an important part in the clothing of the human race.

Animals Make Use of Land Otherwise Unproductive.—According to the last census, only about one-half of the farm area in the United States was improved land, and only about two-thirds of the improved land was in farm crops, including meadows. The other one-third, together with considerable of the unimproved portion, is utilized as pasture for animals. On most farms there are areas more or less extensive which may be steep, stony, partly wooded, undrained or otherwise unprofitable for cultivated crops, that may be utilized for grazing purposes.

Animals Utilize Crops that would be Wholly or Partly Wasted.—The straw of the cereals, the stover of corn, have little value on most farms except as roughage and bedding for livestock. Low grades of hay, damaged

[1] Courtesy of E. K. Hibshmann, Pennsylvania State College.

by rains or delay in harvesting, often are unsalable, but may be utilized for feed for stock. In the same way corn and small grains are sometimes damaged by exposure to the weather or early frosts, and may have considerable feeding value, but no value on the market.

Animals Transform Coarse, Bulky Products into Concentrated Form.—Animals convert coarse, bulky, raw materials into a more concentrated and valuable finished product, and one that may be marketed with less cost and to much better advantage. It requires about 10 pounds of dry matter to produce 1 pound of beef or 30 pounds of dry matter to produce 1 pound of butter. The farmer in transforming such coarse products to a more refined one not only reaps the profit in the process of manufacture, but the pound of butter may be sent to a market a thousand miles away, when the material from which it was made could not be profitably sent to a market ten miles distant. One cent a pound for transporting butter

LIVESTOCK AND THE SILO INCREASE THE PROFITS ON HIGH-PRICED LAND.[1]

would be but a small percentage of its value, but one cent a pound for transporting hay would be prohibitive.

Animals Return Fertility to the Soil.—In the manufacture of these finer products on the farm, animals leave much of the fertilizing material to be returned to the soil. The manure of farm animals is unquestionably the most valuable bi-product of American farms. In considering livestock farming from this standpoint, it is only necessary to determine whether it has been successful in maintaining soil fertility. A study of the crop-producing capacity of the soil in different regions shows conclusively that crop yields are largest where large numbers of livestock are maintained.

Livestock Facilitate Good Crop Rotations.—A good crop rotation should include inter-tilled crops, small grains and grasses and clovers.

[1] Courtesy of Webb Publishing Company, St. Paul, Minn. From "Field Management and Crop Rotations," by Parker.

Livestock make possible the production and profitable utilization of grasses and clovers. When these are fed to livestock and the manure is returned to the land, the fertility of the soil is increased. Good sods, plenty of manure and animals to utilize by-products extend the range of crops that may be grown on the farm and thus provide for better crop rotations.

Capital More Fully Used.—The wheat farmer in the Northwest is very busy from spring until fall, but is generally idle from September to March. When livestock is kept, labor of men and teams is more fully employed and equipment more fully utilized.

Livestock Call for Higher Skill.—Animal husbandry, including keeping of dairy cattle, poultry, etc., may be made to require higher skill than ordinary extensive production of crops. It calls for the same requirements so far as the care of the soil and the production of crops are concerned, and there is added to this the skill of the breeder and the feeder. The products of skilled workmen command a higher price than do those of the unskilled workmen. In this country those communities that have given most attention to livestock are in general the most prosperous. There are, of course, some exceptions to this.

More Land may be Farmed with the Same Labor.—This is true only in the extensive grazing of livestock, as exemplified in the ranches of the West, notably in the breeding and rearing of cattle and sheep. When these are brought to the farm of the feeder, they really reverse the process and call for increased labor and skill on the unit of area.

DISADVANTAGES OF LIVESTOCK

Animals Require Larger Capital—This is especially true when kept in connection with the production of hay and grain. On a 160-acre farm 40 head of cattle worth $1500, 40 sheep worth $300 and 20 hogs worth $300 may be kept, and the farm made to raise all the necessary food for them. This would increase the capital of the farm by $2100. It would also call for additional capital in buildings, and this would all be an increase over what would be required if the same land were used only for cash crops. On a farm that supplies all the feed for livestock, $10 per acre invested in livestock may be considered as moderate. If only the coarse feed is grown it may carry stock to the value of $25 to $30 per acre. This is exemplified in many dairy farms close to market, and sometimes on farms where stock are fattened for market.

Capital of Perishable Nature.—Animal diseases, such as tuberculosis or foot and mouth disease in cattle, cholera in hogs, and internal parasites in sheep, may quickly wipe out the animals on any particular farm. This entails a loss not only of the product for a single year, but also of all the capital that may have been invested in feeds and labor to bring the stock to that stage of maturity at which it was destroyed by disease.

Formerly, it was not uncommon in the corn belt to find farmers keeping 100 or more head of hogs in a single herd, but it is now deemed best to

keep them in herds of small units, not more than 20 or 30, as protection against cholera. More recently, of course, methods of control have been developed, which, if properly administered, hold the disease in check.

Products Cannot be Indefinitely Held.—The holding of livestock for a considerable time after reaching the proper stage of fattening for the market entails considerable loss. It may sometimes result in actual decrease in quality with little or no increase in weight, and a loss of both food and labor for maintenance. In this respect livestock for meat is sharply contrasted with wheat and some other cereals that may be held almost indefinitely with very little deterioration. It is true that the development of better markets, systems of cold storage and methods of preserving meat have lessened somewhat this difficulty.

Crop Failures may Cause Loss on Livestock.—A low production for the staple crops used largely for livestock food results in a marked advance in price. This frequently causes a loss to the farmer on his livestock. This is especially true in case of swine that depend so largely on concentrates for their production. A decrease of one-quarter in the yield of a staple crop for the whole country often causes an increase in price so marked that if the whole crop were sold it would bring more than a normal crop or an extra large one. Since, however, so large a percentage of the crop is fed, this does not mean much to the farmer unless there is a corresponding increase in price of meat animals. A number of instances may be cited whan a marked advance in price of corn without a corresponding advance in hogs has induced farmers to sell their hogs before fully ready for market, thus causing the hog market to decline in the face of advancing prices on corn. This condition once under way will often continue for a full year before normal prices again prevail.

The advantages and disadvantages of keeping livestock have been presented without prejudice, and it must be apparent that the advantages seem to outweigh the disadvantages, especially from the standpoint of permanent systems of agriculture. It is, of course, recognized that with increasing population there should be a tendency for people to depend more and more upon the direct products of the soil in the form of cereals, vegetables and fruits rather than to depend so largely upon animal products; and doubtless the increase in land values and high prices of animal products will gradually tend in this direction.

CHAPTER 2

BREEDING, CARE AND MANAGEMENT OF FARM ANIMALS

By W. H. Tomhave
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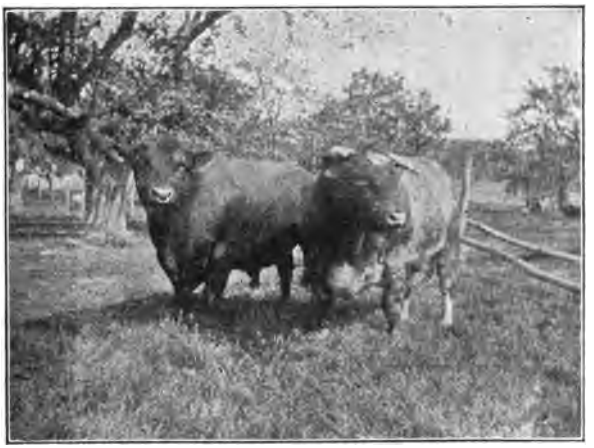
BREEDING OF LIVESTOCK

History of Animal Breeding.—The first systematic work in animal breeding was done among the Arabians. This is indicated by the character of the Arabian horses that were developed during the sixteenth and seventeenth centuries. Following the Arabians, the French did the next constructive breeding of animals, which was at that time encouraged by the French Government in the developing of their breeds of horses. The most important animal breeding from the point of view of the American farmer of today was done by the people of the British Isles during the last half of the eighteenth century, and throughout the entire nineteenth century. Robert Bakewell is known as the foremost early breeder of livestock, having begun his work about 1764 and continued it until the time of his death. He was followed by noted men such as Collings Brothers, Booth and Bates, all of whom were early breeders of Shorthorn cattle. Amos Cruickshank was probably the most noted breeder of recent years, and was recognized as the peer among the Shorthorn breeders of Scotland during the nineteenth century. Great interest was then shown in developing the various classes of livestock and this has resulted in giving us our present breeds of pure-bred livestock.

The foundation work in animal breeding in America was done largely during the last half of the nineteenth century. The foundation animals used by most of the noted breeders were imported into the United States and Canada from Europe. Large importations of well-bred animals were made into the United States from 1880 up to 1900. Since that time only limited importations have been made into this country, as most of the noted animals in America at the present time are the product of American breeders. While a great deal of work has been done in both Europe and America, less than two per cent of all the farm animals in the United States and Canada at the present time are of pure breeding. This seems to indicate that there is a fertile field for livestock breeding for the American farmer.

Lines of Breeding.—There are three distinct lines of breeding that can be followed by the American farmer. These may be enumerated as follows: breeding of pure-breds, grading and cross-breeding. The breeding

of pure-bred animals is by far the most important system of breeding, and the one that should be followed to a greater extent by farmers in the United States and Canada. The greatest improvement can be made in a herd of livestock by this system of breeding. The use of both pure-bred sire and dam enables the farmer to follow a more rigid system of selection and cull out undesirable individuals, which is not always possible in grading and cross-breeding. There is one weakness, however, that every breeder of pure-bred animals is apt to encounter, and that is a certain degree of hesitation about eliminating an animal from his herd that may be pure-bred and yet not up to the standard which he has set for building up his herd.



TWO PURE-BRED BULLS. POLLED ANGUS ON THE LEFT, SHORTHORN ON THE RIGHT.[1]

Sires of this character should head the herd of all well-regulated stock farms.

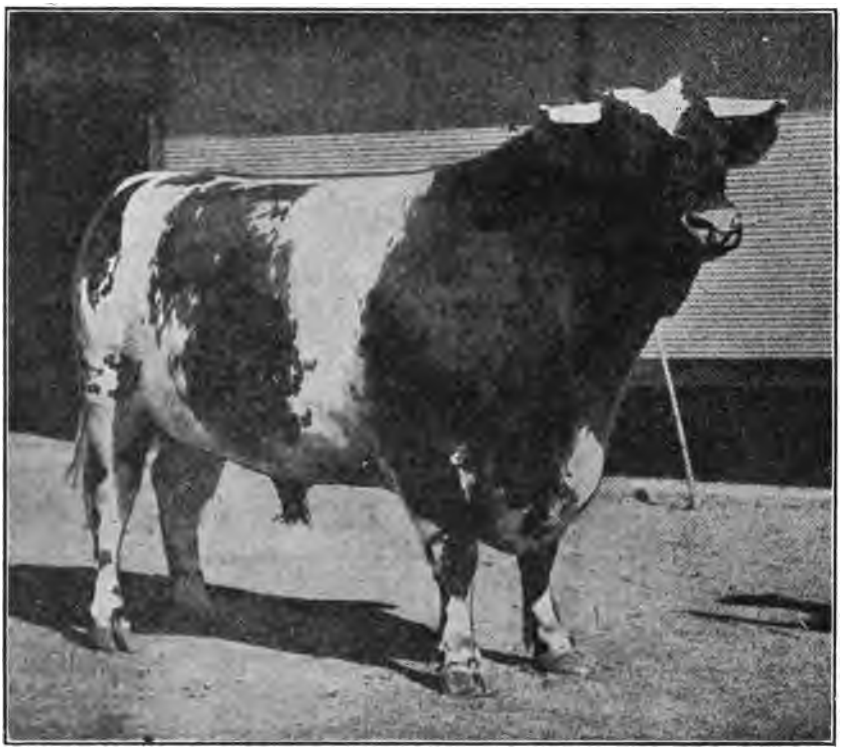
Grading is another means of making a marked improvement on the average farm herd. By grading is meant the mating of a common or relatively inferior animal with one that is more highly improved, usually a pure-bred. This pure-bred may be either the sire or dam, but it is usually the sire, as the sire can be used upon a number of females in the herd and thus exercise greater influence in making the improvement. If the pure-bred dam and a grade sire are used, very little improvement is made; besides, such improvement is restricted to one mating. If a pure-bred sire is used for five generations, it will mean that at the end of that time the herd is practically pure-bred, but can never be registered. Rigid selection and the use of a pure-bred sire should always be continued.

By cross-breeding is meant the mating of two pure-bred animals of different breeds. Nothing is to be gained by such method of breeding, as it destroys the pure lines that may have been established and also has a tendency to cause a greater variation. Cross-breeding is sometimes profitably carried on in producing market animals, but it should never be carried beyond the first generation. Cross-bred animals should never be

[1] Courtesy of Dept. of Animal Husbandry, Pennsylvania State College.

retained as breeders in the herd, as this has a tendency to cause sterility in the breeding animals, besides retarding progress in building up the herd.

Selection of a Breed.—The selection of the breed of animals must be determined by the farmer or livestock grower, as there is no such thing as the "best breed." All breeds of livestock have been developed for a definite purpose and among all breeds are found desirable and undesirable individuals. In deciding upon a breed, the farmer should secure all data available about the breeds in which he is interested and adopt the one that



PURE-BRED SHORTHORN BULL.[1]

will best suit his conditions. It is highly important that he select good individuals of the breed adopted and that he continue with that breed indefinitely. To change breeds at the end of one or two years is not conducive to improvement, and means a loss of time. It is important to select representative animals that possess pronounced characteristics of the breed, and if possible to secure animals with a known ancestry. In the selecting of a brood sow as an illustration, such sow should come from a prolific

[1] Courtesy of U. S. Dept. of Agriculture.

strain. The same thing is true in the selection of a herd boar or any other animal that is to be used for breeding. It is a wise precaution to visit the herd from which the animals are to be selected, in order to study the prepotency of the sire that is at its head. It is also very important to avoid the introduction of barrenness or sterility in the herd. The sires selected should be strong, vigorous and in thrifty condition. Since the sire will be used on a number of animals, it is important that he be given the greatest consideration, both as to individuality and pedigree.

Pedigree.—The mere fact that an animal is pure-bred and has a pedigree is not an indication of its being a desirable animal. The pedigree is not a guaranty of excellence in the animal. There are many poor pure-bred individuals as well as desirable individuals. A combination of good individuality, together with a pedigree tracing back to known ancestry, will usually result in the securing of desirable animals.

Gestation Period.—The farmer or livestock breeder must keep a record of the breeding dates of his animals. This should be done so that he may know at what time they are to produce their young. The gestation period varies with the various classes of animals. For cows, it is about 9 months, or approximately 280 days; for mares, 11 months, or approximately 340 days; for ewes, 5 months, or about 150 days; for sows, 4 months, or about 112 days. The gestation period for all animals as stated is only approximate, and has been known to vary a number of days from this period. It is well, however, to watch the animals closely at the end of the number of days given for each class of livestock.

CARE OF LIVESTOCK

The breeding, feeding and management of livestock must be combined for the greatest success. Each class of livestock must be given special care and attention, and a system worked out to meet the needs of the farm. The feeding of the young animals, for instance, should not begin at the time of birth, as is so often the case, but should be properly carried on during the gestation period. The young life begins at the time of breeding and for the greatest development must be properly nourished throughout the gestation period. A well-bred animal does not guarantee the production of a desirable individual unless the animal is properly fed, so that the growing fœtus may be properly nourished. Young growing animals must have an abundance of food that is rich in protein and mineral matter for the development of muscle and bone rather than fattening material. This, combined with proper exercise and plenty of fresh air and sunlight, will result in a properly developed individual.

Preparation of Feeds—In feeding livestock, it is necessary to economize on the use of grains; yet at the same time, it is not a wise plan to carry this economy to an extreme. The method of preparing the feed for stock will vary with the different classes of livestock and the different kinds of feeds used. Cooking feed for hogs was at one time considered a desirable

practice, but hog-feeding experiments conducted in Canada and the United States for the purpose of comparing the merits of cooked and uncooked grain all show an actual loss from cooking. There was a saving of labor and larger gains for uncooked feed.

The grinding of grain for farm animals will depend upon the kind and price of grain and the animals to which it is to be fed. Small grains, such as wheat, barley and rye, should always be crushed or ground before they are fed. The kernels of these grains are hard and some of it, if fed whole, will pass through the system of an animal without being masticated or digested. There is a saving of about six per cent in feeding value of corn when fed ground or cracked instead of whole. Generally speaking, when corn is worth more than 75 cents per bushel, it will pay to grind it or have it cracked for all classes of farm animals, except when fed to cattle where hogs follow in the feed lot.

Feeding Condimental Stock Feeds.—The feeding of proprietary stock foods or condition powders should be avoided. These preparations usually cost from ten to thirty cents per pound and contain nothing that cannot be secured by using standard feeds. They are usually made up of ground screenings, weed seeds, bark of trees, a little oil meal, and such materials as charcoal, copperas, epsom salts, etc. The feeding of such "foods" will do more harm than good. When animals are out of condition, the addition of a little oil meal to the regular feed will usually give fully as good results. Salt, usually found in these preparations, should always be supplied to farm animals in liberal amounts.

Care of the Breeding Herd.—The breeding herd must be properly cared for if the best results are to be secured. It is not necessary to keep the animals fat, but they should be kept in a thrifty condition, so that they can supply the nutrients necessary to properly develop their young during the gestation period. Breeding animals should have exercise, plenty of nutritious feed and good water. They should be fed largely on farm-grown feeds where the right kind can be produced cheaply.

Care of Work Animals.—The term work animals applies usually to horses and mules. These animals are the principal beasts of burden in the United States and Canada. The best results can be secured only through proper feeding and care. Work horses and mules should receive the largest portion of grain ration during the morning and noon meals, and be allowed the bulk of their roughage at the evening meal. The reason for this is that the horse and mule do not possess large stomachs, and thus cannot carry a large amount of bulky feed without seriously interfering with their ability to work. The amount of grain and roughage to supply depends upon the work that is being done. For a horse doing heavy work, about 1¼ to 1½ pounds of grain to 100 pounds liveweight daily should be allowed, and approximately the same amount of roughage. This amount should be reduced to about one-half the regular allowance when the horses stand idle over Sunday or any other day. Over 90 per cent of all cases of azoturia

in horses taking place on Monday morning result directly from carelessness in over-feeding. Work horses should not be watered when overheated, but a horse accustomed to drinking water from which the chill has been removed will usually suffer no injury if allowed to rest a short time before watering. The usual and common practice is to allow the horse all the water he cares to drink before feeding in preference to heavy watering after feeding.

Assist Animals at Time of Giving Birth to Their Young.—There is probably no time when breeding animals require assistance and watching as much as at the time of giving birth to their young. It is well to watch the animals at this time and provide them with comfortable quarters and the proper feed. It is a good practice to allow only a limited ration at this time. The system will be in a much better condition to give birth to the young than where full allowance of feed is supplied. If the animal has difficulty in giving birth to its young, assistance should be given, which in case of horses and cattle, can best be secured by calling in a competent veterinarian.

MANAGEMENT OF LIVESTOCK

The management of livestock increases in importance with the rise in the value of livestock and the increase in the cost of feeds, labor and, building materials. The three most important factors to be kept in mind in the economical production of livestock is to keep down the cost of shelter, labor and feed. The buildings or housing facilities for all classes of farm animals should be adequate, yet not expensive. If they can be made convenient and comfortable, that is all that is necessary. Too many farmers insist on making their buildings too warm. This is seen in many cases where large basement barns are built that become extremely hot during the winter. Such barns favor the development of livestock diseases, rather than keeping the animals in a healthy condition. Farm animals will thrive much better and be healthier if they are put in open sheds that offer protection from cold winds, rain and sleet. This is especially true in case of cattle and sheep. Hogs and horses can also be kept in open sheds the same as cattle and sheep if they are given plenty of bedding and are kept dry. The sleeping quarters for all farm animals should be kept well bedded.

Open Sheds.—A number of experiments have been conducted to compare open sheds and warm barns for cattle and sheep. In nearly every case it has been found that beef cattle fed in open sheds made greater daily gains, consumed less feed per pound of gain, and were in healthier and thriftier condition than those kept in warm barns. The housing of cattle and sheep in open sheds is a saving to the farmer, as it does not require as much capital to construct a shed as it does to construct the usual expensive barn. It is also a saving of labor, as the cattle are not tied like they are in the barn. Open sheds should be built to face the south so the interior will not be exposed to the severe north winds. They should be built high enough so that the manure can be taken out by driving into the shed with

the wagon or manure spreader. Feed carriers should also be provided in order to save carrying a large amount of feed.

Arrangement of Labor.—The amount of labor necessary to care for the livestock should be reduced to a minimum. This can be done by arranging convenient quarters in which to feed the livestock. The farmer's and livestock producer's business should be so arranged that the bulk of the labor connected with the livestock comes during the winter. If this is done it means that the labor employed upon the farm can be distributed more equally throughout the entire year. It can be used to work the fields during the summer and care for the livestock during the winter. Very

OPEN SHEDS FOR STEER FEEDING.[1]

Shelter of this character is less expensive than warm barns, and wherever the climate is not too severe steers make better gains for feed consumed than when sheltered in warm barns.

little labor is required during the summer if plenty of pasture of the proper kind is provided. Such distribution of labor also makes it possible to secure more competent help than where it can be employed only during a portion of the year.

The Kind of Farm Animals.—The class of farm animals to keep will depend entirely upon the location and equipment of the farm. On farms where a large amount of pasture and rough feed is produced, beef cattle and sheep are best adapted. This is also true of farms where there is no

[1] Courtesy of Dept. of Animal Husbandry, Pennsylvania State College.

adequate means of transportation. With good transportation facilities or near cities where there is a good demand for dairy products, dairying may be advisable. In many sections of the United States and Canada where cream only is sold from the dairy, hogs make an admirable addition to the dairy. Hogs, on the other hand, are well adapted to most all types of farming, and provide a source of quick returns from the feeds fed. The number of farm animals to keep upon a farm depends entirely upon the size of the farm and the feeds that can be grown. It is a good practice to produce as much as possible of the feeds necessary to maintain or fatten the livestock produced on the farm. This does not mean that feeds should not be purchased. The purchase of nitrogenous supplements to feeds grown on the farm is not as universally practiced as it should be.

Regularity in Feeding and Watering.—The best results from farm animals cannot be secured unless the feeding and watering is done with system and regularity. Plenty of clean water should always be supplied. The more water consumed by an animal, the more of the feeds supplied will it consume, thus producing heavier gains or larger amounts of milk. The cost of the feeds supplied is a factor of importance. The cost of the feed bill should be kept as low as possible. This can be done only by the use of farm-grown feeds. In many cases a large amount of roughage or grain is grown that does not have a ready sale, possibly on account of being slightly damaged by weathering or improper curing. Such feeds can best be used upon the farm. Not only does it provide a desirable place to dispose of them, but the fertility which would be lost if the feeds are sold from the farm is thus saved. Such practice makes the land more fertile and more productive than where such crops as hay, stover and corn are sold from the farm.

Observing Individuals.—Every owner of livestock should study the individuals in the herd and see that they are in good condition of health. It frequently happens that animals are not doing well, and upon investigation it is found to be due to internal or external parasites. Usually an unthrifty animal is infested with internal parasites, which, if noticed in the early stages, can often be destroyed. External parasites, such as lice, are a source of annoyance and should be destroyed. In the case of sheep, it is an excellent practice to dip all of the flock in a coal-tar dip at least once a year. This is usually done following shearing in the spring. It is also well to provide new pasture for young lambs at weaning time, as at that time they are more subject to stomach worms than at any other time. This is due to the fact that they become more easily the prey of worms on account of the change from nursing the dam to depending entirely upon food supplied for their maintenance. Hogs should frequently be sprayed or dipped with a coal-tar dip so as to destroy lice that are often found on their bodies. Hogs are also often unthrifty as the result of stomach worms.

Keep up Records.—It is highly desirable for a farmer or livestock breeder who is breeding pure-bred animals to keep his records up to date.

It frequently happens that desirable pure-bred animals are grown on the farm, but their registration is not completed. Such practice is well enough where only market animals are being produced. There may come a time, however, when the breeder will desire to sell animals as breeders. Buyers of pure-bred cattle require the registration to be complete in order that they may sell any offspring produced from such animals for breeding purposes. Registration involves only a small amount of time and expense, but is a practice that is well worth while.

Preparation and Shipping of Livestock.—All livestock, whether breeding animals or market animals, should be in the very best of condition when shipped. If pure-bred stock is shipped by express, it should be properly crated. If shipped by freight, it should be properly tied and bedded. If the animals arrive in good condition, the purchaser will gain a good impression of them upon first inspection. If they arrive in poor condition due to careless preparation, the buyer as a rule will not be satisfied and probably will not make another purchase. In selling pure-bred livestock by mail, it is always a wise plan not to praise too highly the animals that are offered for sale. It is much better to have the purchaser find the animals that are shipped him better than he expected. Such practice usually makes more sales and is a good means of advertising. If a customer is not satisfied with the animals shipped, the breeder should always make it a point to satisfy his customer either by refunding the purchase price and the expense of shipping or by shipping another animal.

Cattle, hogs or sheep when shipped to market should be started in as near normal condition as possible. Some farmers salt heavily before shipping in order to get the proper "fill" on the market. Cattle salted just before they are shipped will arrive on the market in poor condition. They will be feverish, will drink very little water, will not eat much hay and will also be apt to scour. Cattle in such a condition usually sell at a discount. The car in which the livestock is to be loaded should be well bedded and in the case of cattle, the racks should be filled with hay so they can eat while en route. Always ship the livestock so as to reach the market early in the week, as there is usually more active buying at that time than later in the week.

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CHAPTER 3

FEEDS AND FEEDING

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Introduction.—A knowledge of the scientific principles of stock feeding is important to the stockman. This knowledge is not absolutely essential, as many have achieved success in feeding as a result of years of experience. However, "experience is a dear teacher" and if one combines a study of the scientific principles of feeding with the experience gained in the barn and feed lot, he will learn the art of successful feeding more quickly, more thoroughly and with less expense than if he depends upon experience as his only teacher.

Chemical Composition of Feeding-stuffs.—All feeding-stuffs are composed of a great number of different compounds which are grouped into five classes, viz., water, mineral matter, crude protein, carbohydrates and fats. These classes of compounds are usually spoken of as "nutrients," because they are used for the nutrition of the animal.

Water is found in large amounts in such feeds as green pasture, silage, beets and milk, while such feeds as hay, bran, corn, middlings, etc., contain from 10 to 20 per cent water. A knowledge of the water content of feeds is important for two reasons: (1) feeds high in water content are lower in feeding value, pound for pound, than feeds low in water; (2) feeds containing more than 18 or 20 per cent water usually ferment and spoil when stored in bulk.

Mineral Matter, or ash as it is sometimes called, is that part of the feed which remains as ash when the feed is burned. In the animal body, mineral matter is used principally for the repair and growth of bone. It is also used in the growth and repair of the muscles and vital organs. It is found in the blood and other body fluids. A certain amount of it is absolutely essential to proper growth and development, or even for life itself.

Most of the roughages, especially the legumes, as clover, alfalfa and soy beans, are quite high in mineral matter. Also such feeds as tankage, middlings, cottonseed meal, linseed meal and bran are high in mineral matter. The cereal grains, especially corn, are low in mineral matter. Consequently, in feeding horses, cattle and sheep, little account need be taken of the mineral matter of the ration, except to provide salt, as these animals are nearly always given feeding-stuffs, some of which are high in mineral matter. However, in case of hogs, the ration may be deficient in

mineral matter, especially if considerable corn is used in the ration. The hogs should have access to a mineral mixture consisting of charcoal, air-slaked lime, salt, wood-ashes and rock phosphate or "floats."

Crude Protein includes all the compounds of the feed which contain the element nitrogen. Familiar forms of protein are egg albumen (the white of the egg) and casein (the curd of milk). Protein is found in all living matter and is absolutely essential to life. It is found in every plant cell, but in larger amounts in the seeds. It also occurs in every animal cell and makes up a large part of the solid matter of the blood, muscles and organs of the body. Thus the crude protein of the ration is absolutely essential to the animal for the repair and growth of the muscles, bones, organs, etc. It is also essential for a pregnant animal for the formation of the fœtus and, later, for milk production. If there is any surplus of protein in the ration above the requirements of the animal for the purposes just mentioned, the surplus may be used to produce energy or to liberate heat. If there is still a surplus, it may be used for the production of body fat. However, protein is not an economical source of energy or body fat, as it usually is the most expensive nutrient and the one which it is most often necessary to buy. Hence, no more protein should be fed than needed by the animal for repair, growth and milk production. Tankage, cottonseed meal, linseed meal, gluten feed, distillers' grains, brewers' grains, bran, middlings and soy beans are high in protein. The legume hays are also relatively high in protein. Corn, timothy hay, the straws, fodder, stover and silage are low in crude protein.

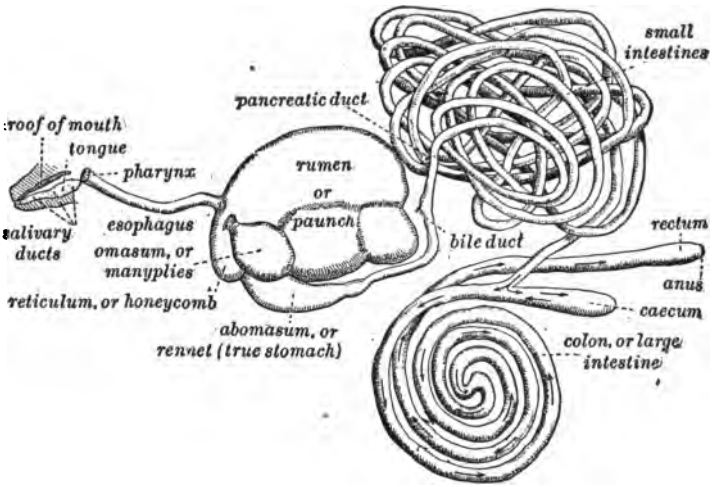
Carbohydrates are the chief constituents of all plants. However, they are not found to any large extent in animals. Familiar forms of the carbohydrates are starch, sugar and vegetable fiber, such as hemp, paper and cotton. As the carbohydrates contain such a variety of compounds which differ considerably in nutritive value, they are often divided into two sub-classes: "nitrogen-free extract" and "crude fiber."

Nitrogen-free extract includes those carbohydrates which are high in feeding value, as starch and sugar. In the animal body these substances are used as a source of energy to do work or for heat to keep the body warm. If there is any surplus, it may be used for the production of energy and the formation of body fat. As carbohydrates are considerably cheaper than protein, it is more economical to use them for these purposes than to use protein. Feeds high in nitrogen-free extract are corn, wheat, barley, rye, rice and oats. The flour by-products, the oil meals, the straws and hays contain medium amounts: while the pastures, silage and packing house by-products are low.

Crude fiber includes the tough, woody, fibrous portion of the plant. Owing to the fact that it is not very digestible, the nutritive value of crude fiber is less than that of the other nutrients. In the animal the digested crude fiber is used as a source of energy and as a source of body fat. Feeds high in crude fiber are the hays, straws, fodders, stovers and roughages in

general. The cereal grains, the oil meals and most mill feeds are low in crude fiber.

The Fats, sometimes called "ether extract," include all the fats and oils found in the feed. Practically all plants contain some fats, although usually in only small amounts. In animals, fats occur much more abundantly, occurring in nearly every organ and tissue. Fat animals often contain 40 or 50 per cent of fat. The fat of the ration is used in the animal as a source of energy and as a source of body fat. It is about two and one-quarter times as valuable as protein and carbohydrates for these purposes. Tankage and the oil meals contain the largest amounts of fat of the ordinary feeding-stuffs.



THE DIGESTIVE TRACT OF A COW.[1]

Digestion of the Nutrients.—Before the nutrients can be of any use to the animal they must be digested and taken up by the blood. Digestion is the process of separating the useful constituents of the feed from those that are useless, and changing the useful constituents to such form that they may be taken up by the blood. These processes take place in the mouth, stomach and intestines. Inasmuch as only the digestible nutrients of a feed are of value to an animal, the amount of digestible components of the feed are of special interest to the stockman. Table I shows the percentages of the digestible nutrients in the ordinary feeding-stuffs. (See Part IV.)

The Nutritive Ratio.—Proteins are used primarily for growth and repair, while carbohydrates and fats are used for energy and fat production. The nutritive ratio expresses the value of a feed or ration as a flesh pro-

[1] Courtesy of Iowa State College.

ducer or as an energy and fat producer, *i. e.*, it is the ratio of digestible crude protein to digestible carbohydrates and fat in the feed or ration. Inasmuch as fat is two and one-quarter times as valuable as carbohydrates, the amount of digestible fat is multiplied by two and one-quarter and added to the amount of digestible carbohydrates. The sum is then divided by the amount of digestible protein. The first term of the ratio is always "1," while the second term is obtained by the following formula:

$$\frac{\text{digestible carbohydrates} + 2\tfrac{1}{4} \times \text{digestible fat}}{\text{digestible protein}} = \text{second term of the ratio.}$$

The nutritive ratio is written as "1 : 6" or "1 : 14," or whatever it may be. It is read as "one to six," or "one to fourteen," Thus one finds the nutritive ratio of corn as follows: from Table I it is found that 100 pounds of corn contain 7.8 pounds of digestible protein, 66.8 pounds of digestible carbohydrates and 4.3 pounds of digestible fat. Then, substituting in the above formula:

$$\frac{66.8 + 2\tfrac{1}{4} \times 4.3}{7.8} = 9.8$$

Therefore, the nutritive ratio of corn is 1 : 9.8. The nutritive ratio of a ration containing two or more feeds may be calculated in a similar manner.

Ordinarily, a nutritive ratio of 1 : 6 or less is called a narrow ratio; *i. e.*, the feeding-stuff or ration contains a relatively large amount of protein and a relatively small amount of carbohydrates and fat. A ratio of 1 : 7 to 1 : 9 is called a medium ratio; *i. e.*, there is present a medium amount of protein and a medium amount of carbohydrates and fat. A ratio of 1 : 10 or greater is called a wide ratio; *i. e.*, the proportion of protein to carbohydrates and fats is relatively small.

The Energy Values of Feeding-stuffs.—One of the functions of the ration of an animal is to act as a source of energy to do work or form heat. Also the formation of body fat may be looked upon as a storage of energy, because it may be used as a source of energy to do work or for heat at any time when the ration is insufficient for these purposes. Hence, in addition to a knowledge of the digestible nutrients in feeds, the scientific stock-feeder should have a knowledge of the energy values of feeds, *i. e.*, the value of different feeding-stuffs for doing work, storage of fat, milk production, etc. Energy values of feeding-stuffs are expressed in "therms." A therm is the amount of energy in the form of heat necessary to raise the temperature of 1000 pounds of water 4° F. The energy values of some of the common feeding-stuffs are given in Part IV, Table II.

Feeding-stuffs.—In general, feeding-stuffs may be divided into two classes, concentrates and roughages, according to the amounts of digestible nutrients and their energy values.

Concentrates are feeding-stuffs which contain a relatively large amount of digestible nutrients and energy in a small bulk. They usually are highly nutritious in nature. Concentrates usually have an energy value of 60 or more therms per 100 pounds. Concentrates may be subdivided into *nitrogenous and non-nitrogenous concentrates.*

A nitrogenous concentrate is one which is relatively rich in protein. It usually contains 11 per cent or more of digestible protein. Common examples are tankage, cottonseed meal, linseed meal, gluten feed, dried distillers' grains, dried brewers' grains, soy beans, bran, middlings and shorts. As a rule, but few nitrogenous concentrates are produced on the

THE RESPIRATION CALORIMETER IN USE FOR AN EXPERIMENT.[1]

farm and therefore they must be purchased. Nitrogenous concentrates are almost essential in the rations of all growing animals in order to furnish protein and mineral matter so essential to the proper development of muscle and bone. Likewise the milk cow requires nitrogenous concentrates in order to provide the large amounts of protein and mineral matter which she excretes in her milk. Fattening animals and work horses often need small amounts of nitrogenous concentrates, especially if they are still growing.

A non-nitrogenous concentrate is low or only medium in protein content, but is usually rich in carbohydrates. It generally contains less than

[1] Year-Book, U. S. Dept. of Agriculture, 1910.

11 per cent of digestible protein. Examples are corn, barley, oats, wheat, rye, molasses and dried-beet pulp. Ordinarily the farmer raises all the non-nitrogenous concentrates necessary, and usually it will not pay him to buy such feeds on the market. All classes of fattening animals require large amounts of non-nitrogenous concentrates in order to furnish the carbohydrates and fats which, as has already been stated, are the cheapest sources of body fat. Also work horses must have large amounts of non-nitrogenous concentrates in order to furnish energy for doing their work. Milch cows need medium amounts, while they should be used more sparingly in the rations of growing and breeding animals.

Roughages are feeding-stuffs which contain a relatively small amount of digestible nutrients, or net energy in a large bulk. They usually contain less than 40 therms of energy per 100 pounds. Roughages contain a large amount of crude fiber which lowers their feeding value considerably. Roughages, like concentrates, may be sub-divided into *nitrogenous and non-nitrogenous.*

Nitrogenous roughages usually contain 6 per cent or more of digestible protein. Examples are clover, alfalfa, cowpea, soy-bean hay and alfalfa meal. In general, all the legume hays fall under this sub-class. Nitrogenous roughages should be grown on nearly every farm, not only for their feeding value but also for their fertilizing value in the crop rotations. It will rarely pay to buy nitrogenous roughages on the market, as they can be produced more cheaply at home. The nitrogenous roughages are valuable in the rations of nearly all classes of animals except hogs, and even they make valuable use of some of them at times. Fattening animals, with the exception of hogs, should have nitrogenous roughage. Unless they do, it will be necessary to feed large amounts of nitrogenous concentrates, and even then the results will be only fair, unless corn silage is used. Growing animals should have nitrogenous roughage, as it furnishes much of the protein and mineral matter so essential to their proper development. Even pigs may make use of some alfalfa or clover hay. It is almost impossible to produce milk economically unless nitrogenous roughages are used. Breeding cattle and sheep need little or no other feed than nitrogenous roughages in winter. Brood sows and boars will eat considerable of the leaves. Horses may have nitrogenous roughages if they are clean, well cured and free from dust. Often, however, they are too dusty for horses.

Non-nitrogenous roughages usually contain less then 6 per cent of digestible protein. Examples are timothy hay, corn silage, corn stover, oat straw, wheat straw, barley straw and rye straw. Silage is the best form in which to get all the feeding value of the corn crop. It may be used to advantage in the rations of practically all classes of animals except hogs, if it is properly supplemented with other feeds. The other non-nitrogenous roughages have little value except in the rations of mature breeding animals, stockers and work horses.

The Requirements of Farm Animals.—Knowing the digestible nutrients and the energy in the different feeding-stuffs and the amounts of nutrients and energy required by farm animals, one can formulate approximately a proper ration for different farm animals under different conditions.

The Balanced Ration.—A balanced ration is a ration which contains all the nutrients in such proportions, forms and amounts as will nourish properly and without excess of any nutrient, a given animal for one day. Extended study of the amount of each nutrient required by the different farm animals for the various purposes for which they are kept has led to the formation of so-called "feeding standards." Theoretically, feeding standards may be looked upon as formulas which tell at a glance the amount of each nutrient necessary to produce a given result. In practice, however, feeding standards cannot be regarded as such, but only as a guide to be used in connection with one's practical knowledge of the amounts, proportions and combination of feeds which are used in stock feeding. Although there are a number of valuable feeding standards, the limits of this chapter will permit a discussion of only a few.

The Wolff-Lehmann Standards show the requirements of farm animals under different conditions, expressed in pounds of total dry substance, digestible crude protein, digestible carbohydrates and digestible fat per 1000 pounds live weight. The nutritive ratio required by the animal also is given.

The calculation of a ration according to any feeding standard consists essentially of three steps: (1) Having given the requirements for an animal of a given weight, usually 1000 pounds, the requirements of the animal under consideration are determined. (2) A "trial ration" is assumed, using the amounts and proportions of concentrates and roughages which, in the opinion of the feeder, are necessary. (3) The trial ration is modified by adding or deducting concentrates or roughages of such composition as to furnish approximately the required amounts of nutrients.

Thus, for example, one calculates a ration according to the Wolff-Lehmann standard for a 1200-pound horse at light work as follows: According to the standard (see Part IV, Table III) the requirements of a 1000-pound horse at light work are as follows: dry substance, 20 pounds; digestible protein, 1.5 pounds; digestible carbohydrates, 9.5 pounds; and digestible fat, 0.4 pounds. The first step is to calculate the requirements of a 1200-pound horse, which are found to be as follows: dry substance, 24 pounds; digestible protein, 1.8 pounds; digestible carbohydrates, 11.4 pounds; and digestible fat, 0.5 pound. The second step is to assume a trial ration which will meet approximately the requirements as determined in the first step. From the amount of dry substance required and from practical experience, one judges that a ration consisting of 12 pounds of oats and 14 pounds of timothy hay will about answer the pur-

pose. Calculating the dry substance and digestible nutrients of this ration from Table I, the following results are obtained:

	Dry Substance, pounds.	Digestible Protein, pounds.	Digestible Carbohydrates, pounds.	Digestible Fat, pounds.
Oats, 12 pounds.....	10.8	1.1	5.9	0.5
Hay, 14 pounds.....	12.2	0.4	5.9	0.2
Total ration.....	23.0	1.5	11.8	0.7

Comparing the nutrients of the trial ration with the requirements of the standard, it is seen that the trial ration is a little below the standard in dry substance and protein, and a little above it in carbohydrates and fat. Thus the third step is to modify the trial ration so that its nutrients conform to the standard. Consequently, a feed which is high in protein and low in carbohydrates should be substituted for part of the ation. Inasmuch as it is not desirable to lessen the bulk of the ration as the dry substance is already a little low, one may substitute two pounds of linseed meal for two pounds of the oats of the ration. The ration then contains the following nutrients:

	Dry Substance, pounds.	Digestible Protein, pounds.	Digestible Carbohydrates, pounds.	Digestible Fat, pounds.
Oats, 10 pounds.....	9.0	0.9	4.9	0.4
Oil meal, 2 pounds.....	1.8	0.6	0.6	0.1
Timothy hay, 14 pounds.	12.2	0.4	5.9	0.2
Total ration.....	23.0	1.9	11.4	0.7

The nutritive ratio is:

$$\frac{11.4 + 2.25 \times 0.7}{1.9} \text{ or } 1{:}6.8$$

This ration, except that it is a trifle low in dry substance, comes very close to satisfying the standard. Of course, in many cases, especially until one has had considerable practice in the calculation of rations, the trial ration may have to be modified several times before the ration conforms with the standard. However, by applying his practical knowledge, the stock feeder should not have much difficulty in calculating balanced rations.

In view of modern investigations, certain modifications must be made to the Wolff-Lehmann standards to adapt them to American conditions. In practically every instance the amount of dry substance prescribed is 10 to 20 per cent too high. The protein prescribed is from 10 to 40 per cent too high, the greatest difference being in the case of fattening and working animals, and, consequently, the nutritive ratio is too narrow. Very little attention should be given to the fat content of the ration, it being considered satisfactory if the requirements for protein and carbohydrates are fulfilled.

The Armsby Standards express the requirements of farm animals in pounds of digestible protein and in therms of energy. Instead of giving separate standards for all the different classes of farm animals, Armsby gives standards for maintenance and growth. Inasmuch as any excess of feed above maintenance may be used for fattening or milk production, he gives the amount of nutrients above the maintenance requirements necessary to produce a pound of gain or a pound of milk. Thus, the standards for fattening and for milk production vary with the amount of gain or with the amount of milk produced. To determine the standard for a fattening animal, one adds 3.5 therms per each pound of daily gain to the energy requirement for maintenance, as all the energy above the maintenance requirement may be used for the production of flesh and fat. Armsby recommends that a 1000-pound ruminant should receive 20 to 30 pounds, or an average of 25 pounds of dry matter per day. A horse should have somewhat less. The amounts of digestible protein and of energy in the common feeding-stuffs as presented by Armsby are given in Table II. His feeding standards are given in Table IV. For example, if one desires to calculate a ration for a 1000-pound steer gaining two pounds per day, the first step is to determine the requirements. From Table IV it is seen that the requirements of a 1000-pound steer gaining two pounds per day are 1.8 pounds of digestible protein and 13.0 therms of energy. As the second step, we will assume a trial ration consisting of 10 pounds of corn and 8 pounds of clover hay. Referring to Table II, it is found that the digestible protein and energy in this ration are as follows:

	Dry Substance, pounds.	Digestible Protein, pounds.	Energy therms.
Corn, 10 pounds	8.91	0.68	8.88
Clover hay, 8 pounds	6.78	0.43	2.78
Total ration	15.69	1.11	11.66

Comparing the trial ration with the standard, we find that it is low in both protein and energy. As the third step, we will add 2 pounds of cottonseed meal, as it is high in both protein and energy. The ration then contains the following nutrients:

	Dry Substance, pounds.	Digestible Protein, pounds.	Energy, therms.
Corn, 10 pounds	8.91	0.68	8.88
Clover hay, 8 pounds	6.78	0.43	2.78
Cottonseed meal, 2 pounds	1.84	0.70	1.68
Total ration	17.53	1.81	13.34

This ration, although a trifle low in dry substance, fulfils the requirements of the Armsby standard.

In calculating a ration for a dairy cow according to the Armsby standard, one adds to the requirements for maintenance, 0.05 pounds of digestible protein and 0.3 therm of net energy for each pound of milk produced. For example, one wishes to calculate a ration for a 900-pound cow giving 22 pounds of milk. According to Table IV the requirements are as follows:

	Digestible Protein, pounds.	Energy, therms.
For maintenance of 900-pound cow	0.45	5.7
Additional for 22 pounds milk	1.10	6.6
Total requirement	1.55	12.3

The ration is then calculated in the manner previously described.

The Haecker Standard for Dairy Cows holds that the requirements of the dairy cow vary not only according to her weight and the quantity of milk yield, but also according to the quality of the milk. According to Haecker, a 1000-pound cow requires for maintenance 0.7 pound of digestible crude protein, 7.0 pounds of digestible carbohydrates, and 0.1 pound of digestible fat. For each pound of 4 per cent milk the Haecker standard requires the addition of 0.054 pound of digestible crude protein, 0.24 pound of digestible carbohydrates, and 0.021 pound of digestible fat in addition to the maintenance requirement. If the milk contains less than 4 per cent of fat, smaller amounts of nutrients are prescribed. The amounts of digestible nutrients to produce one pound of milk containing various percentages of butter fat are given in Table V.

For example, to calculate a ration according to the Haecker standard for a 900-pound cow giving 20 pounds of milk daily containing 5 per cent of butter fat, the process is as follows: (1) determine the maintenance requirement for a 900-pound cow; (2) add to the maintenance requirement the requirement to produce 20 pounds of 5 per cent milk; and (3) calculate a ration to conform with this standard. Thus a cow weighing 900 pounds requires 0.63 pound of digestible protein, 6.30 pounds of digestible carbohydrates and 0.09 pound of digestible fat for maintenance. According to Haecker, to produce one pound of 5 per cent milk requires the consumption of 0.060 pound of digestible crude protein; 0.28 pound of digestible carbohydrates, and 0.024 pound of digestible fat, in addition to the maintenance requirements. Thus the total requirement to produce 20 pounds of 5 per cent milk is calculated as follows:

	Digestible Protein, pounds.	Digestible Carbohydrates, pounds.	Digestible Fat, pounds.
For maintenance	0.63	6.30	0.09
To produce 20 pounds of 5 per cent milk	1.22	5.60	0.50
Total	1.85	11.90	0.59

The ration is then calculated in the same manner as described under the discussion of the Wolff-Lehmann standards.

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CHAPTER 4

HORSES AND MULES

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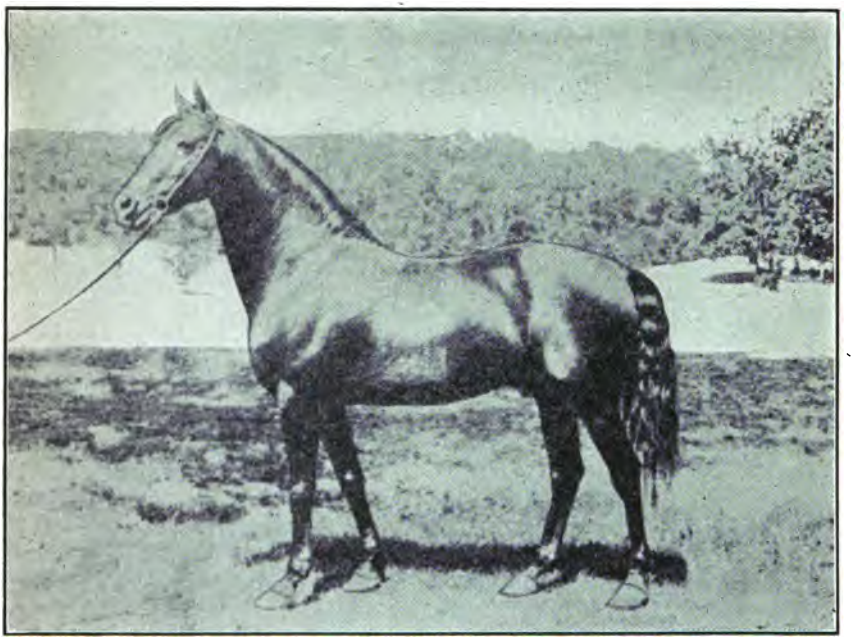
The horse even today plays a very important part in moving merchandise and performing other labor. The work on our farms is largely accomplished by the horse, and in spite of the motor truck the horse is



MORGAN STALLION, "GENERAL GATES."[1]

considered indispensable in a large amount of business in the city. Modern methods of transportation move enormous quantities of freight, yet the demand for the work horse does not diminish.

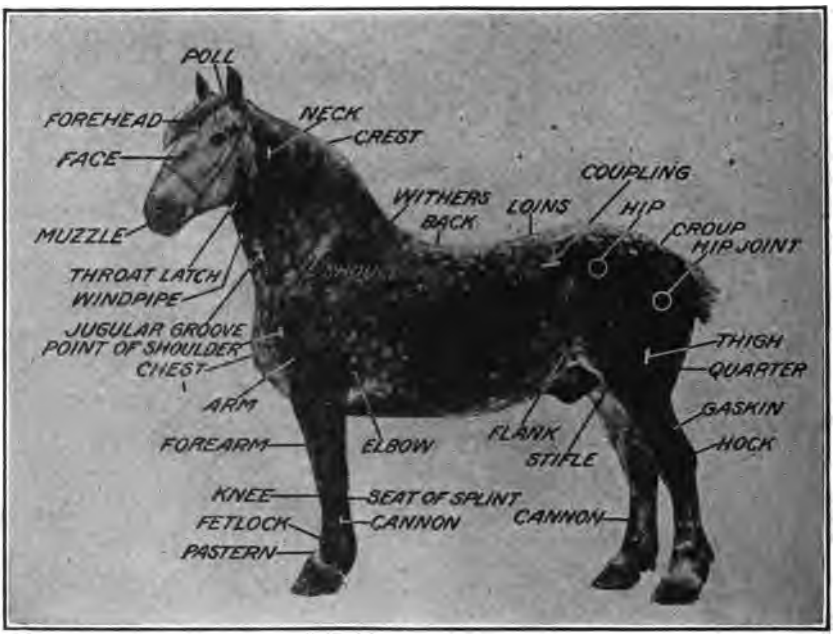
Development of Type.—The usefulness of a horse depends upon his power of locomotion and the characteristics which adapt him to the different

[1] Courtesy of U. S. Dept. of Agriculture.

kinds of service determine his type. Whether he moves with power, speed, extreme action and style or to carry weight, will determine whether he is a draft, a race, a show or a saddle horse.

Our modern breeds of light horses have probably been developed with the Arabian horse as foundation stock. The Arabians developed a light horse with endurance and courage for desert travel, and intelligence and friendliness for companionship on the long journey.

The low-lying, luxuriantly vegetated Flanders led to the development



A High-grade Work Horse of Fine Quality and Good Conformation, Illustrating the "Points" of a Draft Horse.[1]

of the patient, sluggish Flemish horse with plenty of power to accomplish the heavy work required of him. The Flemish blood is the most important basis of the draft types.

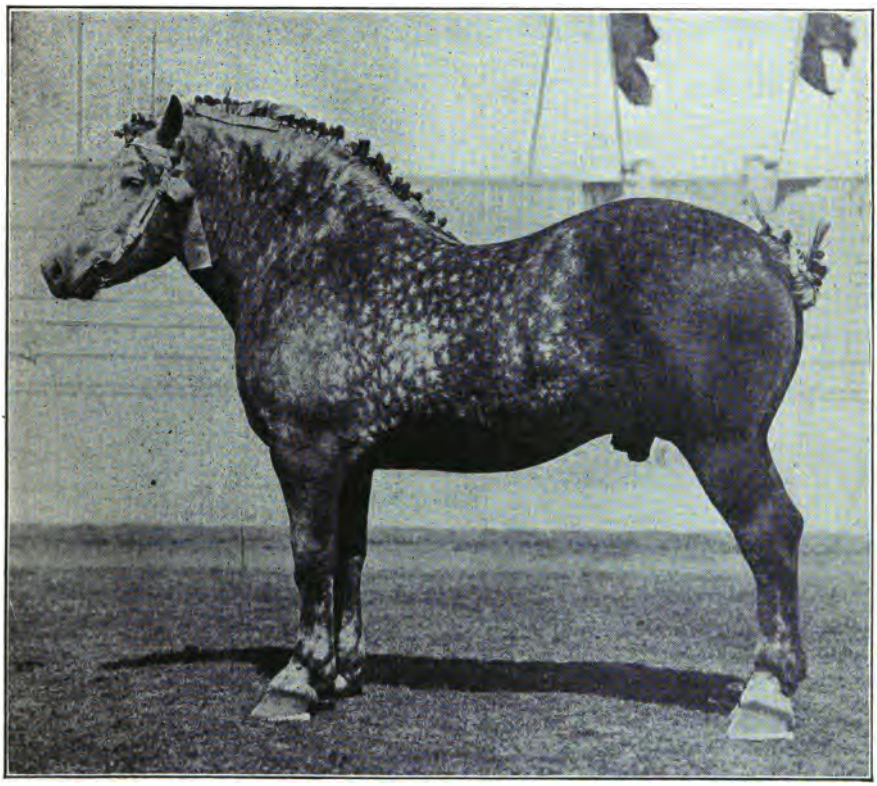
The Light Horse.—It is essential that the horse of this class show refinement in all his parts. His conformation, action, style, finish and endurance should be such that he can meet the requirements for a distinct purpose.

Action is essential in this class. The coach horse should show high action; the roadster must be able to haul a light vehicle at a rapid trot; and the saddle horse is required to give the rider satisfaction.

[1] Courtesy of U. S. Dept. of Agriculture. From Farmers' Bulletin 451.

Weight is not so important. The carriage horse must necessarily be heavier than the roadster, because he is required to draw a heavier vehicle and the saddle horse must be able to perform the gaits of his class. Size will depend upon the use to which he is put.

Draft Type.—Horses of this type are used in hauling heavy loads at a comparatively slow gait, and should possess strength and endurance. A



PERCHERON STALLION.[1]

draft horse should be massive, relatively close to the ground and weigh at least 1600 pounds. He should have a heavy body; a short, strong back; a strong constitution; a sloping shoulder and a long, level croup. He should also have plenty of bone of good quality and large, sound feet. His legs should set properly under him and his pasterns should be long and sloping.

The important gait of the draft horse is the walk. The stride should be long and straight. A combination of weight, muscle and good feet and

[1] Courtesy of The Field, New York City.

Light Horses.

Breeds.	Native Country.	Origin.	Height, hands.	Weight, pounds.	Color.	Other Characteristics.
Arabian.	Arabia.	Native horses.	14–15.2	850–1000	Bay, brown, chestnut, occasionally black or gray.	Good action; intelligent.
Thoroughbred.	England.	Arabian mixed by English people.	14.2–16.2	900–1100	Bay, brown, chestnut, black or gray.	Running horse; great speed; intelligent, sometimes difficult to manage.
Standard bred horse.	America.	English horse.	14–16.2	900–1200	Bay, brown, chestnut or black; few grays and roans.	Fastest of harness horses; remarkable endurance; intelligent.
Morgan (branch of standard bred)	America.	Thoroughbred (Justin Morgan foundation horse).	14.3–16	950–1150	Bay, chestnut, brown or black.	Not extreme action or speed; noted for endurance; intelligent.
Saddle.	U. S.: Virginia, Kentucky, Missouri.	Thoroughbred.	15–16	900–1200	Chestnut, black, bay, brown, gray and roan.	Action, style, manners, five gaits, walk, trot, canter, rack, running-walk, foxtrot or slow pace.
Hackney.	England.	Arabian; thoroughbred native horse.	13.2–16	750–1200	Chestnut, bay, brown, black, and roan, white markings common.	Extreme high action.

German coach, French coach and Cleveland bay horses have not greatly influenced the horse business in this country.

Draft Horses.

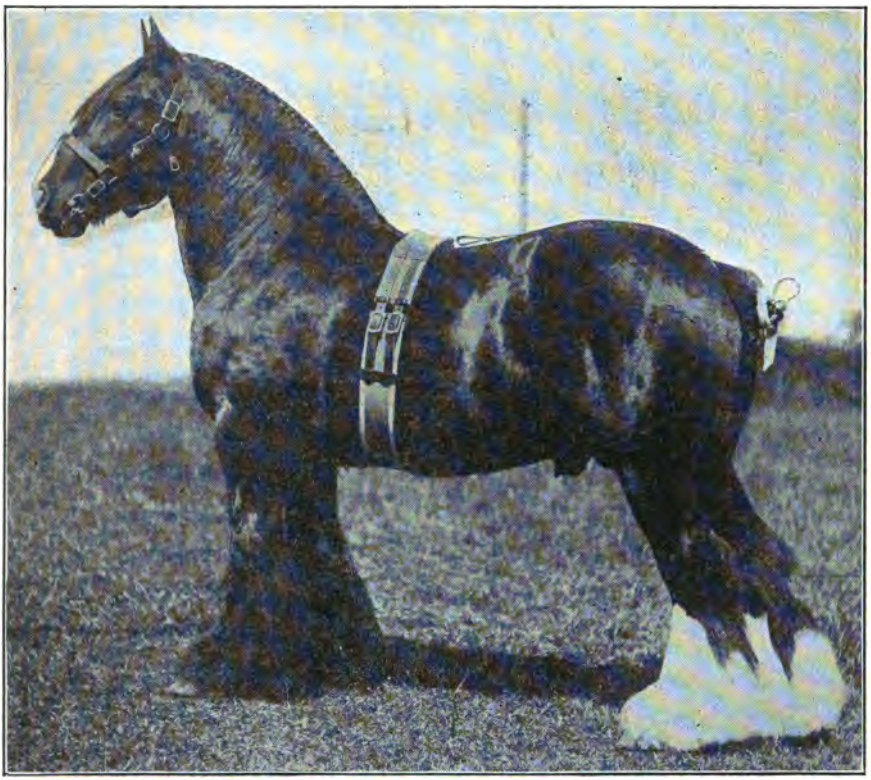
Breed.	Native Country.	Origin.	Height, hands.	Weight, pounds.	Color.	Other Characteristics.
Percheron.	France.	Native horses, Flemish, Arabian.	15.3–17	1600–2200	Gray, black, bay, brown, roan, chestnut.	Good action; intelligent.
Belgian.	Belgium.	Flemish.	15.3–17	1600–2400	Roan, chestnut brown, black, gray.	Compact, deep and wide; heavily muscled.
English Shire.	England.	Native horses, Flemish.	16–17.3	1700–2400	Bay, black brown, gray, chestnut, roan, white on legs and face.	Largest of draft breeds; heavy feather on legs.
Clydesdale.	Scotland.	Native horses, Flemish.	16–17	1600–2100	Bay, black, brown, chestnut, roan, gray, white on face and legs.	Very good action; intelligent; feather on legs.
Suffolk-punch.	England.	Native horses.	16–16.2	1600–2000	Chestnut.	Smallest of the draft breeds.

Mules.

Class.	Height, hands.	Weight, pounds.	Color.	Other Characteristics.
Draft.	16–17.2	1200–1600	Bay, brown, gray or dun. Most desirable color is black with a tan nose and flank.	Large, heavy boned, heavy set mules.
Sugar.	16–17	1150–1300		Tall, with considerable quality and finish.
Cotton.	13.2–15.2	750–1100		Small and compact, with quality.
Mining.	12–16	600–1350		"Pit" mules, small; "miners," large and rugged.
Farm.	15.2–16	1000–1350		Plain and thin, with good constitutions.

legs should be an indication of a horse's ability to haul a load at a fair rate of speed.

The Mule is a hybrid, having for parents a mare and a jack. Because of this fact it shows many parental characteristics which are common to both ancestors. It has longer ears than the horse, a Roman nose, heavy lips, clean legs, small, narrow feet of good quality, and a scanty growth of



ENGLISH SHIRE STALLION.[1]

hair on the tail and a scanty mane. The sexual organs of both mare and horse mules are undeveloped, consequently they do not breed.

The mule is generally smaller than the draft horse, being from 14 to 17 hands high, and weighing from 600 to 1600 pounds. Mares of good quality weighing about 1350 pounds when bred to a heavy-boned jack with long ears produce mules which have good size, quality and action. As a rule, mare mules bring better prices on the market than do horse mules.

America has done more towards the economical development of the

[1] Courtesy of The Field, New York City.

mule than any other country, and more than one-half the mules in the world are in the United States.

Due to his hardiness and his ability to take care of himself, the mule is adapted to most climates and to kinds of work for which it would not be practical to use a horse. In most contagious and infectious diseases, however, the mule has no more resistance than a horse.

Market Requirements.—The market requires that a horse shall fill some definite purpose. There is a demand for good horses that fill a definite

CLASSIFICATION OF MARKET CLASSES OF HORSES.*

CLASS.	SUB-CLASS.	HEIGHT, HANDS.	WEIGHT, POUNDS.	OTHER CHARACTERISTICS.
Draft.	Light draft.	15.3–16.2	1600–1750	Heavy, rugged, compactly built, denoting strength and endurance.
	Heavy draft.	16–17.2	1750–2200	
	Loggers.	16.1–17.2		
Chunks.	Eastern Export.	15–16	1300–1550	The same type as draft, except that he is more compact and lighter in weight.
	Farm.	15–15.3	1200–1400	Low down, blocky horses not as heavy as the Eastern chunk. Possess quality finer and not so heavy as the other sub-classes.
	Southern.	15–15.3	800–1250	
Wagon.	Expressers.	15.3–16.2	1350–1500	Upstanding, deep-bodied, closely coupled, with good bone quality, energy and spirit.
	Delivery.	15–16	1100–1400	Conformation similar to express; not so large.
	Artillery.	15.1–16	1050–1200	Sound, well bred, with quality; prompt action in walk, trot or gallop. Free from vicious habits, without blemish, and broken to harness and saddle.
	Fire horses.	15–17.2	1200–1700	More rangy in conformation than expressers; ability to take long runs.
Carriage.	Coach.	15.1–16.1	1100–1250	Smoothly turned, full-made horses with high action combined with beauty of form.
	Cobs.	14.1–15.1	900–1150	Small horses of stocky build with plenty of quality.
	Park.	15–15.3	1000–1150	Excellent quality; high action.
	Cab.	15.2–16.1	1050–1200	Similar to coach horses; calk in finish; good feet and legs and endurance.
Road.	Runabout.	14.3–15.2	900–1050	Not so stockily built as cob, having more speed.
	Roadster.	15–16	900–1150	Conformation more angular than runabouts, denoting speed, stamina and endurance.
Saddle horses.	Five-gaited.	15–16	900–1200	Conformation denoting style, action, with strong back; possesses five distinct gaits under the saddle.
	Three-gaited.	14.3–16	900–1200	Size depending on weight to be carried with ability to walk, trot and canter.
	Hunters.	15.2–16.1	1100–1250	Large, strong; must be jumpers; stand long country rides.
	Cavalry.	15–15.3	950–1100	Sound, well bred; have quality; broken to saddle; easy gaits.
	Polo Ponies.	14–14.2	850–1000	Smallest saddle class; used for playing polo.

purpose, but misfits sell at a low figure. The horse should be sound, at least serviceably sound, with a conformation adapted to the work required of him. He should be in good condition in order to look well and be ready for hard work. Condition is also an indication of the health and feeding quality of the horse. The market requires that a horse be broken and of good disposition. Horses between five and eight years old sell the best. Solid colors are preferred because they can be matched more easily, and many firms use their teams of two, four or six horses and equipment as a part of their advertising.

* Illinois Experiment Station Bulletin No. 122.

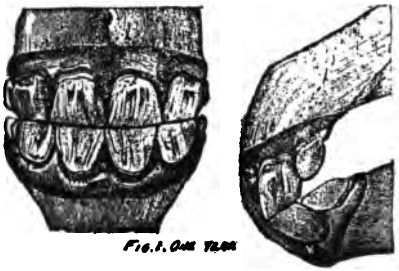


FIG. 1.—At one year of age the jaw is narrow, the temporary teeth are small and the corner incisors are not yet in contact.

FIG. 2.—At two years of age the jaw shows greater width than at one year of age, and the teeth are all in contact and show considerable wear.

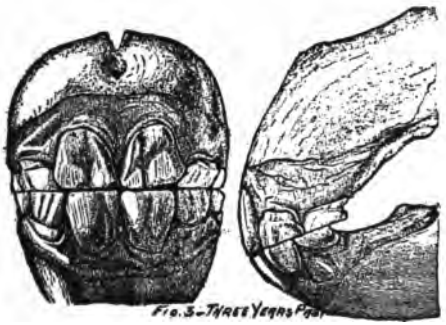


FIG. 3.—At three years of age the permanent incisors above and below are in wear. Note the greater width and length in comparison to the temporary teeth.

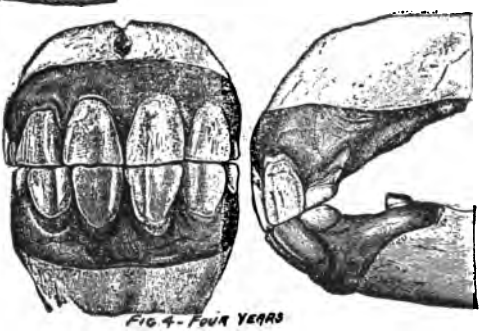


FIG. 4.—At four years of age the permanent and intermediate incisors on lower and upper jaws are in wear. The corner pair of temporary teeth have not been displaced; they appear very small in comparison with the permanent teeth.

NOTE.—Photographs showing teeth at various ages, by courtesy of Prof. S. T. Simpson, Agricultural Extension Service, Missouri Experiment Station.

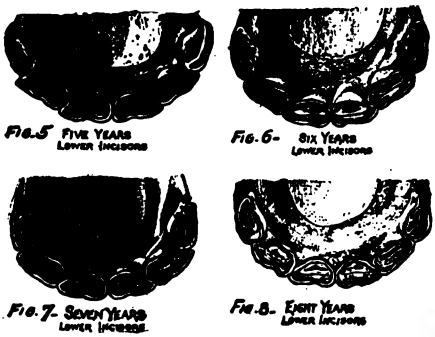


FIG. 5.—Complete set of lower permanent incisors showing deep cups at five years.

FIG. 6.—The cups in the lower central incisors have nearly disappeared and the tables are smooth at six years.

FIG. 7.—The cups in the lower intermediate pair of incisors have disappeared at seven years.

FIG. 8.—The cups in the lower corner pair of incisors have disappeared and the tables are all worn smooth at eight years.

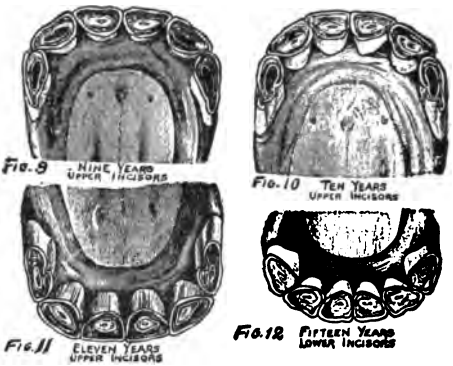


FIG. 9.—The cups in the central incisors above have practically disappeared at nine years.

FIG. 10.—The cups in the intermediate incisors above have disappeared at ten years.

FIG. 11.—At eleven years the tables on the upper jaw are nearly smooth.

FIG. 12.—Note the smooth tables and the length of the teeth showing considerable wear at fifteen years.

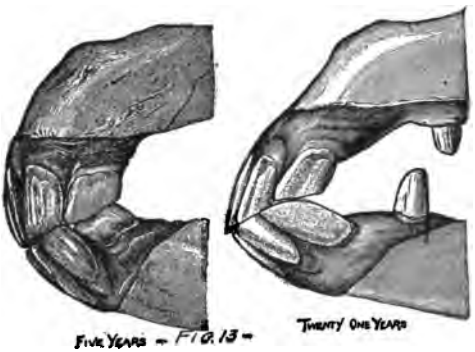


FIG. 13.—Showing a comparison of the angles of the jaw at five and twenty-one years. Note the acute angle of the teeth at twenty-one.

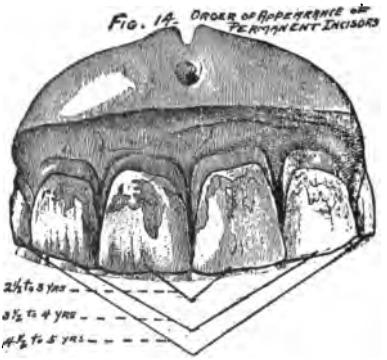


FIG. 14.—Showing order of appearance of the permanent incisors. The central pair at 2½ to 3 years. The intermediate pair at 3½ to 4 years. The corner or outside pair at 4½ to 5 years.

NOTE.—Photographs showing teeth at various ages, by courtesy of Prof. S. T. Simpson, Agricultural Extension Service, Missouri Experiment Station.

The Age of the Horse.—The teeth form the most accurate basis for estimating the age of a horse. The first teeth which appear are called colt, milk or temporary teeth. As the horse grows older these are replaced by broader, thicker, darker-colored permanent teeth.

The central incisors in the upper and lower jaws usually appear within two weeks after foaling. The intermediate incisors, one on each side of the central incisors, make their appearance between the second and fourth week, and the corner or outside incisors are in at six months of age (Fig. 1).

The central pair of permanent incisors will displace the temporary incisors and be in use at three years of age. (Fig. 3). The permanent intermediate ones will be in use at four (Fig. 4) and the corner pair of permanent incisors will displace the temporary corner or outside incisors at five years of age.

The five-year-old horse has a full mouth of permanent teeth (Fig. 5). These have large cups that wear smooth as the age of the horse advances. The cups or tables of the central incisors below have worn smooth at six years of age, the intermediate incisors below are smooth at seven and the corner pair at eight. (See Figs. 6, 7 and 8.)

The cups of the central pair of incisors on the upper jaw have disappeared at nine, the intermediates above are smooth at ten and the cups in the corner incisors are worn smooth when the horse reaches his twelfth year. (See Figs. 9, 10, 11 and 12.)

There is no accurate method of estimating the age of a horse after he is twelve years old; however, the angle of the teeth becomes more acute as he becomes older (Fig. 13).

HORSE FEEDINGS

Proper management in feeding and caring for the horse is an essential for his best health and development. The digestive system of a horse is not large, therefore a comparatively small amount of roughage and a relatively larger amount of grain is required. Sudden changes in feed should be avoided, as the digestive system requires time to readjust itself to the new conditions.

Grinding or soaking of feed is not economical except in the case of colts or horses doing exceptionally hard work; however, many horsemen favor rolling the oats they feed. Salt should be accessible at all times.

Feeds for the Horse.—It is economical under most conditions to use the feeds at hand. The most common feeds for horses are oats with timothy hay, or a mixture of timothy and clover. In many sections corn is substituted for a part or all of the oats in the ration and prairie hay or alfalfa is substituted for the timothy.

A combination of oats and timothy hay forms an excellent ration for work horses. The nutrients are in about the proper proportions and the

bulk seems to fit the needs of the horse. Both are usually free from dust. For the light horse that is required to make long, hard drives no satisfactory substitute for oats and timothy hay has been found.

Grain.—Corn and barley are used extensively in some sections for a part or all of the grain ration. Because of its hardness the barley should be ground or cracked.

Bran and oil meal are often used to supplement corn or barley, and for growing animals or brood mares corn, oats and bran form an excellent ration. The bone and muscle-building elements in bran and its laxative effect are considered indispensable by many horsemen.

Roughages.—A mixture of timothy and clover is considered an excellent roughage for horses. Either clover or alfalfa hay is good, except for horses doing heavy or rapid work. Oat hay, when cut a little green, forms an excellent roughage and sheaf oats are often fed with good results. Millet hay is considered unsafe to feed by most horsemen.

Corn stover and oat straw are used with success when properly balanced with a grain ration.

Good clean silage that is not too acid is an excellent feed for brood mares, idle horses and growing colts, though it should be fed in limited quantities and with some dry roughage. It has been fed with good results, but great care must be exercised in feeding. No mouldy or musty silage should be fed.

Watering.—Horses, under natural conditions, drink frequently. The most common practice among horsemen is to water the horses before feeding, although many practice watering before and after feeding. Horses that are heated should be compelled to drink very slowly. The value of good running water in the horse pasture cannot be overestimated.

The Work Horse.—A horse at work should receive ten to eighteen pounds of grain daily, depending upon the kind of work performed and the size of the horse. On days when idle the grain ration should be reduced and the roughage increased. The addition of a small amount of bran is recommended.

The Foal.—The foal should be taught to eat grain and hay as early as possible. Oats and bran with some clover or alfalfa hay of good quality are the best feeds because they contain the muscle and bone-forming elements required for growth.

While the mare and colt are in the pasture some grain can be fed very satisfactorily in a small creep. After weaning, at about five or six months of age, feed for growth rather than condition.

The Orphan Foal.—Milk from a fresh cow, one whose milk is low in butter-fat, is well adapted to raising an orphan foal. To a dessert-spoonful of granulated sugar should be added enough warm water to dissolve it. To this three tablespoonsful of lime water and enough fresh milk to make a pint should be added. A small amount, one-half pint, should be given each hour. In a short time the amount should be increased and feed should

be given every two hours, more being given gradually and the time between feeding lengthened.

The Brood Mare, used for breeding purposes only, does well without grain when on good pasture. In winter, if she is in foal, she should be given feeds high in protein and mineral matter for the best development of the fœtus. She should receive plenty of exercise at all times.

The Stallion.—Good whole oats and bran with plenty of clean timothy hay is a very good ration for the stallion. The addition of corn or barley to the ration lends variety and increases its palatability. Exercise is at all times absolutely essential for the best results with any stallion. When standing for service he should be required to walk six to ten miles per day.

STANDARD RATIONS

	Parts.	Parts.	Parts.
Foals:			
Ground oats	6	Oats	4
Ground corn	2	Corn	4
Bran	2	Bran	2
Whole oats, Shelled corn, Bran	equal parts.		
With either of the above rations, feed clover, alfalfa, or timothy and clover mixed.			
Work Horses:			
Oats	5	Oats.	Corn 9
Corn	5	Hay.	Oatmeal 1
Hay.			Hay.
Timothy and clover mixed or just timothy is recommended as roughage.			
Brood Mare:			
Corn	4	Corn 7	Corn 8
Oats	4	Bran 2	Linseed oil meal 1
Bran	2	Linseed oil meal 1	
Clover or alfalfa of good quality, or timothy and clover mixed are good roughages to feed with the above grain rations.			

Grooming.—For the best health of the horse he should be groomed before he is harnessed and at night after the harness has been removed. A good currycomb, a stiff brush and a soft woolen cloth are the only utensils ordinarily needed. The currycomb is used to loosen the dirt and sweat in the hair and skin over the body and is followed by the brush. The woolen cloth is then rubbed very firmly over the entire body to take up the fine dust and to put the coat in good condition.

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CHAPTER 5

BEEF CATTLE

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Beef production is associated with the best type of farming in every country. A careful survey of any community shows that the cattlemen are leaders in public matters, are financially responsible, farm the best land and are considered among the best citizens. Counties and communi-

PURE-BRED HEREFORD BULL.[1]
A hardy, early maturing, beef breed of good quality.

ties noted for their production of beef are also noted for their large yields of agricultural crops and their great productive wealth. There never has been a permanent and profitable system of farming established on an extensive scale in any country where beef cattle have been eliminated from

[1] Courtesy of The Field, New York City.

the farms. Beef cattle make the greatest and most profitable use of roughage and grass, are comparatively free from disease, require less shelter and attention than other farm animals, enable the farmer to distribute his work uniformly throughout the year and are easily marketed.

Sources of Profit.—The cattleman has four sources of profit: (1) from growing crops; (2) from feeding crops; (3) from using by-products which otherwise have no market value, such as straw, stover, damaged hay and grain; and (4) from increasing soil fertility and the yield of crops. It frequently happens that the greatest profit comes from the use of farm by-products and the increase of soil fertility. The successful cattleman of the future must be as good a farmer as the man who produces grain and hay for the market, and also have the ability and judgment to select and feed animals that can convert grain and hay into meat profitably.

There are four distinct methods of handling beef cattle, dependent upon the amount of capital available and the kind of crops adapted to the farm, as follows: (1) breeding pure-bred cattle, (2) producing stockers and feeders, (3) grazing cattle, and (4) fattening cattle.

Breeding Pure-Bred Cattle.—This is the highest type of beef production and requires the investment of a large amount of money for a series of years. The breeder must not only understand and practice the best methods of breeding, feeding and developing livestock, but must also follow the best methods of farming. He should keep the buildings and grounds neat and attractive to impress customers with the fact that breeding pure-bred livestock is profitable and attractive.

Excellent pasture should be available for summer grazing and the best methods of feeding must be practiced during the winter to develop the inherited type and form to the maximum. More breeders fail because of poor feeding than of any other one factor. In addition to the ability to select the approved type of the breed and to feed successfully, the breeder of pure-bred cattle must be a business man and a salesman so that he can successfully dispose of what he produces. It is usually better for the beginner to start with grade or market cattle and, if he succeeds, to purchase a few pure-bred animals and go into the business gradually, than to invest all his capital in a specialty with which he is unacquainted.

Producing Stockers and Feeders.—The production of stockers and feeders should be confined to those parts of the country where the larger part of the land cannot be plowed profitably, and grass is the principal crop. This class of cattle is kept on grass during the summer season and fed on roughage, with little or no grain, during the remainder of the year. Lying east of the Rocky Mountains is a large area which is peculiarly adapted to the production of grass and roughage, such as Kaffir and sorghums on the uplands, and alfalfa on the bottom land, and which logically should be the great stocker and feeder producing section of the United States. Where both legumes and silage crops are produced, little or no commercial feeds are required. If it is impossible to grow legumes, protein

should be supplied in the form of linseed meal, cottonseed cake or some other protein concentrate.

It is essential that cattle of the best beef type be used in producing stockers or feeders, because the chief profit comes from producing animals of superior merit for which there is always a keen demand. It is very important that the herd of cattle used for this purpose be uniform in type, color, size, breeding and quality and that the animals have large feeding capacity, because buyers prefer to buy feeders or stockers as nearly alike as possible.

Grazing Cattle.—The business of grazing cattle is generally followed in those sections where the area of land in cultivation is very small compared with that which must be left in grass. The cattle are seldom produced in the grazing sections, but are usually shipped in by the train-load about the first of May, and are pastured on grass until they are fat enough to be marketed as grass-fat cattle during the late summer and early fall.

The cattle used to convert grass into fat are usually older, coarser and plainer than cattle selected to convert corn into the same product. Not so much attention is paid to quality and breeding as in pure-bred cattle, stockers or feeders, because the profit comes from the increase in value secured by fattening rather than in the final price per hundredweight. Very thin steers, three years old or older, make much larger gains than younger or fatter cattle. However, it frequently happens that when fleshier cattle are used, they may be shipped from grass earlier in the season, thus avoiding extreme heat, flies, water shortage or a heavy run of cattle on the market, which will more than overbalance the larger gains made by thinner cattle.

Fattening Cattle.—This has proven profitable in sections where corn is the leading crop and the area devoted to permanent pasture is relatively small. The kind of cattle selected for the feed lot depends upon the season of the year, the feeds available, the probable demand for the cattle when fat and the experience of the feeder. Young cattle make cheaper gains than older cattle, but they require a longer feeding period to become fat, because they use a large part of their feed for growth.

Calves that are to be fattened should show quality and breeding. They should have short legs and blocky, broad, deep bodies, otherwise they will grow rather than fatten. It will require from eight to nine months from the time calves are weaned to make them prime even when on full feed. An excellent ration is ten pounds of silage, five pounds of alfalfa hay, one pound of linseed meal or cottonseed cake per head daily, and all the corn they can eat. Older cattle consume more roughage in proportion to the grain and are fed where corn is relatively scarce.

To fatten cattle successfully and to secure satisfactory gains, the ration should be improved as the animals become fat. The customary farm practice is to start the cattle on roughage, such as silage, hay and fodder, with about six pounds of corn per thousand pounds liveweight daily, and

to increase the amount of corn as they become fatter. This makes the period when they are really on full feed very short.

Fitting Show Animals.—The production of show animals is in reality a form of advertisement, and is restricted largely to the breeders of pure-bred cattle. Every art known to the feeder is utilized to develop such animals. The ration is quite similar to that fed to fattening animals during the last part of the feeding period, and is improved by grinding the grain, cutting the hay and adding a greater variety of feeds. Sometimes barley is boiled and fed at the rate of one gallon per day and sugar or molasses is mixed with the grain to increase the palatability. In fact, everything possible is done to keep up the animal's appetite.

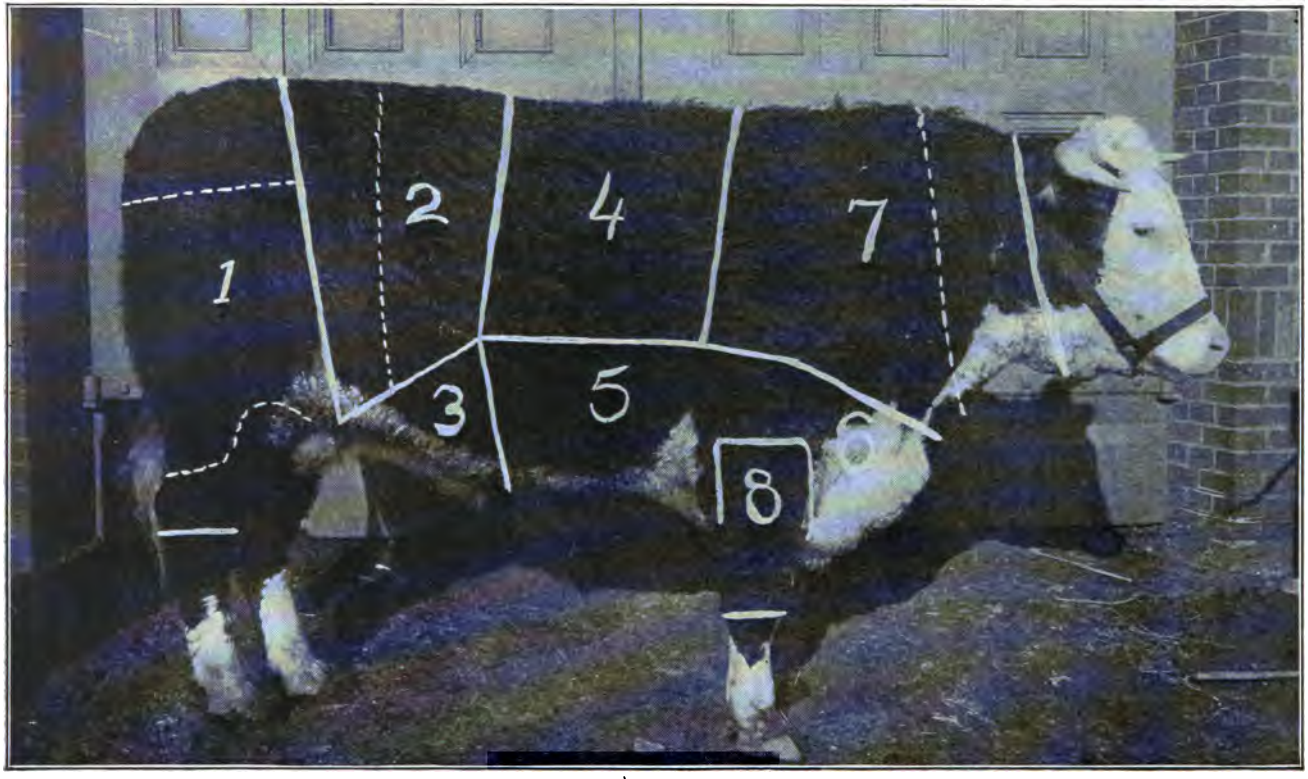
THE SELECTION OF CATTLE FOR THE FEED LOT

The selection of cattle for the feed lot is probably the most vital question before the cattle feeders today. Upon this one problem depends the ultimate financial success of those who make a business of converting grain and roughage into beef. There are three factors which should always be given consideration: (1) the purpose for which the cattle are to be used, (2) the ability of the individuals to consume feed over and above that required for maintenance, and (3) the probable demand for beef when the cattle are returned from the feed lots.

Methods of Feeding.—Cattle feeders may be divided into different groups according to their methods of feeding: (1) those who produce market-topping animals, (2) those who handle shortfed cattle, and (3) those who produce the great bulk of beef which usually finds its way to market after a period of grazing or roughing followed by a finishing period of either short or long duration.

Characteristics of Good Feeders.—It makes little difference which method is followed. The essential characteristics of a good feeding steer remain constant. He must have good constitution and capacity associated with as much quality and type as it is possible to secure. A wide, strong, short head; short, thick neck; and deep, wide chest indicate constitution, and a deep, roomy barrel indicates capacity. These characteristics may be found in steers of plain as well as of excellent breeding, which accounts for the fact that individual dairy and scrub steers frequently make as rapid gains in the feed lot as beef-bred steers. The type, quality, form and finish as indicated by the deep covering of muscle, even distribution of fat, high percentage of the higher priced cuts of meats, high dressing percentage, smoothness and symmetry of carcass, and quality and texture of meat, are always associated with beef blood.

The success of a feeder buyer depends largely upon his ability to see in thin cattle the possibility of improvement which results from the deposit of fat. As a general rule, there is little change in the skeleton proper. A feeder with a low back will finish into a fat steer with a low back. A feeder with a high tail, head or prominent hook-bones will finish into a fat steer



THE PRINCIPAL CUTS OF BEEF.

1—The round; upper portion, rump roast; middle portion, round steak; lower portion, for stews and soup. 2—Loin; fore portion, porter-house or tea-bone steak; rear portion, sirloin steak. 3—Flank; used mostly for stewing, considerable of it is waste. 4—Prime ribs; roasts. 5 and 6—Plate; used for stews and corned beef. 7—Chuck; rear portion used for steaks, roasts and stews; fore portion used for hamburg, minced meat, etc. 8—Shank; soup bone.

with these same deficiencies. A feeder with a long, narrow head, long legs, or shallow body will not alter his type in the feed lot. The greatest improvement comes in those regions of the body where the natural covering of muscle is thickest, in the shoulder, crops, back, loin and round. The body will increase more in width than in length and will decrease in apparent paunchiness due to the greater proportional increase in the width of the upper half of the body than in the lower half. The quality of meat will be improved by the deposit of fat within the bundles of muscle fiber, and the tenderness of meat will be improved because of the distention of all cells with fat, and the proportion of edible to non-edible parts of the animal will increase during the fattening period. These are potent reasons for the immense industry represented by the cattle feeders.

Kind of Feed Related to Class of Cattle.—In addition to these factors which are inherent in the steer, the successful feeder buyer must give attention to the kind of feeds at his disposal. If he intends to use a large amount of grass or roughage in proportion to grain, he should select thin steers carrying some age. Older and thinner cattle will make better use of roughage than those which are younger and fleshier. If the feeder has a large acreage of corn and comparatively little pasture and roughage, he should select either heavy, fleshy feeders which he can return to market within a comparatively short time, or fancy calves of the best possible type and breeding which will develop into prime yearlings. If heavy fleshy feeders are selected, their quality and type should determine their market value, as compared with that of the plainer sort. The probable demand for the various grades of beef at the close of the feeding period is also a determining factor. The feeder should limit his selection to those cattle which will make the greatest improvement in value per hundred pounds while in the feed lot.

Calves and Yearlings.—Quality and type are essential in the selection of calves for feeding purposes. They should be bred for early maturity, otherwise they will grow rather than fatten and the cost of production will exceed their market value. The majority of yearlings are marketed from sixty to ninety days before they are fat, which indicates that it is essential to secure calves of the type that will fatten. The feeder should realize that he is entering into a proposition that requires eight to twelve months to complete and that he must feed the best of feeds in a concentrated form to secure satisfactory gains and finish.

Time to Market.—The time to market fat cattle is when further gains will not result in an increase in the value per hundredweight. For this reason plain, rough steers which will not produce attractive carcasses should be sold before they are thoroughly fattened. When fancy cattle of quality and type are fed, it is a general rule that they are more profitable the fatter they become, because there is usually a demand for fancy finished beef.

The season of the year also controls to some extent the quality of

cattle that should go into the feed lot. Where grain-fed steers are to be marketed from the middle of July to the first of December, a better grade of cattle and a higher finish are demanded than at any other season of the year. In the late summer and early fall the markets are usually well supplied with beef that has been produced cheaply on grass with which the half-fat grain-fed cattle cannot compete profitably. After the Christmas holidays all the cattle come from dry lots and have been fattened on expensive feedstuffs so that the plain, rough cattle can be marketed to better advantage than during the grazing season, because the competition of grass-fed cattle is eliminated.

The reasons for feeding beef cattle are that they reduce farm crops into a more concentrated market product and they are a means of permanently maintaining the soil fertility. All feeding operations should be conducted with these facts in mind. The selection of feeding cattle which will serve the purpose and at the same time produce an immediate profit is the mark of the successful cattle feeder.

THE DEFICIENCY IN THE MEAT SUPPLY

Statistics need not be presented to substantiate the assertion that there is a decided deficiency in the supply of meat. The shortage is the result of a long-continued series of years during which the final value of the finished animal was less than the market value of the crops necessary for its production. During the early development of the country there were a considerable number of meat animals bred and fed in the Atlantic states. When the territory west of the Alleghenies and east of the Mississippi River was settled, the breeding industry moved to this section because cattle were the only means of marketing the grass, grain and forage. When transportation facilities were provided for the shipment of grain and other farm products, the breeding industry moved on to Missouri, Iowa, Kansas and Nebraska, where more favorable conditions existed. Here it dominated the agricultural practice until the free range in the West was made available through the suppression of lawlessness. The trend of the cattle-breeding industry has been westward toward the less expensive grazing lands, until there is now no cheap land available. With the decline of breeding operations, finishing or fattening for market became a well-established practice in those sections where the breeding of livestock was unprofitable. The result of this condition is that the demand for animals suitable for the feed lot has finally become so great that the West is no longer able to furnish an adequate supply of feeders, with subsequent high prices.

In recent years the papers and magazines have kept up an almost continual agitation against the high price of meat. The high price has been attributed to the avarice of the farmer, the packer, the stockyards or the retail dealer, rather than to the laws of supply and demand. It has discouraged many from entering into a legitimate business venture for

fear that unfavorable public opinion might at any time crystallize into the form of laws of such restrictive nature as to obliterate profits.

Reliable data in regard to methods of meat production are insufficient to enable us to recommend practices which can be substantiated by records of unquestioned reliability. There is, however, so great an abundance of information as to methods of fattening that it is possible for one familiar with the publications and the general farm practices to recommend rations which are certain to produce rapid and economical gains in the feed lot with acceptable dressing percentages.

Tenant Farming Unfavorable to Beef Production.—The rapid growth of tenant farming has eliminated the production of meat from thousands of acres of land which should never have been plowed, and will probably continue to exert a depressing influence upon the business until the value of farm lands is based upon production rather than upon speculation. Under the present system of renting, it is almost impossible to handle beef cattle profitably on a tenant farm. The cattle business requires a number of years to develop and a system of farming that will produce the feeds necessary to maintain a herd of cattle during the winter. A further reason is that the chief profit in cattle farming is the increase in the fertility of the soil and the yield of crops which comes from using the manure on the land. Where land is rented annually there is no incentive to build it up and increase crop production when a different renter may farm it the next year. A system of longer leases must result which will give the tenant an incentive to increase rather than exhaust the fertility of the soil.

Breeding Cattle Requires Capital.—If means of financing breeding operations were provided, the supply of breeding animals on both farms and ranges would be increased tremendously. It is possible for a farmer who has produced a crop of corn or has pasture, to go to almost any bank and secure funds with which to purchase steers to consume these products. Money is loaned for ninety to one hundred and eighty days with the privilege of renewal. It is impossible, however, for him to borrow the same money with breeding females as security, because three to five years must elapse before the increase will be marketable. This is probably the greatest problem to be solved if breeding operations are to be materially increased in the near future.

Breeding herds should be established in the South, the East and in the cut-over districts near the Great Lakes on the land that is adapted to the production of pasture grasses. More attention should be given to pastures to increase their carrying capacity by fertilizing them with manure or fertilizers, by thickening the stand of grass by natural or artificial means and by using silage during unfavorable periods. While grass is the most important crop produced in the United States, more land being devoted to its production than to all others except trees, there is not an important investigational project on the subject reported which the meat

producer can use in a practical manner. Throughout the great grazing areas of the country something of definite permanent value must be done to re-establish pastures or the supply of feeding stock will diminish rather than increase in the next few years.

The tremendous waste of the farm by-products of the cereal crops, corn, oats and wheat, which takes place annually throughout the entire country is sufficient to maintain thousands of animals in good breeding condition. This material has not, as yet, been successfully used on a large scale, but recent investigational work indicates that the use of a succulent feed during the winter makes these dry, coarse feeds palatable to a large extent. Refinement in the methods of feeding will in the future enable us to utilize other waste products which are now considered almost worthless.

In the sub-humid sections, the use of the silo to preserve drought-resisting crops, such as Kaffir, milo, feterita and sorghums, and the introduction of new crops, such as Sudan grass, will make it possible to more than double the livestock production of that area. In all parts of the United States at least 300 pounds increase in weight can be secured on the average two-year-old steer by furnishing him an abundance of grass in the summer and an abundance of roughage in the winter. A limited amount of high protein feed should be used to make up the deficiency of the ordinary roughages usually produced where legumes cannot be successfully grown.

It is probable that the loss of livestock from infectious and contagious diseases will be greatly reduced by the practice of sanitary measures, that a more careful study of breeding will result in the production of animals of greater efficiency, that a better knowledge of feeding will result in decreasing the cost of production, but the most potent remedy for the present deficiency in the meat supply is now being administered in the form of market values which leave a reasonable profit to the man who has courage to invest his capital in breeding cattle and the feeds necessary to maintain them. The farmer, as a business man, increases his operations along those lines which promise to return the greatest profit.

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CHAPTER 6

SWINE

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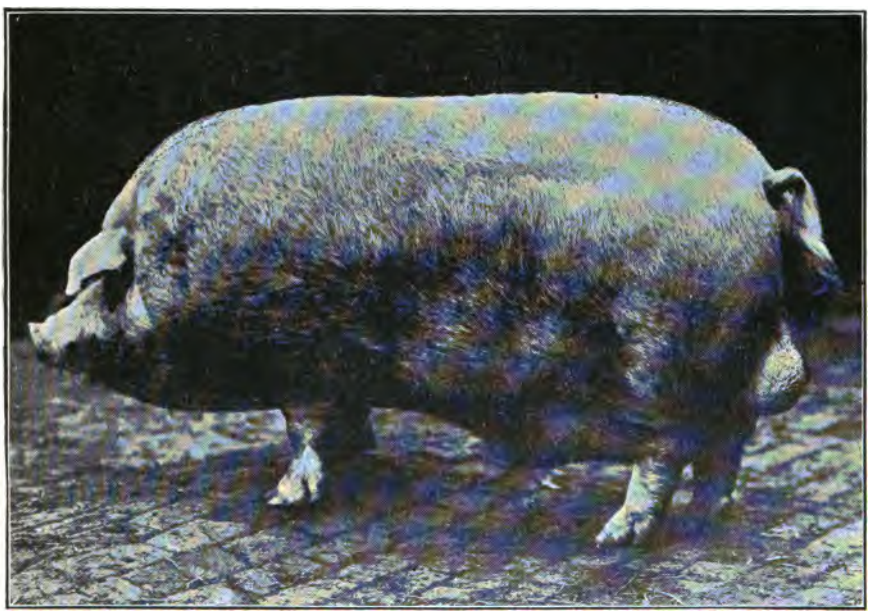
Iowa Experiment Station

The hog is one of the most valuable and profitable domestic animals the farm can produce.

In the selection of the herd these factors need to be considered:

1. **Personal Preference** is a most important consideration.



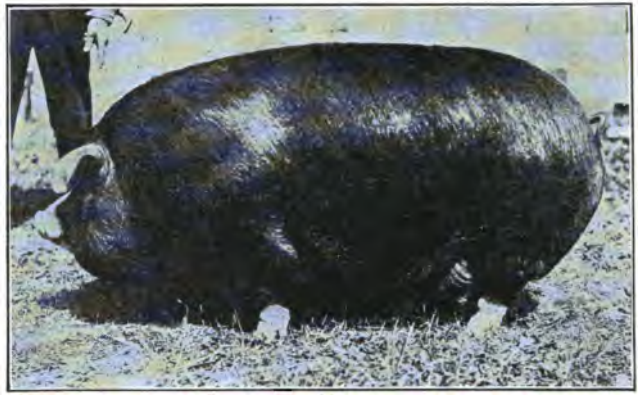
Chester White Boar.[1]

2. **The Feeds Available.**—In the corn belt lard type hogs are best because of their adaptation, whereas in Canada a bacon type will utilize the northern grown feeds to better commercial advantage.

3. **Location and Climate.**—The hog that is best for a certain county in

[1] Courtesy of The Field, New York City.

POLAND-CHINA BOAR.[1] Lard Type Hog.



POLAND-CHINA SOW.[1] Lard Type Hog.

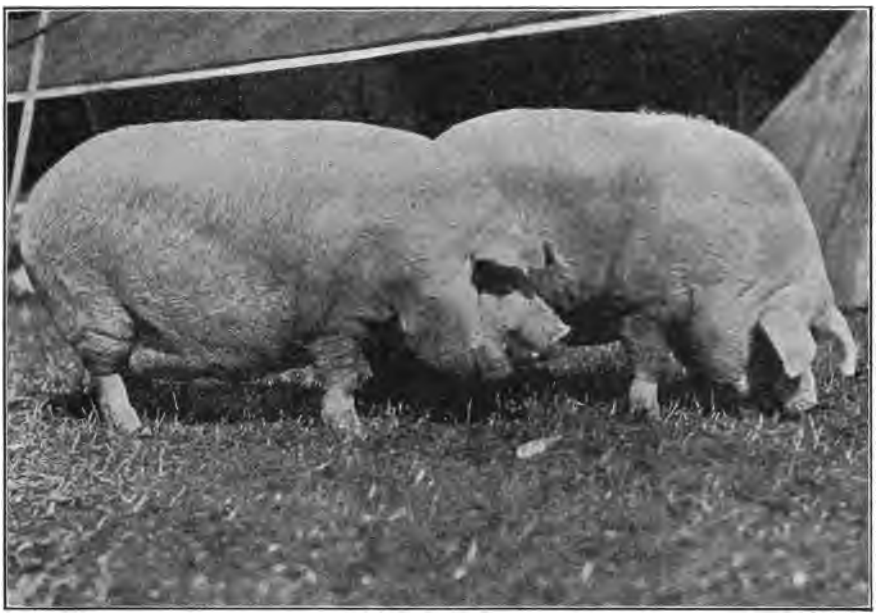
DUROC-JERSEY BOAR.[1] Lard Type Hog.

DUROC-JERSEY SOW

[1] Courtesy of The Field, New York City.

Iowa may be ill-adapted to a county in Maine because various community conditions, such as customs, pasture range and cattle raising have their unmistakable effects. The climate in the South, because of the hot, long hours of piercing sunshine, puts the white hog at some disadvantage, whereas in the northern country he gets along exceptionally well.

4. **Distribution.**—A large number of swine of one type in a certain district usually indicates that they are well adapted. When in doubt, that breed which is well distributed in the community should be adopted. To raise Poland Chinas in a county where practically none but Tam-



CHESTER WHITE SOWS.[1]
Lard Type Hogs.

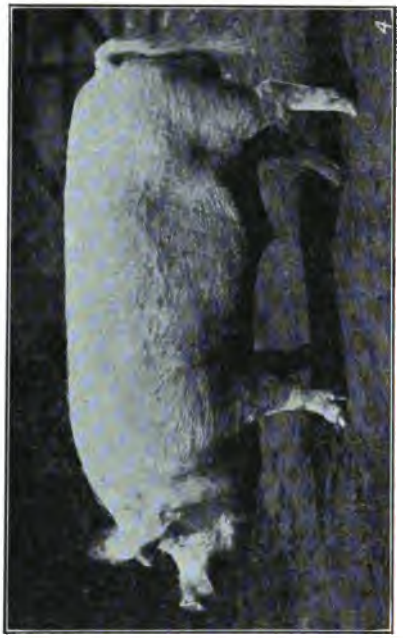
worths were raised, may result in disappointment, this being especially true if one depends upon local buyers for the sale of hogs.

5. **Markets.**—A nearby market which demands the bacon type, discriminating against the lard type, pound for pound, would have much influence in determining the kind of swine to raise in that particular section.

Breeds of Swine.—The two principal types of hogs are the lard and the bacon. Lard hogs are noted for their great depth, breadth, general compactness, smoothness, short legs, large hams, heavy jowls, relatively heavy shoulders, mellow finish (due to heavy fat layers) and docile

[1] Courtesy of The Field, New York City.

Hampshire Sow.[1]



Yorkshire Boar.

Hampshire Boar.[1]

Yorkshire Sow.[1] Bacon Type Hog.

[1] Courtesy of The Field, New York City.

temperament. Bacon hogs stand in marked contrast in that the typical representatives have greater relative length, medium depth and breadth, similar smoothness but more trimness, long legs; small, trim, tapering hams; very neat, tidy jowls; very light and trim shoulders; exceptionally firm finish (with slight external fat layers) and active temperament.

The general or dual purpose breeds are a combinaton of the bacon and lard types, emphasis being placed upon the development of suitable market hams, bacon, ribs and loin, as well as the tendency to produce marketable animals suitable for lard.

The most typical lard type representatives are the Poland Chinas, black with white markings or spotted black, white and sandy; the Duroc Jerseys, entirely of a cherry red; and the Chester Whites, wholly white. These three breeds are especially popular in the corn belt, and deservedly so. Other lard type breeds are the Mulefoots, black, sometimes with white markings; the Victorias, white; the Cheshires, white; the Suffolks, white; the small Yorkshires, white; the Essex, black; and the Sapphires, blue (sometimes white markings).

The typical bacon type representatives are the large Yorkshires, white; and the Tamworths, red; both being especially prominent in Canada and the northern United States.

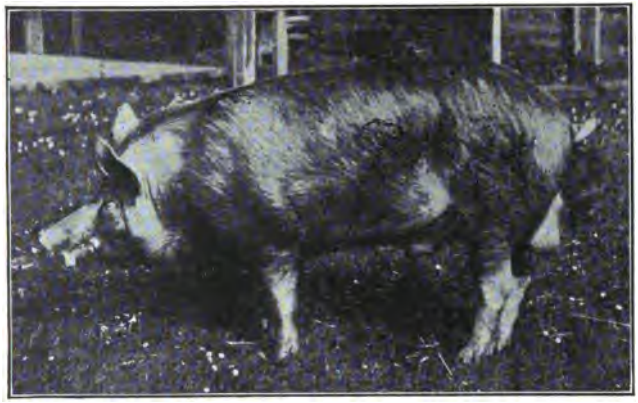
The dual purpose representatives are the Berkshires, black with white markings; the Hampshires, black with white belt; and the middle white or middle Yorkshires, white but little known in this country.

Of the breeds mentioned, seven are white, six all black or black with either white or sandy markings, two red and one blue. The most widely distributed pigs in the Canadian country are white, whereas in the corn belt and southern districts they are either black or red. This probably represents climatic adaptation.

Grading Up the Herd.—An ordinary farm herd composed of native individuals may be advantageously graded up by using successive pure-bred sires of the same breed. The first-cross animals are especially vigorous for market as well as for breeding purposes; they gain very rapidly and economically, and likewise make very good mothers.

In a grading-up program, assuming that a Duroc Jersey is used for the first cross and the offspring of the first cross are again bred to Duroc Jersey sires, it is surprising how quickly the offspring approach the Duroc types. In a few years, providing gilts only are kept each year for breeding, a typical Duroc Jersey herd, resembling closely the typical pure breed, will be a reality. The same grading-up process may be followed with any pure breed. This is an excellent practice and one to be followed with profit in the production of a uniform, dependable market type.

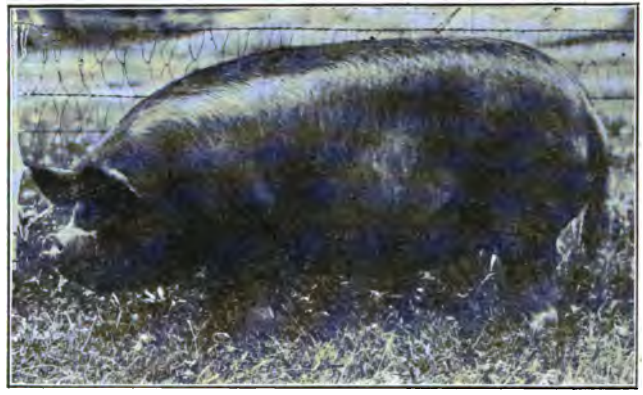
The crossing of breeds already crossed is to be discouraged, largely because of the heterogeneous individuals which result, these being of various types, sizes, colors and so on; this dissimilarity of offspring being



TAMWORTH BOAR.[1] Bacon Type Hog.

TAMWORTH SOW.[1] Bacon Type Hog.

BERKSHIRE BOAR.[1]



BERKSHIRE SOW.[1] Dual Purpose Hog.

[1] Courtesy of The Field, New York City.

all the more marked if the original pure-breds used are very different and less true if they are very similar.

Age of Breeding Stock.—Mature sows as compared to gilts enjoy some very marked and practical advantages, as follows:

1. A larger number of pigs at farrowing time.
2. Heavier, stronger, bigger-boned new-born pigs.
3. More pigs usually saved to each sow up to weaning time, hence more reach the market.
4. They are tried mothers, the undesirable brood sows being naturally eliminated.
5. Less high-priced protein feeds are needed to supplement the cheaper carbohydrates.
6. More rough feeds may be used, such as alfalfa hay and pasture.
7. Matured and tried-out sires can be used to advantage; this ofttimes not being feasible with young gilts unless a breeding crate is used.
8. Immunized, cholera-proof sows may be continuously kept, and the expense and bother of the annual immunization of young sows thus eliminated.
9. Two litters a year are raised with less difficulty. All young gilts cannot raise two litters successfully the first year.
10. Less loss in condition during the suckling period.
11. More dependable as breeders.

The disadvantages of sows older than gilts are not to be overlooked, and are as follows:

1. Require more feed.
2. More house room necessary.
3. If the "one litter a year" practice is followed these sows must be carried through a six months' unproductive period, which is relatively expensive.
4. Greater capital investment imperative.
5. Greater risk involved because of the greater capital invested.
6. Swine money not turned so often because the sows are kept longer and not sold annually as are the gilts.
7. Docked more on marketing, ofttimes twenty-five cents per hundred, than "trim-bellied" gilts.
8. Gains while "fattening off for market" more expensive.
9. Usually need an older, mature boar, because the younger ones are not so handily used; hence, the breeding more difficultly managed.
10. Apt to become overfat, clumsy and awkward, and hence overlie the new-born pigs. This tendency to overfatness must be carefully guarded against.
11. More difficult, generally speaking, to manage.

In profitable practice, a happy combination of both gilts and old sows may be kept to good advantage. The breeder of pure-bred swine

obviously may well keep more old sows proportionately than does the market man.

In the selection of individual sows for the herd it is well that they show:

1. Trueness to the particular type and breed wished, having a desirable ancestry and being preferably from a prolific, tested family.
2. A well-formed udder with active teats and no blind ones.
3. Feminine characteristics of refinement.
4. Roominess and capacity.
5. A kindly disposition.
6. Good breeding record as manifested in their offspring.
7. Absence of overfatness and flabbiness.
8. A good, healthy constitution free from vermin and diseases.

The boar should possess most of these general requirements, emphasis being placed upon his masculinity as indicated in the well-developed crest, shield, tusks and general ruggedness. A mature, tried boar is more acceptable than an immature, untried one.

Housing.—In the housing of swine emphasis should be placed upon warmth, dryness, abundance of light and direct sunlight, shade, ventilation, sanitation, safety, comfort, convenience, size, durability, low first cost, minimum cost of maintenance and pleasing appearance of the structure to be used. This applies to the large centralized community or the small movable individual type.

The selection of a correct site for the location of the hog house is very important. Emphasis should be placed upon the economy of labor and time in management, drainage, exposure, slope, windbreaks, nearness to pasture and shade, elevation, prevention of odors reaching home dwelling and risk from disease infection. To place any hog house in an undesirable, ill-adapted place is to invite loss, dissatisfaction and possible failure.

The large community house as compared with the small movable one has some advantages in that the time and labor required for some operations is less; durability is usually greater; lighting from direct and diffuse sunlight better arranged; ventilation made more simple and systematic; general equipment usually less and more compactly arranged; close attention to the herd easily and practically possible; herdsman experiences minimum of exposure; feed storage, water supply and general rooms may be conveniently arranged; sanitation in some respects may be more encouraged; vermin more largely eliminated; site selection is simplified because only one site is needed; the heating problem is comparatively easy; common feeding floor and water wallow may be more handily arranged; danger of loss less than with large number of houses in common yards; provides headquarters for the swine farm; fire and other risk may be minimized through masonry construction; a number of swine under one cover become better acquainted; makes possible adjustable pens; facilitates collection of liquid manure; and advertising value may be greater.

On the other hand, the community house is a disadvantage in that location is not easily changed; isolation is practically impossible; sanitation may be sometimes discouraged; construction is more complex; it is not so practical for beginners; the first cost is somewhat high; more fencing is required to provide similar range conditions; it is likely to be used solely for a farrowing house and thus decrease serviceability; and fire and other hazardous risks may be greater if it is built of wood and is in close proximity to other buildings.

A combination of the two types of houses, *i. e.*, the large centralized or community one supplemented with the small movable one, deserves favor in practice. Each type has its own peculiar advantages and disadvantages, whereas the two together counterbalance each other so as to make a very complete efficient practical combination system.

Feeds for Swine.—Feeding swine has to do with the balancing of the grain ration to make it most efficient. The shortcomings of corn as feed for swine have their counterpart in other grains used less extensively in pork production, namely, barley, wheat, rye, sorghum seed, Kaffir corn and milo maize.

The predominating deficiencies of corn as a grain for growing swine are:

1. **Low in Protein.**—A young growing pig should have a pound of protein with every three to four pounds of carbohydrates. Corn has only one pound of protein to about eight and one-half pounds of carbohydrates.

2. **The Quality of Protein is Only Fair.**—Corn products alone, partly because of the protein content being of low quality, are inefficient in dry lot feeding, even though an abundance of protein be supplied as in the form of gluten meal.

3. **Lacking in Mineral Elements.**—Corn is particularly low in calcium, which comprises 40 per cent of the dry ash of bone. The young pregnant gilt would have to eat something like thirty pounds of corn a day in order to get enough calcium to supply the growing fœtus. Common salt and calcium and potassium phosphate have been found beneficial when added to a corn diet. The deficiency of minerals in corn has been largely responsible for the widespread general use of condimental material, such as wood-ashes, charcoal, bone phosphate, rock phosphate, cinders, slaked coal and others being used in practical hog feeding.

4. **Presents an Acid Ash.**—When corn is high in protein this acidity is especially marked. To make corn more productive this acidity should be counteracted. This is made possible by the judicious use of efficient and proper supplements.

The most acceptable, practical supplements to corn and the other similar starchy grains may be briefly enumerated as follows: skimmed milk, buttermilk, tankage, blood meal, linseed oil meal, cottonseed meal, gluten meal, wheat middlings, Canada field peas, soy beans, alfalfa and clover hay.

The production of pastures is an economical proposition and is to be encouraged on every American as well as Canadian swine farm in order to obviate the necessity of purchasing high-priced protein concentrates. The most profitable supplemental pastures in the corn belt in the order of merit are: alfalfa, rape, red clover, blue grass and sweet clover of the first year's growth. In the South cowpeas, soy beans, Spanish peanuts and Lespedeza clover may be added, inasmuch as these plants give excellent success in warm climates and on soils that are sandy and relatively unproductive as compared to the corn belt soils of Iowa and Illinois.

Swine feeding and dairying, along with judicious use of green forages in a good corn, barley or other similar grain country, is a most excellent swine-farming proposition. If alfalfa can be raised, so much the better.

Preparation of Feeds.—Hard, tough, fibrous-shelled seeds such as Kaffir corn, sorghum, milo maize and millet will be much more efficient if fed in the ground condition. If grinding is impossible, soaking is the next best possible procedure.

Wheat, rye and barley likewise give better results when ground, and can also be soaked as an alternative. Some experiments show as much as 20 per cent increase in the efficiency of wheat through the grinding as compared to feeding the grain dry and whole.

The general herd, young pigs and sows on a maintenance ration do better on ear corn than any other form. However, fattening sows and heavy fat hogs in the final stages of fattening make more economical gains on the soaked shelled grain. If any preparation should be used other than dry ear, it should be shelled soaked corn rather than the ground grain dry or soaked.

Corn-and-cob meal has little to commend it to any class of swine except possibly the brood sows on maintenance, and even with these the ear corn is the most profitable.

Hays, such as ground alfalfa, may be ground ofttimes in order to facilitate their mixture with the grain rations and to encourage their consumption.

Wetting and cooking of feeds is not ordinarily profitable, although to produce rapid gains these procedures are sometimes permissible, this being especially true in the production and finishing of show stock.

Hand vs. Self-Feeding.—Better results will be secured by the self-feed method than by hand-feeding twice daily. However, feeding three times a day is the most efficient, considering rapidity of gains and economy in feed required for 100 pounds of gain. Under our ordinary high-priced labor conditions, thrice a day is not enough better to excel self-feeding.

The "Free-Choice" scheme of feeding consists of allowing acceptable feeds before swine in such a manner that they can balance their own rations. In 1914 a group of pigs fed at the Iowa station according to this scheme, receiving shelled corn, linseed oil meal, oats and meat meal (or tankage), limestone, charcoal and salt in separate feeds, weighed 316

pounds when 8 months 7 days old. They did as well as if they had been fed according to accepted feeding standards. Tests now in progress (1915) at the Iowa station indicate that pigs can feed themselves better than a trained animal husbandman can feed them if he follows the customary feeding standards.

When pigs are allowed starchy corn and high-protein meat meal (tankage) in separate feeders, this feed being kept before them from weaning time until they reach a weight of 300 pounds, they will eat of these two dry lot fed feeds approximately as follows:

	Approximate Age, days.	Approximate Weight, pounds.	Pounds 60 Per Cent Protein Meat Meal (Tankage) Eaten with Every 100 Pounds Corn.	Pounds Protein Eaten with Every 100 Pounds Starches.
Weanling	60	35	20	3.38
Shote	120	100	15	3.84
Fattening hog	180	210	8	4.79
Fat marketable hog	240	300	1	6.50

The self-feeding method is excellent in dry lot feeding, on pastures and where skim milk or buttermilk is used.

Feed for the Brood Sows.—The brood sow should have good feed in order to produce strong, healthy pigs. Skim milk, tankage, alfalfa pasture, etc., combined with corn or other grains, often increase the litters as much as one pig over corn alone.

To demonstrate the advantage of supplementing the starchy grain feeds such as corn with the proper protein supplement, the resulting average weight and strength of the pigs secured is given for a few typical rations:

Ration Fed.*	Average Weight per Pig, pounds.	Strong Pigs, per cent.	Cost of New-born Pigs, cents.
Corn only	1.74	68	41
Corn plus 4 per cent tankage	2.01	92	18
Corn plus 16 per cent tankage	2.23	93	22
Corn plus alfalfa in rack	2.12	98	31

These gilts were charged at the rate of 50 cents a bushel for shelled corn, $2.50 for meat meal and $15 a ton for the alfalfa hay; yet in spite of the comparative high cost of the supplements, the pigs produced were not only cheaper but much better pigs were secured, the animals being much larger and stronger than where corn only was fed.

* Animal Husbandry Section—Iowa Experiment Station Results.

The unborn pig must be well fed indirectly through its host the brood sow if a strong, vigorous, active pig carrying big bone and strong muscle at the time of farrow is desired.

In general, it is well to emphasize in brood sow management:

A. Acceptable balanced feeds in sufficient quantity.
B. Maximum growth without excessive fattening.
C. Abundant exercise, especially the latter two months of gestation.
D. Riddance of lice and worms.
E. Moderate laxativeness, because constipation is a menace.
F. Gentleness in handling the herd.

The suckling sow and litter should be fed better than any other class of swine. The demand for growing feeds by both the sow and pigs at this time is great. Such feeds as corn, barley, skim milk, buttermilk, tankage, wheat middlings, alfalfa, rape, clover, blue grass and other pastures, and similar feeds equally as good are to be particularly commended.

Feeding the Pigs.—From time of weaning to maturity pigs should have plenty of suitable forage. Nothing is better than pastures of clover, alfalfa, rape, etc. Here they may be given a full or limited ration, depending on circumstances.

If the usually better early fall markets are the goal, full-feeding will be in order; whereas if the later but somewhat lower markets are most acceptable, the grain ration can be limited. Ordinarily, it is not a paying proposition to feed less than three pounds of grain with every 100 pounds of pig daily. A lesser amount, especially if the pasture be poor, will cause the pigs to become stunted.

The fall pigs which are raised in winter dry lot must be fed a relatively high-priced ration; in other words, one high in protein. The fall pigs need warm shelter, and it is best to feed them inside the shelter. They must be protected from the cold winds, snows, hails, and general wintry conditions, while the spring pig should be protected from the hot sun and the flies. The fall pig lives at a time when attacks from worms are at low ebb and are not readily passed from one host to another.

The "hogging-down" of corn deserves much emphasis. It is practiced profitably in all of the corn belt states. It may be likened to dry lot feeding if the field is clean and free from weeds, and supplemental protein feeds should be supplied accordingly. It is well to have an alfalfa, rape or similar pasture field adjoining in order to supply this protein at the lowest cost.

Rape, winter rye or winter wheat in the northern corn belt may be sown in the corn at the last cultivation or shortly thereafter with excellent success; in the more southern districts cowpeas and soy beans may be included with profit.

Successful swine rations for general American conditions, and suitable

for the various sizes, ages and classes of hogs are suggested in a ready reference table presented herewith:

The Swine to be Fed.	Pounds of Tankage* (60 per cent Protein) to be Fed along with every 100 Pounds of Corn to Swine of Various Classes in		
	Dry Lot.	Low-Protein Pasture.†	High-Protein Pasture.‡
I. *Growing and Fattening for Market.*			
1. Suckling pigs (a creep) 5–40 pounds..	25	25	20–12
2. Weanling pigs, 30–100 pounds.....	25–18	23–16	12–5
3. Shoats, 100–175 pounds.....	18–10	16–9	5–2
4. Hogs, 175–250 pounds.....	10–4	9–4	2–2
5. Fat Hogs, 250–350 pounds.....	4–1	4–1	0
II. *Fattening Sows for Market.*			
1. Yearlings (gilts) after weaning.			
A. In poor condition, run-down.....	11–8	11–8	5–0
B. In good condition, thrifty.....	9–5	8–5	0
2. Two years or older.			
A. In poor condition, run-down.....	6–4	6–4	4–0
B. In good condition, thrifty.....	2–0	2–0	0
III. *Stags, Fattening.*			
A. Young.....	9–4	9–4	0
B. Old.....	5–0	5–0	0
IV. *Carrying Sows, Breeding.*			
1. Breeding swine, flushing.			
A. Gilts.....	14	14	10
B. Yearlings and older.....	11	11	8
2. During pregnancy.			
A. Gilts.....	14–10	10–7	0–5
B. Yearlings and older.....	10–6	6–4	0–4
V. *Suckling Sows.*			
A. With large litters.....	25–18	25–18	10
B. With small litters.....	20–8	20–8	3–5

* If corn is not available, it may be substituted pound for pound in these proportions with barley, wheat, rye, sorghum seed, Kaffir corn, milo maize, or feterita, or a combination of any of these. If 60 per cent protein tankage is not available, linseed oil meal or soy bean meal may be substituted, 2 to 2½ times as much being used. For example, the suggested dry lot ration for growing and fattening shoats is "corn 100, tankage 18 to 10;" now substitute oil meal 2 times as much and we have corn 100, linseed oil meal 36 to 20. To substitute wheat middlings, allow 17 times as much, skim or buttermilk 20 times, and blood meal 60 per cent as much, or almost two-fifths less. Blood meal runs about 85 per cent protein and but little is required, but blood meal is not so good a supplement as tankage, everything considered.

† *Low-Protein Pastures.*—Dry, hard, fibrous blue grass; sorghum; feterita; millet; Sudan grass; milo maize; timothy when over four inches high; rye or wheat over eight inches; or oats and barley over five inches, or beginning a couple of weeks before beginning to joint; and sweet clover of second year's growth after two feet high.

‡ *High-Protein Pastures.*—Alfalfa; rape, Dwarf Essex; medium red, mammoth, alsike, and white and other clovers; young, tender, sweet clover, first year's growth; quite early, tender, new coming timothy, rye or wheat; short, "shooting," tender, green, succulent blue grass, cowpeas; and soy beans.

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CHAPTER 7

SHEEP AND GOATS

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Early Importance of Sheep.—There is evidence that sheep were under domestication in Europe in prehistoric times. The primitive man used the skin for clothing and the meat and milk for food. As man has advanced in civilization, sheep farming has become an important branch of agricul-

A TYPICAL COTSWOLD EWE.[1]

ture. Sheep and their wool were very early acknowledged to be the foundation of the national prosperity and the wealth of Great Britain and other European countries. The more recent introduction of silk manufactures and the establishment of the cotton trade have lessened the demand for woolen goods; still, the sheep and its fleece are of great importance.

[1] Courtesy of The Field, New York City.

The Sheep of Spain.—The Spanish Merino, the only type of sheep in Spain, are noted for: (1) the production of a very fine wool, (2) hardiness and ability to travel, and (3) the disposition to stay close together when feeding, resting and traveling. These characteristics have had an important influence on their later history.

The Sheep of England.—In England were developed several types of sheep, and each type or breed was adapted to a certain locality. These breeds were quite unlike in fleece. The wool found favor on the market because of its variety in length and quality, which made it adaptable to

A Typical Lincoln Ewe.[1]

different uses. The Royal Agricultural Society of England in its show catalogue recognizes twenty-five breeds. These were all developed on the British Isles. Some were developed in the lowlands, some in the hills and others in the midlands. They were developed principally for meat; fresh meat in England, with its great population, being of greater consequence than wool. The various breeds were divided into four classes, namely, the long-wool breeds, the middle-wool breeds, the highlanders or mountain breeds and the upland breeds.

Breeds of Sheep.—Two distinct types of sheep have been produced, namely, the mutton and wool types. The former are valued chiefly on

[1] Courtesy of The Field, New York City.

account of their ability to make mutton economically, although the wool-producing ability of the mutton sheep constitutes no small part of their value to the farmer. The wool type, however, is raised mainly for the wool it produces.

In conformation, the mutton sheep are compact, with a short head and neck, a broad, level back, a full leg of mutton, a deep body and short legs. The wool ranges in length from $2\frac{1}{2}$ inches in the middle-wools to 10 inches in the long-wools. The fleece does not cover the body so compactly as does the fleece of the fine-wool sheep. The medium-wool breeds greatly

A Typical Shropshire.[1]

excel the long-wools in this respect. The fleece of the medium-wool breeds is much less fine in quality and has much less yolk or oil in it than does the fleece of the Merino sheep.

LONG-WOOL BREEDS

Leicester.—Very large sheep, wool 6 inches long at 12 months, being bright and lustrous; face and legs white; no wool on head. Weight of mature rams ranges from 225 to 250 pounds; ewes from 175 to 200 pounds.

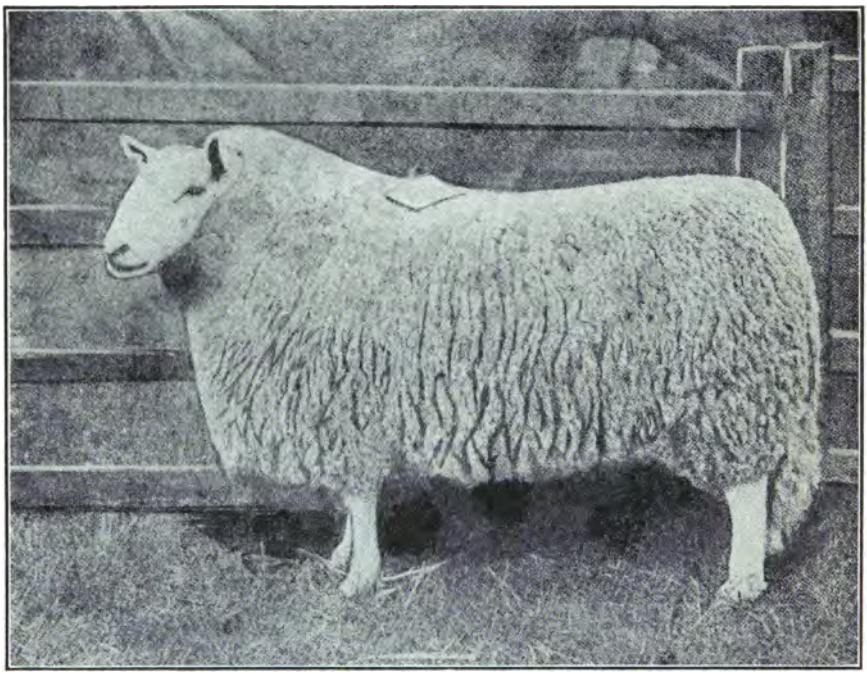
Cotswold.—Wool 8 inches long at 12 months; pronounced tuft of wool on forehead; face and legs white. Rams weigh from 250 to 275 pounds; ewes from 200 to 225 pounds.

[1] Courtesy of The Field, New York City.

Lincoln.—No breed furnishes so long a fleece as the Lincoln. It ranges from 8 to 12 inches; tuft of wool on forehead. Rams weigh about 385 pounds; ewes about 275 pounds.

MEDIUM-WOOL BREEDS

Southdown.—They are smallest of the middle-wools, very low-set and compact, with steel-gray or mouse-brown markings on face and legs. Fleece is 2½ inches long at 12 months. Rams weigh from 185 to 200 pounds;



A Typical Cheviot.[1]

ewes from 125 to 140 pounds. Criticised for lack of wool production and insufficient size. Much improvement has been due to this breed.

Shropshire.—They are stylish sheep with pronounced extension of wool over face and legs; color marking is a deep, soft brown. Wool 3 inches long at 12 months. Rams weigh about 225 pounds; ewes from 140 to 160 pounds. Rank high as a dual purpose breed.

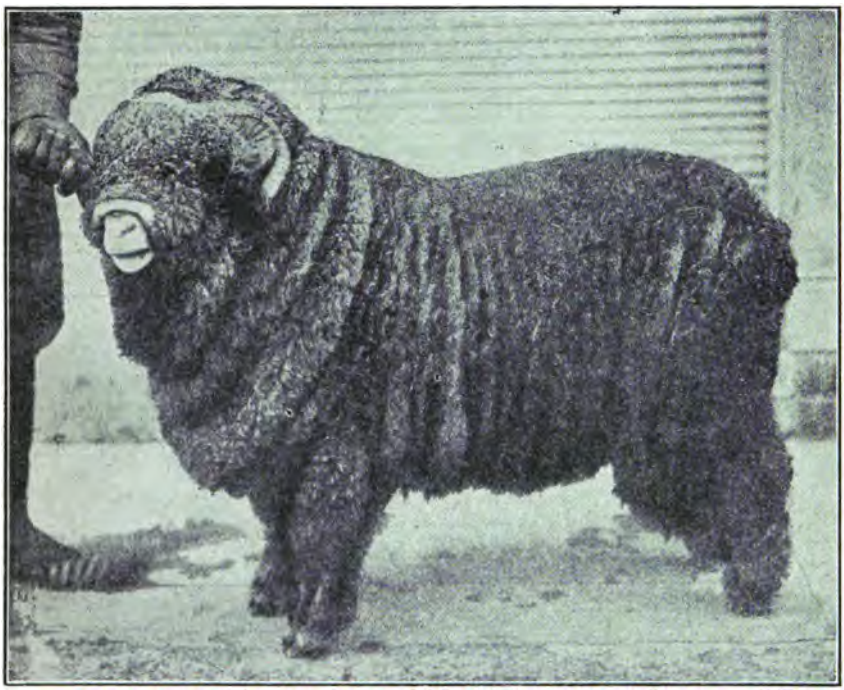
Oxfords.—They resemble the Shropshire, but are larger and do not have as great wool extension over face and legs. Lighter brown is the color marking, and usually are more upstanding. Wool is 4 inches long at 12

[1] Courtesy of U. S. Dept. of Agriculture.

months. Heavier than Southdowns and Shropshires, equal to Hampshires. Rams weigh from 275 to 300 pounds; ewes about 175 to 200 pounds. They give size and weight when crossed on short-wools and quality and better mutton when crossed on the long-wooled breeds.

Hampshires.—They have darker color markings than the Oxfords, and a very pronounced Roman nose. Wool is $2\frac{1}{2}$ inches long at 12 months. Very early maturing sheep.

Dorset Horn.—Have white color markings; very little wool on face



A Typical Merino.[1]

and legs and it does not extend well over lower parts of the body. Both ewes and rams have horns. Wool at 12 months is 3 inches long. Weight of rams from 250 to 275 pounds; ewes 175 to 185 pounds. A mutton breed of merit; valued as early lamb raisers.

Cheviot.—They are very alert, stylish sheep with white markings. Face and legs are free from wool. Wool is 4 inches long. Rams weigh from 200 to 225 pounds; ewes from 125 to 140 pounds. It is a very hardy breed and individuals graze independently of each other.

Fine-Wool or Merino Sheep.—This type is the result of efforts to

[1] Courtesy of U. S. Dept. of Agriculture.

produce a fleece of finest quality. In developing this type some breeders did not overlook the mutton qualities, while others did. The Spanish Merino was the foundation of the three classes of Merinos as they exist today. The three classes are A, B and C. This classification is based on differences in conformation, character of fleece, and number and disposition of wrinkles or folds on the sheep.

The Merino blood must predominate on our western ranges because of the gregarious nature of this breed. They have great constitution and vigor and are much less susceptible to parasitic trouble than the breeds of the mutton type. They can be kept in smaller quarters and the ewes do not need as much care at lambing time as ewes of the mutton breeds. They are lacking greatly in mutton qualities, and there is a strong demand for

A Typical Flock of Sheep in Pasture.[1]

the dual purpose animal. The Merino will not be supplanted, but as the demand for mutton becomes stronger, they will no doubt be supplemented very largely by the mutton breeds.

Establishing a Flock.—Sheep may be kept profitably on either high or low-priced land. On the high-priced lands of England sheep are found in great numbers and they would certainly not be kept if they were not profitable. Sheep do best on slightly rolling land where dry footing prevails. They get more sustenance and at the same time do the land more good than any other class of livestock. The manure from sheep contains more fertilizing value per ton than any other kind of farm manure with the exception of poultry.

[1] Courtesy of The Macmillan Company, N. Y. From "Crops and Methods for Soil Improvement," by Agee.

Very little capital is needed to start a flock of sheep. They need not be housed in expensive buildings. Nature has fitted them to endure cold weather. A small flock requires very little labor, especially during the busy summer. These advantages, along with the fact that sheep destroy weeds, thereby helping to beautify the farm, make the sheep a valuable asset to the American farmer. These advantages are not mentioned with the view of urging the farmer to give up other classes of farm animals, but to remind him of the advantage of supplementing his stock with a small flock of, say, forty ewes or even less.

Essentials to Success.—One should choose the breed best adapted to local conditions, especially the climate and market. There is no best breed for all conditions. It is best that a man gain his experience with grade stuff. One may purchase either Merino or mutton breeds and then grade them up by using a pure-bred ram. The latter is of great importance. A ram having a good pedigree and good individuality should be selected. He should be purchased from a reliable breeder and the stockman should not hesitate to pay a good price for a desirable ram. The ram should possess good breed type and be masculine. An effeminate ram should have no place in a flock. Masculinity is indicated by a short, broad head, large, broad nostrils, ruggedness in appearance and a lack of too great refinement throughout. Rams should have a good conformation, and those which have been very highly fitted should be avoided, as they often prove non-breeders. There are only a few instances where it would be permissible to use a ram lamb to head the flock. This is done more often in the case of the Hampshire breed than others. Older rams usually make the best breeders. A ram of the middle-wool breeds is sufficiently developed and fit for service at the age of 1½ years.

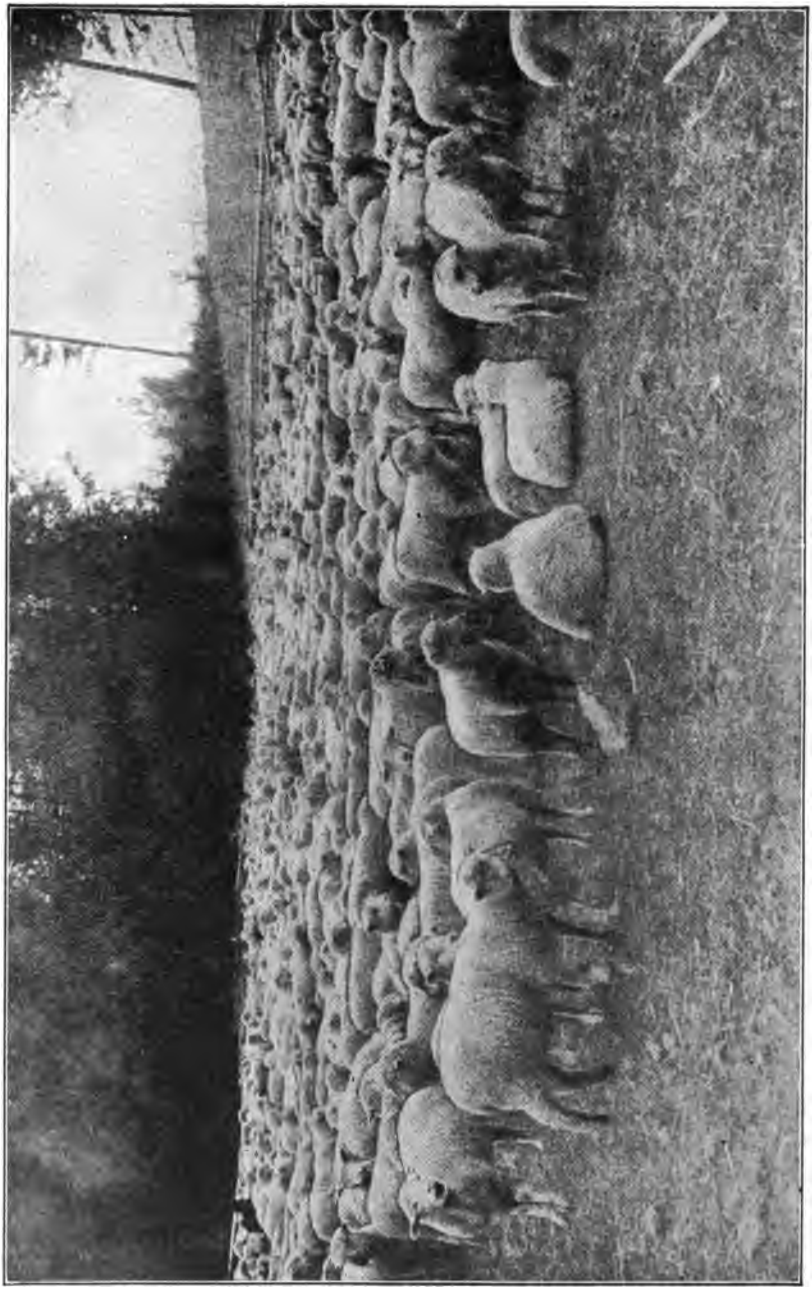
Only ewes that are sound in their mouths and udders, and that possess feminine characteristics and good general conformation should be purchased. It must be remembered that the ewes are half the flock.

One should not make the mistake, after establishing a flock, of allowing the sheep to care for themselves. Suitable but inexpensive shelter and plenty of forage should be provided and plenty of salt and water should be kept before them. It is necessary to be on the lookout for internal parasites, especially in lambs, during the summer months.

The Breeding Season.—The breeding season of the year in this country commences in September or just as soon as the cool nights begin. The heat periods of the ewes last from one to two days and normally appear at intervals of 16 days. The Dorset Horn and Tunis will breed at any time.

Period of Gestation.—The usual period is 146 days. Ewes, however, are very irregular about bringing forth their young. Shepherds in the old country figure on 140 days. The period of gestation is often longer for Rambouillets than for other breeds.

Care of Ram During Breeding Season.—Not more than 40 ewes should



A Good Flock of Sheep.[1]

[1] Courtesy of U. S. Dept. of Agriculture.

be allowed to one ram. The last born lambs are often weaker than those born earlier in the season. This indicates that it is not advisable to breed the ram to too many ewes. In a large flock, the ram should be put with the ewes for an hour at the end of each day. In a small flock, he may be allowed to run with the ewes all the time. Where hand coupling is not practiced, one should paint the brisket between the ram's fore-leg with paint. Red lead and linseed oil make a desirable paint for this purpose. This mark will indicate that the ewes have been bred. After 16 days the ram may be painted another color. By this means the breeder may know whether the ewes are returning. The ram should be fed liberally during the breeding season, but not too well. A mixture of equal parts of oats, bran and oil-cake, say one pint, both mornings and evenings, will prove a good ration.

Winter Care of Ewes.—A lamb gets its start on the right or wrong way before it is born. The pregnant ewes should be sufficiently fed, but not overfed during winter. They should be given plenty of exercise; the more they get, the healthier the lamb crop will be. The feeding of too much grain just previous to lambing time should be avoided. Bran, oats, oil meal and clover make an ideal ration for the breeding ewe. Silage and roots are good succulent feeds. but must be fed in small quantities and must be of good quality.

Care of Young Lambs.—Lambs should be weaned when 3½ to 4 months old, and put on fresh pasture. The secret of successful and profitable lamb raising is to keep them growing and in good condition from birth to maturity. Lambs should be given grain as soon as they can thoroughly digest it. In order that they may eat at will, it is necessary to build creeps for them. The feeds given and the amount will depend largely on the purpose for which they are being prepared. Those being fitted for the market should be fed liberally with grain until they are of market age. Their ration may consist almost wholly of corn. A good grain ration for lambs just beginning to eat is ground corn, one part; crushed oats, one part; linseed oil meal, one part; and wheat bran, two parts.

All lambs should be docked and all males intended for the open market should be castrated. Lambs that are not castrated often sell for at least $1.50 per 100 pounds less than castrated lambs. This does not take into consideration the loss of flesh due to activity of ram lambs. The lamb that is not docked gets filthy around the dock and presents a poor appearance on the market. They may be docked and castrated when about two weeks old. It is much more convenient to do both at the same time, and no evil results will follow if the operations are performed in the right way.

Marketing the Lambs.—It is usually best to market the lambs at weaning time. This will occur about July 1st. There is great demand for lambs weighing from 65 to 70 pounds. They furnish a superior prod-

uct for the consumer and make very economical gains for the producer. There are other reasons for marketing lambs at this time. First, lambs gain very little during hot summer months; second, there is risk of losing them through the internal parasites; third, one avoids heaviest run of western lambs; and lastly, one gets the use of his money earlier.

Shearing the Flock.—Time of shearing depends on the weather, the season and the locality and equipment. It is advisable to shear as soon as warm weather begins in the spring. Late shearing is unadvisable, as the sheep will lose in weight if compelled to carry heavy fleeces. They

AN ANGORA BUCK.[1]

are also liable to lose some of their wool during the later months. Well-fed ewes with comfortable sheds may be sheared fairly early. They will not suffer if the days should become a little cool. Wethers fed under the same conditions may often be sheared as early as March. They will gain faster when fleeces are removed. Care should be exercised to see that they do not overeat at this time.

Both hand shearing and machine shearing are practiced.

Dipping the Flock.—All sheep should be dipped for three reasons. First, to promote healthy condition of the skin; second, as a remedy for scabies in sheep; third, to kill the lice and ticks.

[1] From Farmers' Bulletin 573, U. S. Dept. of Agriculture.

The time for dipping depends upon the time of shearing. It is best to dip five or six days after shearing. The ticks and lice leave the shorn ewes and go to a more sheltered place on the bodies of the young lambs. If one delays dipping for any length of time after shearing, the lambs will suffer a great deal with these pests. A second dipping should take place during the fall.

Any of the recommended coal tar dips may be used. In using these, one should see that they have the approval of the Department of Agriculture and should follow the directions carefully.

A flock thus handled will afford the owner much pleasure and profit for capital and labor invested. The earnings from sheep will compare very favorably with those of any of our domestic animals.

GOATS

Goats are very valuable as a renovator of brush lands. They are not naturally grazing animals, but rather browsers. In some states, the cost of clearing large tracts of land has been greatly reduced by pasturing with flocks of goats.

Besides this, many goats, especially the representatives of the breeds of milch goats, are noted as milk producers. They have held a recognized place as such for a great many years among the poorer people of the world. In some countries varieties of goats are bred especially for their milk-producing qualities.

In this country, the Angora goat and the common goats give milk, but milking families have not been produced.

The Angora goat yields a fleece which is valued highly on the market. It is commercially known as mohair. It is coarser than fine wool, but longer and stronger.

When sold on the market, goats bring a lower price than sheep. The mutton from goats is not considered nearly as good as mutton from sheep.

Angora and common goats are found in almost every state in this country . They seem to do well under a wide range of climatic conditions. A dry climate, however, seems most favorable for them.

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CHAPTER 3

THE FARM FLOCK (POULTRY)

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Improved methods of production and the establishment of large specialized poultry farms have greatly increased the supply of poultry and eggs during recent years. The demand for these products, however, has been increasing even more rapidly than the supply. This increasing demand is due both to the rapid increase of the consuming population and to a growing preference for these products as food. The increase in the demand for eggs is especially marked, due largely to the increased price of meats and the fact that modern transportation facilities, storage warehouses and improved methods of handling eggs have resulted in a better distribution of the supply throughout the year and a higher standard of quality upon the large city markets.

Importance of the Farm Flock.—The farm flocks of the country furnish 90 and possibly 95 per cent of the total supply of poultry and eggs. It is natural that the general farms should be the principal source of supply, because poultry husbandry is essentially a livestock industry, and for this reason, best adapted to development under farm conditions. The farm provides those conditions which are essential to profitable poultry production, viz., ample range and pasture at low cost, cheaper feeds, the opportunity to make use of waste materials and convert them into marketable products, low labor cost, and of greatest importance, natural conditions which tend to increase rather than to decrease the health and vigor of the flock.

Unfortunately, the average farm flock falls far short of its productive possibilities. This is due largely to the fact that fowls are kept on the farm primarily for the purpose of supplying the home table with fresh meat and eggs and have not been regarded as an important source of income. This has resulted in flocks of small size and poor quality, inadequate equipment and a general indifference toward poultry on the farm. The increasing demand for poultry and eggs, and the general increase in the farm price of these products have resulted in making the farm flock of good size and quality, and properly equipped and handled, an important source of income. In addition it performs its primary function in supplying poultry and eggs for the home table.

The Size of the Farm Flock.—The size of the farm flock is an important factor in determining whether poultry is to be a profitable farm enterprise

or not. The optimum size of the flock for a particular farm depends upon a number of conditions. These conditions are so variable that it is impossible to set a definite standard which will be applicable to all farms. It is evident, however, that the flock should number at least 100 fowls, and, except under very favorable circumstances, should seldom exceed 500 fowls. As many fowls should be kept as possible without allowing the poultry work to come in direct competition with more important farm enterprises. For the average farm, this will mean a flock of 300 to 500 fowls.

Sources of Income.—The principal sources of income from the farm flock are poultry and eggs for market. The production of eggs for market is the more important because of the relatively greater demand for them and the greater convenience with which they may be produced and mar-

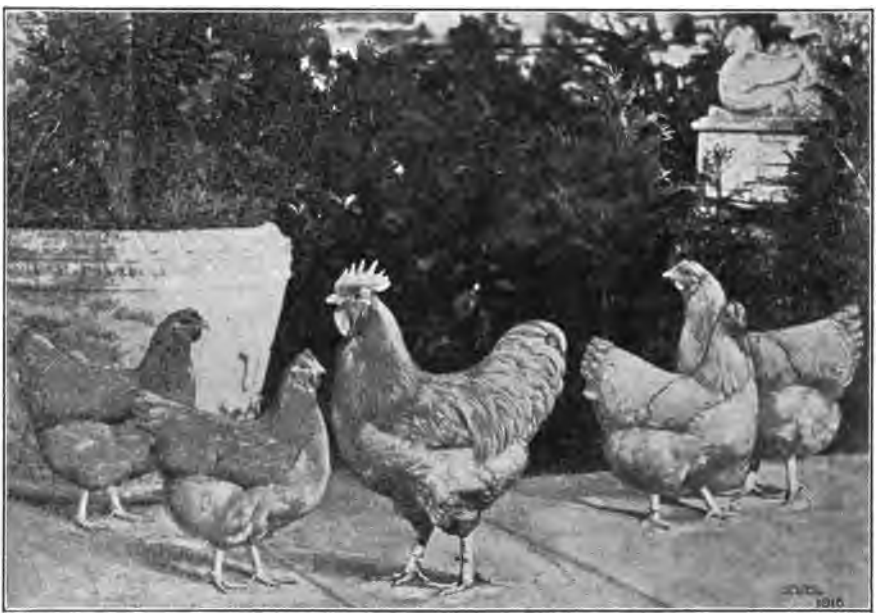
A Typical Farm Flock.

keted. It is impossible to separate the two and, under some conditions, the production of market poultry may become the more important. Other possible sources of income are the sale of eggs for hatching, fowls for breeding purposes, day-old chicks, and the production and sale of pullets for egg production. The relative importance of each of these sources of income and the extent to which they may be combined will be determined by the personality of the poultryman and the organization of the farm business.

Advantages of Pure-Bred Poultry.—A second factor of greater importance in determining the value of the farm flock is the quality of the fowls. Pure-bred poultry is superior to mongrel, cross-bred or grade fowls because of greater reliability in breeding, more attractive appearance, ability to feed more efficiently, greater uniformity in the size, shape and color of the eggs, and greater uniformity in the appearance and condition of the dressed fowls. The first cost of pure-bred fowls is greater than of inferior stock, but no greater investment is needed. The best practice in starting

WHITE PLYMOUTH ROCKS.[1]

Winners of First and Second Prize Exhibition Pens, Madison Square Garden, N. Y., December, 1911.



BUFF ORPINGTONS.[1]

First Prize Exhibition Pen, Madison Square Garden, N. Y., December 31, 1915–January 5, 1916.

[1] Courtesy of Owen Farms, Vineyard Haven, Mass., Maurice F. Delano, Proprietor.

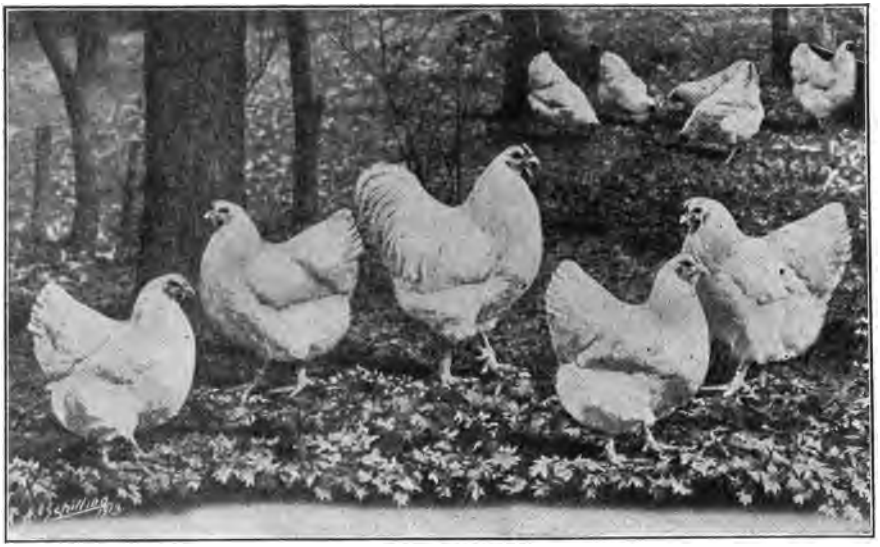
a flock of pure-bred fowls is to purchase a pen consisting of a male and four to ten females. These should be housed apart from the main flock and all of the good eggs laid during the breeding season should be incubated. Pure-bred fowls of good quality may be purchased in the late summer or early fall for $3 to $5 each for males and $2 to $4 each for females. Yearlings or two-year-old stock should be bought. After the pure-bred flock has been established, the many advantages of the pure-bred fowls are obtained without additional cost.

Grading Up a Farm Flock.—While pure-bred poultry are always to be preferred, it is possible to improve the quality of the average farm flock by the use of a pure-bred male. If a pure-bred male of the desired variety is mated with ten or twelve of the best hens on the farm, the offspring will carry one-half the blood of their sire. If the male is a strong, prepotent individual, a large percentage of the offspring will resemble him in many of his characteristics. Ten or a dozen of the best pullets resulting from the original mating should be selected and mated to their sire for the second season. The offspring from this mating will carry 75 per cent of the blood of the pure-bred male. For the third season, ten or a dozen of the best of these pullets should be mated to another pure-bred male of the same variety and of similar breeding. It is advisable to obtain the second male from the same breeder as the first one. If the fowls used have been carefully selected, the offspring from this third mating will be practically as uniform in size, shape and color as pure-bred fowls.

The Choice of a Variety.—The choice of a variety for the farm depends upon the purpose for which poultry is kept and the type of product most in demand in the best available market. The efficiency of the various varieties depends more upon the breeding and handling of the fowls than upon breed or variety differences.

The most popular fowl for the production of white eggs is the Single Comb White Leghorn. It is not a good market fowl, however, because of its small size, nervous temperament, and greater loss in dressing. The cockerels make good broilers at weights of 1¼ to 1½ pounds, but do not make good roasters or capons.

The Plymouth Rocks, Rhode Island Reds and Wyandottes are the most satisfactory breeds for the production of both eggs and meat. The solid-colored varieties of the Plymouth Rock and Wyandotte, particularly the white and buff, are preferable on account of the absence of dark-colored pin feathers. The Columbian varieties are rapidly increasing in popularity. The most popular farm fowl in the past has been the Barred Plymouth Rock. It is slowly being replaced by some of the newer varieties. The three breeds mentioned are good layers, hardy, easily handled; the chicks grow rapidly, making them well adapted to the production of broilers. They make superior roasters and capons. Where the market prefers brown eggs or will not pay a premium for white eggs, one of the many varieties of these three breeds should be chosen.



WHITE WYANDOTTES.[1]
First Prize Pen, Chicago Show, December, 1912.

SINGLE COMB RHODE ISLAND REDS.[1]
First Prize Young Pen at Boston Show, January, 1915.

[1] Courtesy of Owen Farms, Vineyard Haven, Mass., Maurice F. Delano, Proprietor.

Selection of the Breeding Stock.—It is seldom necessary and never desirable to use all of the fowls on the farm for breeding. Special matings are necessary each season in order to make any definite improvement in the quality of the flock. It is seldom necessary to use more than 20 per cent of the entire flock for breeding. The fowls used for this purpose should be the choicest on the farm. They should be strong, healthy and vigorous, above the average in size for the variety, good layers and fully matured. Hens are always preferable to pullets, because the eggs from hens are larger, hatch better and produce larger and more vigorous chicks. Strong, vigorous, early-hatched cockerels may be used, but yearling or two-year-old cocks of proven breeding ability are to be preferred. Care should be taken to avoid using for breeding purposes any fowl which has had any sickness at any time, no matter how well it may appear to have recovered.

Housing the Breeding Stock.—It is not necessary to house the breeding flock separately during the entire year. The fowls to be used for breeding should be separated from the main flock three or four weeks before it is necessary to save eggs for hatching. They should be housed in portable colony houses during the breeding season, and may be returned to the main flock as soon as the last eggs needed for hatching are gathered. The colony houses may then be used for the growing chicks or for some other purpose.

INCUBATION

Selection of Eggs for Hatching.—Eggs for hatching should weigh not less than two nor more than two and one-half ounces each. They should be of a medium type, neither very long and pointed nor very short and rounded. The shells should be clean, smooth and strong, free from ridges, cracks, transparent spots or lime deposits. The eggs selected should be as uniform in color as possible. Dead chalk-white or uniform brown eggs are to be preferred. Careful selection of the eggs to be incubated will aid greatly in improving the general quality of the eggs produced by the flock.

Care of Eggs for Hatching.—Eggs for hatching should be gathered frequently, two or three times daily, and immediately removed to a clean, dry place where the temperature is less than 68° F. A temperature of 50° to 60° F. is best. Eggs for hatching should not be held longer than two weeks, as there is a rapid loss of vitality after that time. They should not be washed. Eggs hatch better if they are turned once daily from the time they are laid until set.

Natural or Artificial Incubation.—Whether hens or incubators should be used depends upon local conditions. If chicks are wanted before April 1st, or if non-setting varieties are kept, or if more than 150 chicks are to be reared each season, incubators should be used. There is no apparent difference between the vigor and vitality of hen-hatched and incubator-hatched chicks.

Hatching with Hens.—Hens of medium weight, from five to seven

pounds, and of quiet disposition should be selected. They should be kept where they will be comfortable, easily controlled and free from annoyance by other fowls. A small brood coop is advisable for each hen during warm weather. These coops may be placed in a cool, shady location and the nest made upon the ground, a bottomless box about five inches high being used to confine the nesting material. During cool weather, a comfortable room should be provided. The nests used should be approximately 14 inches square. They should be constructed so that each hen may be confined to her own nest. In this way a number of hens may be set in the same room, all being released for food and water at the same time. It is necessary to see that each hen returns to her nest as soon as through feeding. Several hens should be set at the same time. This will save labor and allow the chicks hatched by two or three hens to be given to one for brooding. Hens should be removed from their regular nests to the nests in which they are to be set after dark. If handled quietly and given a few decoy eggs they may usually be moved without difficulty. The hen should be allowed to become accustomed to her new surroundings before setting her. This usually requires two to three days.

Setting hens must be kept free from lice and mites. The nest box and the walls of the coop or room should be painted or sprayed with a good lice killer a few days before the hens are set. The hen should be well dusted with a good insect powder two or three days before the eggs are placed under her and again two or three days before the chicks hatch.

The feed for setting hens should consist of hard grains. No wet or dry mashes should be given. A constant supply of fresh water, grit and shell should be provided.

One hen should not be given more than twelve eggs during cold weather or more than fifteen during warm weather.

Should any eggs become broken in the nest, the nesting material should be renewed and all badly soiled eggs washed in water at a temperature of 90° F.

Hatching with Incubators.—There should be no difficulty in hatching chicks with incubators if a good machine and good eggs are used. Different types of incubators require different care. Each manufacturer has compiled a set of directions for the operation of his incubator under average conditions. These directions should be carefully followed and an exact record kept of the operation of the machine throughout the hatch. If results are not satisfactory, variations should be made in the operation of the incubator during the following hatch as the judgment of the operator indicates. Poor hatches are more often due to poor eggs than to any failure on the part of the incubator.

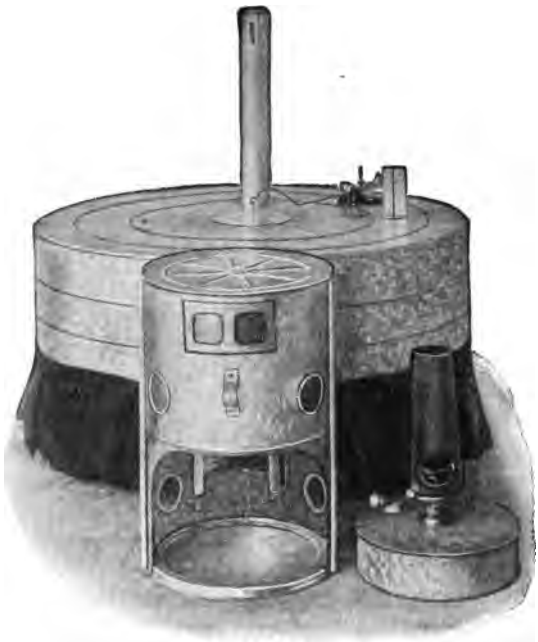
BROODING

Importance of the Brooder.—The greater part of the mortality among young chicks occurs during the first four to six weeks. The losses during

this period are very great, careful observers placing the total mortality as high as 40 to 50 per cent of all chicks hatched. The greater part of this loss is due directly or indirectly to poor brooding. In order to reduce the mortality among chicks to a minimum, good brooders must be used.

Qualifications of a Good Brooder.—A good brooder for farm use should be capable of maintaining a temperature of 90° to 100° F. under the hover and a temperature of 70° to 85° F. outside of the hover. The chicks should be allowed to choose the temperature in which they are most comfortable, and should not be compelled to submit to any given temperature.

The brooder must be well ventilated, providing an abundant supply of pure, fresh air without drafts striking the chicks. Fresh air is as essential for growing chicks as good food and water. A two-compartment brooder is advisable, as it permits of feeding the young chicks in fairly cool, fresh air and they are not required to pass directly from the warm hover into the outside atmosphere.



A Brooder Heated by Oil Lamp.[1]

The brooder for farm use should be portable. Chickens should not be reared on the same ground year after year. The most satisfactory results will be obtained by rearing them in the orchard, in the cornfield after the last cultivation, or on the hay and grain fields after the crops are harvested, moving the brooders from place to place frequently. If handled in this manner, the chicks will make use of a large amount of waste material and will be more healthy and vigorous and make more rapid growth than if confined to small yards.

The brooder should be usable for some purpose during the entire year. Any brooder which can be used only for brooding chickens is unsatisfactory for farm use. It should be capable of housing the chicks

[1] Courtesy of Prairie State Incubator Company, Homer City, Pa.

from the time they are hatched until fully matured, and should be readily convertible into a breeding house or fattening pen.

The brooding device which best meets these requirements is a portable colony house 6 by 8 feet to 8 by 15 feet in size, equipped with portable hovers, gasoline brooder heater or a coal-burning brooder stove.

Management of the Brooder.—During the first two weeks a temperature above 90° and below 100° F. should be maintained two inches above the floor in the warmest part of the brooder, that is, beneath the hover. After the second week the temperature should be gradually reduced, the exact temperature to be maintained being determined from the actions of the chicks. If the temperature is right, the chicks when at rest will be spread out around the outer edge of the hover. Any evidence of crowding is an indication of a lack of heat. If the temperature under the hover is kept a degree or two higher than the chicks actually need, there will be very little crowding.

The brooder must be kept absolutely clean at all times. The floor should be covered to a depth of several inches with clean, dry litter, such as short-cut clover, alfalfa, straw or chaff. The litter should be removed whenever it becomes damp, dusty or soiled.

Ration for Chicks.—A good ration for chicks consists of a grain mixture of 30 pounds finely cracked corn, 20 pounds cracked wheat and 10 pounds pin-head or cracked hulled oats. With this should be fed a mash consisting of 30 pounds wheat bran, 30 pounds wheat middlings, 30 pounds corn meal, 20 pounds fine beef scrap or granulated milk and 10 pounds of bone meal. This ration should be supplemented by a liberal supply of succulent food such as alfalfa, clover, sprouted oats or beets. Fine grit, finely crushed oyster shell, charcoal and clean fresh water should be before the chicks at all times. If skim milk is available, the chicks should have all they will consume.

The grain should be scattered in the litter on the floor of the brooder in order to induce the chicks to exercise. Grain should be fed early in in the morning, at noon and later in the afternoon. As much should be fed as the chicks will clean up from one feeding time to the next. If any considerable amount remains in the litter, a feed should be omitted and the amount reduced. No definite information can be given as to the exact amount to feed, as the needs of the chicks vary from day to day. The poultryman must study the appetite and actions of the flock in order to feed intelligently.

The mash should be fed dry. Shallow pans may be used for feeding the mash while the chicks are small. Small feeding hoppers should be used as soon as the chicks are large enough to feed from them. Chicks should never be without the dry mash.

This method of feeding should be continued until the chicks are large enough to do without artificial heating or are weaned from the hen, with the exception that the cracked wheat should be gradually replaced by

whole wheat, and the finely cracked corn by the coarse cracked corn, when the chicks are six to eight weeks old. After the chicks have free range, the grain mixture may be changed to equal parts of cracked corn and whole wheat. The same dry mash should be continued until the chicks are mature. The grain may also be fed in hoppers after this time.

The Care of Growing Chicks.—The age at which chicks may be deprived of artificial heat will depend upon weather conditions and the condition of the chicks. This should not be done until all danger of sudden changes in temperature is past and the chicks are well feathered out. During the brooding period the brooders may be kept close to the farmstead and small, portable runs provided for the chicks. As the chicks increase in size, the brooder should be moved farther away and the size of the yards increased. As soon as the chicks no longer require artificial heat they should be given free range. They must have plenty of shade, abundant pasture, be kept free from lice and mites and protected from their natural enemies. The brooder should be proof against rats, weasels, etc., and should be closed every night. The chicks should be confined to the house in the morning until the grass is well dried off. This practice should be followed at least until they are half grown. The cockerels should be separated from the pullets as soon as the sex can be determined. It is advisable to caponize all males except a few of the most promising to be reserved for breeding purposes. The pullets will be hindered in their development if the cockerels are allowed to remain with them. The cockerels, if not caponized, should be put together in a separate field or on another part of the farm.

The Care of the Pullets.—The pullets should be transferred from the colony house on the range to their permanent winter quarters as soon after the first of September as possible. This will give them an opportunity to become accustomed to their new surroundings before cold weather sets in. Careful attention must be given the pullets at this time. There is usually a tendency for them to crowd on the roosts at night or to roost above the open doors and windows. This should be prevented, as it may result in colds which will hinder egg production. The bulk of the eggs received from October 1st to March 1st are produced by the pullets.

Feeding Mature Fowls.—The principal object in feeding should be to use the poultry on the farm for the purpose of converting grains, mill by-products and waste materials not suitable for human consumption in their raw state into concentrated, easily handled, nutritious food products. For this reason the farmer should make use of grains grown on his own farm and of mill products which are easily obtained at comparatively low prices, supplementing them with the necessary protein concentrates.

Suitable rations may be made from a great many combinations of grains and mill feeds. There is no one combination which is superior to all others under all conditions. For this reason it is possible for the farmer

to adjust any suggested ration to meet his own conditions without seriously impairing its efficiency.

The ration should contain in proper proportions the various food elements required by the fowl. It should be easily digested and assimilated, palatable, economical, suitable for its intended purpose, easily obtained, easily handled and conveniently fed. It should be a two-part ration consisting of a grain mixture of scratch feed and a mash. It is not possible to obtain a maximum of production with either grain or mash alone. They should be fed in combination with grain constituting approximately two-thirds of the ration.

The following ration and method of feeding is particularly adapted to farm conditions. The ration as given is based on feeds at normal prices and may be varied with a variation in the price of any feed. The grain mixture consists of 200 pounds corn, preferably cracked, 200 pounds wheat, and 100 pounds heavy oats. If buckwheat is available, 100 pounds may be added during cold weather. The mash consists of 200 pounds corn meal, 100 pounds wheat bran, 100 pounds wheat middlings and 100 pounds of beef scrap containing not less than 55 per cent protein.

The grain should be fed by hand, being scattered in clean litter six to twelve inches deep. The grain should be fed at least twice daily, preferably early in the morning and late in the afternoon. If it is necessary to keep the fowls confined to the house, it is advisable to give additional light feeds in the middle of the forenoon and in the middle of the afternoon in order to keep the fowls busy.

The amount to be fed will vary with the variety, the weather conditions, the egg production and various other factors. It should be determined by the actions and appetites of the fowls. They should be well fed. Endeavor should be made to regulate the feeding so that they will consume approximately twice as much grain as mash. Fowls of medium size when in full lay will consume from 2 to 2½ ounces of grain daily.

The mash should be fed dry. Self-feeding hoppers should be used. For Leghorns and similar varieties and for pullets of the dual purpose varieties, such as Plymouth Rocks, Wyandottes, etc., the hopper should be open during the entire day. For yearlings and older hens of the dual purpose varieties, the hopper should be opened at noon and closed when the evening feed is given.

This ration should be supplemented by a constant supply of clean, fresh water, grit and oyster shell. Sour skim milk should be fed as a drink if it is available, allowing the fowls to consume all they will. Succulent feed of some sort is necessary. During the late fall and winter, mangels, sprouted oats, unsalable cabbage, beets, apples, potatoes, steamed clover or alfalfa, or any other succulent food available may be used. The yards should furnish all the green feed required during the spring and summer.

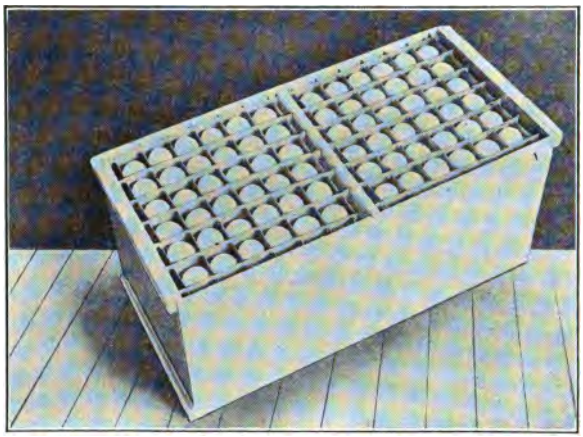
The Care of Market Eggs.—The quality of market eggs is determined

by their size, shape, appearance and freshness or interior quality. All of these factors may be controlled by the poultryman to a considerable degree through breeding and the care with which the eggs are handled. Improvement of the quality of the eggs produced is fully as important from a financial point of view as increased production. If the following suggestions are observed, there should be no difficulty in producing eggs of a quality that will meet the requirements of the best grades in any market.

Breed only from hens which lay eggs of the desired size, shape and color.

Provide for at least one clean, convenient, well-ventilated nest for every four or five hens in the flock.

Renew the nesting material whenever it becomes damp, dusty or soiled. Planer shavings make excellent material for nests, but soft hay and clean straw may be used.



Shipping Cases for Eggs.[1]

Gather eggs at least twice daily and more often if convenient. This is particularly important during cold weather to avoid freezing, and during warm weather to avoid the development of the embryo and to retard evaporation.

From the time eggs are gathered until marketed, keep them in a clean, cool, dry place. Fertile eggs will begin to develop at any temperature over 68° F.

Do not put eggs into a box, basket, carton or case until all the animal heat has escaped. When gathered, place them on a wire tray similar to an incubator tray for ten to twelve hours and then grade and pack them in standard cartons or cases.

Market eggs at least once weekly and more often if possible. Nothing is ever gained by holding eggs for a rise in price. The egg is a perishable food product and should be marketed as soon as possible in order to avoid deterioration and loss.

Market eggs in standard egg packages. The standard thirty-dozen egg case is preferred. If production is not great enough to enable a case or two of graded eggs to be shipped weekly, use the smaller, returnable cases which may be secured from any dealer in poultry supplies.

[1] Courtesy of Missouri State Poultry Experiment Station, Mt. Grove, Mo.

When eggs are being transported from the farm to the market or shipping point, they should be protected from the rays of the sun.

Do not wash eggs. The washing of eggs greatly impairs their keeping qualities and spoils their appearance. Market eggs should never be allowed to become wet. Moisture dissolves the protective bloom or covering of the shell, opens the pores and allows bacteria and moulds to enter. Avoid the necessity for washing by providing sufficient nests and keeping the house and yards clean.

Remove all males from the flock as soon as the hatching season is over and keep them away from the hens during the warm weather. The male has no influence on the number of eggs produced. His only function and use on the farm is to fertilize the eggs to be used for hatching. Fertile eggs spoil very quickly during warm weather. Approximately 18 per cent of all eggs produced upon farms become unfit for food before reaching the consumer. At least half of this loss could be avoided if only infertile eggs were produced.

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656. "The Community Egg Circle."
682. "A Simple Trap Nest for Poultry."

CHAPTER 9

BEES

Many farmers are unaware of the great service rendered them by the honey bee; especially in horticulture and vegetable raising is he a necessary asset. Estimates from reliable data show that bees in the United States produce $25,000,000 worth of honey and beeswax annually. Their value as agents in the pollinization of fruits and vegetables is many times their worth as producers. Many small fruits are entirely dependent upon insect visitors for fertilization. Cucumbers, squash, melons and tomatoes are also dependent upon the bees for the production of fruit. Pear trees especially need the bees for cross-pollinization.

Aside from the service rendered as pollinators, bees, if properly handled, make a most profitable side line in the business of farming. While they need intelligent care, and care at the proper time, yet much of this can be given at odd hours and at times when the regular farm work is not pressing. Even the time of swarming can be anticipated and to some extent regulated.

Bee keeping furnishes a most pleasant recreation and one that pays its own way as well as produces a profit. There is so much of marvel in the economy of the honey bee that the most casual observer becomes an enthusiast.

One disadvantage may be mentioned, however. Many orchard and garden diseases are easily spread by means of spores carried by insects. The bee plays no small part in the distribution of plant contagion. Pear-tree blight, the brown rot of plums and the wilt of cucumbers and melons are diseases spread through the agency of bees and other insects. The danger of infection may be reduced to the minimum by exterminating all diseased plants and trees; thus giving the bees no opportunity to carry contagion.

Breeds of Bees.—The German bee is the most common in the United States. Although not very attractive in color, being black, they winter well and make whiter honey combs than any other race. At times they are inclined to be cross and frequently use their stings. They are not easily handled by the novice.

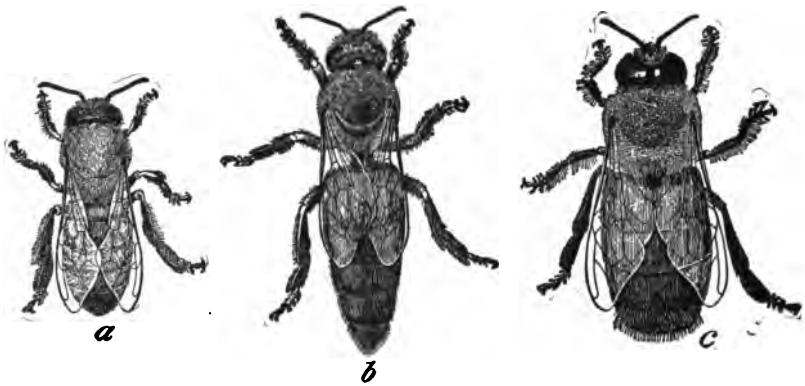
The Cyprian bees are handsome, being yellow in color, but have not come into wide popularity on account of their extreme sensitiveness. When once aroused, they will not even be subdued by smoke.

The Carolina bee is one of the most gentle of all bees. It is gray in color and very prolific. The chief objection to this bee is its ever-ready tendency to swarm.

The Caucasian bee has only recently been introduced into this country and has not yet established wide popularity. It is prolific and so gentle that some report it to be without sting. This, however, is not the case.

The Italian bee is the most satisfactory and profitable. It is more gentle than either the German or Cyprian, and quite prolific. It is handsome in color, having yellow bands, and is an energetic worker in gathering honey. It is also most active in defence of its home against marauders. In order to winter well, the Italian bee must be well protected.

Personnel and Activity of Colony.—A bee colony consists ordinarily of one queen bee, who is the mother of the colony, and a multitude of females (sexually undeveloped), who carry on the work of the hive. The



THE HONEY BEE.[1]
A—Worker. B—Queen. C—Drone. Twice natural size.

queen bee lays all the eggs. The female workers lay no eggs at all. It is their duty to gather honey, feed the young, keep the hive clean; in fact, perform all the labors of the hive.

During some parts of the year, hundreds of males, commonly called drones, live in the colony. These perform no labor. Their mission is to mate with the young queens. Their number should be restricted by the keeper.

The bee hive permits of no idlers after the young queens are mated. The drones are then destroyed by the workers. Even the queen bee is killed or superseded by a younger queen as soon as she lays no more eggs. In fact, any individual in the colony who ceases to be useful is immediately put to death or thrown out to perish.

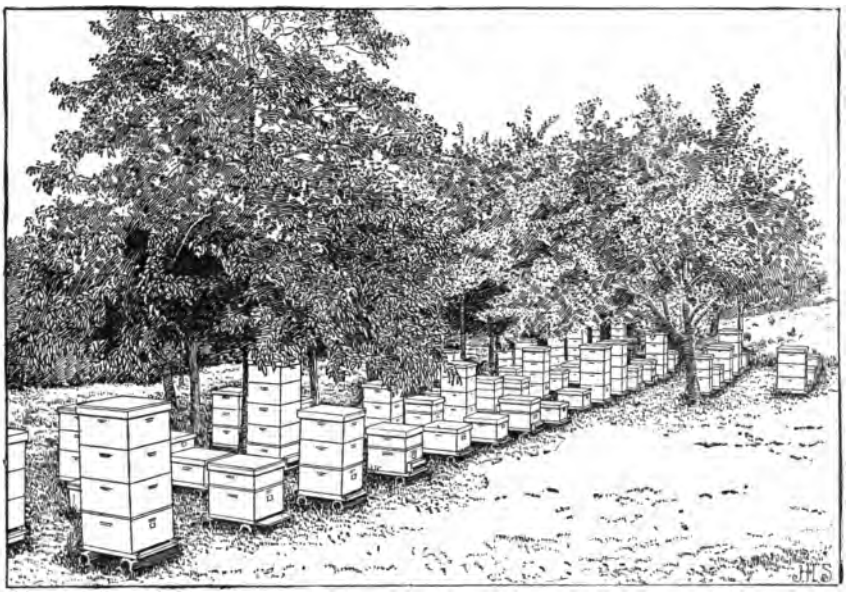
The length of life of any bee depends much upon the time of year and amount of labor performed. In summer, which is the working season, a worker bee will live about 45 days. During the winter months, while

[1] Courtesy of U. S. Dept. of Agriculture. Farmers' Bulletin 447.

dormant, time of life will extend from 6 to 8 months. It is, therefore, necessary to maintain a strong, prolific queen in order to repopulate the colony.

Size and Location of Apiary.—Authorities agree that for the most intensive bee culture, 100 colonies are all that can be managed with profit.

The beginner will do well to start with a colony or two and gradually build up as he becomes more familiar with the work. A year or two will prove his success or failure. While the necessary initial capital is small,



General View of an Apiary.[1]

still a plunge into the bee business without previous experience and a thorough knowledge of bee habits is very apt to end in disaster.

The ideal location for an apiary is in an orchard or near fields where bloom is plenty; although colonies have been successfully maintained in city back yards and even on housetops.

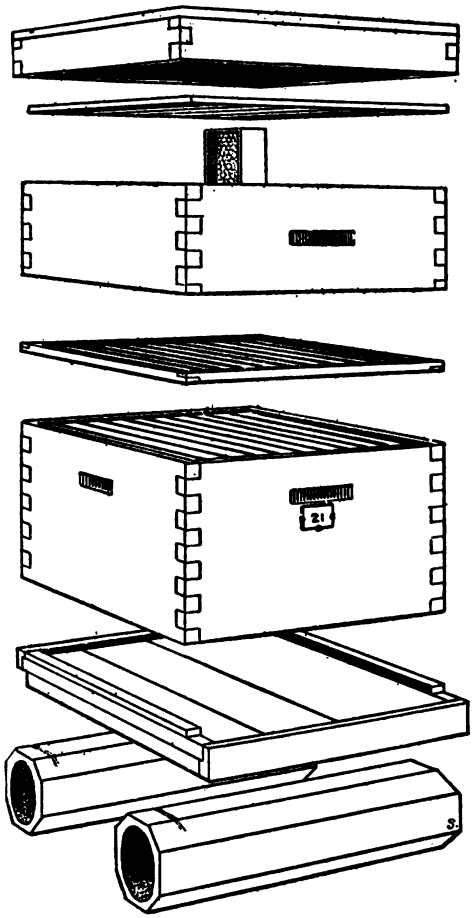
Although bees travel a distance of two miles in search of nectar, it is best to provide for it nearer home. The time wasted in transit is negative, as the bee flies very rapidly; but if far from home, sudden rain or wind storms bewilder the bees and cause loss of life. In rainy or cold weather, bees do not travel far from the hive. Should the nectar be far afield, continued unfavorable weather necessarily decreases their activity.

The hives should be placed a few feet apart so that in working with

[1]Courtesy of U. S. Dept. of Agriculture. Farmers' Bulletin 447.

one, the adjacent hive is not disturbed. They should be far enough away from roads or walks so as not to annoy passersby.

In the North, hives should be placed on a sunny slope, facing away from the prevailing winds. Some shade is desirable, but the hives should be so placed as to catch the morning sun. This encourages bee activity early in the day, thus gathering the best of the nectar.



A Modern Bee Hive.[1]

The colony must be located in a dry place and kept free from weeds, each hive being raised a few inches from the ground by means of a stand. These stands may be of wood, stone or concrete, and serve to keep the hive dry.

Shade and Ventilation.—A reasonable amount of shade is beneficial, although dense shading of the apiary is disastrous. It promotes dampness and encourages disease. If a natural shade is not possible, a temporary shade of boards or canvas should be used during the heated portions of the day. Newly swarmed hives should be kept well shaded and cool. Temperature influences the swarming habit; a colony subjected to the burning rays of the sun will swarm much sooner than one well shaded.

Roomy, well-ventilated hives are necessary for comfort and health. During warm weather, ventilation is improved by raising the front of the hive two or three inches by supporting it upon small blocks of wood. Care must be taken, however, to lower the hive in case of a change in temperature. Most authorities do not approve of opening the upper part of the hive. It is apt to cause a draft through the hive, and also encourage robber bees. A wide entrance at the bottom is much preferred for ventilation purposes.

[1] Courtesy of U. S. Dept. of Agriculture. Farmers' Bulletin 503.

Stocking the Apiary.—Bees may be secured more easily at swarming time and the colonies are apt to be stronger at that time. Usually the purchaser provides a hive into which the apiarist puts the new swarm. This may be moved at night and, if taken a distance of a mile or more, there is no danger of the bees returning. A good strong colony purchased at this time will yield a second swarm if the season is favorable.

Introducing a New Queen.—The prosperity of the colony depends much upon the strength of the queen. Bees from a strong queen winter better than those from a weak one, and are more prolific in spring. If the queen becomes weakened, it is best not to wait until the workers destroy her, but to make away with her and introduce a new one at once. Queens may be purchased from any dealer in bee-queens. They are sent through the mail in a small cage, accompanied by a few workers.

Many methods of introducing a new queen are used, but if the queen is a valuable one, it is best to use a perfectly safe method. Remove the old queen in the evening. In the morning lay the cage containing the new queen and attendants, wire side down, on the frames under the quilt. Close the hive and leave it alone. In a short time the bees will have eaten their way into the cage and released the queen. The wait over night is necessary on account of the excited condition of the bees when their queen is removed. This excitement might cause them to destroy the new queen. Queens introduced in this manner are generally at work in two or three days laying eggs.

Some introduce by first blowing tobacco smoke down the hive to drive the bees down, then release the queen and allow her to run down between the combs, blowing a little smoke after her. This not only obscures all strange odors about the queen, but stupefies the bees.

Introducing a queen makes the opportunity to change breeds of bees, as the new queen is usually mated when purchased. Queens are sold under one of three labels: tested queens that are mated with a drone whose race is known; untested queens mated with an unknown drone; and breeding queens, those that have shown superiority for breeding purposes before leaving their home. The bees in the colony have no influence on the progeny of the new queen already mated. By the time the new brood hatches out, the old ones begin to die, and soon the race is changed.

Uniting and Transferring Colonies.—It often becomes advisable to unite two weak colonies, making one strong one. Some fundamental facts about bees must be understood in order to make this a success. Every colony has a distinct odor and resents bees from other colonies. It is necessary, therefore, to obscure this odor by using smoke. Smoke also stupefies the bees and renders them more docile. Both colonies should be smoked, but care should be taken not to use too much smoke, or the bees will be completely overcome. One queen should be destroyed; the one saved should be caged for a day or so to prevent the bees killing

her. At swarming time when the bees are full of honey, it is a simple matter to unite colonies. If the two colonies are not near each other, one should be moved nearer the other, a few feet each day, that the bees may not notice the changed location. When side by side the change can be made without difficulty.

Transferring a colony from a box hive to one with movable frames often becomes necessary. This should be done during the honey season and while the larger number of bees are in the field. The two hives should be adjacent. The new hive should contain combs or sheets of foundations. Turn the box hive upside down and fit over it a small empty box, inverted. Then drum on the hive until most of the bees desert their combs and go into the empty box above. These may be carried to the new hive and put at the entrance. Care must be taken to secure the queen, as the bees will not remain without her. If there is brood in the old hive, turn it right side up again and after twenty-one days this will be hatched out. These bees may then be gathered in the same manner and, by smoking both colonies, reunited in the new hive.

General Methods of Handling.—Certain general rules will apply at all times in handling bees.

Hives should never be jarred or disturbed more than necessary. Rapid movements should be avoided. Bees have a peculiar eye structure which enables them to see movements more readily than objects. Quick movements irritate them, causing them to sting. Stings are not only painful, but the odor of the poison irritates the other bees, thus making them difficult to manage. The novice should wear a veil over a broad hat, and use a good smoker. A few puffs are sufficient to subdue the bees. Gloves generally prove a nuisance, but rubber bands on the arms prevent the bees crawling up inside the sleeves. Black clothing is particularly objectionable to bees. Do not handle bees at night or on cold, wet days, unless absolutely necessary. The middle of the day, particularly during the honey season, is the best time to manipulate bees. Always stand to the side or back of the hive, never in front of the entrance. In handling frames, care should be taken not to let the bees drop off on to the ground.

Swarming.—Swarming is the exit of the original queen with part of her workers to seek a new home. In this manner, new colonies are formed. An abundant supply of honey and a crowded condition of the hive are the immediate causes of swarming. Swarming may occur in May, but is more apt to occur during July and August, or when the honey flow is at its best.

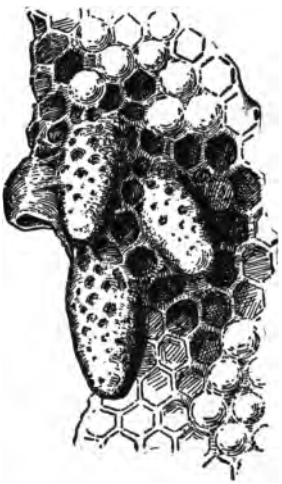
The only outward indication preceding swarming is a partial cessation of field work and the loafing of many bees about the entrance, as if waiting for some signal. Suddenly the bees all rush forth, accompanied by the old queen, and after circling about for a time, cluster on a nearby limb. This is the critical time for the bee keeper. If he has made no previous preparation to house his departing swarm, he may lose them altogether.

A wise keeper will have clean hives in readiness. These should be kept in a shady place, so as to be cool as possible for the incoming swarm. Newly swarmed colonies will not remain in overheated hives. For this reason the hive should be kept well shaded and well ventilated for several days after the swarm goes into it. Some recommend giving a frame of brood to the newcomers, as bees are less apt to desert this.

Bees rarely fail to cluster after swarming. If they light on a limb that can be spared, it may be sawed off and the bees carried to the new hive. If this is not practical, the bees may be shaken off into a basket or box and taken to the hive. A box with a long handle is useful for swarms on high limbs. It is not necessary to secure all the bees. If the queen is hived the rest will follow. If she is not hived, however, the bees will leave the hive and join the cluster again. Bees are usually peaceful at swarming time, having filled themselves with honey before starting out. A little smoke blown into the cluster usually subdues them.

Great care must be used in handling the bees that none be crushed. The odor from a crushed bee excites the living bees and makes them difficult to handle.

Soon after hiving the bees resume their normal duties. The queen begins to lay eggs and the workers store honey in anticipation of the new brood. Extra frames should now be placed for the storage of honey. If there were incomplete supers on the parent hive, these should be lifted over on the new hive.



QUEEN CELLS.[1]

The departing swarm leaves behind several queen cells which will hatch in a few days. All but one of these will be destroyed by the workers. Two or three days after the remaining queen bee has been fertilized she begins to lay eggs and the colony resumes its normal routine.

How to Prevent Swarming.—A reasonable amount of swarming is desirable, as in this manner new colonies are started. However, much swarming weakens the colonies. Weak colonies do not store an abundance of honey or winter well. Neither do they resist moths and disease. An overcrowded colony is the most common cause of swarming. As a preventive, plenty of room should be kept in the hive by removing the honey supply often and furnishing extra supers. The hives should be kept well shaded and ventilated.

One queen to a colony is the rule. Too many queens cause swarming. If the queen cells are carefully watched and cut out, the number can be regulated. The queen cells are readily recognized by the keeper, as they

[1] Courtesy of U. S. Dept. of Agriculture. Farmers' Bulletin 447.

are larger than any other cells. They are rough on the outside and hang vertically on the comb, having much the shape of a peanut. The supply of queens should not be entirely cut off, however, as a vigorous colony needs requeening at least once in two years.

Artificial swarming is sometimes resorted to by dividing an overcrowded colony and furnishing a new queen to the queenless portion. This process is expedient, however, only after indications of swarming are observed. Otherwise, the bees may swarm naturally later on.

Clipping the queen's wings to prevent her flying is sometimes resorted to to prevent swarming. In this event, she will be found near the hive when the swarm issues and can be recaptured and put into a new hive. The parent colony should be removed and the new hive put in its place. The swarming bees will then enter the new hive. The bees afield at the time of swarming will also return to the new hive, thus strengthening the new colony and relieving the congestion of the parent colony. The same shifting of hives should take place in event of a natural swarming.

Wintering of Bees.—Queens showing lack of vitality as winter approaches should be replaced, in order that the colony may begin the inactive period with young and vigorous bees. Cellar wintering is not advisable unless under the direction of an experienced bee keeper. The dangers from moths, sweat and other bee troubles make the practice doubtful. A dry, well-ventilated cellar with an even temperature is imperative.

Throughout the South, where the winters are mild, no packing is needed for outside wintering. The entrance should be closed enough, however, to keep out cold drafts and prevent the entrance of mice and other enemies. Enough space must be left for the passage of the bees.

In the North the hives must be well packed to retain the heat generated by the bees. Heavy building paper tacked around the hive, leaving the entrance open, makes a good winter protection for bees. A piece of burlap, tacked over the front of the hive and hanging over the entrance, makes a good shield from snow and wind. This may be lifted on fair days to permit the passage of the bees. Dark wrapping paper should be avoided, as it absorbs the rays of the sun. This creates a rise in temperature within the hive, resulting in too much bee activity. Dampness is more fatal than cold to bees. It is advisable to place burlap or other absorbent material on top of the frames to absorb the dampness which otherwise might condense and dampen the cluster of bees.

Bee Feeding.—A colony of bees should enter the winter with from 25 to 40 pounds of honey stored for food. The quantity depends upon the length and severity of the winter.

Fall and spring feeding is often resorted to in order to continue activity in the colony late in the season and stimulate it early in the spring. Honey from unknown sources should not be fed, on account of introducing disease. Syrup made from granulated sugar makes a satisfactory food.

A small pan filled with shavings or excelsior saturated with the syrup may be placed on top of the frames.

Hives.—There are many good hives on the market, but the one most widely used is the Langstroth hive. Unless one is skilled in making hives, it is best to purchase them ready-made. All hives in the apiary should be of the same style and size, so that the frames are interchangeable.

Foundation Combs.—Foundation combs should be furnished either as starters or as entire sheets. The finished product will then be beautifully uniform. If the bees are left to furnish their own wax, much time is consumed and the resulting comb is irregular. Full sheets of foundation produce the finest quality of comb. When one super is half full or more, it should be raised and an empty one put under it. Care must be taken not to furnish too many sections at once or some will be left unfinished.

Handling and Marketing.—In handling the honey combs, care must be taken to keep the frames in a perpendicular position. If placed on their sides, the combs will be broken. The same caution applies in packing for market or in handling foundation or brood frames.

Honey should not be stored in a cool, damp cellar, but kept in a warm, dry room. Honey taints easily and care must be taken to use as little smoke as possible in the hives in handling the bees.

The home market is the best for the small honey producer. The product deteriorates rapidly in shipping, and much care is needed to pack, so as to ship without loss. Unless handled in large quantities the added expense of packing will offset the higher price at a distant market.

Wax from extracted honey and that scraped from frames can be melted and made into beeswax. Beeswax not only has a market value as wax, but if sent to a foundation factory, new foundations can be made from it at a cost much less than the purchasing of new foundations.

Diseases of Bees.—Moth is not a disease, but is a common enemy of the bee. The presence of moth denotes a weak colony, for a strong colony will destroy moth webs and keep them out. Once in, not much can be done save to so strengthen the colony, that it rids itself of the moth.

Foul brood is the most common bee disease. It is a germ disease. much to be dreaded, as it spreads rapidly from one apiary to the other, the first trace is noticeable in the grubs. They turn yellow and stretch out in their cells instead of being white and curled up. Later a stench arises from the hive. Drastic measures must be taken at once to keep the disease from spreading. The bees should be removed to a clean hive without comb and kept for thirty-six hours with the hive closed. At the end of that time they may be put into a new hive with clean comb and a fertile queen. Sugar syrup must be furnished them for a time. The infected hive and all its parts must be burned.

So serious has this disease become that many states have passed laws governing its control, and provide inspectors to see that the laws

are enforced. It is to a bee keeper's advantage to co-operate in every way possible with these inspectors in controlling this disease.

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PART II

DAIRY FARMING

(Dairy Husbandry)

CHAPTER 10

THE DAIRY HERD; ITS SELECTION AND IMPROVEMENT

BY F. S. PUTNEY
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The dairy cow of today has been so long domesticated that it is impossible to identify her exact origin. Several possible origins have been written about, but one thing we are sure of is that the original cow gave milk only for her young for a few months. The modern dairy herd is the result of selection and improvement by man.

Scrubs, Grades, Crosses and Pure-Breds.—A dairy herd which is the result of accident and which has never been improved is called a common or scrub herd. Such a herd usually has the blood of several breeds, but has been bred without thought. Occasionally a scrub dairy cow is profitable, but it is rare indeed to find a scrub herd that is profitable. A large percentage of the dairy cattle in the country today are high-grades. A grade animal carries over 50 per cent of the blood of some particular breed. The pure-bred sire is now believed to be an essential of a good dairy herd, hence the result is that most of the cows are now high-grade, carrying over 75 per cent of the blood of one breed. A cross-bred animal has the blood of two pure-bred animals of different breeds in its veins. Such breeding is good to produce vitality, but is not good for milk production; especially is this true in the crossing of such distinct breeds as the Holstein-Friesian and the Jersey. Comparatively few pure-bred dairy herds exist. However, the number is sufficient to permit of every one owning a pure-bred sire, and the number of pure-bred animals is on the increase. A pure-bred animal does not have the blood of any other breed since the founding of that breed.

Value of Pedigrees.—A pedigree is a list of the names and registry numbers of the ancestry of an animal. A dairy farmer who keeps pure-bred animals should exercise care in keeping his animals registered in the herd-book of the breed association. This is profitable because pure-bred animals sell better than grade animals, as the offspring are more uniform, especially in type and color. The latter fact adds a great deal to the selling price. Further, the pure-bred dairy animals have been developed to higher milk production than any other class of farm animals and naturally the dairyman is willing to pay for their production ability. The more high producing animals in the ancestry of an animal, the better is that pedigree.

Breed Differences.—Within dairy cattle are several definite strains of a special type. These definite strains are called breeds. Some breeds have been developed for the large amount of milk they give, other breeds for the large percentage of fat which the milk contains. The size of the different breeds also varies a great deal. These breeds are quite largely the result of conditions that exist in different countries. Great as is the difference in the quantity and the quality of the milk and size of the breeds, the individual variations within a breed are nearly as great.

The following table, from Bulletin No. 114 of the Pennsylvania Experiment Station, shows the difference in percentage of fat of breeds:

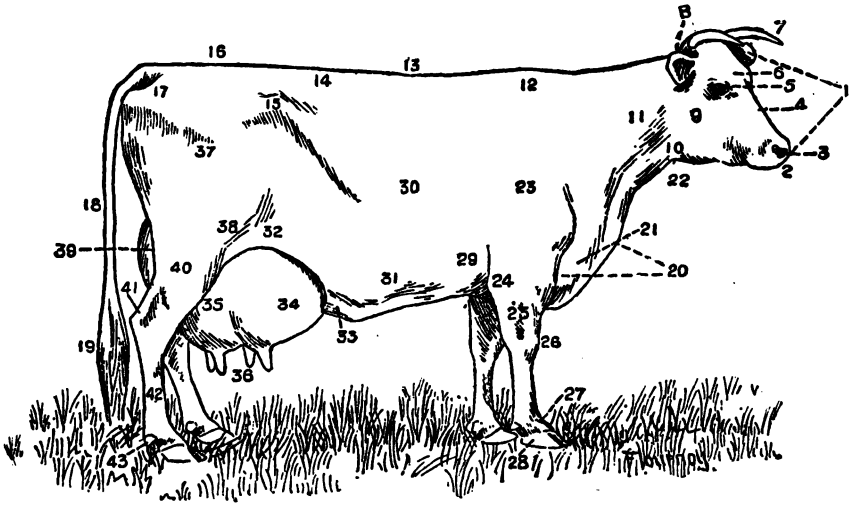
	Per cent.
All Jerseys or Guernseys of high-grade	5.0
Mixed herd with some Jersey or Guernsey animals	4.5
Common mixed herd	4.0
Mixed herd with some Holstein animals	3.5
All Holsteins	3.0

A Standard of Production Necessary.—In order to select and improve animals for the dairy herd, it is necessary to have a standard of production. The standard is, of course, the lowest limit for profitable production. Since production of milk varies with the age of the animal, it is necessary to have a standard for the first few lactation periods. A heifer with first calf usually gives about 70 per cent of her future production as a mature cow. A cow makes her maximum production at about seven years of age. The standard of production varies with each community, but in a very general way, where up-to-date dairying is followed, a cow should produce between 6000 and 8000 pounds of milk and 250 to 300 pounds of fat to stay in the herd.

Individual Selection.—If it is necessary to have a standard of production for each cow, it is equally necessary to have some way of selecting animals that should come up to this standard. This will be discussed in the paragraphs on Records which follow. In order to improve a herd properly, one must keep more than records of production. The individuals must be selected for size, vigor and trueness to type. This selection must begin with the calf. Only calves of the right type and vigor should be raised. Size in the animal is important, but vigor is even more essential. Vigor and lung capacity are essential to enable the cow to resist all the diseases to which the dairy cow is heir. It is desirable to raise farm animals that have shown prolificness, as this quality is reproduced to a marked degree in dairy animals. Having decided to raise a particular breed, it is necessary to know the characteristics of that breed better than any other.

In starting a new herd, the females should be selected for uniformity of type, and should be typical of the breed they represent. In selecting a bull, some breeders prefer one that is strong, where the females in the herd are weak. If possible, this is a good practice. The bull should always

be from as long a line of high producing animals as is possible to secure. In starting a herd, do not allow passing fads to have undue weight. To illustrate, the Jersey cattle have been greatly hurt by the solid color fad that went over the country. The breed was not solid colored at its foundation, and whatever fad comes into a herd after it has been founded reduces the number of animals to select from for production and hence weakens the herd instead of strengthening it. The Guernsey fad of light-colored noses and the white color of the Holstein-Friesian and Ayrshires are illustrations



A Typical Cow, Marked to Show Points in Judging.[1]

1—Head. 2—Muzzle. 3—Nostril. 4—Face. 5—Eye. 6—Forehead. 7—Horn. 8—Ear. 9—Cheek. 10—Throat. 11—Neck. 12—Withers. 13—Back. 14—Loins. 15—Hip Bone. 16—Pelvic Arch. 17—Rump. 18—Tail. 19—Switch. 20—Chest. 21—Brisket. 22—Dewlap. 23—Shoulder. 24—Elbow. 25—Forearm. 26—Knee. 27—Ankle. 28—Hoof. 29—Heart Girth. 30—Side or Barrel. 31—Belly. 32—Flank. 33—Milk Vein. 34—Fore Udder. 35—Hind Udder. 36—Teats. 37—Upper Thigh. 38—Stifle. 39—Twist. 40—Leg or Gaskin. 41—Hock. 42—Shank. 43—Dew Claw.

of this fad. In order to select animals wisely, one should be a good judge of the breed in which he is interested.

Records.—While a breeder can select cows by the eye for many good and desirable points, the only real test of a dairy cow is the record of her milk and butter-fat yield. This should be kept for every year that a cow stays in the herd. If the farmer has the time, he should keep other records, such as list of offspring, feed records and the like. The greatest improvement is possible only when complete records have been kept.

In order to ascertain the production of a cow, a pair of scales, a Babcock testing outfit and milk sheets are necessary. The most popular scale today is the Chatillon Improved Spring Balance, which can be hung

[1] Courtesy of U. S. Dept. of Agriculture. B. A. I. 15th Report.

in some handy place in the barn or milk room. The two hands on the dial enable one to read the amount of milk directly. The milk sheet can be made for the month, week or any convenient length of period. The monthly record is the most popular. It is desirable to have a space for tabulating ten-day periods for the reason that grain is usually fed in accordance with the yield of milk. The amount fed should be adjusted at least as often as every ten days. Some adjust it every week, but when added for ten days the amount can be read directly without division.

Records show that about one-third of the cows in the United States are "boarders," or cows that do not even pay for their feed. When it is remembered that so many cows are unprofitable, and that if records are not kept, the daughters of these same unprofitable cows will be retained in the herd, and in turn more than likely become unprofitable, the value of records in dairy herd improvement is readily understood. Records show that one-third of the dairy cows in the country should be killed. The net profits of the herds remaining would then be greater than is now the case.

Cow-Testing Association Records.—Since it takes time to keep records, groups of farmers find it economical to organize and employ a man to keep records for them. This man is called a supervisor, and his services enable a group of both small and large farmers to practice selection based on production. Since the supervisor must visit each farm at least one day in a month, only about twenty-five farmers can co-operate in the hiring of one man. A supervisor can be had for from $500 to $600 a year with board and room. If these twenty-five farms keep 500 cows, the expense of keeping records by the supervisor method is less than though the owners paid themselves for the time that they would take to keep the same records. The supervisor weighs all feed given to the cows during the day on which he visits the farm. From this data he figures the cost of the feed by the month. In the same way he weighs the milk from each cow and tests it for butter-fat. This enables him to calculate the production for a month. He figures for the owner the value of the product from each cow for the month at the price that the owner is receiving.

Each cow-testing association is bound together by by-laws, contracts and some sort of articles of confederation. In some cases the association buys feed in carload lots so as to reduce the cost to the members. Such an association must be gathered from a community covering a small area. Some cow-testing associations stretch over considerable territory.

Bull Associations.—One of the outgrowths of the cow-testing association is the bull association. These associations are often formed from a group of men within the cow-testing association. It is necessary that the members keep the same breed of stock. These men own a bull, or several bulls, together. The bull is kept in the community as long as he is a good producer. A good producing bull is one that is a sure getter, and whose heifer calves prove to be better producers as cows than their

dams. Such a bull should be given a herd as long as he will breed. Through the bull associations, it is often possible to bring into a community a bull of better breeding than any single member of the community could finance alone. It is not the cost of the bull that determines its value, but rather the producing ability of his daughters.

The bull association, to be of value, needs records, and the cow-testing association assures the records. They work well together.

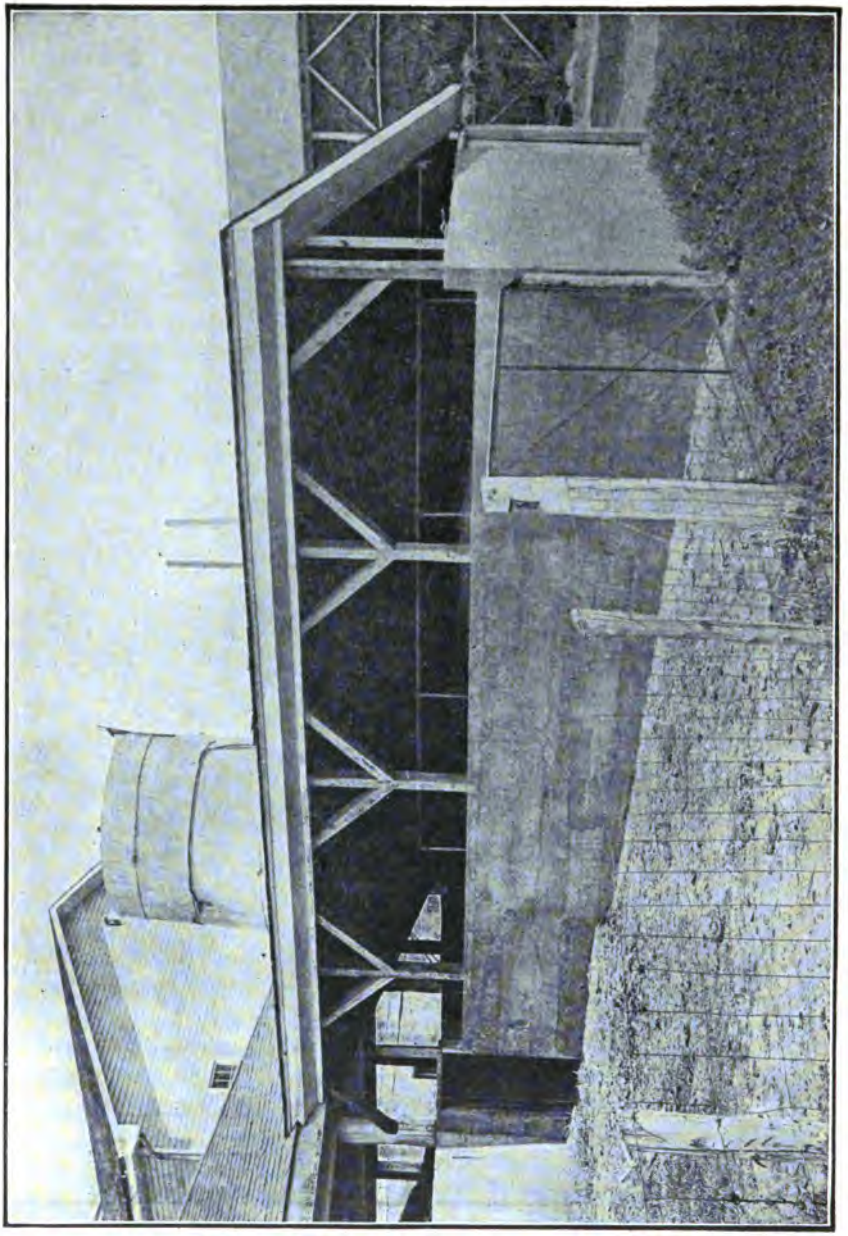
Advanced Registry Records.—Any daughter or son of a registered dam and sire can be registered in the herd-books of that breed association. Unfortunately, many registered animals are no better producers than scrubs. In order to improve the animals within a breed, the different breed associations have started Advanced Registry Requirements. These

A Good Dairy Herd.[1]
Exercise is beneficial to the health of the cows.

requirements are based upon performance, and hence only worthy animals find their names on its lists. The different breeders have different names for the books in which such animals are listed, but all serve the same purpose. Representatives from the different experiment stations vouch for the production of the animals after personal visits. Such records have done much toward developing the modern, wonderful milking cow. Pure-bred sires should have some near relatives whose names appear in the advanced registry of the particular breed. All breeders of pure-bred stock should be encouraged to make advanced registry tests so as to improve the sale of bull calves from their herds.

The Bull is Half the Herd.—It is one of the sayings of breeders that "the bull is half the herd." Where in-breeding is practiced, he is even

[1] Courtesy of the Department of Dairy Husbandry, Pennsylvania State College.



AN OPEN STABLE FOR HEIFERS.[1]

[1] From Maryland Agricultural Experiment Station Bulletin 177.

more than half. Even if the cows are scrubs, there is no place in the herd for a grade or scrub bull. Only a pure-bred bull should head a herd of cows. The bull should possess quality and type and come from a long line of good producing females. In order to be sure that a bull can improve a good herd of cows, only tested bulls should be used. In order to test a bull he should be bred when young to a few of the good cows in the herd and the resulting heifer calves watched. If they are better than their dams, a good herd sire is indicated.

Professor W. J. Fraser, of the University of Illinois, calculates that in a herd of thirty-five cows it costs $3 per heifer more to have them sired by a pure-bred bull than by a scrub. This, then, is the total cost of providing each heifer calf with one good parent. If this same heifer calf produces only three pounds of milk more a day than her dam, this, at 80 cents a hundred pounds, means that in six years of milking, for 300 days a year, she would bring the owner $43 more than her dam. On this basis the rate of interest on the investment is better than anything else on the farm. Professor Fraser believes his figures to be conservative.

The University of Missouri has a Jersey herd that has had the fortune of having some excellent bulls at its head and the misfortune of having had some sires of very poor quality. To illustrate: ten daughters from Lorne of Meridale, one of their bulls, would have produced in six years $900 more than their dams, while ten daughters of Missouri Rooter in the same time would have produced $980 less than their dams. This shows that two farmers of equal ability living on farms side by side, and of the same size, would differ $2000 in wealth at the end of six years with only ten daughters from such different character bulls. The necessity of records is seen when it is remembered that the "bull is half the herd."

Buying Cows or Raising Calves.—One cannot build up a dairy herd and continue to improve it by buying cows. The only way to improve a herd is by raising calves that are better than their dams. Near large cities it is a common practice to buy cows to replenish the herd. In this country, far from large cities, an excess of calves is raised. If all the cows in this far-removed section had good records this method could continue. The farmer who gets his herd free from tuberculosis and contagious abortion can hope to keep it so, providing he raises his own calves. It can never be done if he buys cows.

The new-born calf must be well fed and made to grow. The feeding of the calf undoubtedly has some effect on the later usefulness of the cow. A stunted calf will never be as good a cow as though she had never been stunted.

For purposes of record it is necessary that every calf be marked before being taken from its mother. This often seems unnecessary, but when the young heifer spends her first summer on pasture, the owner is liable to forget the particular animal unless he visits the pasture frequently, or unless the heifer has some very distinguishing mark. If the habit of

putting a tag in the ear, or some other good system of marking is established, trouble is avoided.

The calf should be fed so as not to develop scours or disorders of any kind. The best way is to feed the mother's milk for a few days, and see that all milk is warmed to blood heat. It should be fed only from clean pails. For the first few days it is well to feed three times a day; after that, twice a day is sufficient. The calf should be fed liberally, but more danger comes from over-feeding than under-feeding. Modern milk substitutes grow good dairy calves.

Developing the Young Animal.—Dairy cows are developed successfully in several different ways. The essential point is that the bone must be nearly grown at the time of dropping the first calf. Some feeders simply give large amounts of roughage to heifer calves during the winter after weaning from milk. In this way the frame grows, but little fat is put on. Other feeders give some grain, up to four pounds per animal per day, and this assures the heifer being in good flesh. When pastures are excellent, the first method is all right, but when pastures are only good or fair, better results are obtained by feeding some grain to heifers. A well-developed growing heifer gives more milk than one poorly developed, since she requires less feed for growth.

Open Stables for Heifers.—Heifers over one year old are today kept in open sheds facing the south. It is believed that this open-air method develops a stronger constitution and more hardiness, two qualities of great value in warding off disease later. This method of housing is much cheaper than housing in expensive closed quarters, and the results are at least equally good.

REFERENCE

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CHAPTER 11

DAIRY HERD MANAGEMENT

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The dairy cow is more sensitive to her treatment than any other of our productive animals. By care and breeding she has been developed into an animal of habit, and upon the care she receives depends largely the profits of the herd. The feed is an important item in the cost of milk production, but the systems practiced also materially affect the profits of the herd. It is no longer profitable to keep a cow all the year for the small amount of milk that she produces during the summer months while on pasture. The cheapest method of keeping a herd is not always the most profitable. This chapter deals only with the heifers from breeding time.

Age to Breed.—The age at which a heifer should be bred depends largely upon her size, but in general, an animal that has grown well can be bred to have her first calf when two years of age. During the last three months of the gestation period a heifer grows very little, so that it is not advisable to breed a small heifer too young, and some prefer to wait until the heifer is two and one-half years old before she has a calf. A heifer bred too young will not attain a large size, which is desirable in a dairy cow.

Gestation Period.—The gestation period of a cow is from 280 to 285 days. It is a good practice to keep a record of service, so that the cow can be properly taken care of before calving time.

Regularity.—A regular routine of work should be planned for the herd so that the cows will receive the same treatment each day. Any disturbance or irregularity affects both the amount and quality of milk. The cows should be milked at the same time each day. The milker should start at the same end of the row and be as regular in the treatment of the cows as possible. There are a number of points to keep in mind in planning the routine of the cow stable. Grain may be fed before milking, but hay should not be, because of the length of time it takes to eat it and because of the dust it will raise. Silage also should not be fed immediately before milking, because of the effect in the flavor of the milk. The stable should be cleaned before milking, if possible, and if the cows are kept in the stable, the grooming should also be done before milking. The cows need not be watered until after the morning feed is given. Hay should be fed late in the evening.

Care of Cow at Calving Time.—A cow should be carefully watched and fed during calving time. She should be provided with a clean, well-bedded

stall. For several days previous to calving she should be fed a bulky ration and one that is laxative. She should not be given heavy grains. A mash of ground oats and bran is good. For two or three days before calving time she should be given slightly warmed water. Do not give cold water. After two or three days the cow can gradually be put on the regular grain and roughage feed, but the feeding should not be too heavy to start with.

Rest for Dairy Cows.—It is desirable to give a cow at least six weeks of rest each year. Most cows dry off before this time, but occasionally persistent milkers give a considerable supply up to the time of their next calving. When this is allowed, it is at the sacrifice of the milk in the next

A Good Cow Stable.[1]

Convenience in arrangement, ease of cleaning, plenty of light and good ventilation are essential to the health of cows and the production of clean, pure milk.

lactation period, and also sometimes at the sacrifice of the calf. It is sometimes difficult to dry off a cow, but usually by cutting down the grain and giving straw or timothy hay she can be reduced to a sufficient amount to be safe to stop milking her. It is sometimes desirable to milk once a day for a while and then stop altogether. It is not safe to stop milking her if she is giving too much, although cows producing as much as six to eight quarts have been dried off without injuring them.

Care of Cows when Dry.—A cow should be well taken care of when dry, for she is then preparing for her next milking period, besides growing the calf. Nearly all of the development of the calf takes place during the last few weeks. She should be given succulent and laxative feeds and should be well fed.

[1] Courtesy of the Department of Dairy Husbandry, Pennsylvania State College.

Exercise.—Many dairymen believe that a cow receives all the exercise she needs in producing milk, but on many farms it is desirable to turn the cows out for a part of the day. It not only gives a better opportunity to clean out the barn, but also gives the cows an opportunity to rub themselves, and their feet and legs keep in better condition. Too much exercise, of course, requires energy at the expense of milk production. Cows that are required to walk long distances do not do as well as those that are more confined. Cows should not be turned out during bad weather and exposed to rains and cold winds.

Grooming.—Cows kept in the stable all, or nearly all, of the time should be carefully groomed at least once a day. It is believed by many that grooming has an effect upon the milk flow. Cows seem to do better for having been groomed.

Milking.—A good milker has a fairly rapid, uniform stroke which he continues throughout the milking period. The whole hand should grip the teat and the pressure should come from the whole hand. The practice of using the thumb and first finger is not recommended. The milking of diagonal teats is thought to give best results. The Hegelund method of the manipulation and milking has been found to stimulate milk production. A cow milked by this process gives more milk. The steps are described as follows:

"First Manipulation: The right quarters of the udder are pressed against each other (if the udder is very large, only one quarter at a time is taken) with the left hand on the hind quarter and the right hand in front on the fore quarter, the thumbs being placed on the outside of the udder and the forefingers in the division between the two halves of the udder. The hands are now pressed toward each other and at the same time lifted toward the body of the cow. This pressing and lifting is repeated three times, the milk collected in the milk cistern is then milked out, and the manipulation repeated until no more milk is obtained in this way, when the left quarters are treated in the same way.

"Second Manipulation: The glands are pressed together from the side. The fore quarters are milked each by itself by placing one hand, with fingers spread, on the outside of the quarter and the other hand in the division between the right and left fore quarters; the hands are pressed against each other and the teat then milked. When no more milk is obtained by this manipulation, the hind quarters are milked by placing a hand on the outside of each quarter, likewise with fingers spread and turned upward, but with the thumb just in front of the hind quarter. The hands are lifted and grasped into the gland from behind and from the side, after which they are lowered to draw the milk. The manipulation is repeated until no more milk is obtained.

"Third Manipulation: The fore teats are grasped with partly closed hands and lifted with a push toward the body of the cow, both at the same time, by which method the glands are pressed between the hands

and the body; the milk is drawn after each three pushes. When the fore teats are emptied, the hind teats are milked in the same manner."

Difficult Milking.—Occasionally cows are difficult to milk because of defective teats. Sometimes the openings are too small, in which case an instrument known as the bistoury may be used, but there is danger of greatly injuring the teat, and it should be used only by those experienced in its use. Only with especially good animals does it pay to spend much time with such cows. Sore teats, caused sometimes by teats becoming wet and exposed to the cold, can best be treated by rubbing them with vaseline or some antiseptic grease. A cow that has developed the kicking habit is a great annoyance. Sore teats and abuse, however, are often the cause. Most cows, by gentle treatment and care of the teats, will cause little trouble. Some, however, are naturally vicious, but these are few in number. A strap tied around the body of the cow just in front of the udder, and drawn fairly tight, will prevent most cows from kicking. A clamp made of wood with two straps, long enough to reach around the leg of the cow, will prevent her from bending her leg, making it impossible for her to kick.

Abuse.—A dairy cow should always be handled gently, for any disturbances affect her. Loud noises or any unusual disturbances should be avoided. A cow should never be struck or mistreated, nor should she be talked to in a loud voice.

Water and Salt.—A cow requires considerable salt, and this should be given regularly. One practice is to mix it with the grain, but the maximum requirements should not be given in this way, for a cow may be required to eat more than she wants of it. A little in the grain is all right, but a small amount should be given regularly, perhaps once a week, so that she can get all she wants. A cow will eat about one-half pound of salt a week.

An abundance of good water should be provided for dairy animals. A cow producing large quantities of milk will consume as much as one hundred pounds, or more, per day. Heavy milkers should be watered twice a day. The water should not be too cold, but at the same time it is well not to have it too warm. A uniform temperature is desirable.

Stabling.—With most large dairy herds it is customary to have regular stanchions in which the cows can all be tied up in rows. This seems the best system where high-class milk is being produced. For the small herd, the practice of allowing the cows to run in an open shed is being followed. This method of housing, however, makes it possible to keep the cows in a more healthy condition and to produce milk more economically. An experiment has been conducted by The Pennsylvania State College of housing cattle in an open shed as compared with a closed stable, and is summarized as follows:

"1. From the data presented it appears that cows kept under an

open shed have keener appetites and consume more roughage than those kept in stables.

"2. There was sufficient protein consumed when either Van Norman's or Eckles' Standard was used to account for the yield of milk in addition to maintenance.

"3. Figured on Eckles' Standard, there was a slight excess of energy consumed above maintenance and milk production the first two years, and a small deficiency the last year. When computed on Van Norman's Standard, there was a deficiency in energy consumed for maintenance and milk production, except for one group the second year.

"4. The milk yield of the outside group decreased more rapidly each winter than that of the inside group.

"5. Sudden drops in atmospheric temperature caused corresponding decreases in milk yield for both groups, the outside group having a slightly greater decrease.

"6. More bedding was required outside, but less labor was necessary to keep the animals clean.

"7. Both groups finished each winter's trial in good health with the exception of one that reacted to the tuberculin test in April, 1914. She had shown no reaction in two previous tests. The hair of the animals kept outside was longer and coarser the first two winters. The third winter this was noticeable in only one ainmal."

Flies.—In the management of a milking herd, the problem of flies is a difficult one. Not only are they annoying to the cow and the milker, but they also carry disease. They should be reduced to as small a number as possible. It is believed that they do not travel a great distance, so that a farmer may have them fairly well under his control. Manure should not be allowed to accumulate, and if it does, it should be treated with some spray or disinfectant that will kill the flies. There are a number of sprays on the market that can be used for killing flies in the barn. Some have found traps to be practical.

Marking the Cow.—For the purpose of identification, dairy animals should be marked. Some have a system of clipping the ears with certain notches to represent the various figures and thus of keeping records. This, however, is not very satisfactory. An ordinary hog ring with a metal or composition tag fastened to it makes a satisfactory marker. Occasionally these are torn out, but if they are properly put in and the tag is small and round, they will stay a long time. The tattoo is also being used successfully when good tattoo material is used.

Dehorning.—In the general milking herd all cows should be dehorned. There is more or less pain connected with the operation, but it does not, in the estimation of the writer, compare with the pain due to the cows being gored day after day. It prevents the possibility also of one animal that may be "boss" depriving others of their rightful share of food and water. The dehorning, however, should not be done until the animal has

reached the age of two years, for if it is done before this, growth takes place and scurs will be formed. The dehorning should be done in cold weather and when there are no flies. The horns should be cut or clipped as quickly as possible.

CARE OF THE BULL

A young bull should not be used too much for breeding purposes. He should be kept growing and should be well cared for, but not overfed. A good, thrifty young bull may breed six or seven cows before he is one

LEADING A BULL.[1]

year old with no injury to him. Even during the second year he should not be used too much. Often a young bull is injured by overuse. A cow should be served only once during a period of heat. A bull should never be allowed to run with the herd, but should be kept in a separate inclosure. He should be given exercise and be kept out in the open as much as possible. Where two bulls are needed in a herd, it is a good practice to dehorn them and then turn them together, or even train them to drive. A yard in which a bull is kept should be strongly fenced, for they are powerful, and once they break through a pen, it is very difficult to get anything that will hold them. They should be sheltered from the winds and rain, but can stand the cold. Bulls sometimes become vicious, due to treatment, although

[1]Courtesy of Orange-Judd Company, N. Y. From "The Young Farmer," by Hunt.

some bulls are naturally cross. In any case, great care must be take with them. They should never be trusted. They should always have a ring in their noses and be led by a stock from the ring. Bulls seem to know when a man is afraid and are more apt to attack such a one than one who is more courageous. A bull that becomes vicious is often subdued by being thrown with a rope. He then learns that he is under the control of man. The amount of service that a bull may have depends upon his age and condition. During the second year, a good, thrifty bull can be used once a week. A mature bull may serve one hundred to two hundred cows a year if the periods are distributed well throughout the year. In general, however, because of the variation in the intervals in which cows come in heat, a bull should be provided for each forty to fifty cows.

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CHAPTER 12

DAIRY BREEDS OF CATTLE

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Dairy Breeds Essential.—Choosing a dairy breed of cattle is fundamental to successful dairying. The modern improved breeds of dairy cattle are the result of high ideals, carefully laid plans and systematic effort on the part of many generations of dairymen who realized there were great possibilities in the development of breeds of cattle especially adapted for large and economical production of milk and butter-fat. Cattle which are true representatives of the recognized dairy breeds are very distinct from ordinary native cattle and cattle of the improved beef breeds, both in conformation and production of milk. They also tend to reproduce themselves from generation to generation with such marked degree of uniformity that one familiar with their history and characteristics would reject any other kind if he were engaged primarily in dairying. Natural laws that govern the reproduction of plant and animal life and preserve forms of like character from generation to generation and the experience of a vast number of dairymen teach the value of preserving and utilizing the distinct dairy breeds of cattle for dairy purposes.

Dairy Type Common to All Dairy Breeds.—The development of dairy breeds has established a distinct dairy type that is naturally correlated with extensive milk production. Dairy type refers to the conformation and peculiarities of the body that are characteristic of animals capable of producing large and economical yields of milk and includes the following:

1. Medium to large size of body for the breed.
2. Large feed capacity, as indicated by a roomy and capacious abdominal cavity, a large mouth and sufficient strength of body to consume and utilize a large quantity of feed.
3. Dairy temperament or a disposition to convert the larger portion of feed consumed into milk rather than body flesh. It is indicated by the absence of surplus flesh and a comparatively lean and refined appearance of the entire body.
4. An udder that is large, carried well up to the body, evenly and normally developed in all quarters and of good quality.
5. A strong, healthy flow of blood to all parts of the body, giving vigor, alertness and constitution. These characteristics are indicated by prominent facial, udder and mammary veins, abundant secretions in the ears, skin of the body and at the end of the tail and a coat of fine straight hair.

Ignorance of breeds and breeding and of proper feeding and management cause a great many cows to fall below the standard embodied in the foregoing qualifications for dairy type. This fact, however, is no argument against the merit of improved breeds and should not cause one to question the value of well-established dairy breeds.

Recognized Dairy Breeds of America.—Ayrshire, Brown Swiss, Guernsey, Holstein-Friesian and Jersey breeds of cattle are recognized and have been exhibited at the National Dairy Shows of America as specific dairy breeds. Dairy cattle of the Dutch Belted, French Canadian and

A Typical Ayrshire Cow. "Auchenbrain Hattie."
Medium in size, usually red and white, horns upturned and pointed.

Kerry breeds are bred and maintained in America in comparatively small numbers. The unimportance of these breeds in well-developed dairy districts, however, does not warrant more than mention and a very brief discussion of them in the limited space of this article.

AYRSHIRE CATTLE

Origin and Development.—The County of Ayr in southwestern Scotland is the native home of the Ayrshire breed. The land in this section is rolling and more or less rough, the climate moist and the winters extremely cold, except for being somewhat tempered by the Irish Sea. The hills

produce rolling pastures in most parts, while the better lands grow grain crops and grass in abundance. The conditions, on the whole, demand a hard yrustling breed of dairy cattle, and Ayrshires have been developed to suit the needs of their native country. Early history records the use of several different breeds of cattle which undoubtedly have contributed to the establishment of the Ayrshire breed. Teeswater, Shorthorn, Dutch, Lincoln, Hereford, Devon and West Highland breeds are mentioned by various authors as having been used. Whatever the true origin may have been, the breed has been bred pure for many years, and its character fixed after the manner of other pure breeds of livestock developed by the Scotch people. The production of a breed of cattle suited to the condition of environment of that country, and especially adapted for the production of large yields of milk, was the standard which guided the breeders in fixing the characteristics of this breed. The breed has found favor in other countries and to a greater or less extent in all dairy sections of America, especially in the New England states and the provinces of Canada.

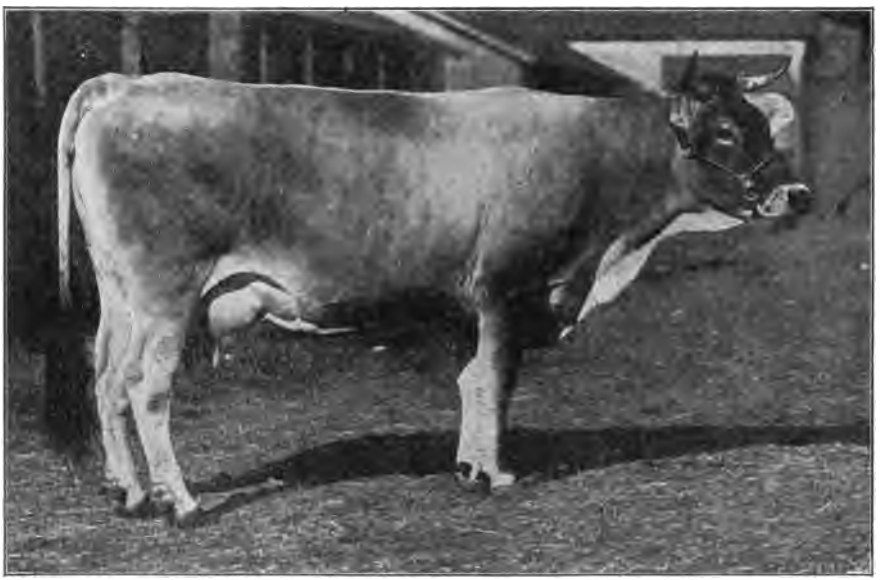
Characteristics of Ayrshire Cattle.—Ayrshire cattle are medium in size. Cows should weigh on the average 1000 pounds and bulls 1500 pounds. The color is a combination of white, red, brown and black. White predominating with red or brown markings is the more popular color. There are black and white Ayrshires in Scotland whose purity of blood is not questioned. A neat head with horns of medium length, inclining upward, a body with straight top line, well-developed chest, arched ribs, deep flank, and comparatively smooth hind quarters and an udder that is symmetrical and well balanced in form and well carried up to the body characterize the typical Ayrshire cow. The size of teats in many cows is subject to the criticism of being too small and one will do well to bear this in mind in making selections. The milk production of mature cows has in a few instances, under official tests, exceeded 20,000 pounds of milk per annum. An Ayrshire cow should be expected to yield 6000 to 8000 pounds of milk under ordinary conditions. The milk tests in the neighborhood of four per cent butter-fat. The highest official yearly production for an Ayrshire cow to date was made by Auchenbrain Brown Kate 4th, 27943, owned by Percival Roberts, Jr., Narberth, Pa. Her yearly production amounted to 23,022 pounds of milk testing 3.99 per cent and 917.6 pounds of butter fat.

BROWN SWISS CATTLE

Origin and Development.—The Brown Swiss breed of cattle has its origin in Switzerland and the cattle by virtue of their native home are strong, rugged and hardy. In this country they have been developed with reference to their dairy qualities to the extent that they have become recognized as one of the distinct dairy breeds. Up to 1907 they were bred and largely advertised as a dual purpose breed. In the meantime, however, the American breeders have given careful attention to selecting

types and developing strains which excel more particularly in yield and economy of milk production. In the eastern and middle sections of the United States the breed is gaining favor and promises to have a place sooner or later of equal rank with older and better recognized breeds of dairy cattle.

Characteristics of Brown Swiss Cattle.—The breed is noted for its large size and ruggedness. Due to comparatively large bones and robust appearance, it is sometimes regarded as too coarse for economy of production. Cows will vary from 1200 to 1400 pounds in live weight at

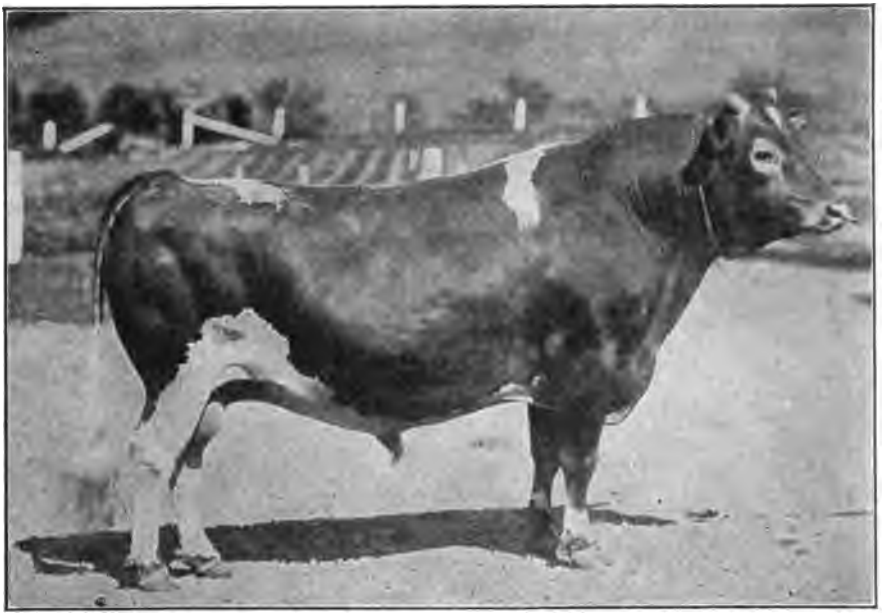


A Brown Swiss Cow.[1]

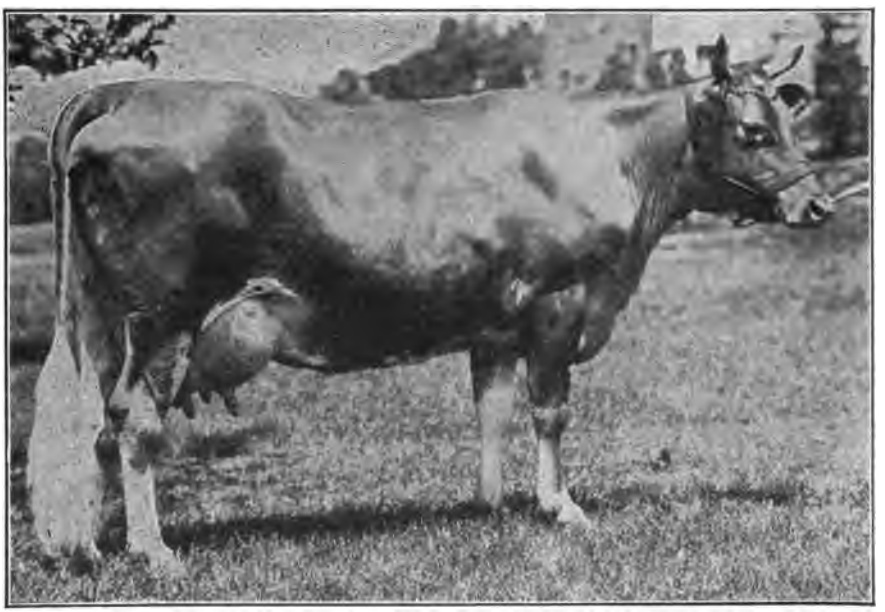
maturity, and bulls quite frequently exceed 2000 pounds in weight. There is a tendency toward refinement and less size where dairy type is sought and selected to take the place of the former dual purpose type. Breeders aim, however, to maintain good size and large capacity for milk production in their efforts to develop herds of this breed.

A dark-brown or mouse color with a line of gray along the back, a mealy ring about the muzzle, a light fringe of hair on the inner side of the ear and more or less light hair on the under side of the body, constitutes the characteristic color of the cattle of this breed. Quite frequently the lighter gray color covers the entire body.

[1] Courtesy of The Field, New York.



A Guernsey Bull.[1]



A Typical Guernsey Cow.

[1] Courtesy of The Field, New York.

The head and neck are comparatively heavy; the males, and quite frequently the cows, carrying more or less dewlap. Well-developed udders, proportionate in size to the size of body, are sought in the selection of mature cows. A register of production for animals of superior merit has been formed by the American Brown Swiss Cattle Breeders' Association and there is a loyal effort on the part of breeders to make records that will compare favorably with records of other breeds. The breed has demonstrated its ability to make very profitable productions of milk and butter-fat. The milk tests on the average about 4.0 per cent. The highest official yearly record for a Brown Swiss cow at the present time is 19,460.6 pounds of milk, testing 4.1 per cent and 798.16 pounds of butter-fat. This record was made by the cow College Brauvura 2d, 2577, owned by the Michigan Agricultural College, East Lansing, Mich.

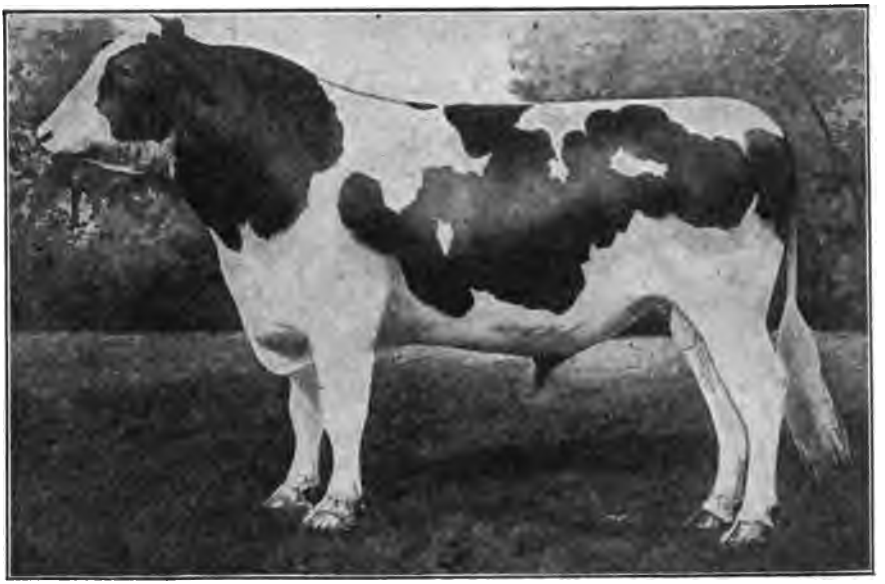
GUERNSEY CATTLE

Origin and Development.—Guernsey cattle take their name from Guernsey Island, located in the English Channel not far from France. This island and two smaller ones, Alderney and Sarnia, belong to the Channel Islands group, and is where the Guernsey breed originated and has been developed. These islands, of which Guernsey is the largest, contain only 2600 acres. On Guernsey the land is more or less hilly and rough, and the farms are small and devoted exclusively to horticulture and dairying. Many of the crops, such as grapes, melons and flowers, are grown in greenhouses. The cattle are owned in small herds and, in order to make the best use of the available pastures, are tethered or staked out when allowed to graze.

The people devote their attention to the one breed of cattle and exclude all other cattle from the island, except those which may be imported for immediate slaughter. The breed undoubtedly has its origin in stock of early French varieties known as Brittany and Normandy cattle. The production of a rich quality of high-colored milk and butter has always been the principal object in breeding and developing this breed, and naturally this has resulted in excellence of performance on the part of well-grown cattle of the breed.

Guernsey cattle were introduced into America early in the nineteenth century, but not until 1893, when the dairy qualities of Guernsey cattle were brought to the attention of the general public by records made at the World's Columbian Exhibition at Chicago, did Guernsey interests develop to the extent they deserved. The American Guernsey Cattle Club was organized in 1877, and of late years many importations of Guernsey cattle have been made and much enthusiasm has been aroused on the part of dairymen in exploiting and developing the interests of the breed. The breed ranks at the present time as one of the most popular.

Characteristics of Guernsey Cattle.—The standard weight for Guernsey cows is 1050 pounds, and for bulls 1500 pounds. Standards which



A Holstein-Friesian Bull.[1]
The largest of dairy breeds—color, black and white.

A Typical Holstein Cow.[1]

[1] Courtesy of The Field, New York.

demand excellence in conformation and characteristics pertaining to dairy type are fulfilled by many cattle of the breed. Development for usefulness rather than for beauty of form has resulted in a lack of refinement and neatness of outline in a good many of the cattle. The comparatively few Guernsey cattle in the country encouraged breeders to retain all pure-bred animals and this accounts for much of the lack of uniformity that exists. The American Guernsey Cattle Club was first to establish an advanced registry for official annual productions of milk and butter-fat and this again has been a standard toward which breeders have worked to a greater extent in many instances than they have for excellence of form. Marked improvement, however, in uniformity and excellence of dairy form has been noted in the show herds exhibited during the past few years.

In color the Guernsey is a shade of fawn, varying from dark-red to light-yellow with white markings. The color of the muzzle in most instances, which is regarded as most desirable, is buff or flesh color. A dark muzzle is permissible but undesirable on the part of critical judges. More emphasis is laid upon rich yellow secretion in the skin, especially in the ear and at the end of the tail, together with a yellowish appearance of the horns and hoofs than is laid upon the color markings. The rich orange secretions of the body are believed to indicate a rich yellow color of the milk, which is regarded as a most important Guernsey characteristic. Guernsey milk is not only yellow but of good quality, testing in the neighborhood of five per cent. The yield of milk under ordinary conditions should be 6000 to 7000 pounds per annum. Under official tests, many Guernseys have far exceeded this amount. In three instances Guernsey cows have held the world's championship record in butter-fat production. The highest official yearly record of milk and butter-fat production held by a Guernsey cow was made by Murne Cowan, 19597, owned by O. C. Barber, Akron, Ohio, her production amounting to 24,008 pounds of milk, testing 4.57 per cent and 1098.18 pounds of butter-fat.

HOLSTEIN-FRIESIAN

Origin and Development.—Holstein-Friesian cattle, commonly called Holsteins in America, have their origin in Friesland, a province of Holland bordering on the North Sea, where low, fertile dyke lands have been favorable for the development of a large breed of cattle capable of making large productions of milk. History records that for a thousand or more years these cattle had been bred and utilized for dairy purposes. Since 1885 they have been extensively introduced into most of the dairy sections of America and because of their large size and the large quantity of milk which it is characteristic of them to produce, the breed ranks as one of the most popular.

Characteristics of Holstein-Friesian Cattle.—The type and size of the cattle of this breed varies considerably and the terms "beef," "beef

and milk," "milk and beef," and "milk forms" are used to describe the different types. The milk and beef form is the most generally accepted type and should be the aim of men engaged in the breeding of these cattle. Extreme milk form is usually the result of improper growth on the part of young animals or selection of breeding stock which produces too much refinement. The following quotation characterizes true Holstein type and owners and breeders of Holstein-Friesian cattle base their claim for the superiority of this breed on the following points:

1. "That the Holstein-Friesian is a large, strong, vigorous cow, full of energy and abounding in vitality.
2. "That her physical organization and digestive capacity is such that she is able to turn to the best advantage the roughage of the farm, converting the same into merchantable products.
3. "That she produces large quantities of most excellent milk fit for any and all uses, and fit especially for shipping purposes.
4. "That heredity is so firmly established through her long lineage that she is able to perpetuate herself through strong, healthy calves.
5. "And that when, for any reason, her usefulness in the dairy is at an end, she fattens readily and makes excellent beef."

Cows of this breed should weigh 1200 to 1400 pounds. Mature bulls ordinarily weigh 1900 to 2000 pounds or over.

Black and white is the characteristic color in America. More or less white should extend below the knee and at least some black should be present where white predominates. The two colors should be distinct from one another. In Holland red and white is characteristic of many cattle of this breed and occasionally in America there are cattle born of this color. Such cattle, however, are not eligible to register in the herd books of the American Holstein-Friesian Association.

The breed excels in quantity of milk rather than quality, the fat in the milk under ordinary conditions being 3 to 3.5 per cent. A higher test is unreasonable to expect where the large flow of milk characteristic of this breed is maintained. In some instances, the fat falls below 3 per cent, which is regarded as too low, even in cheese districts where this breed is very popular. A low percentage of fat should be avoided by the careful selection of sires whose dams yield milk of a higher percentage of fat. Naturally this breed with its large size and natural tendency to produce milk of low percentage of fat has always excelled all other breeds in milk production. Cows of this breed have in four instances won the championship record for both milk and butter-fat production, and hold the world's record at the present writing, with a production amounting to 28,403.7 pounds of milk testing 4.14 per cent and 1176.47 pounds of butter-fat, made by the cow, Finderne Pride Johanna Rue, 121083, owned by Somerset Holstein Breeders' Company, Somerville, N. J.

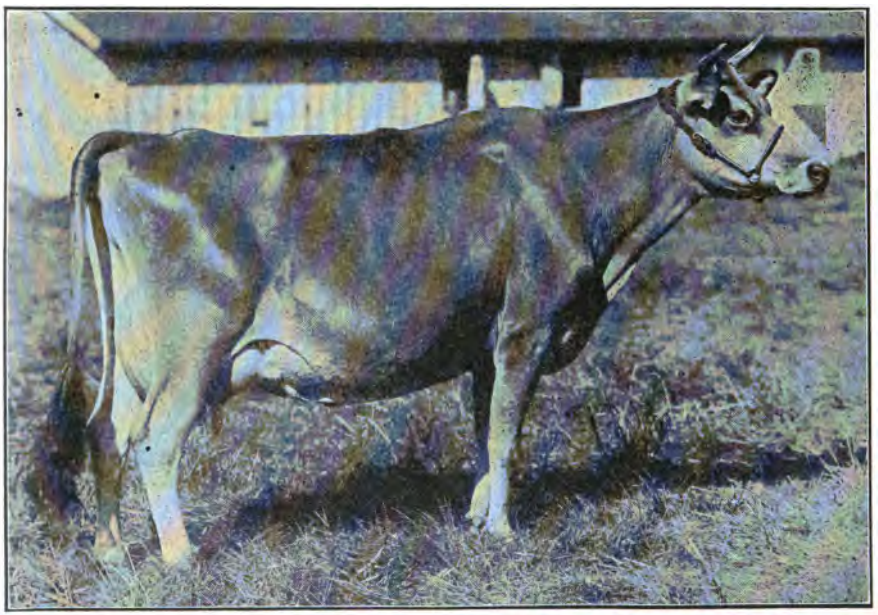
HOLSTEIN-FRIESIAN BULL AND COWS.[1]

This breed excels in size and production of milk. They can be fattened readily should their usefulness in the dairy herd cease, and make excellent beef.

[1] Courtesy of "The Field, Illustrated," N. Y.

JERSEY CATTLE

Origin and Development.—Jersey cattle were originally developed on the Island of Jersey, the largest of the Channel Islands group, where a delightful climate, a rich soil and a people united in their effort to excel in the production of a single breed of dairy cattle combined to make conditions most favorable for perfecting and preserving the breed. In 1793 enactments began restricting the importation and maintenance of cattle other than Jerseys, which finally resulted in its being a crime to keep cattle of other kinds on the island for a longer period than twenty-four hours when they had to be slaughtered for beef.



A Jersey Cow.[1]

Jerseys, as nearly as history reveals, share with Guernseys the blood of the old Brittany and Normandy cattle of France, in which they undoubtedly have their principal origin.

The Jersey breed early attracted the attention of England's aristocracy, who introduced them into England to beautify parks and furnish the rich milk that it was characteristic of them to produce. Beauty of form has been as much a part of the standard of excellence that guided the breeders in the development of their cattle as has production of milk, and has resulted in cattle of marked refinement and beauty.

[1] Courtesy of The Field, New York.

Remarkable herds were produced in England, From the herd of Philip Dancey of that country, the bull Rioter, 746E, was brought to America and to him the St. Lambert family of Jersey cattle, so prominent in this country, all trace.

The American people have imported many Jersey cattle both from the Isle of Jersey and from England, and have always regarded cows of the breed most excellent butter producers. Practical dairymen whose choice of breeds has been the Jersey, have favored the larger-sized cows and persistently worked to secure large productions of milk and butter. As a result, many of the American-bred Jerseys are larger and more robust and productive than the so-called island type. The greater size and production of the American type of Jerseys has enabled the breed to hold a popular place in dairy states and districts with other dairy breeds.

Parallel with the development of the American-bred type of Jersey, many people have taken great pride and pleasure in maintaining and preserving the refined and smaller sized island type. Jersey cattle have been quite universally distributed over the world and under proper care and supervision give excellent satisfaction.

Characteristics of Jersey Cattle.—Jersey cattle conform to a dairy type that is usually extreme. They are regarded as most economical producers of butter because of the marked dairy capacity they possess in proportion to their size. The size varies according to the strain or family and for cows ranges from 700 to 1000 pounds. Bulls will range from 1100 to 1500 pounds. The American-bred families, more especially the St. Lambert's, are larger than the imported stock from the Isle of Jersey or from England.

The breed matures early and as a result many mistakes have been made in carelessly and intentionally having young heifers produce their first calves at too young an age. This practice, together with scant feed rations, not only reduces the size but the constitution and usefulness of any breed and, for a breed that is naturally small, results in severe criticisms that are unfair when they apply to a breed rather than to individuals. Jersey cattle that are properly reared and well cared for tend to be long lived and very satisfactory dairy cattle. They have ranked high in economy and production tests at many shows and expositions and the production of cows admitted to the Jersey register of merit verify the fact that cows of this breed have highly developed powers for dairy production. The milk is of rich quality, testing ordinarily around 5 per cent. It is reasonable to expect a production of 300 pounds of butter-fat annually as an average per cow in herds that are well selected and managed. Jacoba Irene, 146443, an American-bred cow, owned by A. O. Auten, Jerseyville, Ill., in three consecutive years produced 42,900 pounds of milk and 2366.1 pounds of butter-fat. The present highest yearly record of butter-fat production made by a Jersey cow is 999.14 pounds, the amount of milk being 17,557.8 pounds testing 5.69 per cent, a record made by Sophie 19th of Hood Farm, 189748, owned by C. I. Hood, Lowell, Mass.

OTHER DAIRY BREEDS

The Dutch Belted, French Canadian and Kerry breeds of cattle heretofore mentioned rank as dairy breeds, but representatives of them are comparatively few and in many sections unknown.

Dutch Belted cattle are so-called from their peculiar marking which is black with a white band about the middle of the body. This characteristic color is uniformly found in all pure-bred herds of the breed, and is the result of scientific breeding experiments in Holland where the breed had its origin, and was known as Lakenfeld cattle from the word "Laken," meaning blanket or sheet about the body.

The usefulness of the breed was not a primary object in its development and for that reason it does not enjoy a popularity common to more prominent breeds.

Marked general improvement in type and production and an increase in the number of cattle is the ambition of those who are promoting the breed in America.

French Canadian cattle are a local and popular class of dairy cattle in the somewhat rough country and severe winter climate of the province of Quebec, Canada. Here the breed has been developed from early French stock and bred for over two hundred years. The characteristics of the cattle resemble very much the Jersey breed and lead to the belief that they have the same origin in blood. Their hardiness and adaptability to withstand Canadian winters and make economical yields of rich milk are commendable.

A production of 5000 pounds of milk testing 4 per cent or more is regarded as a fair average annual production for cows of this breed.

Kerry cattle originated in the Kerry mountains of Ireland under most adverse conditions of soil, climate and people. They have been called "the poor man's cow." They are very small as a natural result of their poor environment, bulls weighing 800 to 1000 pounds and cows 400 to 700 pounds. There are two types of the breed resulting from a cross which resulted in the type called the Derter-Kerry, which is smaller and more beefy than the original true Kerry. The economic value of Kerry cattle is best appreciated in its native home, where its adaptability, hardiness and ability to rustle and thrive recommend it. The novelty of the breed has led to a very limited distribution of the breed, a few herds having been introduced into Canada and the United States.

DAIRY BREED ORGANIZATION IN AMERICA

The welfare and preservation of breed interests are secured by responsible national breed associations that are recognized and approved by the United States Department of Agriculture, Washington, D. C., and the Canadian Department of Agriculture, Ottawa, Ont. All the dairy breeds of cattle except the Kerry have such organizations which are supported by a membership composed of the cattle breeders whose interest

prompts them to become members, and by all who register pure-bred cattle of the respective breeds. Each association registers only cattle that are eligible by virtue of their purity of breeding, proper identification and being formally and regularly presented for registration on forms of application furnished by the association and certified to by the breeder or owner. Certificates of registry are furnished the breeders or owners and all transfers of ownership of registered animals where the identity of subsequent offspring is to be preserved must be formally reported. Upon being reported it is recorded and a certificate of transfer issued to the owner.

The associations all publish herd books containing a complete list of all registered animals and in most instances also publish literature that is useful and helpful in promoting its cattle interests. One who is particularly interested in a given breed will do well to avail himself of such literature, which is usually furnished gratis to those who apply for it. The location of the office and the secretaries of the respective associations can be readily determined by writing the national departments of agriculture, heretofore mentioned, if not by acquaintance with breeders of registered stock.

In addition to a registry of the names of pure-bred animals, the five more important breed associations maintain an advanced registry or register of merit for cattle which have excelled in production and made official records of milk and butter-fat equivalent to or surpassing definite standards fixed for periods varying from seven days to one year.

Following is a tabulated statement of the requirements for respective breeds, ages and periods of production:

Age.	Ayrshire.		Brown Swiss.		Guernsey.	Holstein.	Jersey.		
	Year Record.		Year Record.		Year Record.	7-Day Record.	7-Day Record.		Year Record.
	Pounds Milk.	Pounds Butter Fat.	Pounds Milk.	Pounds Butter Fat.	Pounds Butter Fat.	Pounds Butter Fat.	Pounds Butter Fat.	Pounds Butter Fat.	Pounds Butter Fat.
2 years.....	6000	214.3	6000*	222.0*	250.5	7.2	12.0	14.0	250.5
3 years.....	6500	236.0	6430	238.5	287.0	8.8	12.0	14.0	287.0
4 years.....	7500	279.0	7288	271.3	323.5	10.4	12.0	14.0	323.5
5 years.....	8500	322.0	8146	304.2	360.0	12.0	12.0	14.0	360.0.
6 years.....	....	.....	9000	337.0	.....	....	....	....	.....
Requirements increase each day by pound	1.37 and 2.74	0.06 and 0.12	2.35	0.09	0.1	0.00439	....	....	.1

* Two and one-half years.

Great advancement in the appreciation and breeding of pure-bred cattle has been and is being brought about by volunteer state and community organizations. The closer contact which these associations have with the masses engaged in dairying make their opportunity greater than that of national associations for giving encouragement to men to use the very best breeding animals, especially sires, that it is possible to secure. In fact, such organizations cannot be encouraged too much, for in the work of local breeders and community effort lies the success of maintaining high standards of excellence and the preservation of all breeds.

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CHAPTER 13

CLEAN MILK PRODUCTION

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More than half of the milk produced in the United States is used for direct consumption. Pure, clean milk is an excellent food and is cheap. It contains all the essential elements for a complete and balanced ration for man. On account of its being used by infants, children and invalids who are least able to resist the effects of unclean food, and because milk is so easily contaminated, it is essential that great care be taken in its production and handling.

CLASSES OF MILK

Sanitary Milk is no definite class of milk. It is simply a term used to designate good, clean milk produced with extra care. It is usually sold at a price somewhat above prevailing milk prices.

Guaranteed Milk is milk that the producer guarantees to be produced under certain conditions and usually with some standard of fat and bacterial content.

Standardized Milk is milk which has been altered in its amount of butter-fat by skimming or the adding of cream.

Certified Milk is milk that has been produced under certain conditions prescribed by a commission, usually consisting of a veterinarian, a physician, a chemist and a bacteriologist. The prescribed conditions include scrupulously clean methods, healthy cows, healthy milkers and carefully sterilized utensils. Such milk should not contain over 10,000 bacteria per cubic centimeter. It is usually sold at a considerably higher price than ordinary milk.

Inspected Milk is produced from healthy cows that have been inspected. The inspection involves an examination by a city or state inspector of premises and methods.

Pasteurized Milk is milk that has been heated to a sufficiently high temperature to kill the harmful bacteria, or germs, and then immediately cooled. The temperature to which it is heated varies with the length of time it is held. For market milk, it is customary to heat to 140° to 145° F. for twenty minutes.

Modified Milk is high-class milk, such as certified or sanitary milk, altered in composition to suit certain uses. Such milk is used for infants and invalids.

EQUIPMENT AND METHODS

Clean, Healthy Cows.—The first essential in the production of clean, healthy milk is to have cows that are clean and free from disease. The milk from emaciated animals, or those suffering from any disease, should not be sold. The milk from cows having inflamed udders or sore teats should not be put into the general supply. The cows should be comfortable in order to produce normal milk. Any unusual condition or disturbance will cause them to produce abnormal milk. They should be kept in dry, clean, properly-bedded stalls. The food should be free from mustiness and no decomposing silage or wet foods should be given after they become mouldy. The drinking water should be clean and fresh.

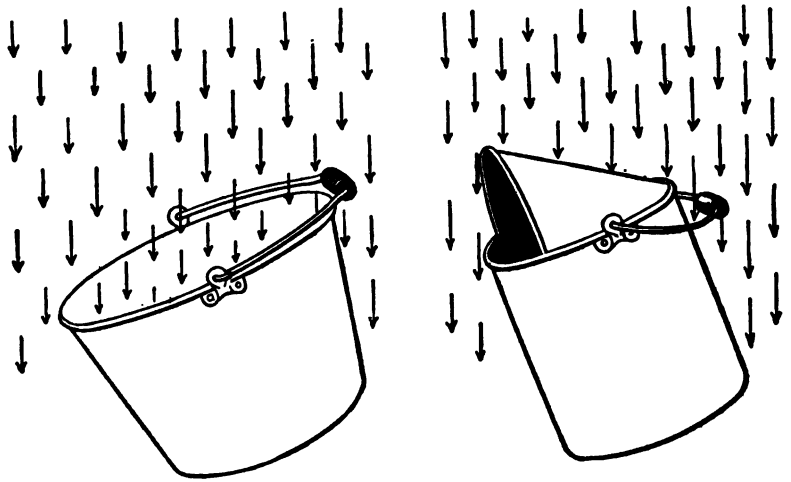
Most of the dirt that finds its way into the milk pails falls from the bodies of the cows. It is essential, therefore, that the cows be kept clean. One of the most important factors in keeping cows clean is to have the platforms on which they stand the proper length, so that the manure will drop into the gutter. Adjustable stanchions are also desirable, so that the proper alignment can be made on the platform. Cows kept in the stable should be groomed at least once a day, but this should be sufficiently long before milking time to permit the dust to settle. Wiping the udder and the flanks with a clean, damp cloth requires only a short time and will do much to remove dirt that would otherwise fall into the pail. It is practical, where clean milk is being produced, to clip the udder and flanks occasionally. This prevents the dirt from sticking, and makes it possible to keep the cows cleaner.

Stables.—Expensive barns are not essential to the production of clean milk. The health of the cows and the methods of the milker are of greater importance and have more effect upon the finished product. Good construction and convenient arrangement of the stable may lessen the work, keep the cows more comfortable and have a beneficial effect upon the milkers.

The barn should be located on well-drained land and be free from contaminating surroundings. Horses, chickens, stagnant water and manure piles, when near the stable, may pollute the air. Odors are easily absorbed by milk. The stable floor should be of concrete or some other material that does not absorb the liquid manure, and at the same time should be sufficiently smooth to be easily cleaned. The walls should be smooth and free from ledges to avoid collecting dirt. The occasional use of whitewash on the walls and ceiling is recommended.

The barn should not be overcrowded and at the same time should not have an excessive amount of space in cold climates. From 500 to 1000 cubic feet per cow is satisfactory. Too much light cannot be provided. Sunlight destroys bacteria and also makes a healthy atmosphere for the cows. The more light the better, and it is well that it be evenly distributed and that the windows be located, if possible, so that the light can shine into the gutter.

The dairy barn should be well ventilated. Experiments at the Pennsylvania Experiment Station have shown that cows will do well even in an open shed, providing they are kept dry and out of the wind. Since, therefore, it is not necessary to have the dairy barn warm, the problem of ventilation is greatly lessened. It is not difficult to get fresh air into the barn, but it is difficult to get sufficient fresh air without cooling the atmosphere. The air in the barn should be changed, even if it does become cold. Cows must have fresh air in order to produce their maximum of milk and keep healthy. Have many and small intakes and few and large outlets. The capacity of the intakes and the outlets should be equal and provide about one square foot in cross section for each four or five cows.



MILK PAILS OF BEST DESIGN.[1]

Milkers.—A clean and careful milker can produce clean milk in a poor barn, but an unclean milker cannot produce clean milk in any barn. The milker must be clean and healthy and, above all things, should milk with dry hands. The practice of wetting the hands with milk is deplorable. It is unnecessary. The milker should always wash his hands before starting to milk. The air, during the milking, should be kept free from dust and odors. Manure should not be removed from the barn, nor should any dusty feed be given during the milking time. Silage or other feeds that have an odor should be fed at least three hours before milking, so that the odor will not be taken up by the milk.

Small-top Milk Pails.—Most of the dirt that gets into the milk drops from the cows during milking time. If, therefore, the opening at the top of the pail is closed to one-sixth the size of an ordinary pail, only

[1] Courtesy of U. S. Dept. of Agriculture.

one-sixth as much dirt gains access to the milk. With a little practice, the small-top milk pail can be used as easily as the large-top pail.

Clean Tinware.—All the cans and pails that are used for milk should be of metal, and all of the joints and corners should be completely filled with solder. Wooden pails should not be used. To wash the tinware, it should first be rinsed with lukewarm water, then thoroughly scrubbed with brush, hot water and washing powder, and finally, either steamed or rinsed with boiling hot water. It should not be wiped with a cloth, but should be allowed to drain and dry. The heat of the steam or boiling water will soon dry the tinware.

Strainers.—Where milk is produced in a clean way it is not necessary to have a strainer. It is usually not desirable to have a strainer on the milk pail, for the dirt collected will have all the injurious effect washed from it into the pail during the milking. A strainer may be used on the can or milk cooler. For this a cloth strainer, made especially for that purpose and used only once, is satisfactory. The cheesecloth strainer that is used from day to day contaminates the milk instead of purifying it. A metal strainer is satisfactory.

Handling the Milk.—As soon as the milk has been drawn it should be removed from the stable so that it will not absorb odors. A convenient milk-room should be provided. This room should be clean and free from dust and odors. The milk should be cooled at once. Under the best of conditions, some bacteria or germs get into the milk, and the problem, therefore, is to prevent these bacteria from increasing in number. At a temperature of 70° F. one bacterium may increase to two in twenty minutes, but at 50° F. or lower it requires a much longer time. One bacterium at 50° F. may increase in twelve hours to six or seven, while at 70° F. it may increase to six or seven hundred. Since, therefore, there are several hundred bacteria in every cubic centimeter of good milk, some realization may be had of how many thousands of bacteria will be developed in ten or twelve hours at 70° F. The following table, prepared by Stocking, shows the importance of cooling milk at once to a low temperature. The milk that was used in this experiment contained a low percentage of bacteria when produced.

EFFECT OF DIFFERENT TEMPERATURES UPON THE DEVELOPMENT OF BACTERIA IN MILK.

Temperature Maintained for 12 Hours.	Bacteria per c.c. at end of 12 Hours.
40° F.	4,000
47° F.	9,000
50° F.	18,000
54.5° F.	38,000
60° F.	453,000
70° F.	8,800,000
80° F.	55,300,000

Coolers.—There are various styles of apparatus on the market for cooling milk. These are called coolers. They are arranged so that the

water passes on the inside of the tubes and the milk passes over them. By having a supply of cold water passing through the tubes, the milk can be cooled to within two or three degrees of the temperature of the water. Unless the cooler is placed in a room free from dust, the milk may become contaminated. Coolers with a hood or covering are preferred. Those having few joints so that they may easily be cleaned are also preferable. When it is not necessary to cool the milk immediately for shipment, or otherwise, it may be cooled by placing the can in a tank of cold water. Unless the water supply is plentiful and the water cold, it is desirable to have ice.

Suggestions for Improvement.—A list of suggestions and instructions of good methods and practices placed in a conspicuous place in the barn does much to improve the quality of the milk. A list of twenty-one suggestions, composed by Webster, gives the essential points to be followed in the production of clean milk. These suggestions are as follows:

"I. Cows.

"1. Have the herd examined frequently by a skilled veterinarian. Remove all animals suspected of not being in good health. Never add an animal to the herd unless it is known to be free from disease.

"2. Never allow a cow to be abused, excited by loud talking or other disturbances. Do not unduly expose her to cold and storm.

"3. Clean the under part of the body of the cow daily. Hair in the region of the udder should be kept short. Wipe the udder and surrounding parts with a clean, damp cloth before milking.

"4. Do not allow any strong-flavored foods such as cabbage, turnips, garlic, etc., to be eaten except directly after milking.

"5. Salt should always be accessible.

"6. Radical changes of food should be made gradually.

"7. Have plenty of pure, fresh water in abundance, easy of access and not too cold.

"II. Stables.

"8. Dairy animals should be kept in a stable where no other animals are housed, and preferably one without a cellar or storage loft. Stables should be light—four feet of glass per cow—and dry, with at least 500 cubic feet of air for each animal. The stable should have air inlets and outlets so arranged as to give good ventilation without drafts over the cows. It should have as few flies as possible.

"9. Floors, walls and ceilings should be tight and the walls and ceiling should be kept free from dust and cobwebs and whitewashed twice a year. There should be as few dust-catching ledges and projections as possible.

"10. Allow no musty or dirty litter or strong-smelling material in the stable. Store the manure under cover at least forty feet from the stable and in a dark place. Use land-plaster in the gutter and on the floor.

"III. Milk House.

"11. The can should not remain in the stable while being filled. Remove the milk from each cow at once from the stable to a clean room. Strain immediately through absorbent cotton or cotton flannel; cool to 50° F. as soon as possible. Store at 50° F. or lower.

"12. Utensils should be of metal with all joints smoothly soldered. If possible, they should be made of stamped metal. Never allow the utensils to become rough or rusty inside. Use them for nothing but milk.

"13. To clean the utensils, use pure water. First rinse them with warm water, then wash them inside and out in hot water in which a cleaning material has been dissolved. Rinse again and sterilize in boiling water or steam. Then keep them inverted in pure air, and in the sun as much as possible, until ready to use.

A Clean Milker in a Clean Stable at Milking Time.[1]

Note the clean suit, sanitary milking stool, small-top pail, cow with clean flanks and udder, and sanitary stable construction. Under these conditions clean milk can be easily produced.

"IV. Milking and Handling Milk.

"14. A milker should wash his hands immediately before milking and should milk with dry hands. He should wear a clean outer garment, which should be kept in a clean place when not in use. Tobacco should not be used while milking.

"15. In milking be quiet, quick, clean and thorough. Commence milking the same hour morning and evening. Milk the cows in the same order.

"16. If any part of the milk is bloody, stringy or not natural in appearance, or if, by accident, dirt gets into the pail, the whole should be rejected.

[1] From Farmers' Bulletin 602, U. S. Dept. of Agriculture.

"17. Weigh and record the milk given by each cow.

"18. Never mix warm milk with that which has been cooled. Do not allow milk to freeze.

"19. Avoid using any dry, dusty feed just previous to milking.

"20. Persons suffering from any disease, or who have been exposed to any contagious disease, must remain away from the milk.

"21. The shorter the time between the production of the milk and its delivery, and between its delivery and its use, the better will be the quality."

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CHAPTER 14

DAIRY BUTTER-MAKING

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Farm dairying has attracted public attention to an uncommon degree in the last few years. This is due largely to the modern development in the dairy field as well as to the adaptability of dairy farming or certain phases of it to average farm practices.

Adaptation.—Dairy farming is especially adapted to farms located near markets, because of the regular demand for fresh dairy products. Dairy products are, as a whole, perishable and must be marketed soon after being produced. For this reason easy and frequent access to markets is very desirable. Dairying is also adaptable as a side line in general farming, fruit raising and poultry farming. It provides for the utilization of waste products on the farm as feed for cows and aids in the continuous and economical employment of labor.

It is also particularly adapted to the person starting in to farm on a small scale, as it is possible with a comparatively small capital to start a dairy business which enables the dairyman to live while his business grows.

The Need of Dairy Farming.—According to late authorities, the people of the United States consume over seven-tenths of a pint of milk per capita daily. To this should be added the enormous consumption of butter, cheese, ice cream, condensed milk and other minor dairy products. This gives an idea of the possibilities which are before the American dairyman today.

Types of Dairy Farming.—Several types of dairy farming are pursued in the United States; they are: (1) the production of milk for wholesale and retail trade; (2) the production of cream for creameries and ice cream factories; (3) the manufacture of cheese on the farm; (4) the manufacture of butter upon the farm, or farm butter-making.

Market Milk.—The production of market milk is one of the leading types of dairy farming. It requires easy access to reliable markets, and is most successful when conducted on a fairly extensive scale. It requires less labor than most other types of dairy farming. Clean milk production is discussed in the preceding chapter.

Farm Cheese-making.—This type is especially adapted to dairy farms not located close to dairy markets. Cheese is less perishable than the other dairy products and this enables the farmer to engage in dairying

and market his products at his convenience. Farm cheese-making is most extensive in the eastern part of the United States, especially in the rougher sections. Cheddar and brick cheese are largely made. Much soft cheese, such as schmier kase, cottage and Dutch hand is also produced in many localities. Successful farm cheese-making requires some special cheese apparatus, as well as a fair understanding of the principles which govern cheese manufacture.

Farm Butter-making.—On the general farm more attention is paid to the making of farm butter than to any other phase of farm dairying. This is true because of the large market for the product and the adaptability of farm butter-making to average farm conditions.

A Good Type of a Dairy House.[1]

Control of Products.—The production of good butter of uniform quality starts with the cow. Milk from unhealthy cows can never be made into first-class products. Neither can cows that are kept in unclean, unsanitary places produce clean milk.

One making butter on the farm can have complete control of his milk from the time that it is drawn from the cow until it is made into butter. This is not true of the creamery man or manufacturer, who has to secure his product from outside sources over which he has no supervision. This advantage means much to the farm butter-maker if he realizes it and makes the most of it.

Cleanliness Necessary.—The cows should always be brushed off and kept clean at milking time. Care should be taken that all utensils be kept clean and in good condition, so that the cream, whether skimmed or separated, shall be good, sweet and not absorb any undesirable taints or odors. Much butter which would otherwise be good is damaged in flavor because

[1] Hygienic Laboratory, Washington, D. C.

care is not taken to keep dirt and impurities out of it. Milk not separated by a cream separator should be at once cooled by some suitable method and held as cold as possible until the cream has risen. Cream should be cooled as soon as it is separated.

Percentage of Fat in Cream.—If a separator is used the percentage

A Good Type of Cream Separator.[1]

of fat in the cream may be regulated. When it is impossible to test the cream for its percentage of fat, the separator so regulated that about 12 to 14 per cent of the total milk is separated and comes out as cream, will give approximately the proper richness to the cream. The best results

[1] Courtesy of the Sharples Separator Company, West Chester, Pa.

will be obtained when the cream has about 28 to 30 per cent of fat. Cream with too high a percentage of fat has a tendency to adhere to the sides of the churn, which causes difficult churning and increases the danger of loss of fat in the buttermilk.

Thin Cream Undesirable.—When cream is too thin or has too small a percentage of fat in it, as in the case of hand-skimmed cream containing from 12 to 20 per cent of fat, good, uniform churning is hard to secure. Such cream loses too much fat in the buttermilk and also requires longer churning.

Methods of Ripening Cream.—Poor quality in farm butter is most frequently due to a lack of proper ripening of the cream previous to churning. On the farm it is often necessary to store the cream from two or or more days' milkings in order to secure a sufficient amount for a churning. The common method now in use on most farms is simply to collect in a cream can or jar successive creamings, until enough has been secured for a churning. Meanwhile the cream is held in the cellar, milkhouse, back porch or springhouse. The temperature at which it is held varies with the weather, season of year and other conditions. Under these conditions the cream usually ripens or develops acid until at the end of three or four days it becomes sour and is then stirred and churned. If it is kept too cold for ripening during this holding period, it is warmed for several hours and allowed to sour before churning.

This is a bad practice and is responsible for many of the taints and off flavors found in farm butter. The reason for this is that the temperature of the cream is usually about 55° F., which is a little too low to secure a good growth of the lactic or acid-forming bacteria which produce the proper flavors in the cream. Some claim that this average cellar temperature favors the proper conditions for the growth of the bacteria that produce objectionable flavors and taints in cream. These undesirable bacteria produce no acid, will not grow well in the acid medium and seem to grow best at a temperature of 50° to 60° F.

The Pennsylvania Experiment Station, Bulletin 135, has conducted some experimental work to determine the best way to ripen cream on the farm. This work indicates that there are three other methods, any one of which will give better results than the storing of cream at cellar temperatures. They are: (1) holding or storing the cream at a very low temperature (below 45° F.) until enough is secured for a churning, and then warming it up to 70° to 80° F. and ripening; (2) ripening the first collection of cream at once and adding each skimming to it, from day to day, until a churning is secured; (3) adding a portion of buttermilk to the first cream gathered and then adding each skimming until enough is secured for a churning.

The first method is a good one for butter-makers who have ice for keeping the cream cold. Immediately after separating each day's cream, it should be cooled to 45° F. or below, and held at this low temperature

until enough is secured for a churning. It is then warmed up to 75° F. and held at that temperature until the proper amount of acid is developed in it. At this temperature about twelve hours is required to develop the proper percentage of acid.

The second method is to ripen the cream of the first separation that is to form the new churning at about 75° F. until 0.3 per cent of acid is developed. It is then cooled to the temperature of the springhouse or cellar, and each subsequent creaming, after it has been cooled, is added to this lot until enough is secured for a churning. Under average conditions this will give enough acid development in the whole churning for best results. The ripening of the first separation of cream develops a large number of lactic acid bacteria and produces some acid, which serves to hold in check the undesirable types of bacteria.

The third method is to add a portion of buttermilk of good quality to the first separation, and then add each succeeding creaming and hold the whole amount at cellar or springhouse temperature until a sufficient quantity is secured for a churning. If the ripening has not sufficiently developed by that time the temperature can be raised to 75° F. and the cream allowed to ripen until the proper amount of acid has developed.

The object in the last two methods is essentially the same, namely, to hold in check the undesirable bacteria by having developed or introduced into the cream a preponderance of the desirable bacteria and a small amount of acid. The last two methods are simple, handy and require no special apparatus. Care must be taken, however, in the last method to make sure that the buttermilk comes from butter of a good flavor and quality. The using of buttermilk of medium or poor quality is very likely to produce butter of much the same kind as that from which the buttermilk was secured.

Amount of Acid to Develop, or Degree of Ripening.—Large amounts of farm cream are ripened or soured too much before churning. Because of this, an old and tainted or stale flavor is developed. Cream ripened until it is sharply sour usually contains from 0.6 to 0.8 per cent of acid, which is too much. The best flavors and keeping quality are secured when it is ripened so as to contain about 0.4 to 0.5 per cent of acid. Where no acid test is used, this amount of acid may be approximated. The cream should taste only very mildly sour. Cream naturally ripened at 70° to 75° F. will develop about this amount of acid if held ten hours.

The Use of Starters.—Starters are not much used on the farm and when used are generally of the natural kind, that is, made up of buttermilk or good sour milk. They are very desirable, if care is taken to use only good buttermilk or sour milk, and in most cases will improve the quality of the butter produced. They are especially desirable when cream is hard to churn because of improper ripening, and where it is difficult to secure proper ripening. The amount to use varies with the con-

dition of the cream, but in most cases from 10 to 20 per cent is a suitable quantity.

Natural Starter.—The natural starter made from sour milk is perhaps the best for farm conditions. To make it, set several samples of good, clean skim or whole milk in small jars until the milk becomes sour. The holding temperature should be about 70° F. When the samples have become sour they should be examined. They should have formed a good, smooth curd, free from gas bubbles. The flavor and taste should be clean and sharply sour. The sample showing the best flavor and condition of the curd should be selected for the starter. It may be built up in larger quantities by adding the sample to about ten times its volume of clean, sweet skim milk and allowing the mixture to stand at about 70° F. until it has coagulated. The coagulated milk is then the starter to use in the cream-ripening process. It contains a preponderance of the desirable lactic bacteria which are necessary for that process.

The Amount of Starter to Use.—The amount of starter to add to cream varies from 8 to 50 per cent. If the starter is a good one, the more added the better, but if too much be added it will dilute the cream too greatly and make it hard to churn. About 10 per cent is a common amount to use.

Churning Temperatures.—The temperature at which cream is churned is very important. Properly ripened cream should be cooled down to the temperature at which it is to be churned and held at that temperature at least two hours to allow the fat to become cool and firm enough to churn.

The churning temperature varies widely. It is affected by the season of the year, kind of feed given the cows, condition of the cream and temperature of the churning room.

Variations in Churning Temperature.—In the spring and summer, when the cows are fresh and the feeds succulent and soft, the butter-fat is naturally softer than later in the season. Under average conditions temperatures ranging from 52° to 56° F. will give best results for these seasons. This temperature should be increased to about 56° to 60° F. in the winter. Much cream is now churned on the farms at above 60° F. Experiments seem to indicate that the lower temperatures are to be preferred, as butter is much firmer when coming from the churn, does not so easily incorporate buttermilk, and will stand more working, thus producing a better body and a more uniform quality. Because of the cream being poorly ripened or abnormal in some way, it is often necessary to use higher temperatures than are here given. When difficulty in churning is experienced, the cream should never be raised in temperature by adding hot water to the churn, but should be poured from the churn into a can and gradually raised a few degrees in temperature by setting the can in a pan of warm water.

Care of the Churn.—The proper care of cream in the ripening process, although very essential, does not insure good butter. Good cream can

easily be spoiled in churning. Unless the churn is kept in good condition it is impossible to make good butter with it. The churn should always be well scalded out and well cooled down before using. There are two reasons for this: first, the hot water will scald out and kill all moulds that may be growing in the wood and will close the pores of the wood so that the cream or butter will not adhere to it; second, the churn should be cooled so that the temperature of the cream will not be raised while churning and yield soft, greasy butter.

Length of Time to Churn.—The length of time best for churning varies with the condition of the cream, but ranges from 15 to 30 minutes.

FARM BUTTER-MAKING APPARATUS.[1]

If the cream churns in less than 15 minutes, the butter is very likely to be too soft to work well and will have a poor body when finished. Cream that requires much longer than 30 minutes may be improperly ripened or abnormal in some way. Taking the cream from the churn and raising the temperature in the manner suggested above will in most cases overcome the trouble.

The churning should stop when the butter begins to collect in the buttermilk in granules from the size of a pea to that of a grain of corn. Granules of this size do not contain so much buttermilk as do larger ones. The butter is easier to wash, salt and work.

Washing Butter.—It is a common practice on the farm to wash butter through several wash waters. This is unnecessary if the churning has been stopped at the right time. If the granules are about the size of peas

[1] Courtesy of Pennsylvania Agricultural Experiment Station.

or grains of corn, one washing will remove all the buttermilk. Too much washing has a tendency to remove the finer flavors and give the butter a flat taste. The amount of wash water should be about equal to the volume of cream churned.

Temperature of Wash Water.—The temperature of the wash water may vary considerably, but it should not be much above or below the churning temperature. Very cold wash water is to be avoided. Cold water absorbs the flavors of the butter readily, causes brittleness of body and lowers the quality.

When a low churning temperature is used, the washing temperature may be the same, and should never be more than 4 to 6 degrees less. Where a higher temperature is used for churning, the washing temperature may differ as much as 4 to 10 degrees from that of the churning. The wash water should be pure and clean and free from odors or taints, as these will be readily absorbed by the butter.

Preparation of Working-Board.—After the wash water is drawn from the butter—unless a combined churn and worker is used—the butter should be taken out in the loose, granular form and placed on the working-board or table. This table should be clean and thoroughly wet with cold water. Butter will stick to a dry, warm or dirty board.

Salting.—Fine dairy salt of the best quality should be used. The quantity varies with the taste of the maker and the markets on which the butter is sold. Under average conditions where the butter is worked on a hand-worker, three-quarters of an ounce of salt to each pound of butter-fat is a desirable amount to use. Butter made in a combined churn requires heavier salting, and as much as one and one-quarter ounces of salt per pound of butter-fat may be required. This larger amount is necessary because of the wash water which is held in the churn.

The salt should be evenly distributed over the granules of butter on the working-board, and the working may begin at once. It is a common practice to let the butter stand with the salt on it for a while before working. This is unnecessary if the butter is in a good granular condition, firm in body and the salt fine and of a good grade.

Working of Butter.—The working should begin by first using the sharp edge of the worker to cut and flatten the butter out into a thin sheet. This sheet should then be folded to the center of the working-board, and the process repeated.

The working of butter accomplishes three important things: It evenly incorporates the salt, removes the excess water and makes the body compact. The working should be continued until the excess water no longer appears and the salt is worked evenly through the mass. The texture of the body may be ascertained by breaking off a piece of the butter. The break should show a brittle, grainy appearance, similar to that of broken steel.

When the butter has been sufficiently worked it should be printed into some desirable shape. The common rectangular one-pound mould is the best, as it makes a neat, attractive print and is easy to handle.

Wrapping of Butter.—After the butter is printed it should be wrapped in a good grade of parchment butter paper. This is very essential. Much butter is wrapped in cloth or oiled paper. This is a very bad practice, as the cloth holds moulds, which readily grow and produce taints and odors. The oiled paper, if kept for any length of time in a warm place, becomes very rancid and imparts undesirable flavors.

Value of Standard Product.—It is always advisable to have the name of the producer or his farm name on the wrapper of the butter, if it is sold on the market. If the butter is of good quality, this will tend to increase the sales and be an incentive to the highest effort for maintaining uniformity in quality. The attractiveness and neatness of the package always helps to sell the butter, often at much above the average market price.

BUTTER PRINTER.

Care of the Farm Churn.—After the butter is taken from the churn, the latter should be rinsed out with warm water and the rinsing followed by a thorough washing with very hot water. The rinsing out with warm water will remove any buttermilk which may remain in the pores of the wood. The hot water will remove any fat which may be left in the churn.

It is never well to use soap powders on the interior of the churn, but the occasional use of a small amount of dairy washing powder or lime-water is beneficial.

To keep the churn sweet and free from odors and taints a small handful of lime placed in some water in the churn or in the last rinsing of the churn is very effective. It is essential in good butter-making to see that all apparatus used is absolutely clean and free from undesirable odors and taints, as these are quickly absorbed by the butter.

Dairy Apparatus.—In the selection of dairy apparatus there are several things which must be taken into consideration. They are: Simplicity of construction, ease of cleaning, durability and first cost.

Care of Other Dairy Apparatus.—All other dairy apparatus should at all times be kept scrupulously clean and free from rust. Pails, buckets, crocks, etc., after being used should be rinsed out and washed well with

a brush and a dairy washing powder. After they are carefully cleaned they should be rinsed out and then either scalded with very hot water or steamed if steam is available.

The cream separator should be taken apart and well cleaned after each milking and left apart until its next use. If it is left unclean, or is not well aired, bad taints and odors will develop in the cream, causing a poor quality of finished product.

All dairy apparatus should be placed in the sun after it is washed, as the sun will quickly dry it. Sunlight also acts as a powerful disinfecting agent. However, care should be taken to see that the appa-

BUTTER READY FOR MARKET.[1]

ratus is so placed that there is no danger of dust and dirt blowing in on it.

Churns.—The farm churn should be of ample size for the largest churning made during the year. The common barrel churn is the most practical for farm use, as it is simple, easy to clean and very durable as well as economical in the first cost. On farms where large amounts of butter are made a small combined churn, as illustrated, is very desirable.

On farms where more than three cows are kept a cream separator, of a size depending upon the number of cows kept, is advisable. It is best to select a make of separator that is sold in the community, so that the purchaser can always quickly secure necessary repairs. Cream separators have been so well perfected that there is practically no difference in the skimming efficiency of the several machines. They all skim sufficiently

[1] Courtesy of Hinde & Dauch Paper Co., Sandusky, Ohio.

clean, but one should look to simplicity of construction and durability of wearing parts.

Buckets and Tinware.—All buckets should be made of heavy stamped metal, heavily tinned and with all joints and corners smoothly soldered so as to leave no place for dirt or impurities to collect. Buckets like those shown in the preceding chapter are desirable for milking purposes, as they admit the smallest amount of dust and dirt and are still simple in construction.

WOODEN LADLE.

Wooden Apparatus.—Wood is best suited for the construction of certain dairy apparatus such as butter ladles, butter moulds, workers, etc., because, by proper treatment, butter will not adhere to wood as it will to other materials.

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PART III

ANIMAL DISEASES, CROPPING AND FEEDING SYSTEMS

CHAPTER 15

DISEASES OF ANIMALS AND THEIR MANAGEMENT

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"You say you doctored me when lately ill;
To prove you didn't, I'm living still."

Domestic animals contribute largely to the benefits of country life, and, aside from house pets, these pleasures are denied the residents of towns and cities. Farms devoted to trucking and fruit growing may prove financially profitable, as do mercantile pursuits, but they fail to make the farm *a home* as do those which possess a varied assortment of species of live stock.

Domestic animals share our labor, contribute to our food supply and furnish the means for improving our soil and maintaining its fertility. While the different species of domestic animals are materially unlike in some respects, yet the general scheme on which their conformation and action is planned makes it possible to apply similar broad rules for the care and management of them all.

Animals in health are by nature intended to serve man's purposes and, according to the degree of impairment of health, so is the degree of their usefulness to man affected.

Strictly considered, there are not different degrees of health, since health signifies a normal condition of the body. Abnormal conditions of the body occur, however, which are variable in degree, and these constitute disease.

Disease, therefore, may range from slight unrecognizable disturbances of the body functions to extremely complex modifications which terminate life in death.

An animal is most highly profitable to its owner when in a normal or healthy condition, and its value to him diminishes according to the degree of abnormality or disease. It is for the stockman, therefore, to interest himself in maintaining animals in health, rather than in the study of the nature and treatment of their diseases, if he is to derive the greatest benefits from them.

The Essentials for Health.—In order to be most successful in the management of animals, a study should be made of the efficacy of sound, wholesome food and pure water; the necessity for pure air and proper exercise; the effects of proper dieting, over-feeding and abstinence; the

necessity for comfortable quarters, and lastly the benefits of humane and intelligent treatment. This means familiarity with the laws of hygiene and as far as possible with the structures (anatomical parts) and the functions (normal actions) of the animal body. There is a general similarity of the organization of animal bodies and of the human body, and what is bad for mankind is most likely bad for animals.

Knowledge of Disease Should Precede Treatment.—No one should undertake the treatment of a disease of animals whose nature he is not familiar with, nor to administer medicines whose effects are unknown to him, any more than he should attempt to treat similar disorders in the human. The mere fact that one is animal and the other human does not alter the chances for success, nor prove more creditable to his intelligence.

Stockmen should exercise *common sense* in the management of animals in health and disease, and remember that there is always to be regarded the powerful effort on the part of nature to combat bodily disturbances and disease. Intelligent assistance would frequently restore, where indiscreet meddling will destroy.

There is a strong propensity on the part of stockmen to resort to the use of powerful remedies for all diseases without first deliberating on the *nature* of the disorder, its *cause*, its *symptoms*, its *course*, its *normal duration* and, finally, its *rational treatment*. Such deliberation would frequently indicate that the disorder was due to some *lapse* in management; that some of the symptoms were mere evidences of nature's effort to overcome the disorder; that its normal cause and duration was dependent upon the duration of mismanagement and that rational treatment should be directed towards assisting rather than in opposing nature's efforts. For example, an animal has been over-fed and diarrhea results. More frequently than otherwise, such a case is treated with opium preparations or astringents, to check the diarrhea, possibly with serious consequences; while on the other hand, rational treatment would consist in restricting the diet, perhaps modifying it, and administering a mild laxative, mashes, flaxseed tea, or raw linseed oil, to assist nature in her efforts at the expulsion of the offending material as shown by the condition of diarrhea. After the desired result has been secured, the animal is brought back, by gradually increased amounts of food, to the usual ration which had been fed.

Intelligent and judicious management is essential, both in preserving health and in restoring it when impaired.

GENERAL RULES FOR MAINTAINING HEALTH

1. Feed only sound, wholesome grain and fodder. Supply abundantly pure water, at short intervals.

2. Supply salt regularly to all animals. Rock salt is preferable to purified salt, as it contains other needed elements than soda. Hogs and poultry need little salt compared to other farm animals, excessive amounts being poisonous to them.

3. Charcoal may be given occasionally with benefit to all animals, and may be fed with salt.

4. Feed with extreme regularity, and according to the requirements of animals, in quantity and nutritive value.

5. Developing or growing animals, females with young, pregnant females, males for breeding purposes, work animals and animals not at work require different feeds, in quantity and quality.

6. Animals at pasture require attention. Pasturage may be adequate or it may need to be supplemented with additional feed.

7. Make all changes in rations gradually. Add any new variety of feed to the ration in small and successively increasing amounts until the desired addition is secured.

8. Unwholesome food is frequently produced on farms, and, being unmarketable, is kept for feeding purposes. Such foods may be fed safely if proper methods are employed.

Damaged grain, soft, rotten, mouldy, worm-eaten and otherwise unwholesome, may be made safe for feeding if it is first shelled from the cob or threshed from the straw and then carefully fanned to remove the light, badly damaged and unwholesome grains. By the same process, the spores of mold and poisonous dust are largely eliminated.

Damaged fodder and hay may be made less objectionable and safer by shaking out as much as possible the dust and must as it is removed from the stack. It should then be run through a cutting box and cut into convenient lengths. This cut fodder should be mixed with a proper amount of grain and salted at the rate of one pound of salt to the hundred pounds of chop. Moisten the entire mass and after macerating for several hours, it can be fed. Where this is practiced, the chop box should be kept scrupulously clean.

Comfort.—Animals may be well bred and well fed and yet not develop nor thrive properly if kept in uncomfortable surroundings.

Stables which are comfortable should be well lighted, but the light must be admitted into the building in such a way as not to subject the animals to a constant glare of bright sunlight and they should not face dark, unlighted walls. Stables, however, should be so arranged that all parts of the enclosure are well lighted with diffuse light. They should be devoid of dark recesses which might serve for the accumulation of filth, as breeding places for vermin or for the decomposition of feed and fodder.

Mangers and racks for feed should be convenient alike for feeder and animals and easy to clean. Refuse must not be allowed to accumulate, as when moistened with saliva it sticks to the mangers and affords an ideal place for decomposition processes and the development of attendant poisons.

Floors must be kept with even surfaces, and be clean. If hard and impervious, they should be well bedded. If porous, they must not be permitted to become foul. Foot and hoof troubles, lameness and foul skins develop in dirty stalls.

The air of stables must be pure. Any ventilating system which admits an abundance of pure air and allows the escape of foul air is a proper one. There is no one system suited to all stable designs. Muslin stretched across window openings, instead of glazed sash, makes a desirable covering. It at the same time allows the passage of air through its meshes and subdues the light from without.

Animals must be kept well groomed. It is an old adage that "grooming is half the feed." The skin of animals becomes dirty with dust from without and from the dried sweat and skin emanations from within the body. Unless accumulations are removed through grooming, the natural function of the skin is impaired and debility results. Dirty coats of animals afford desirable breeding places for vermin.

Proper light, pure air, suitable mangers and floors, together with cleanliness of stables and bodies, all tend toward the comfort of animals, and the less perfect these are, the more likely is it that the animals will be affected with abnormal sight, unhealthy skin, disordered respiration and impaired digestion, with all their consequent ills. It is necessary, therefore, to study carefully the comfort of animals, to insure good condition or physical fitness of their bodies.

Exercise.—Regularity of exercise in the open air is necessary for the health of all classes of animals. Animals closely confined in stables, even though well fed and watered, properly groomed and otherwise well cared for, will become soft, their body tissues more or less watery. They become less resistant to disease and less vigorous in every way.

The proper assimilation of food and bodily comfort is dependent upon proper exercise. The appearance of animals is deceptive in this respect. If a lot of young animals with similar treatment is divided and one part is allowed a paddock for exercise and the other part confined to stalls, the latter will usually appear to better advantage. They will be well rounded, smooth and apparently in prime condition, compared with the other lot, which is rough, rugged and more or less angular. As they mature, however, the lot which has been allowed to exercise in the open will continue a steady development to maturity, while the stalled lot will undergo a period of arrested development and fail totally in becoming large, robust, resistant animals. It is in the young and developing animals particularly that opportunity for exercise in the open should be given.

Failure to provide this has resulted, among other things, in the unnecessary susceptibility of horses to heaves, or cattle to tuberculosis, and of hogs to thumps, etc.

General Management.—Intelligent management of animals, therefore, may be said to consist of the following essentials:

1. An abundant supply of pure air at all times.
2. Proper food and water, regularly and judiciously provided.
3. Good grooming for all animals when stabled.
4. Proper exercise in the outside air.

Nursing.—In spite of intelligent management and due regard for the laws of hygiene, disorders and disease of the animal system will occur. Sick animals require intelligent care and greater attention to details of management even than do animals in health. Good nursing is of prime importance in the treatment of disease.

Sick animals should be placed in detached, well-ventilated and clean box stalls, conveniently located. Such stalls should be roomy, clean, cool and dry. In certain cases body clothing—blankets and bandages—are necessary.

All utensils, buckets, brooms, etc., used in the care of sick animals should be kept clean and should not be used in other parts of the stable.

All food not eaten should be removed from the sick animal and under no circumstances offered to other animals.

Bedding must be clean, sufficient in amount and comfortable for the patient.

Sick animals should be seen frequently, but should not be disturbed more nor oftener than is absolutely necessary.

Sick animals are more comfortable and improve more rapidly when the bowels are in a lax state. Mashes and soft feed tend to keep them in this condition. In addition to having laxatives, mashes, flaxseed tea, apples, carrots or potatoes are serviceable in catering to their appetites. Exposure for a short while daily to sunlight acts as a tonic to convalescent animals and enables them to regain strength rapidly.

Disease.—With the appearance of disease in an animal, it is essential that its true nature be speedily recognized or diagnosed. To this end there are observed the modifications in the external visible or otherwise accessible parts of the body which indicate the nature of the internal changes occurring.

These modifications are perceived through one or more of the special senses: sight, revealing alteration in size, conformation, color, etc.; sound, differentiating cavities and solid parts; touch, the texture, sensibility to pain, temperature variation, etc.; smell, the natural or modified odor and even the sense of taste, in milk examination for instance, serving an important end.

In addition to the immediate employment of the senses, the clinical thermometer gives accurately the internal temperature, and various tests are at the command of veterinarians for special examinations. It is necessary for the stockman to recognize health and the earliest approach of disease and be capable of applying the treatment prescribed. To do so, he must acquaint himself with a system of examination which will enable him to fairly well approximate the condition of the animal, as well as to secure information which, compared with later examinations, will show the *progress* of disease.

The modifications in form and function of the body are known as *symptoms*. By observing these the disease is located, and by them also

its character is shown or a *diagnosis* made. For correctly diagnosing disease it is necessary that *all changes* be noted.

The following procedure is recommended to the stockman who should make written rather than mental notes, in order to have positive and complete information about the patient prior to a veterinarian's examination, if such proves to be necessary.

Examination of Sick Animals.—1. *Description of Animal.*—This refers to the kind of animal, the sex, color, age, size and breed. This serves not only as a mark of identification, but such information may limit the diagnosis to certain diseases or may eliminate certain diseases from consideration.

2. *Characteristic Pose.*—The attitude of the patient, whether standing or lying down, and the particular positions assumed are to be noted. The mere pose of an animal is more or less significant in some diseases, *e. g.*, by rigidity of muscles, dilated nostrils, slightly extended tail and extension of the haw over the corners of the eyes in the standing horse, picture tetanus or lockjaw; the recumbent cow with muzzle at the flank, dull eyes, slow respiration and grating teeth, with history of calving within a few hours or days, designates calving fever or paralysis, etc.

The physical *condition* of the animal suggests the possibility of certain diseases, *e. g.*, azoturia, while *conformation* and *temperament* may point equally well to other diseases; *e. g.*, long-coupled, thin-barreled and long-legged horses are liable to scours.

3. *The Skin.*—The *condition* of the skin indicates in an accurate way the *condition* of the body. In its examination we must take into account the disposition of the hair, the action of the sweat glands, presence of enlargements or growths upon the skin, any changes in the color of skin and whether these are *confined* to the skin or are evidences of general disease.

4. *The Eye.*—An examination of the eye will indicate the volume and character of the blood, as seen in the visible capillary vessels. The color of the conjunctiva shows the condition of the animal and the character of its blood. The discharge of tears and swellings about the eyes should be noted as important to diagnosis.

5. *Temperature.*—The internal body temperature in health varies within certain narrow limits, the average being for—

Horses	100.0°–101.5° F.
Cattle	100.5°–102.5° F.
Sheep	102.5°–105.0° F.
Hogs	100.5°–104.0° F.

In diseases, these temperatures may range for—

Horses	102.0° F. and over
Cattle	103.5° F. and over
Sheep	104.0° F. and over
Hogs	104.0° F. and over

In all animals the temperature may rarely reach as high as 110° F., but life will soon terminate at such. The temperature must be accurately gotten with a thermometer inserted into the rectum for at least three minutes. The clinical thermometer registers only from 95° to 110° F. and is self-registering. This allows ample time for accurate reading and does away with the errors of estimating fever by the sensation of touch.

Temperatures should be taken throughout the course of the disease and should be taken at about the same hour, once or twice daily.

Fevers are measured by temperature and, in addition, by noting the accompanying chill, the uneven surface temperature, the alteration of pulse and respirations, the alteration of appetite and the general depression produced.

6. *The Pulse.*—The pulse or blood force in the arteries indicates the frequency or rapidity of circulation, its rhythm or regularity and its quality and character.

The normal pulse rate for animals is for—

Horses	30–40
Cattle	40–60
Swine	60–80
Sheep	70–80

The rapidity of circulation or pulse frequency varies and is easily influenced by age, sex, external temperatures, exercise, the digestive processes, and by disease.

The regularity of the pulse beat is greatly modified according to the state of health.

The quality or character of the pulse is determined by the resistance to pressure by the finger tips when placed over the accessible arteries.

7. *The Respirations.*—The examination of the respiratory system should be complete and thorough. The respirations are to be noted as to frequency, the manner in which they are produced and by the various chest sounds. The normal respiration of animals is as follows:

Horses	8–16
Cattle	10–30
Swine	10–20
Sheep	12–20

In health, the respirations are carried on noiselessly. There are certain physiological or normal noises, as the snort and the blowing sound made by horses when galloping.

On the other hand, with abnormal conditions, there is the *snoring* sound produced with the mouth partially open in semi-comatose animals from any cause; a *wheezing* sound from the nostril when polyps, tumors or thickening of the bones occur; *gargling* or *gurgling* sounds are produced when mucus is present; and, finally, grunting sounds occur when the abdomen is greatly distended.

The *breath* of animals in health is inoffensive. In disease it may become intensely disagreeable. It may indicate bad teeth, pus in the sinuses or chronic catarrhal conditions. Septic and gangrenous pneumonia is accompanied by foulness of breath.

The *nasal discharges* signify various conditions by their quantity, color, consistency, odor, and by the presence of particles of food, blood, etc.

They afford an excellent opportunity for examination of the quantity and the character of capillary blood circulation and characteristic evidences of particular diseases.

The cough is indicative of various conditions such as *heaves, bronchitis* or *pneumonia.*

8. *The Mouth.*—An examination of the mouth is of particular importance, inasmuch as it exposes to view mucous surfaces which are altered in some diseases. It allows an opportunity for judging age, by the characters upon the teeth; and further, the amounts of secretion present indicate the degree to which the secretory glands are disturbed.

9. *The Kidneys and Bowels.*—Direct examination of the kidneys and bowels is only safely conducted by experienced and trained men, but the stockman has an opportunity to examine the urine and the excrement. He should note the amount, color, consistency and any unusual odor of either. He should observe the frequency of the evacuations and whether they were made without causing distress.

Rational Measures for Treatment.—Not until after having made a critical examination of the sick patient is the stockman or attendant justified in the attempt to supply remedial measures.

If the condition of the patient justifies it, the services of a veterinarian should be secured promptly. If, on the other hand, there is no necessity for professional services, it is advisable that a comparison be made of the symptoms presented by the animal and the symptoms described in books on diseases of animals. When these are found to closely correspond, then, and only then, should the administration of medicines be begun. Many animals are destroyed or permanently ruined by unwise treatment. The eagerness "to do something" for these animals prevents proper deliberation and proper judgment, and the result is that the "cure is worse than the ill."

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CHAPTER 16

CROPPING AND FEEDING SYSTEMS

The character of cropping and feeding systems on a farm determines to a considerable extent the success of the farm. Cropping systems from the standpoint of crop production and maintenance of soil fertility will only be discussed here in a general way. The discussion will pertain more especially to the farm management phase of it and its relation to the other enterprises of the farm.

Feeding systems pertain to the rations and methods of feeding livestock and will be discussed especially from the farm management standpoint.

The Farm Scheme.—Success in farming does not rest on the results of a single year. It is not enough to be successful in the production of one crop, but one must continually grow a satisfactory crop at regular intervals. This calls for a cropping system in order that the chief crop or crops may be rotated with other crops to avoid the numerous difficulties mentioned in the chapter on rotations.

From the crop standpoint the two dominant factors are how to maintain the yield of cash crops year after year and at the same time prevent any decline in soil fertility. When animals enter into the farm scheme the cropping system must also meet the needs for animal feed, including necessary bedding. Profits necessitate considering the enterprises as a whole. The order in which crops may be grown and the feeding system to be adopted is a local question. It will be determined by a great many factors, such as character of soil, climatic conditions, price of land, markets, transportation and the personal preferences of the farmer. No definite system can be laid down that will be best under all conditions, but there is a philosophy underlying the question that will aid every farmer in working out the system best suited to his conditions.

Crops Related to Farm Management.—Crops are grown either to sell or to feed to livestock. One farmer may desire to grow corn principally, another cotton, a third one potatoes, and still another some other crop. Usually, several crops are grown. The problem from the standpoint of farm management will be that of determining how much of each of the different crops should be grown. From the standpoint of crop production the farmer is interested only in the method of growing the crop, and when the crop is harvested the task is completed. As a farm manager, it will be necessary for him to decide what to do with the crop. Will he profit more by feeding it or by selling it? If so, when should it be sold or to what class of livestock can it be most profitably fed?

Animals Related to Farm Management.—Most farmers raise some livestock. They should know the nature of animals and their requirements. The care, the character of feed and the breeding that will give best results are generally questions of animal husbandry. From the standpoint of farm management, farmers must decide what classes of stock they will raise. This will be determined by many factors. The class of livestock to be kept will depend largely upon the character of the crops to which the farm is best adapted. On some farms, horses, sheep and poultry may be most desirable. On others, dairy cows for market milk will prove most profitable. The problem resolves itself into making plans for a specific farm, arranging it into fields, selecting the kinds of crops and the classes of livestock that are best adapted to it, and deciding upon the proper proportion of each. The buildings, equipment and capital must all be considered in this connection.

Cropping and Feeding Systems are Related.—When crops are of prime importance on the farm, the livestock kept is generally selected chiefly for the utilization of by-products. Statistics show that four-fifths of the farms in the United States keep dairy cows. Two-thirds of the farms make butter. The small dairies are maintained largely on cornstalks, straw and hay of poor quality, and the cows are pastured on land that is not well adapted to the growing of crops.

On most farms a few swine and 50 to 100 head of poultry are kept largely as scavengers to utilize what would otherwise be wasted. In some instances a few sheep are kept in the same way, and more might be kept in small flocks at low cost, to the advantage of both the farmer and the consumer of meat.

On farms where livestock predominates, crops become subsidiary and the crops grown are those that meet the needs of the livestock.

Adaptation of Cropping and Feeding Systems.—Crop adaptation must take into account the texture and structure of soils as well as the rotation of crops, but there is a further adaptation involved in the cropping system as well as in the feeding system. These two are dependent upon each other. If crops are grown chiefly for livestock, consideration must be given not only to yields, but also to feeding values. Corn generally produces more digestible nutrients per acre than any of the small grains, clovers or grasses. For example, 12 tons of ensilage, a fair yield on an acre, contains approximately 3600 pounds of digestible nutrients. An acre of timothy yielding 2 tons contains only about 1700 pounds of digestible nutrients. An acre of clover yielding 2½ tons of hay contains about 2300 pounds of digestible nutrients. The clover also contains much more protein than the timothy. Crops for feed must be compared in this way, and definite information from the standpoint of yield and feeding value may be ascertained from the tables given on "Feeding Values of Different Crops" in Part IV.

Adaptation must also be considered from the standpoint of cost of

production and the relation to the labor problem of the farm as a whole. The relative cost per unit of digestible nutrients is the safest basis for comparison.

Usually the farms should provide sufficient pasture or the number of animals should be regulated in accordance with the available pasture. Generally the cropping system should provide all of the necessary pasture and roughage for livestock. To secure these from the outside usually entails much additional expense. In most cases the farm may also produce the major portion of the concentrates, and in many cases will produce all of the concentrates. This will generally be true in case of the production of swine, beef cattle and sheep. It is less frequently true in case of the

Hogging Down Corn.[1]

production of dairy products. There are many factors that determine the proportion that should be produced and that should be purchased.

Cropping System Related to Future.—The plan of the cropping system should take into consideration the future productivity of the soil. Humus and nitrogen are most important in this connection. No cropping system will prove satisfactory for a long term of years that does not include at intervals of four to five years a leguminous crop such as clover, alfalfa or some of the annual legumes. Nitrogen in commercial form is much more expensive than that secured through the production of legumes. There is about $11,000,000 worth of nitrogen in the air resting on each acre of land. It is of prime importance to secure the soil nitrogen for crop production from this abundant supply. The humus will be maintained largely

[1] Courtesy of South Dakota Experiment Station, Brookins, S. D.

through the return of crop residues in the form of barnyard manure. This calls for the feeding of a considerable portion of the general farm crops.

Crop Rotations.—From the standpoint of the farm scheme, a rotation should ordinarily provide the roughage and pasture for the number of animals that are to be kept. It should include a sod and a legume for the supply of organic matter and nitrogen. It should also include as large an area of the profitable cash crops as can be produced advantageously. In nearly every region there is one cash crop or sometimes several that pay better than other crops. In the South it is cotton; in the corn belt it is corn; in the New England states it may be hay; in some other districts it is apples. These crops should dominate both from the standpoint of area and the care which they are given. Agricultural surveys show that the most successful farmers follow this practice.

Crops for Cash or for Feed.—The cash products may be either soil products or animal products. When animals dominate, the cropping system should be adjusted to meet their needs. Many small factors should be considered. The amount of bedding required should not be neglected. A crop that is of low value as a cash crop may be grown particularly for the straw it supplies for bedding.

Milk may be produced more cheaply by allowing the liquid excrements of the cows to go to waste rather than by going to the expense of securing sufficient bedding to absorb it. If, however, the saving of the liquid by the use of straw will increase the yield of corn for ensilage and result in 12 tons per acre instead of 8 and a corresponding increase in the other crops that are grown for feed, the enterprise as a whole will undoubtedly be much more profitable by providing the necessary straw for bedding purposes.

Straw contains a considerable part of the fertilizer constituents removed from the soil by a crop of grain. Prices for straw seldom justify selling it. If it cannot be used as bedding for livestock and returned to the fields in the manure, it should be returned in some other way. The practice of burning straw should be universally condemned. In cereal farming, the grain should be cut as high as possible, thus leaving the major portion of the straw on the land.

In some localities a cash crop may be grown, marketed and the proceeds enable the farmer to purchase twice as much of a given stock feed as he could produce on an equal area of land. Under such conditions the exchange is justifiable. In dairy districts farmers are often able to produce potatoes, and with the potatoes purchase more cow feed than they could possibly produce on the land devoted to potatoes.

Crops Related to Feed Requirements.—When grown chiefly for livestock, the proportion of the different crops should be determined to considerable extent by the requirements of the stock. One can ascertain how much of each crop should be produced by establishing what seems to be the best feeding system for the animals in question and calculating the year's requirements of silage, clover hay and grain as concentrates. Knowing the

yield for these crops on the farm in question, the relative acreage of each can then be approximately determined.

Plenty of pasture may reduce the requirements for hay. Where corn does well, it is generally cheaper to feed than oats. A horse or mule without pasture generally requires about 3 tons of hay or its equivalent annually. He needs approximately 70 bushels of corn or 100 bushels of oats. Some of each is better than either alone.

Cows usually require about 1 to 1½ tons of grain, 1 ton of hay and 4 tons of silage per year. If silage is not available, about 2½ tons of hay per cow is needed.

Seven sheep require about as much feed as one cow. Hens eat about twice as much in proportion to their weight as other farm animals; 100 hens are equivalent to a 1000-pound cow and are considered an animal unit.

Buildings on a Dairy Farm.[1]

Changing Cropping System.—The development of the livestock enterprises on the farm will often necessitate changing the cropping system to meet the feed requirements. This will often require increasing the area of crops that produce the roughage. Such a change may be effected by substituting forage crops for cash crops or by increasing the length of the rotation. For example, the amount of hay produced could be very materially increased by increasing the ordinary four-crop rotation of equal areas of corn, oats, wheat and hay to a five-years' rotation of the same crops in which hay would remain for two years. This would increase the proportion of total cropped land in hay from one-fourth to two-fifths.

Two Rotations on the Same Farm.—The best development of the cropping system often calls for two rotations. This will be determined chiefly by the nature of the crops grown and the sequence that gives best

[1] Courtesy of Hoard's Dairyman.

results. Potatoes give good results when grown in a three-years' rotation consisting of potatoes, small grain and clover. At the same time a longer rotation of general farm crops may prove more advantageous for the major area of the farm.

On dairy farms where soiling crops are used, a subsidiary rotation on small fields close to the farmstead may prove advantageous for the production of a succession of suitable soiling crops. These will be supplementary to the general farm rotation that occupies the large fields for the remainder of the farm. The two systems can usually be worked together, so that a field is sometimes in one and sometimes in the other rotation.

Combining Fields.—Some farms are laid out in many small, irregular fields that cannot always be satisfactorily combined. The number and size of fields may not fit the most desirable rotation. This will involve a plan of cropping the fields in the most advantageous way to meet the desired cropping system.

Having decided upon the length of the rotation, ascertain the acreage of all fields and divide by the years in the rotation. This will give the area of each crop for each year. With this data, select the fields that are to be cropped the same in any given year in such a way that the acreage of two or possibly more, may equal as nearly as possible the desired acreage of the crop to be grown.

Fixed Rotations with Unequal Areas.—The livestock requirements often call for an unequal acreage of the several crops. This makes the cropping system more complicated, but never impossible of solution. Fields of equal area may be maintained without growing an equal area of each crop. Suppose the farmer wishes to grow 8 acres of potatoes, 20 acres of corn, 28 acres of oats, 16 acres of wheat and 40 acres of hay, making a total of 112 acres of crops. It will be necessary to decide on the number of fields that give best results in accommodating these crops. If the area is divided into four fields of equal size, there will be 28 acres in each. The following rotation and arrangement might be used:

Field.	1914.	1915.	1916.	1917.
1	8 acres potatoes 20 acres corn	28 acres oats	12 acres hay 16 acres wheat	28 acres hay
2	28 acres oats	12 acres hay 16 acres wheat	28 acres hay	8 acres potatoes 20 acres corn
3	12 acres hay 16 acres wheat	28 acres hay	8 acres potatoes 20 acres corn	28 acres oats
4	28 acres hay	8 acres potatoes 20 acres corn	28 acres oats	12 acres hay 16 acres wheat

Rotations for Dairy Farms.—The rotations on dairy farms will depend chiefly on the location and the relative cost of producing the dairy feeds as

compared with purchasing. The cost of production may be relatively low, because the manure from the dairy is an important factor in the crop yields, and because labor will be available for a certain amount of field work and still fully meet the needs of the dairy. Corn as ensilage will prove an important crop wherever it can be successfully grown. Hay for supplementary roughage, and oats or wheat for the sake of the straw, will frequently be found advantageous.

Careful investigations of the success of dairymen show that a combina-

A Feed Lot Rack for Both Grain and Roughage.[1]

tion of dairy products and cash crops is generally more successful than dairying alone.

Corn, wheat, clover or clover and timothy mixed is a very common rotation. Where wheat does poorly, oats generally succeed and may supplant the wheat. In other districts both oats and wheat are advantageously grown. Alfalfa in limited acreage is generally advisable. It affords a most excellent crop, both for hay and soiling purposes.

Feeding Systems.—The feeding system for any particular farm should be based on the class of animals, their age and the chief purpose for which grown. The feeding system for the rearing of young stock is quite different than for dairy cows or stock that is being fattened. Many farmers find it advantageous to raise young stock and sell it for feeding purposes, while others are better equipped to purchase feeding stock and fatten it for

[1] Courtesy of The Pennsylvania Farmer.

market. The cheap feeds should be utilized to the fullest possible extent. Waste should be avoided.

Economy in feeding often calls for two or more classes of stock. Swine will follow steers and secure much feed from the droppings that otherwise would be wasted. They will also utilize the skim milk and buttermilk on farms that make butter. Under these conditions one may be justified in feeding steers whole grain in greater abundance than he would in the absence of swine.

The rearing of young stock generally necessitates depending chiefly on roughage and cheap feed. The roughage develops bone, and so long as the animal is kept thrifty and develops a good frame, the fat required for marketing can be secured by the use of concentrates during the feeding period. In this connection stockmen are cautioned to avoid the stunting of young stock by insufficient feed. The higher the grade and value of stock, the greater the necessity for quality in the feed consumed.

Feeding System Depends on Type of Farming.—Types of farming differ greatly in different sections of the country, depending on many factors previously mentioned in the chapter on this subject. Consequently, the feeding systems will vary greatly, depending on crops available. A type of farming that includes intensive crops, like tobacco, that respond abundantly to animal manures, may be justified in adopting a feeding system in which concentrates predominate. This results in more valuable manure which may increase the value of the cash crop to such an extent that stock can be fed on such a basis, even though there is no direct profit in the feeding enterprise.

The type of farming, however, will regulate the feeding system more largely from the standpoint of the products that are available for feed. On the grain farms in the corn belt, roughage in the form of stover and straw, supplemented with corn and oats, together with small amounts of hay, should constitute the chief products in the feeding system. In the cotton belt, corn and annual legumes which can be grown advantageously with cotton, should constitute the major portion of the livestock ration. This may be supplemented with cottonseed meal.

In the semi-arid belt, grazing combined with alfalfa and Kaffir corn would doubtless dominate the feeding system.

Feeding System Related to Cost of Production.—Agricultural surveys show that crops generally pay better than livestock for the time put upon them, but a combination of crops and livestock is generally more profitable than either alone. The feeding system for livestock produced in combination with cash crops will generally be more economical than that used when livestock alone is sold. When full time is spent upon crops, the waste products are not utilized and there is absence of manure to maintain yield; and when one devotes full time to livestock, time is spent in a line of production that is carried on at a very low margin of profit. It is a mistake either to overstock or understock on general farms. It is a good policy to keep

enough livestock to consume all the by-products. When a farm is so heavily stocked that all the farm products are consumed, in years of low yields feed will have to be purchased, generally at such a high price as to make livestock an unprofitable enterprise.

Feed Units.—Feeds of different kinds are most readily compared by using a standard. Corn, being the leading crop in America, is the best standard to use. When corn is taken as 1, the equivalent value of a few other products is as follows: mixed hay .4, alfalfa .5, cottonseed meal

THE SCALE IS A NECESSARY ADJUNCT TO PROFITABLE FEEDING.[1]

1.25, wheat bran, oats, malt sprouts and similar feeds .91, corn silage .17, root crops .08. These equivalents vary somewhat, depending on the quality of the product in question. The value of other products is more definitely given in the feeding tables. Roughly, a cow or horse requires about 25 pounds of dry matter daily. This will generally contain from 18 to 20 feed units. The relation of protein, carbohydrates, etc., will depend on the work that the animal is doing or the product that is made.

Profits from Cheap Crop Products.—The cheapest stock feeds are products on which little labor has been expended and the cheapest way of

[1] Courtesy of The Pennsylvania Farmer.

feeding is to allow animals to harvest their own feed. The grazing of grass lands and the pasturing of cornstalk fields is typical of this process. It is further illustrated by chickens and pigs in small numbers that are allowed to forage for themselves about the farm premises. The farmer who produces pork on concentrates alone is at a disadvantage with the one who depends partly on hog pasture.

Livestock Gains in Relation to Feed.—Swine gain about 10 pounds in weight for each bushel of corn; steers require about 1000 pounds dry matter to make 100 pounds of gain; sheep require somewhat less food per pound of gain than steers; 100 pounds dry matter in dairy rations will produce about 74 pounds of milk containing 3½ per cent of fat.

Better gains are made with given amounts of feed during the early portions of the feeding period than toward its close. Young animals make a more profitable use of feed than older ones. It is seldom that the value of gain in fattening cattle is equal to the cost of the feed consumed. The profit is usually made on the increase in value of the total weight of the animal. Generally, a feeder weighing 1000 pounds can be purchased for from 1 to 3 cents per pound less than he will bring when in prime condition and weighing 1200 to 1400 pounds.

Corn Silage as Base for Ration.—In the corn belt, corn silage should form the base for feeding rations. It should be supplemented with dry roughage and nitrogenous concentrates in such a way as to meet the requirements of the stock raised. It has a wide adaptation and may be extensively used, either for the production of dairy products, the fattening of steers or the feeding of horses and young stock.

The following are a few rations which include corn ensilage as taken from an article by J. G. Grigsdale, published in the *Tribune Farmer:*

	Pounds.
For yearling heifers:	
Corn silage	25 to 35
Straw or chaff	4 to 6
Clover hay	4
Bran	2
For dry cows:	
Corn silage	50 to 60
Straw	8 to 10
Clover hay	4
Bran	1 to 2
For cows in milk:	
Corn silage	45
Straw	6
Clover hay	4 to 6
Meal mixture: Bran, oats, gluten or oilcake or cottonseed meal, equal parts. One pound of meal to three or four pounds of milk produced per diem.	
For steers running over winter (1000 pounds weight):	
Corn silage	60 to 75
Straw	8 to 12
Clover hay	2 to 4

For fattening steers (1000 pounds):	Pounds.
Corn silage	50 to 60
Straw	6 to 10
Hay	3 to 6

Meal, starting at one pound, go up to 10 pounds per diem.

Balanced Rations.—Animals require not only a sufficient amount of feed, but also enough of each of the different food elements as well. This pertains to the relationship of protein to carbohydrates and fat, and is spoken of as the nutritive ratio. The nutritive ratio is determined, as above indicated, by the character of animal and the work performed. It may vary somewhat within reasonable limits without seriously affecting the yield of animal products. The relative cost of protein and carbohydrates often justifies some modification in the ratio.

Standard rations for different classes of livestock will be found in the chapters pertaining to each class of animals. Methods of calculating rations are given in the chapter on "Feeds and Feeding," in Part I.

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PART IV

TABLES OF AGRICULTURAL STATISTICS

TABLE I.—PERCENTAGE OF TOTAL DRY MATTER AND DIGESTIBLE NUTRIENTS IN FEEDING-STUFFS.

Feeding-stuff.	Total Dry Matter, per cent.	Digestible Nutrients.			Nutritive Ratio, 1:
		Protein, per cent.	Carbohydrates, per cent.	Fat, per cent.	
GRAINS AND SEEDS.					
Cereals:					
Dent corn	89.4	7.8	66.8	4.3	9.8
Corn meal	85.0	6.1	64.3	3.5	10.8
Corn and cob meal	84.9	4.4	60.0	2.9	15.1
Wheat	89.5	8.8	67.5	1.5	8.1
Oats	89.6	8.8	49.2	4.3	6.7
Barley	89.2	8.4	65.3	1.6	8.2
Rye	91.3	9.5	69.4	1.2	7.6
Rice	87.6	6.4	79.2	0.4	12.5
Emmer (Spelt)	92.0	10.0	70.3	2.0	7.5
Legumes:					
Field pea	85.0	19.7	49.3	0.4	2.5
Cowpea	85.4	16.8	54.9	1.1	3.4
Soy bean	88.3	29.1	23.3	14.6	1.9
Peanut	92.5	25.1	13.7	35.6	3.7
Oil-bearing seeds:					
Flax seed	90.8	20.6	17.1	29.0	4.0
Cotton seed	89.7	12.5	30.0	17.3	5.5
Sunflower seed	91.4	14.8	29.7	18.2	4.8
CEREAL BY-PRODUCTS.					
Gluten meal	90.5	29.7	42.5	6.1	1.9
Gluten feed	90.8	21.3	52.8	2.9	2.8
Germ oil meal	91.4	15.8	38.8	10.8	4.0
Corn bran	90.6	6.0	52.5	4.8	10.5
Hominy feed	90.4	6.8	60.5	7.4	11.3
Corncobs	89.3	0.5	44.8	...	89.6
Wheat bran	88.1	11.9	42.0	2.5	4.0
Wheat middlings (standard)	88.8	13.0	45.7	4.5	4.3
Wheat middlings (flour)	90.0	16.9	53.6	4.1	3.7
Red Dog flour	90.1	16.2	57.0	3.4	4.0
Oat hulls	92.6	1.3	38.5	0.6	30.6
Oat dust	93.5	5.1	32.8	2.3	7.5
Dried brewers' grains	91.3	20.0	32.2	6.0	2.3
Wet brewers' grains	23.0	4.9	9.4	1.7	2.7
Malt sprouts	90.5	20.3	46.0	1.4	2.4
Dried distillers' grains	92.4	22.8	39.7	11.6	2.9
OIL BY-PRODUCTS.					
Linseed oil meal (O. P.)	90.2	30.2	32.0	6.9	1.6
Linseed oil meal (N. P.)	91.0	31.5	35.7	2.4	1.3
Cottonseed meal	93.0	37.6	21.4	9.6	1.1
Peanut cake	89.3	42.8	20.4	7.2	0.9
Corn germ cake	91.4	15.8	38.8	10.8	4.0

TABLE I.—PERCENTAGE OF TOTAL DRY MATTER AND DIGESTIBLE NUTRIENTS IN FEEDING-STUFFS (*Continued*).

Feeding-stuff.	Total Dry Matter, per cent.	Digestible Nutrients.			Nutritive Ratio, 1:
		Protein, per cent.	Carbohydrates, per cent.	Fat, per cent.	
PACKING HOUSE BY-PRODUCTS.					
Dried blood	91.5	70.9	....	2.5	0.09
Tankage	93.0	50.1	....	11.6	0.52
Meat scrap	89.3	66.2	....	13.4	0.45
MISCELLANEOUS CONCENTRATES.					
Beet molasses	79.2	4.7	54.1	...	11.5
Cane molasses	74.1	1.4	59.2	...	42.3
Molasses beet pulp	92.0	6.1	68.7	...	11.3
Dried beet pulp	91.6	4.1	64.9	...	15.8
Molasses alfalfa feed	90.9	9.8	40.8	0.9	4.4
Cows' milk	12.8	3.4	4.8	3.7	3.9
Skim milk	9.4	2.9	5.3	0.3	2.1
Buttermilk	9.9	3.8	3.9	1.0	1.6
HAYS.					
Legumes:					
Red clover	84.7	7.1	37.8	1.8	5.9
Mammoth clover	78.8	6.2	34.7	2.1	6.4
Alsike clover	90.3	8.4	39.7	1.1	5.0
Alfalfa	91.9	10.5	40.5	0.9	4.1
Soy bean	88.2	10.6	40.9	1.2	4.1
Cowpea	89.5	9.2	39.3	1.3	7.3
Grasses:					
Timothy	86.8	2.8	42.4	1.3	16.2
Redtop	91.1	4.8	46.9	1.0	10.2
Blue grass	86.0	4.4	40.2	0.7	9.5
Bermuda grass	92.9	6.4	44.9	1.6	7.6
Prairie grass	90.8	3.0	42.9	1.6	15.5
Cereals:					
Oat	86.0	4.7	36.7	1.7	8.6
Barley	85.0	5.7	43.6	1.0	8.0
Millet	86.0	5.2	38.6	0.8	7.8
FODDER AND STOVER.					
Corn fodder	83.3	2.4	50.4	1.2	22.1
Corn stover	81.8	1.9	43.9	0.5	23.7
STRAWS.					
Oat	90.8	1.3	39.5	0.8	31.8
Wheat	90.4	0.8	35.2	0.4	45.1
Barley	85.8	0.9	40.1	0.6	46.0
Rye	92.9	0.7	39.6	0.4	57.9

TABLE I.—PERCENTAGE OF TOTAL DRY MATTER AND DIGESTIBLE NUTRIENTS IN FEEDING-STUFFS (*Continued*).

PASTURE OR FORAGE, AND SOILING CROPS.

Feeding-stuff.	Total Dry Matter, per cent.	Digestible Nutrients.			Nutritive Ratio, 1:
		Protein, per cent.	Carbohydrates, per cent.	Fat, per cent.	
Grasses:					
Blue grass	34.9	2.8	19.7	0.8	7.7
Timothy	38.4	1.5	19.9	0.6	14.1
Orchard grass	27.0	1.2	13.4	0.5	12.1
Bermuda grass	28.3	1.3	13.4	0.4	11.0
Green corn	21.0	0.9	12.2	0.4	14.6
Sorghum	20.6	0.6	11.6	0.3	20.5
Rye	23.4	2.1	14.1	0.4	7.1
Rape	14.3	2.0	8.2	0.2	4.3
Legumes:					
Red clover	29.2	2.9	13.6	0.7	5.7
Alsike clover	25.2	2.6	11.4	0.5	4.8
Alfalfa	28.2	3.6	12.1	0.4	3.6
Cowpea	16.4	1.8	8.7	0.2	5.1
Soy bean	24.9	3.1	11.0	0.5	3.9
SILAGE.					
Corn	26.4	1.4	14.2	0.7	11.3
Corn and soy bean	24.0	1.6	13.2	0.7	9.3
ROOTS.					
Mangel	9.1	1.0	5.5	0.2	5.9
Rutabaga	11.4	1.0	8.1	0.2	8.5
Sugar beet	13.5	1.3	9.8	0.1	7.7
Carrot	11.4	0.8	7.7	0.3	10.5
Potato	20.9	1.1	15.7	0.1	14.5

TABLE II.—DRY MATTER, DIGESTIBLE PROTEIN, AND NET ENERGY PER 100 POUNDS OF FEED. (ARMSBY.)

Feeding-stuff.	Total Dry Matter, pounds.	Digestible Protein, pounds.	Net Energy, therms.
Green fodder and silage:			
Alfalfa	28.2	2.50	12.45
Clover, red	29.2	2.21	16.17
Corn fodder, green	20.7	0.41	12.44
Corn silage	25.6	1.21	16.56
Hungarian grass	28.9	1.33	14.76
Rape	14.3	2.16	11.43
Rye	23.4	1.44	11.63
Timothy	38.4	1.04	19.08
Hay and dry coarse fodders:			
Alfalfa hay	91.6	6.93	34.41
Clover hay, red	84.7	5.41	34.74
Corn forage, field cured	57.8	2.13	30.53
Corn stover, field cured	59.5	1.80	26.53
Cowpea hay	89.3	8.57	40.76
Hungarian hay	92.3	3.00	44.03
Oat hay	84.0	2.59	26.97
Soy bean hay	88.7	7.68	38.65
Timothy hay	86.8	2.05	33.56
Straws:			
Oat straw	90.8	1.09	21.21
Rye straw	92.9	0.63	20.87
Wheat straw	90.4	0.37	16.56
Roots and tubers:			
Carrots	11.4	0.37	7.82
Mangels	9.1	0.14	4.62
Potatoes	21.1	0.45	18.05
Rutabagas	11.4	0.88	8.00
Turnips	9.4	0.22	5.74
Grains:			
Barley	89.1	8.37	80.75
Corn	89.1	6.79	88.84
Corn and cob meal	84.9	4.53	72.05
Oats	89.0	8.36	66.27
Pea meal	89.5	16.77	71.75
Rye	88.4	8.12	81.72
Wheat	89.5	8.90	82.63
By-products:			
Brewers' grains, dried	92.0	19.04	60.01
Brewers' grains, wet	24.3	3.81	14.82
Buckwheat middlings	88.2	22.34	75.92
Cottonseed meal	91.8	35.15	84.20
Distillers' grains, dried:			
Principally corn	93.0	21.93	79.23
Principally rye	93.2	10.38	60.93
Gluten feed, dry	91.9	19.95	79.32
Gluten meal, Buffalo	91.8	21.56	88.80
Gluten meal, Chicago	90.5	33.09	78.49
Linseed meal, O. P	90.8	27.54	78.92
Linseed meal, N. P	90.1	29.26	74.67
Malt sprouts	89.8	12.36	46.33
Rye bran	88.2	11.35	56.65
Sugar beet pulp, fresh	10.1	0.63	7.77
Sugar beet pulp, dried	93.6	6.80	60.10
Wheat bran	88.1	10.21	48.23
Wheat middlings	84.0	12.79	77.65

TABLE III.—WOLFF-LEHMANN FEEDING STANDARDS.
(Showing amounts of nutrients per day per 1000 pounds live weight.)

Animal.	Total Dry Matter, pounds.	Digestible Protein, pounds.	Digestible Carbohydrates, pounds.	Digestible Fat, pounds.	Nutritive Ratio, 1:
Oxen, at rest in stall	18	0.7	8.0	0.1	11.8
Fattening cattle:					
First period	30	2.5	15.0	0.5	6.5
Second period	30	3.0	14.5	0.7	5.4
Third period	26	2.7	15.0	0.7	6.2
Milch cows, when yielding daily:					
11.0 pounds of milk	25	1.6	10.0	0.3	6.7
16.6 pounds of milk	27	2.0	11.0	0.4	6.0
22.0 pounds of milk	29	2.5	13.0	0.5	5.7
27.5 pounds of milk	32	3.3	13.0	0.8	4.5
Sheep:					
Coarse wool	20	1.2	10.5	0.2	9.1
Fine wool	23	1.5	12.0	0.3	8.5
Breeding ewes, with lambs	25	2.9	15.0	0.5	5.6
Fattening sheep:					
First period	30	3.0	15.0	0.5	5.4
Second period	28	3.5	14.5	0.6	4.5
Horses:					
Light work	20	1.5	9.5	0.4	7.0
Medium work	24	2.0	11.0	0.6	6.2
Heavy work	26	2.5	13.3	0.8	6.0
Brood sows	22	2.5	15.5	0.4	6.6
Fattening swine:					
First period	36	4.5	25.0	0.7	5.0
Second period	32	4.0	24.0	0.5	6.3
Third period	25	2.7	18.0	0.4	7.0
Growing cattle (dairy breeds):					
2–3 months, 150 pounds	23	4.0	13.0	2.0	4.5
3–6 months, 300 pounds	24	3.0	12.8	1.0	5.1
6–12 months, 500 pounds	27	2.0	12.5	0.5	6.8
12–18 months, 700 pounds	26	1.8	12.5	0.4	7.5
18–24 months, 900 pounds	26	1.5	12.0	0.3	8.5
Growing cattle (beef breeds):					
2–3 months, 160 pounds	23	4.2	13.0	2.0	4.2
3–6 months, 330 pounds	24	3.5	12.8	1.5	4.7
6–12 months, 550 pounds	25	2.5	13.2	0.7	6.0
12–18 months, 750 pounds	24	2.0	12.5	0.5	6.8
18–24 months, 950 pounds	24	1.8	12.0	0.4	7.2
Growing sheep (mutton breeds):					
4–6 months, 60 pounds	26	4.4	15.5	0.9	4.0
6–8 months, 80 pounds	26	3.5	15.0	0.7	4.8
8–11 months, 100 pounds	24	3.0	14.3	0.5	5.2
11–15 months, 120 pounds	23	2.2	12.6	0.5	6.3
15–20 months, 150 pounds	22	2.0	12.0	0.4	6.5

TABLE III.—WOLFF-LEHMANN FEEDING STANDARDS (*Continued*).

Animal.	Total Dry Matter, pounds.	Digestible Protein, pounds.	Digestible Carbohydrates, pounds.	Digestible Fat, pounds.	Nutritive Ratio, 1:
Growing sheep (wool breeds):					
4–6 months, 60 pounds.....	25	3.4	15.4	0.7	5.0
6–8 months, 75 pounds.....	25	2.8	13.8	0.6	5.4
8–11 months, 80 pounds....	23	2.1	11.5	0.5	6.0
11–15 months, 90 pounds....	22	1.8	11.2	0.4	7.0
15–20 months, 100 pounds...	22	1.5	10.8	0.3	7.7
Growing swine (breeding stock):					
2–3 months, 50 pounds.....	44	7.6	28.0	1.0	4.0
3–5 months, 100 pounds.....	35	4.8	22.5	0.7	5.0
5–6 months, 120 pounds.....	32	3.7	21.3	0.4	6.0
6–8 months, 200 pounds.....	28	2.8	18.7	0.3	7.0
8–12 months, 250 pounds....	25	2.1	15.3	0.2	7.5
Growing fattening swine:					
2–3 months, 50 pounds.....	44	7.6	28.0	1.0	4.0
3–5 months, 100 pounds.....	35	5.0	23.1	0.8	5.0
5–6 months, 150 pounds.....	33	4.3	22.3	0.6	5.5
6–8 months, 200 pounds.....	30	3.6	20.5	0.4	6.0
9–12 months, 300 pounds....	26	3.0	18.3	0.3	6.4

TABLE IV.—ARMSBY FEEDING STANDARDS.*

FOR MAINTENANCE.

CATTLE.			HORSES.		SHEEP.		
Live Weight, pounds.	Digestible Protein, pounds.	Net Energy, therms.	Digestible Protein, pounds.	Net Energy, therms.	Live Weight, pounds.	Digestible Protein, pounds.	Net Energy, therms.
150	0.15	1.7	0.3	2.0	20	0.03	0.30
250	0.20	2.4	0.4	2.8	40	0.05	0.54
500	0.30	3.8	0.6	4.4	60	0.07	0.71
750	0.40	4.95	0.8	5.8	80	0.09	0.87
1000	0.50	6.0	1.0	7.0	100	0.10	1.00
1250	0.60	7.0	1.2	8.15	120	0.11	1.13
1500	0.65	7.9	1.3	9.2	140	0.13	1.25

FOR GROWTH.

CATTLE.				SHEEP.			
Age, months.	Live Weight, pounds.	Digestible Protein, pounds.	Energy Value, therms.	Age, months.	Live Weight, pounds.	Digestible Protein, pounds.	Energy Value, therms.
3	275	1.10	5.0	6	70	0.30	1.30
6	425	1.30	6.0	9	90	0.25	1.40
12	650	1.65	7.0	12	110	0.23	1.40
18	850	1.70	7.5	15	130	0.23	1.50
24	1000	1.75	8.0	18	145	0.22	1.60
30	1100	1.65	8.0				

* Modified from Armsby's original table for the sake of simplicity.

TABLE IV.—ARMSBY FEEDING STANDARDS* (*Continued*).

FOR FATTENING.

CATTLE.			SHEEP.		
Live Weight, pounds.	Digestible Protein, pounds.	Net Energy, therms.	Live Weight, pounds.	Digestible Protein, pounds.	Net Energy, therms.
250	1.1	2.4+(3.5×daily gain)	40	....	0.54+(3.5×daily gain)
425	1.3	3.4+ "	60	....	0.70+ "
500	1.5	3.8+ "	70	0.30	0.79+ "
650	1.7	4.5+ "	80	0.28	0.87+ "
750	1.7	5.0+ "	90	0.25	0.94+ "
850	1.7	5.4+ "	100	0.24	1.00+ "
1000	1.8	6.0+ "	110	0.23	1.06+ "
1100	1.7	6.4+ "	120	0.23	1.13+ "
1250	1.6	7.0+ "	130	0.23	1.19+ "
1500	1.5	7.9+ "	140	0.22	1.25+ "
			145	0.22	1.28+ "

*Modified from Armsby's original table for the sake of simplicity.

TABLE V.—HAECKER'S STANDARD FOR MILK PRODUCTION.

Digestible nutrients for the production of one pound of milk.

Fat in Milk, per cent.	Protein, pounds.	Carbohydrates, pounds.	Fat, pounds.	Fat in Milk, per cent.	Protein, pounds.	Carbohydrates, pounds.	Fat, pounds.
2.5	0.0446	0.176	0.0151	4.8	0.0591	0.276	0.0236
2.6	0.0451	0.180	0.0155	4.9	0.0597	0.280	0.0240
2.7	0.0455	0.185	0.0159	5.0	0.0604	0.284	0.0243
2.8	0.0460	0.190	0.0163	5.1	0.0611	0.288	0.0247
2.9	0.0464	0.194	0.0166	5.2	0.0618	0.291	0.0250
3.0	0.0469	0.199	0.0170	5.3	0.0625	0.295	0.0253
3.1	0.0474	0.203	0.0174	5.4	0.0632	0.299	0.0256
3.2	0.0478	0.207	0.0178	5.5	0.0639	0.302	0.0259
3.3	0.0483	0.212	0.0181	5.6	0.0644	0.307	0.0263
3.4	0.0486	0.216	0.0185	5.7	0.0651	0.310	0.0266
3.5	0.0492	0.221	0.0189	5.8	0.0656	0.314	0.0269
3.6	0.0501	0.225	0.0193	5.9	0.0663	0.318	0.0273
3.7	0.0511	0.229	0.0196	6.0	0.0668	0.322	0.0276
3.8	0.0520	0.234	0.0200	6.1	0.0679	0.326	0.0279
3.9	0.0530	0.238	0.0204	6.2	0.0689	0.330	0.0283
4.0	0.0539	0.242	0.0208	6.3	0.0700	0.334	0.0286
4.1	0.0546	0.247	0.0211	6.4	0.0710	0.338	0.0289
4.2	0.0553	0.251	0.0215	6.5	0.0721	0.342	0.0293
4.3	0.0558	0.255	0.0218	6.6	0.0724	0.345	0.0296
4.4	0.0565	0.260	0.0222	6.7	0.0728	0.349	0.0299
4.5	0.0572	0.264	0.0226	6.8	0.0731	0.353	0.0302
4.6	0.0579	0.268	0.0230	6.9	0.0735	0.357	0.0305
4.7	0.0584	0.272	0.0233	7.0	0.0738	0.359	0.0308

TABLE VI.—PERCENTAGE COMPOSITION OF AGRICULTURAL PRODUCTS.

Crop.	Water.	Ash.	Protein.	Crude Fiber.	Nitrogen-Free Extract.	Ether Extract.
Corn, dent	10.6	1.5	10.3	2.2	70.4	5.0
Corn, flint	11.3	1.4	10.5	1.7	70.1	5.0
Corn, sweet	8.8	1.9	11.6	2.8	66.8	8.1
Corn meal	15.0	1.4	9.2	1.9	68.7	3.8
Corn cob	10.7	1.4	2.4	30.1	54.9	0.5
Corn and cob meal	15.1	1.5	8.5	6.6	64.8	3.5
Corn bran	9.1	1.3	9.0	12.7	62.2	5.8
Corn germ	10.7	4.0	9.8	4.1	64.0	7.4
Hominy chops	11.1	2.5	9.8	3.8	64.5	8.3
Germ meal	8.1	1.3	11.1	9.9	62.5	7.1
Dried starch and sugar feed	10.9	0.9	19.7	4.7	54.8	9.0
Starch feed, wet	65.4	0.3	6.1	3.1	22.0	3.1
Maize feed, Chicago	9.1	0.9	22.8	7.6	52.7	6.9
Grano-gluten	5.8	2.8	31.1	12.0	33.4	14.9
Cream gluten	8.1	0.7	36.1	1.3	39.0	14.8
Gluten meal	8.2	0.9	29.3	3.3	46.5	11.8
Gluten feed	7.8	1.1	24.0	5.3	51.2	10.6
Wheat, all analyses	10.5	1.8	11.9	1.8	71.9	2.1
Wheat, spring	10.4	1.9	12.5	1.8	71.2	2.2
Wheat, winter	10.5	1.8	11.8	1.8	72.0	2.1
Flour, high grade	12.2	0.6	14.9	0.3	70.0	2.0
Flour, low grade	12.0	2.0	18.0	0.9	63.3	3.9
Flour, dark feeding	9.7	4.3	19.9	3.8	56.2	6.2
Bran, all analyses	11.9	5.8	15.4	9.0	53.9	4.0
Bran, spring wheat	11.5	5.4	16.1	8.0	54.5	4.5
Bran, winter wheat	12.3	5.9	16.0	8.1	53.7	4.0
Middlings	12.1	3.3	15.6	4.6	60.4	4.0
Shorts	11.8	4.6	14.9	7.4	56.8	4.5
Wheat screenings	11.6	2.9	12.5	4.9	65.1	3.0
Rye	11.6	1.9	10.6	1.7	72.5	1.7
Rye flour	13.1	0.7	6.7	0.4	78.3	0.8
Rye bran	11.6	3.6	14.7	3.5	63.8	2.8
Rye shorts	9.3	5.9	18.0	5.1	59.9	2.8
Barley	10.9	2.4	12.4	2.7	69.8	1.8
Barley meal	11.9	2.6	10.5	6.5	66.3	2.2
Barley screenings	12.2	3.6	12.3	7.3	61.8	2.8
Brewers' grains, wet	75.7	1.0	5.4	3.8	12.5	1.6
Brewers' grains, dried	8.2	3.6	19.9	11.0	51.7	5.6
Malt sprouts	10.2	5.7	23.2	10.7	48.5	1.7
Oats	11.0	3.0	11.8	9.5	59.7	5.0
Oat meal	7.9	2.0	14.7	0.9	67.4	7.1
Oat feed	7.7	3.7	16.0	6.1	59.4	7.1
Oat dust	6.5	6.9	13.5	18.2	50.2	4.8
Oat hulls	7.3	6.7	3.3	29.7	52.1	1.0
Rice	12.4	0.4	7.4	0.2	79.2	0.4
Rice meal	10.2	8.1	12.0	5.4	51.2	13.1
Rice hulls	8.2	13.2	3.6	35.7	38.6	0.7
Rice bran	9.7	10.0	12.1	9.5	49.9	8.8
Rice polish	10.0	6.7	11.7	6.3	58.0	7.3
Buckwheat	12.6	2.0	10.0	8.7	64.5	2.2
Buckwheat flour	14.6	1.0	6.9	0.3	75.8	1.4
Buckwheat hulls	13.2	2.2	4.6	43.5	35.3	1.1
Buckwheat bran	10.5	3.0	12.4	31.9	38.8	3.3
Buckwheat shorts	11.1	5.1	27.1	8.3	40.8	7.6
Buckwheat middlings	13.2	4.8	28.9	4.1	41.9	7.1
Sorghum seed	12.8	2.1	9.1	2.6	69.8	3.6

TABLE VI.—PERCENTAGE COMPOSITION OF AGRICULTURAL PRODUCTS (*Continued*).

Crop.	Water.	Ash.	Protein.	Crude Fiber.	Nitrogen-Free Extract.	Ether Extract.
Broom-corn seed	11.5	3.4	10.2	7.1	63.6	3.0
Kaffir seed	9.3	1.5	9.9	1.4	74.9	3.0
Millet seed	14.0	3.3	11.8	9.5	57.4	4.0
Hungarian grass seed	9.5	5.0	9.9	7.7	63.2	4.7
Flaxseed	9.2	4.3	22.6	7.1	23.2	33.7
Flaxseed, ground	8.1	4.7	21.6	7.3	27.9	30.4
Linseed meal, old process	9.2	5.7	32.9	8.9	35.4	7.9
Linseed meal, new process	10.1	5.8	33.2	9.5	38.4	3.0
Cotton seed	10.3	3.5	18.4	23.2	24.7	19.9
Cotton seed, roasted	6.1	5.5	16.8	20.4	23.5	27.7
Cottonseed meal	8.2	7.2	42.3	5.6	23.6	13.1
Cottonseed hulls	11.1	2.8	4.2	46.3	33.4	2.2
Cottonseed kernels (no hulls)	6.2	4.7	31.2	3.7	17.6	36.6
Cocoanut cake	10.3	5.9	19.7	14.4	38.7	11.0
Palm nut meal	10.4	4.3	16.8	24.0	35.0	9.5
Sunflower seed	8.6	2.6	16.3	29.9	21.4	21.2
Sunflower seed cake	10.8	6.7	32.8	13.5	27.1	9.1
Peanut kernels (no hulls)	7.5	2.4	27.9	7.0	15.6	39.6
Peanut meal	10.7	4.9	47.6	5.1	23.7	8.0
Rape seed cake	10.0	7.9	31.2	11.3	30.0	9.6
Pea meal	10.5	2.6	20.2	14.4	51.1	1.2
Soy bean	10.8	4.7	34.0	4.8	28.8	16.9
Cowpea	14.8	3.2	20.8	4.1	55.7	1.4
Horse bean	11.3	3.8	26.6	7.2	50.1	1.0
Corn fodder, field cured	42.2	2.7	4.5	14.3	34.7	1.6
Corn stover, field cured	40.5	3.4	3.8	19.7	31.5	1.1
Corn husks, field cured	50.9	1.8	2.5	15.8	28.3	0.7
Corn leaves, field cured	30.0	5.5	6.0	21.4	35.7	1.4
Corn fodder, green	79.3	1.2	1.8	5.0	12.2	0.5
Dent varieties, green	79.0	1.2	1.7	5.6	12.0	0.5
Dent, kernels glazed green	73.4	1.5	2.0	6.7	15.5	0.9
Flint varieties, green	79.8	1.1	2.0	4.3	12.1	0.7
Flint, kernels glazed green	77.1	1.1	2.7	4.3	14.6	0.8
Sweet varieties, green	79.1	1.3	1.9	4.4	12.8	0.5
Leaves and husks, green	66.2	2.9	2.1	8.7	19.0	1.1
Stripped stalks, green	76.1	0.7	0.5	7.3	14.9	0.5
HAY FROM GRASSES:						
Mixed grasses	15.3	5.5	7.4	27.2	42.1	2.5
Timothy, all analyses	13.2	4.4	5.9	29.0	45.0	2.5
Timothy, cut in full bloom	15.0	4.5	6.0	29.6	41.9	3.0
Timothy, cut soon after bloom	14.2	4.4	5.7	28.1	44.6	3.0
Timothy, cut when near ripe	14.1	3.9	5.0	31.1	43.7	2.2
Orchard grass	9.9	6.0	8.1	32.4	41.0	2.6
Redtop, cut at different stages	8.9	5.2	7.9	28.6	47.5	1.9
Redtop, cut in full bloom	8.7	4.9	8.0	29.9	46.4	2.1
Kentucky blue grass	21.2	6.3	7.8	23.0	37.8	3.9
Kentucky blue grass, cut when seed is in milk	24.4	7.0	6.3	24.5	34.2	3.6
Kentucky blue grass, cut when seed is ripe	27.8	6.4	5.8	23.8	33.2	3.0
Hungarian grass	7.7	6.0	7.5	27.7	49.0	2.1
Meadow fescue	20.0	6.8	7.0	25.9	38.4	2.7
Indian rye grass	8.5	6.9	7.5	30.5	45.0	1.7
Perennial rye grass	14.0	7.9	10.1	25.4	40.5	2.1
Rowen (mixed)	16.6	6.8	11.6	22.5	39.4	3.1

TABLE VI.—PERCENTAGE COMPOSITION OF AGRICULTURAL PRODUCTS (*Continued*).

Crop.	Water.	Ash.	Protein.	Crude Fiber.	Nitrogen-Free Extract.	Ether Extract.
HAY FROM GRASSES (*Continued*):						
Mixed grasses and clovers	12.9	5.5	10.1	27.6	41.3	2.6
Barley hay, cut in milk	15.0	4.2	8.8	24.7	44.9	2.4
Oat hay, cut in milk	15.0	5.2	9.3	29.2	39.0	2.3
Swamp hay	11.6	6.7	7.2	26.6	45.9	2.0
Salt marsh hay	10.4	7.7	5.5	30.0	44.1	2.4
Wild oat grass	14.3	3.8	5.0	25.0	48.8	3.3
Buttercups	9.3	5.6	9.9	30.6	41.1	3.5
White daisy	10.3	6.6	7.7	30.0	42.0	3.4
Johnson grass	10.2	6.1	7.2	28.5	45.9	2.1
FRESH GRASS:						
Pasture grass	80.0	2.0	3.5	4.0	9.7	0.09
Kentucky blue grass	65.1	2.8	4.1	9.1	17.6	1.3
Timothy, different stages	61.6	2.1	3.1	11.8	20.2	1.2
Orchard grass, in bloom	73.0	2.0	2.6	8.2	13.3	0.9
Redtop, in bloom	65.3	2.3	2.8	11.0	17.7	0.9
Oat fodder	62.2	2.5	3.4	11.2	19.3	1.4
Rye fodder	76.6	1.8	2.6	11.6	6.8	0.6
Sorghum fodder	79.4	1.1	1.3	6.1	11.6	0.5
Barley fodder	79.0	1.8	2.7	7.9	8.0	0.6
Hungarian grass	71.1	1.7	3.1	9.2	14.2	0.7
Meadow fescue, in bloom	69.9	1.8	2.4	10.8	14.3	0.8
Italian rye grass, coming in bloom	73.2	2.5	3.1	6.8	13.3	1.3
Tall oat grass, in bloom	69.5	2.0	2.4	9.4	15.8	0.9
Japanese millet	75.0	1.5	2.1	7.8	13.1	0.5
Barnyard millet	75.0	1.9	2.4	7.0	13.1	0.6
HAY FROM LEGUMES:						
Red clover	15.3	6.2	12.3	24.8	38.1	3.3
Red clover in bloom	20.8	6.6	12.4	21.9	33.8	4.5
Red clover, mammoth	21.2	6.1	10.7	24.5	33.6	3.9
Alsike clover	9.7	8.3	12.8	25.6	40.7	2.9
White clover	9.7	8.3	15.7	24.1	39.3	2.9
Crimson clover	9.6	8.6	15.2	27.2	36.6	2.8
Japan clover	11.0	8.5	13.8	24.0	39.0	3.7
Alfalfa	8.4	7.4	14.3	25.0	42.7	2.2
Cowpea	10.7	7.5	16.6	20.1	42.2	2.2
Soy bean	11.3	7.2	15.4	22.3	38.6	5.2
Pea vine	15.0	6.7	13.7	24.7	37.6	2.3
Vetch	11.3	7.9	17.0	25.4	36.1	2.3
Serradella	9.2	7.2	15.2	21.6	44.2	2.6
Flat pea	8.4	7.9	22.9	26.2	31.4	3.2
Peanut vines (no nuts)	7.6	10.8	10.7	23.6	42.7	4.6
Sainfoin	15.0	7.3	14.8	20.4	39.5	3.0
FRESH LEGUMES:						
Red clover, different stages	70.8	2.1	4.4	8.1	13.5	1.1
Alsike clover	74.8	2.0	3.9	7.4	11.0	0.9
Crimson clover	80.9	1.7	3.1	5.2	8.4	0.7
Alfalfa	71.8	2.7	4.8	7.4	12.3	1.0
Cowpea	83.6	1.7	2.4	4.8	7.1	0.4
Soy bean	75.1	2.6	4.0	6.7	10.6	1.0
Serradella	79.5	3.2	2.7	5.4	8.6	0.7
Horse bean	84.2	1.2	2.8	4.9	6.5	0.4
Flat pea	66.7	2.9	8.7	7.9	12.2	1.6

TABLE VI.—PERCENTAGE COMPOSITION OF AGRICULTURAL PRODUCTS (*Continued*).

Crop.	Water.	Ash.	Protein.	Crude Fiber.	Nitrogen-Free Extract.	Ether Extract
STRAW:						
Wheat	9.6	4.2	3.4	38.1	40.4	1.3
Rye	7.1	3.2	3.0	38.9	46.6	1.2
Oat	9.2	5.1	4.0	37.0	42.4	2.3
Barley	14.2	5.7	3.5	36.0	39.0	1.5
Wheat chaff	14.3	9.2	4.5	36.0	34.6	1.4
Oat chaff	14.3	10.0	4.0	34.0	36.2	1.5
Buckwheat straw	9.9	5.5	5.2	43.0	35.1	1.3
Soy bean	10.1	5.8	4.6	40.4	37.4	1.7
Horse bean	9.2	8.7	8.8	37.6	34.3	1.4
SILAGE:						
Corn	79.1	1.4	1.7	6.0	11.0	0.8
Sorghum	76.1	1.1	0.8	6.4	15.3	0.3
Red clover	72.0	2.6	4.2	8.4	11.6	1.2
Soy bean	74.2	2.8	4.1	9.7	6.9	2.2
Apple pomace	85.0	0.6	1.2	3.3	8.8	1.1
Cowpea vine	79.3	2.9	2.7	6.0	7.6	1.5
Cow and soy bean vines mixed	69.8	4.5	3.8	9.5	11.1	1.3
Field pea vine	50.1	3.5	5.9	13.0	26.0	1.6
Barnyard millet and soy bean	79.0	2.8	2.8	7.2	7.2	1.0
Corn and soy bean	76.0	2.4	2.5	7.2	11.1	0.8
Rye	80.8	1.6	2.4	5.8	9.2	0.3
ROOTS AND TUBERS:						
Potato	78.9	1.0	2.1	0.6	17.3	0.1
Common beets	88.5	1.0	1.5	0.9	8.0	0.1
Sugar beets	86.5	0.9	1.8	0.9	9.8	0.1
Mangels	90.9	1.1	1.4	0.9	5.5	0.2
Turnip	90.5	0.8	1.1	1.2	6.2	0.2
Rutabaga	88.6	1.2	1.2	1.3	7.5	0.2
Carrot	88.6	1.0	1.1	1.3	7.6	0.4
Parsnip	88.3	0.7	1.6	1.0	10.2	0.2
Artichoke	79.5	1.0	2.6	0.8	15.9	0.2
Sweet potato	71.1	1.0	1.5	1.3	24.7	0.4
MISCELLANEOUS:						
Cabbage	90.5	1.4	2.4	1.5	3.9	0.4
Spurry	75.7	4.0	2.0	4.9	12.7	0.8
Sugar beet leaves	88.0	2.4	2.6	2.2	4.4	0.4
Pumpkin, field	90.9	0.5	1.3	1.7	5.2	0.4
Pumpkin, garden	80.8	0.9	1.8	1.8	7.9	0.8
Prickly comfrey	88.4	2.2	2.4	1.6	5.1	0.3
Rape	84.5	2.0	2.3	2.6	5.4	0.5
Acorns, fresh	55.3	1.0	2.5	4.4	34.8	1.9
Apples	80.8	0.4	0.7	1.2	16.6	0.4
Cow's milk	87.2	0.7	3.6	...	4.9	3.7
Cow's colustrum	74.6	1.6	17.6	...	2.7	3.6
Mare's milk	91.0	0.4	2.1	...	5.3	1.2
Ewe's milk	81.3	0.8	6.3	...	4.7	6.8
Goat's milk	86.9	0.9	3.7	...	4.4	4.1
Sow's milk	80.8	1.1	6.2	...	4.4	7.1
Skim milk, gravity	90.4	0.7	3.3	...	4.7	0.9
Skim milk, centrifugal	90.6	0.7	3.1	...	5.3	0.3
Buttermilk	90.1	0.7	4.0	...	4.0	1.1

TABLE VI.—PERCENTAGE COMPOSITION OF AGRICULTURAL PRODUCTS (*Continued*).

Crop.	Water.	Ash.	Protein.	Crude Fiber.	Nitrogen-Free Extract.	Ether Extract.
MISCELLANEOUS (*Continued*):						
Whey	93.8	0.4	0.6	...	5.1	0.1
Dried blood	8.5	4.7	84.4	...	...	2.5
Meat scrap	10.7	4.1	71.2	...	0.3	13.7
Dried fish	10.8	29.2	48.4	...	...	11.6
Beet pulp	89.8	0.6	0.9	2.4	6.3	...
Beet molasses	20.8	10.6	9.1	...	59.5	...
Apple pomace	76.7	0.5	1.4	3.9	16.2	1.3
Distillery slops	93.7	0.2	1.7	0.6	2.8	0.9
Dried sediment from distillery slops	5.0	11.3	27.4	8.0	36.1	12.3

TABLE VII.—COMPOSITION AND AMOUNTS OF MANURE PRODUCED BY DIFFERENT KINDS OF FARM ANIMALS.*

Kind of Animal and Kinds of Food Fed.	Analysis.				Amount per 1000 Pounds Live Weight.			
	Water.	Nitrogen.	Phosphorus.	Potassium.	Pounds per Day.	Pounds per Year.	Pounds Absorbents per Year.	Total Tons Farm Manure per Year.
Sheep.—Fed hay, corn, oats; or hay, wheat bran, cottonseed meal and linseed meal	59.52	0.77	4.10	0.59	34.1	12,446	5,000	8.7
Swine.—Fed skim milk, corn meal, meat scraps; or corn meal, wheat bran and linseed meal	74.13	0.84	0.17	0.32	83.6	30,514	5,000	17.7
Cattle.—Fed hay, silage, beets, wheat bran, corn meal and cottonseed meal	75.25	0.43	0.127	0.44	74.1	27,046	3,000	15.0
Horses.—Fed hay, oats, corn meal and wheat bran	48.69	0.49	0.114	0.48	48.8	17,812	3,000	10.5

NOTE.—The analyses and amounts of manure produced by farm animals, as shown in this table, are from the Cornell Experiment Station, and the estimates of pounds absorbents per year from "Farm Management," by Andrew Boss. It is estimated that under average farm conditions 50 per cent of the elements of fertility in farm manures is lost by leaching and fermentation. Direct hauling of manure to the field or composting in concerete pits will prevent much of this loss.

* From "Field Management and Crop Rotation," by Parker.

TABLE VIII.—LIST OF AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS IN THE UNITED STATES.

STATE.	NAME OF INSTITUTION.	LOCATION OF COLLEGE.	LOCATION OF EXPERIMENT STATION.
Alabama	Alabama Polytechnic Institute	Auburn	Auburn
	Agricultural School of the Tuskegee Normal and Industrial Institute	Tuskegee Institute.	Tuskegee Institute
	Agricultural and Mechanical College for Negroes	Normal	Uniontown
Arizona	College of Agriculture of University of Arizona	Tucson	Tucson.
Arkansas	College of Agriculture of University of Arkansas	Fayetteville	Fayetteville
California	College of Agriculture of University of California	Berkeley	Berkeley
Colorado	The State Agricultural College of Colorado	Fort Collins	Fort Collins
Connecticut	Connecticut Agricultural College	Storrs	Storrs, New Haven
Delaware	Delaware College	Newark	Newark
Florida	College of Agriculture of University of Florida	Gainesville	Gainesville
	Florida Agricultural and Mechanical College for Negroes	Tallahassee	
Georgia	Georgia State College of Agriculture	Athens	Experiment
	Georgia State Industrial College	Savannah	
Hawaii	College of Hawaii	Honolulu	Honolulu
Idaho	College of Agriculture of University of Idaho	Moscow	Moscow
Illinois	College of Agriculture of University of Illinois	Urbana	Urbana
Indiana	School of Agriculture of Purdue University	La Fayette	La Fayette
Iowa	Iowa State College of Agriculture and Mechanic Arts	Ames	Ames
Kansas	Kansas State Agricultural College	Manhattan	Manhattan
Kentucky	The College of Agriculture of State University	Lexington	Lexington
	The Kentucky Normal and Industrial Institute for Colored Persons	Frankfort	
Louisiana	Louisiana State University and Agricultural and Mechanical College	Baton Rouge	Baton Rouge New Orleans (sugar) Crowley (rice) Calhoun, North
	Southern University and Agricultural and Mechanical College of the State of Louisiana	Scotland Heights, Baton Rouge	
Maine	College of Agriculture of University of Maine	Orono	Orono
Maryland	Maryland Agricultural College	College Park	College Park
	Princess Anne Academy, Eastern Branch of the Maryland Agricultural College	Princess Anne	
Massachusetts	Massachusetts Agricultural College	Amherst	Amherst
Michigan	Michigan Agricultural College	East Lansing	East Lansing
Minnesota	College of Agriculture of University of Minnesota	University Farm, St. Paul	University Farm, St. Paul
Mississippi	Mississippi Agricultural and Mechanical College	Agricultural College	Agricultural College
	Alcorn Agricultural and Mechanical College	Alcorn	
Missouri	College of Agriculture of University of Missouri	Columbia	Columbia, College Mountain Grove, (fruit)
Montana	Montana State College of Agriculture and Mechanic Arts	Boseman	Boseman
Nebraska	College of Agriculture of University of Nebraska	Lincoln	Lincoln
Nevada	College of Agriculture of University of Nevada	Reno	Reno
New Hampshire	New Hampshire College of Agriculture and Mechanic Arts	Durham	Durham
New Jersey	Rutgers College	New Brunswick	New Brunswick
New Mexico	New Mexico College of Agriculture and Mechanic Arts	State College	State College
New York	New York State College of Agriculture	Ithaca	Ithaca (Cornell) Geneva (State)
North Carolina	The North Carolina College of Agriculture and Mechanic Arts	West Raleigh	Raleigh and West Raleigh
	The Agricultural College for the Colored Race	Greensboro	
North Dakota	North Dakota Agricultural College	Agricultural College	Agricultural College
Ohio	College of Agriculture of Ohio State University	Columbus	Wooster
Oklahoma	Oklahoma Agricultural and Mechanical College	Stillwater	Stillwater
	Agricultural and Normal University	Langston	
Oregon	Oregon State Agricultural College	Corvallis	Corvallis
Pennsylvania	School of Agriculture of Pennsylvania State College	State College	State College
Porto Rico	College of Agriculture and Mechanic Arts of University of Porto Rico	Mayaques	Mayaques (Federal) Rio Piedras (Insular)
Rhode Island	Rhode Island State College	Kingston	Kingston

TABLE VIII.—LIST OF AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS IN THE UNITED STATES (*Continued*).

STATE.	NAME OF INSTITUTION.	LOCATION OF COLLEGE.	LOCATION OF EXPERIMENT STATION.
South Carolina.	The Clemson Agricultural College of South Carolina	Clemson College...	Clemson College
	The Colored Normal Industrial Agricultural and Mechanical College of South Carolina	Orangeburg	
South Dakota..	South Dakota State College of Agricultural and Mechanic Arts	Brookings.....	Brookings
Tennessee.....	College of Agriculture, University of Tennessee	Knoxville.....	Knoxville
Texas.....	Agricultural and Mechanical College of Texas	College Station....	College Station
	Prairie View State Normal and Industrial College	Prairie View	
Utah.....	The Agricultural College of Utah	Logan.....	Logan
Vermont.....	College of Agriculture of University of Vermont	Burlington.....	Burlington
Virginia.....	The Virginia Agricultural and Mechanical College and Polytechnic Institute	Blacksburg.....	Blacksburg(College) Norfolk (truck)
	The Hampton Normal and Agricultural Institute	Hampton	
Washington....	State College of Washington	Pullman.....	Pullman
West Virginia..	College of Agriculture of West Virginia University	Morgantown.....	Morgantown
	The West Virginia Colored Institute	Institute	
Wisconsin.....	College of Agriculture of University of Wisconsin	Madison.....	Madison
Wyoming.....	College of Agriculture of University of Wyoming	Laramie.....	Laramie

TABLE IX.—HOW TO ESTIMATE AMOUNT OF GRAIN IN BINS AND HAY IN MOW OR STACK.

SMALL GRAIN AND SHELLED CORN.

Length multiplied by width multiplied by average depth in feet gives the cubic feet of grain. This multiplied by 8 divided by 10 equals the bushels.

Example:—A bin of wheat is 8 feet wide by 16 feet long and the average depth of wheat is 6 feet.

$$\frac{8\times16\times6\times8}{10}=614.4 \text{ bushels.}$$

FOR BUSHELS OF EAR CORN.

Multiply the cubic feet occupied by ear corn by 4 and divide by 10.

FOR TONS OF HAY.

If hay has stood for 60 days or more and mow or stack is deep, divide cubic contents in feet by 400. For shallow mows or stacks that have stood only 30 days or less, divide by 600. For intermediate conditions, divide by 500 more or less, depending on conditions. The cubic feet in a stack may be obtained as follows: Subtract the width from the over (the "over" is the distance from the ground on one side over the stack to the ground on the other side), divide by the height, then multiply successively by the over, the width the length, and by .225.