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LIVESTOCK ON THE FARM

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ILLUSTRATED



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PREFACE

THE purpose of this volume is to give information to those who wish to improve their condition by means of livestock, to farmers generally, and especially to those interested in livestock farming and in breeding. It is intended also to serve as a text-book in Animal Husbandry in agricultural schools, in high schools and in elementary courses in colleges of agriculture.

The book is not a treatise on nutrition, nor is it primarily a treatise on swine husbandry. The latter subject is covered by the author's "Swine," published by the Breeders' Gazette, of Chicago. It is not, again, a book of formulæ. On the contrary, its prime object is a discussion of the care, feeding and management of farm animals. In short, it deals in a simple and practical way with the problems which must be met and handled properly every day in order to make live-stock farming successful. It also touches upon the various breeds of farm animals as well as the subject of poultry.

The care and feeding of animals is not merely a mechanical or mathematical problem in which two plus two always equals four. It has to do with life, not merely with the physical mechanism. While many of the factors may be determined mathematically, such as the amounts of the different nutrients—protein, carbohydrates, fat, mineral matter, and water, for example—there are other factors of equal importance to be considered and it is these that will be emphasized in the following pages. They are fundamental to the successful handling of all farm animals.

Acknowledgment is made to W. P. Kirkwood, editor of the Department of Agriculture, of the University of Minnesota, for assistance in editing the manuscript of this book.

The chapter on poultry was written by C. E. Brown, for

many years head of the poultry department, Northwest School of Agriculture and Experiment Station at Crookston, one of the schools of the Department of Agriculture of the University of Minnesota.

WM. DIETRICH.

CROOKSTON, MINNESOTA,

September, 1917.

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LIVESTOCK ON THE FARM

CHAPTER I

GRAIN FARMING

A grain farmer is one whose interest centers in the production and marketing of some kind, or kinds, of grain. He converts the plant food of the soil into corn, wheat, oats, barley, flax, or some other grain and removes it from the farm. His soil each year is made poorer by the amount of plant food he sells.

SOIL

Soil originated from the breaking down of the various kinds of rock on the surface of the earth. The rocks were produced at the time the earth was formed. The agencies or forces by which rocks are reduced or ground up to make soil are water, air, wind, freezing, thawing, etc.

Action of Water on Soil Making.—Water reduces rock to soil particles by friction and by its power as a solvent. When water runs over a rock surface it wears the rock down either by the friction of the water itself or by the friction of different pieces of rock. As a solvent water acts just as it does on sugar or salt. This action is, however, quite slow. But when water is charged with acid or alkali, as it sometimes is, the process of dissolution is materially hastened.

Air in Soil Formation.—Air contains carbonic acid and this has a solvent action on the rock particles with which it comes into contact. When the air is in motion in the form of wind it also causes friction upon the rock and soil particles just as water does. Thus, water and wind work in much the same way in reducing rock to soil particles and in reducing coarser particles to finer ones.



Fig. 1.—A Livestock farm. (Photograph from R. F. Hildebrand, Chicago.)

Temperature in Soil Formation.—Freezing and thawing produce slight motion among different particles of rock and soil. This results in friction similar to that produced by water and wind. But water in freezing expands. Therefore, when water settles in a crevice and freezes, it splits the pieces apart. When a concrete sidewalk, in a climate where the temperature goes below freezing in winter, becomes cracked, the crack constantly becomes wider. Thus, when freezing and thawing occur at short intervals, they are forces of considerable importance in the making of soil. If a hollow iron ball be filled with water and allowed to freeze it will break. This will occur although the ball is of such strength that it is practically impossible to break it with a sledge hammer.

A sandy soil is composed of comparatively large particles, coming from rock of one kind; while clay is made up of very fine particles coming from another kind of rock.

Humus in Soil.—Humus mixed with the soil contributes to fertility. Humus is decayed and decaying vegetable matter. In nature considerable humus lies on the surface of the soil in the form of grass, leaves, and weeds. Where there is vegetation the roots of plants die and decay and add to the supply of humus.

Certain plants grow on soils which contain no humus. Such plants supply humus in the earlier processes of soil formation. Their roots, and acid and alkali by-products which they give off, help, also, to reduce the rock and soil particles to fine grains. Moreover, the parts of soil that are put into solution act directly as plant food. As the soil becomes adapted to vegetation of a different kind, nature seems to provide the seed for such growth.

Humus also loosens the soil, or holds the particles apart, so that the air can get in. Air is needed to furnish oxygen, nitrogen, carbon dioxide, etc. These elements are usually held in solution by the water. This is taken up by the roots and forced into the plant, taking along the food materials. A heavy clay soil is often materially benefited by plowing under coarse rye straw. This puts a lot of tubes into the soil making passages for the air to circulate. When the roots of deep-rooting plants decay they leave openings or pores which



FIG. 2.—Grain farming.—Note the absence of fences and buildings, necessary for livestock farming.
(Photograph by H. H. Chesterman, Crookston, Minn.)

also make air passages. Such openings also help to drain the soil, permitting the water to run down through to the sub-soil.

Humus, again, acts like a sponge, absorbing and holding the water so that the plants can get it.

Water.—There is no more important element in a fertile or productive soil than water. Water is necessary for plant growth. Any soil without water is worthless.

Water, so necessary for plant growth, is in part held in solution by the humus in the soil. In the main, however, it is held in the soil in the form of a thin layer of water around each soil particle. The finer the particles, therefore, the more water the soil will hold.

Water is also held between soil particles by what is known as capillary attraction. By capillary attraction, also, the water from beneath is brought to the surface to maintain the supply as the plants draw it from the soil on the surface. Capillary attraction is well illustrated in the lamp wick which draws oil from the bowl of a lamp to the burner.

Anchorage.—The soil also serves as an anchorage for plants. The roots of plants, trees included, descend into the soil between and below the heavy soil particles, and those hold the plants upright. Sometimes, however, when the wind is high, and the soil is loose, trees or other tall and heavy plants are blown over.

Good Soil and Poor Soil.—The value of the soil depends entirely upon the amount of plant food it contains. A good soil contains much and a poor soil little. Plants need as food, not only the elements brought into the soil by water and air, but the elements composing the rock or soil particles themselves. Different soils are made up of different elements and, therefore, are adapted to different kinds of crops. Different crops need different foods just as do different animals.

A good soil, also, is one that is made up of fine particles. The finer the particles of soil, the more will the surface be exposed to the solvent action of water, acids, and alkalies, and the more easily will food in the soil particles be set free. A soil made up of particles that are easily decomposed, therefore, is better than one whose particles are difficult of decomposition. Some poor soils will grow profitable crops for one,

two or three years. Then the available plant food is reduced to such a degree that not enough can be grown upon the soil to pay for the work involved. Such soils must thereafter be fertilized or fed. This simply means putting on something that the plants need for food. Many good soils, on the other hand, have been known to grow crops abundantly for from twenty to forty years. But even the best of soils will in time become so reduced in plant food that they must be fertilized. Or, if farming is to be continued indefinitely on the same soil, a system of farming must be adopted that will put back into the soil as much as the plants take out.

In a great number of cases people have taken plant food out of the soil and sold it in the form of grain and hay until their farms became unprofitable and then have moved elsewhere. But that can no longer be done because the farming lands of the country are now practically all occupied. Grain farming of the kind mentioned, which has been called soil robbing, must cease. It is not real farming.

Limiting Element.—Some soils have all that is needed for profitable crop production with the exception of one ingredient. This missing ingredient is called the limiting element. Plants cannot grow because they do not have it. The plant is like the animal in this respect. Both grow with a definite composition or will not grow at all. The way to make such soils productive is to supply the lacking material.

Soil Washing or Erosion.—Soils that are not level will wash. Washing, or Erosion, takes away the finer and best particles. The delta at the mouth of the Mississippi river is, in fact, made up of some of the best soil of the whole Mississippi Valley. Grain farming destroys the sod and uses up the humus which helps to hold the soil particles together. It, therefore, puts the soil into condition to wash badly.

When a worn-out soil is washed away leaving the good sub-soil exposed for crop production work, erosion is a good thing. But this holds true only where there is a good sub-soil. In general, soil washing should be prevented if possible.

Soil washing can sometimes be prevented by deep plowing. This loosens the soil to such a depth that rain, unless it is exceptionally heavy, is absorbed and not allowed to run off on

the surface. Soil washing may also be prevented to some extent by applying straw either on the surface or in the texture of the soil by plowing it under.

Soil Bacteria.—A most important element of soil fertility is its bacterial life. Bacteria in general are small living organisms made up of only a single cell. They are so small ordinarily that they cannot be seen. In order to be able to see them one must have a very strong microscope which makes them appear hundreds and even thousands of times as large as they really are. They live, grow, increase in numbers, and also die. When they die they leave a carcass or dead body in the soil which is very rich in the things needed for plant growth. They also eat or dissolve the dead roots, manure, grass, weeds, etc., and thus put them into forms fit for use as foods by growing plants. The bacteria, by their mode of living and by means of the waste products they give off, also, actually help to dissolve soil particles and make available other substances which plants need as food. A soil that is well supplied with these bacteria, therefore, is a better soil than one that is poorly supplied.

Most productive soils in their natural state are covered with leaves, grass, weeds, etc. This material furnishes the bacteria with food and at the same time protects them from the sun. Sunlight will kill most bacteria, not by its heat but because of other qualities. This is one reason why new soil when it is first broken or plowed up is so rich and will produce such good crops.

In grain farming, the crop is cut in the middle of the summer and the soil is exposed to direct sunlight during a large part of the season when the light is the most intense. This has a very damaging effect on the soil. Then when the land grows poorer and will not grow crops continually, it is summer fallowed. This again exposes the soil to the direct rays of the sun for a long period, killing all the bacteria on the surface. Land so treated is benefited in some ways but it is materially damaged by the loss of its bacterial life. It has been found in fact, that by growing a cultivated crop, such as corn or potatoes, the soil receives the same benefit as by summer fallowing and the succeeding crop is just as good. The reason is

that this method saves bacteria, and the crop of corn or potatoes is clear gain.

THE BUSINESS OF GRAIN FARMING

The farmer often looks upon his work as of inferior rank. He is "only a farmer," he says, but the modern successful farmer is a business man, and one must not only till the soil and grow crops; but must come into contact with practically all of the other kinds of business men and know something about their business.

Revenues from Grain Farming.—Since grain farming, as such, is soil robbing, it must necessarily appear very profitable, so long as the store of fertility holds out in sufficient quantity to produce abundant crops. It yields "easy money" which helps in establishing a new farm or a new farming community. When a man settles in a new country he has need of all the cash that is available to establish his home and his enterprise. If, then, he takes some of the capital stored in his soil and invests it in improvements on the farm so that he can make better use of the rest of the fertility in the soil, he is entirely justified. If he goes farther, however, he soon overdraws his account. The man, however, who lives in the city, buys a piece of land, robs it of its soil fertility, does not put the money back into the farm, and then sells the land to some ignorant outsider who wants to be a real farmer, charging a price in accordance with what the land has produced, ought to be considered guilty of a criminal offense.

The Labor Problem.—The grain farm employs very little labor during the winter and a very great deal during the summer. The amount employed in the summer is not uniform. Much more is needed at harvesting and threshing times than at other times. Labor on the grain farm, therefore, is very expensive for the time it is employed, for it demands a wage based upon the need of support through months when no such employment can be had. Possibly grain farming is in part responsible for the tramp evil in the United States.

Looking at the labor problem from another standpoint, the grain farmer, if he is farming properly, must necessarily plow, disc, harrow, seed and harvest all of the land upon all of his

farm every year. Yet all of the work must be done in practically half the year. Considering this fact, with high cost of labor and the added cost of seed, it can readily be seen that grain farming is an expensive method.

Farm Equipment.—The equipment of machinery and horses on a grain farm, moreover, is necessarily large and expensive. There must be sufficient horse or traction power to work all the land every year. And there must be plows, discs, harrows, drills or seeders, harvesters, threshers, wagons, etc. The taxes, interest, depreciation in value, repairs, room for storage, etc., on all of those items is a matter of considerable importance.

Social Aspect of Grain Farming.—The grain farmer, who is idle a large part of the year, develops the habit of idleness, and idleness leads to shiftlessness and laxness. When these characteristics once become firmly established they lead rapidly to social decline.

CHAPTER II

LIVESTOCK FARMING

The statement that "man shall not live by bread alone" is familiar to all. The purpose of livestock on the farm is several-fold: (1) to furnish power—hence the horse; (2) to provide protein foods for man—meat, milk and eggs; (3) to supply fatty foods—butter, lard and tallow; (4) to yield material for clothing—wool; and (5) to conserve soil fertility.

Let it be understood at the start, that livestock farming is not, and cannot be, advocated as the only form of agricultural endeavor. Man needs bread with his butter, potatoes and other vegetables with his meat, fruit with his fatty foods, and cotton with his wool fiber for clothing. Yet in livestock the farmer has an avenue of escape from that poverty which surely follows excessive grain farming without a proper return of soil fertility. Moreover, the raising of livestock promises increasingly rich returns. B. F. Harris, banker-farmer of Champaign, Ill., says:

"In 1890 the average net consumption of meat per capita in the United States was 450 pounds, which in 1912 had fallen to 180 pounds. Meat consumption cannot be reduced much lower, nor will the prices be less for population is fast increasing on production."

The Place of Live Stock.—What is the place of livestock in the economy of the world? If it takes from 5 to 10 pounds of feed to make a pound of gain in live weight on a meat-producing animal, and less than half of this gain is edible, is not the animal on the farm a cause of a great waste and of possible world-wide bankruptcy? Such questions are frequently asked. But which is preferable: to support a large world population by means of grain farming directly for a period of from three to fifty years, or to support a smaller population of higher-class individuals indefinitely for all ages?



FIG. 3.—Common red clover; a good foundation on a livestock farm. (Photograph by H. H. Chesterman.)

The latter is the possibility in livestock farming and the limits in number and quality of population in the world have not yet been reached under livestock farming.

ADVANTAGES OF LIVESTOCK FARMING

The principal livestock product—meat—as an article of human food, contains certain invigorating or stimulating principles not found in the vegetable kingdom. Thus meat-consuming nations, provided they do not consume an excess, are in advance of those living upon a vegetable diet, and aside from the indirect advantages of livestock farming mentioned in the foregoing and to be discussed more fully later, there are certain other important and immediately direct advantages.

Coarse Feeds.—If man were able to produce non-animal feeds that would satisfy his needs, if he could eat the kinds of feeds that livestock eats, and if all the land were available for cropping, there would be no need of the meat-making animals on the farm. But such are not the facts. Most of the farm animals use a large proportion of coarse feeds or roughages in their ration, like grass, hay, corn fodder and straw. These are converted into body tissues in the animal and a large part of this becomes food for man.

Waste Lands.—In many parts of the country there is a great deal of rough, hilly and mountainous land. This land produces forage crops, but frequently cannot at all, or cannot conveniently be farmed by the cropping system. Furnishing grazing for livestock, however, it yields food for man. On most farms, also, there are fence rows and fence corners, and frequently wild land and timber lots, all of which grow more or less grass. This is frequently wasted under the cropping system. With livestock, however, all such land can be grazed, increasing the area upon which human food is produced. On the average farm, too, there is usually a good deal of aftermath which can be used as feed for stock and which would be lost by the other method.

Weeds.—By most classes of stock, and by sheep especially, a great many weeds growing on farms can be converted into human food products.



FIG. 4.—A field of alfalfa and alsite clover; a necessary prerequisite to livestock production.
(Photograph by H. H. Chesterman.)

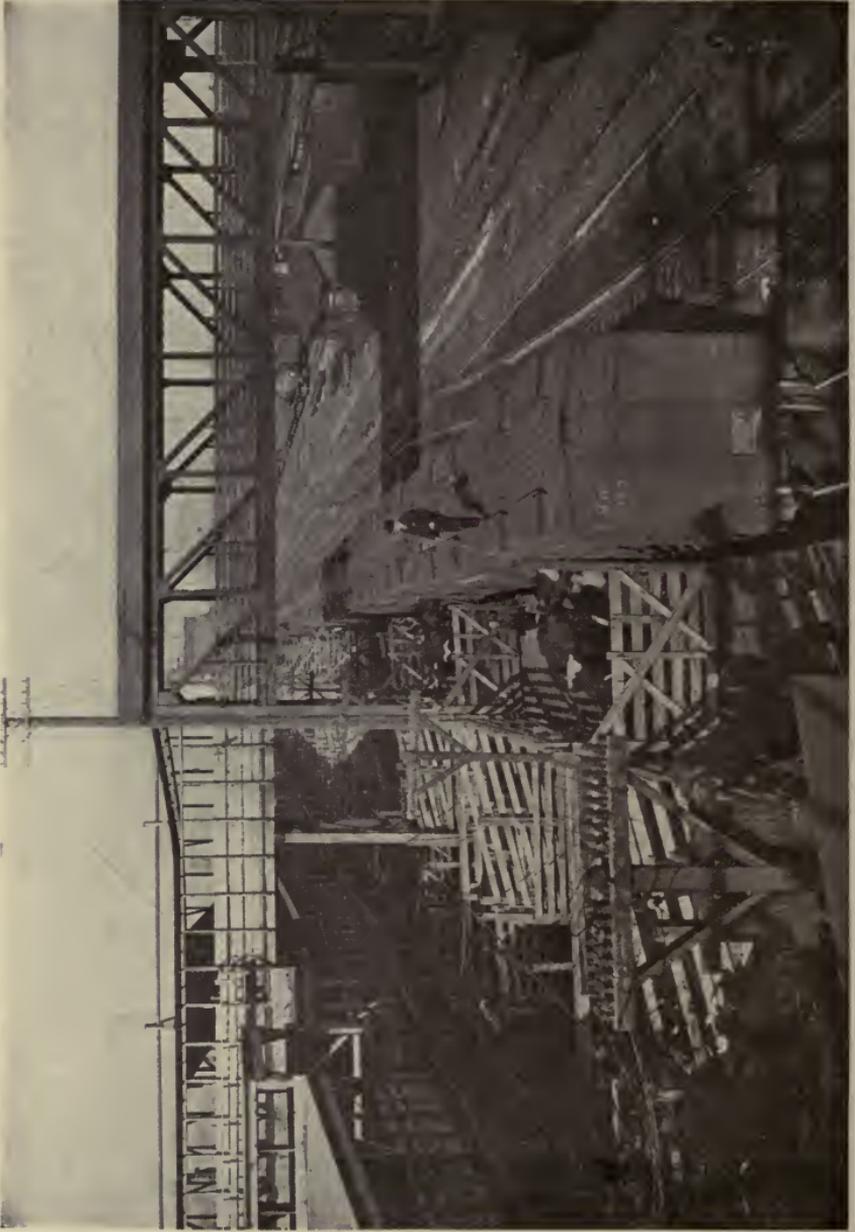


FIG. 5.—The market end of a livestock farm. (Photograph from Hildebrand.)

Waste Feeds.—Kitchen slops, damaged and scattered grain, and similar things would often be wasted were it not for meat-producing animals. Slops from the kitchen, when used fresh and not loaded with broken glass, soap and washing powders, make the best kind of hog feed. They are usually rich in all the substances that are necessary to make hogs grow and fatten. Many times, again, a farmer has soft corn, caused by an early frost which is practically worthless on the grain market, but which makes good hog feed. Sometimes grain spoils in the bin by dampness or by heating or sometimes great quantities of grain become damaged by elevator fires. All such grains make good hog feed, and, indirectly therefore, human food. On most farms also by shattering, lodging, hailstorms, etc., a good deal of grain is left in fields after harvest. Without stock this would be wasted while with livestock it becomes a source of profit and adds to the sustenance and comfort of the human race.

The Labor Problem.—On the livestock farm there is relatively more work in winter and less in summer than on the grain farm. This makes a much more equal distribution of labor during the year and enables the livestock farmer to employ a higher class of help at a lower wage than the grain farmer. This gives economy of production also, and consequently more profit.

Expense of Harvesting.—The expense of harvesting machinery for the grain farm, already mentioned, consists of the original investment, repairs, depreciation, interest, taxes, storage room, etc. There is also the work of harvesting, caring for, gathering in, threshing, and marketing grain to be counted. With the grazing of livestock most of this work and expense is eliminated though the construction and maintenance of fences must be considered (and will be later). Stock or feeder cattle and sheep obtain the greater part of their sustenance by grazing. The grain they are fed and the shelter necessary for winter are very small items when compared with the expenses of grain farming.

FENCES

The cost of fencing is considered by many a serious handicap in establishing a livestock farm. Many, therefore, fence

in small areas in which they confine their stock. This, however, is a mistake and defeats the farmers' purpose. The stock does not have sufficient exercise, or the necessary variety or abundance of feeds. The result is the animals cannot do well and may become a source of loss.

Manner of Fencing.—Farm fences should be built to promote the entire business of the farm—pastures, crop rotation, economy in doing the farm work, etc. The fence rows should be laid out where the fences are intended to remain for all time. Then these should be well constructed and be made as nearly permanent as economy of construction will permit. A poor fence should not be tolerated because when least expected and when the possibility of producing damage is the greatest the stock may break out and spoil a year's profit in one night. The loss may be in damage to the crops or in damage to the stock itself. Overeating may kill the animals, and, it may be, the best ones will die first.

It is not only the immediate damage to the crops and to the stock that should be considered. If animals get out a few times they get the habit of going through fences and then it is practically impossible to keep them back with any kind of a fence. Thus the habit of fence creeping or fence jumping and the habit of remaining in the pasture may be largely developed and one is as bad as the other is good.

Animals' Fence Habits.—An 8-acre area of timber with fields on two sides was fenced by the author with two strands of ordinary barbed wire. At the time the acorns began to fall, a bunch of shotes that had been fed and grazed in an arable pasture were put into this woods pasture. They remained there till snow fell in the late fall when they were ready for market. Never did any of the hogs ever get out of the pasture. It was difficult to drive them out finally with both wires laid down on the ground. The pigs had been trained to remain within their enclosure and they had enough to eat where they were expected to stay.

Kind of Fence.—Fences may be built for different kinds of stock, but a fence that is built to turn all kinds of stock is the most satisfactory. Such a fence can be constructed with a strand of woven wire about 30 inches wide at the bottom

and with three strands of barbed wire above this. The top wires may be spaced 6, 8 and 10 inches respectively, working from the woven wire upward. A fence of this kind is $4\frac{1}{2}$ feet high. The barbed wires may be spaced a little wider to make the fence higher. Two barbed wires above such a strand of woven wire will turn cattle, hogs and sheep.

It is estimated that such a fence can be built at a cost of about 60 cents per rod as follows:

Woven wire—30 inches.....	\$0.30
Post.....	0.10
Three barbed wires.....	0.10
Labor.....	0.10
	<hr/>
Total.....	\$0.60

In some sections and at certain times it might cost a little more than this to build such a fence but if one has the post timber on his own farm it might be built for less.

In building a fence it is well to set the posts $16\frac{1}{2}$ feet or 1 rod apart. It is then an easy matter to calculate the area within the enclosure or in any part of it. The post timber should be well seasoned.

How to Build a Fence.—The posts should be cut and sharpened during the winter while labor is cheap and plentiful. They should then be well piled and allowed to dry thoroughly through the following summer. The next spring when the frost is out of the ground and the fence row has been staked out, one man goes ahead with a crowbar and punches a hole in the ground where each post is to stand. Following this man, come two other men on a wagon with a flat-bottomed rack. The sharpened posts are carried on the wagon and each man has a post maul. The wagon is stopped by the side of a hole made by the man with the crowbar. The post is set and driven down to the desired depth by the men standing on the wagon. Posts should be set from 2 to 3 feet deep with the larger or sounder end down. The corner posts should be larger than the others and should be set in concrete.

This same method of fence construction can also be used

during the summer after a heavy rain when the ground is thoroughly wet. The wire may be nailed on at any time.

Many times the foregoing method of fence construction cannot be used. It is then necessary to dig holes. Many kinds of post-hole diggers are available. A post sharp at the bottom will not heave out as readily by winter freezes, and can be pounded back more easily than one that is sawed square.

Post Timber.—In *The Country Gentleman* of March 6, 1915, Edmund Secrest says:

“Almost every property owner, whether in the city or in the country, uses at some time a certain quantity of post material. . . . Few of our native timber trees make durable posts and it is a waste of time and material to use white elm, maple, beech, ash, pine, spruce and the red and black oaks for this purpose, unless the wood is treated with preservatives; and this is impracticable unless a considerable quantity is used. Untreated the wood of these trees lasts only a few years in the ground.

“Examination of some 30,000 fence posts by an institution with which the writer is connected has disclosed some interesting facts in connection with the problems. . . . The osage orange or common hedge was shown to possess more durability than any other timber examined. Posts that had been planted for thirty or forty years showed only a small percentage slightly decayed. The osage post is without a peer for durability and strength. Small poles no larger than 2 inches in diameter will last for years in the ground and no better vine or garden stakes can be found.

“The black or yellow locust ranks second to the osage as a post timber. This tree grows much faster than the osage and it is the most practicable fence post because it is more easily obtained in larger sizes. The black locust grows quite commonly throughout the Eastern and Central States.

“The red cedar—third in point of durability—is quite limited in some sections of the country and is not commonly on the market. The wood is light and strong, but expensive. It makes good arbor poles, because the trees are usually straight and the posts in consequence are of a quality to be preferred for this use.

“The mulberry ranks almost with the red cedar in durability but the trees are inclined to grow crooked and scraggly, frequently giving the posts poor form. Moreover, mulberry is not plentiful and the posts are rarely on the market. The wood, however, is recommended for its durable qualities.

“White cedar or arbor-vitæ posts are much used and are fairly durable. They are supplied from the swamps of the Lake States and are shipped to many parts of the country. Like the red cedar they are well adapted for arbor purposes, but they decay sooner than the red cedar. White cedar posts have a common defect—heart rot. This rot does not mate-

rially affect the lasting qualities of the posts, however, since the most durable portion is the sap wood, which must be depended upon to perform the service.

"The catalpa has been much planted in recent years, but the durability of its wood in contact with the ground has been overestimated. Some of the earlier plantations are now producing posts but they are rarely on the market, except in certain sections.

"The chestnut is much used throughout the regions where it grows and posts are easily obtained, but it ranks seventh in point of durability.

"White, chinquapin, chestnut and bur oaks—in fact, any of the white oak group—produce fairly durable posts, but they rank below those already named. Black ash and honey locust are not recommended except for temporary fencing. The wood is not long-lived. These species, however, are quite commonly used in some sections of the United States.

"It is well to remember that the condition of the wood has much to do with its lasting qualities. Trees that grow rapidly in the open do not make as durable posts as those grown more slowly in the woods. Open-grained posts of red cedar from fast-growing trees in the open, for instance, would give perhaps not more than a half or one-third the service of those taken from slow-growing forest trees. The same may be said of any of the other timbers that have been described.

"Posts taken from old trees on the decline do not possess the lasting qualities of those taken from young and thrifty trees. This accounts for the saying so often heard that white-oak posts no longer possess the lasting qualities they had years ago. Many of the large white oaks in farm woodlots are on the decline owing to constant abuse and old age.

"Particularly is this true where woodlands are heavily grazed by livestock. The wood of trees that show evidences of decline has already begun to decay, especially in the heartwood, even though such action is not apparent, and the natural result is that the life of the post is reduced."

Cost of Fencing a Farm.—Suppose a quarter section of land is to be fenced on four sides with two fences crosswise through the middle, making four 40-acre fields. One side of the quarter adjoins a public highway. The owner will have to fence the entire side of the road—160 rods. One the other three sides the expense will be shared equally with the neighbors. This will mean 240 rods more. The two cross fences of 160 rods each will bring the total up to 720 rods. At 60 cents a rod, the cost of a first-class, all-purpose fence will be \$432 or \$2.70 per acre. Granting that the fence will last 27 years which is possible even with good, well-seasoned white-oak posts, where there is not too much humidity and the climate is not too hot, the fence will cost only 10 cents an acre per

year. This cost is very small indeed compared with the annual cost of plowing, pulverizing, seed, seeding, harvesting, threshing, etc., which are necessary in grain farming.

THE ECONOMY OF LIVESTOCK

In the first part of this chapter it was mentioned incidentally that it takes 5 pounds or more of feed to obtain 1 pound of gain in the live weight of a farm animal. Sometimes, however, gains may be made on less. But from a financial standpoint, is a gain of 1 pound at a cost of 5 pounds of feed a loss or a gain? How much do the farm animals pay for the feed that is fed them under proper conditions?

People who have made a business of feeding animals say that livestock pays from \$1 to \$1.50 for every bushel of corn fed and for other feeds in proportion (not war prices). From another standpoint, the market price of feeds obtained by the farmer, such as hay, oats, corn, barley, etc., ranges from $\frac{1}{2}$ to $1\frac{1}{2}$ cents a pound. How much does the farmer get for his farm animals when he sells them? Hogs, cattle and sheep sold for slaughter bring from 5 to 10 cents a pound live weight. Horses bring from 10 to 30 cents a pound when sold for work purposes. When any of these animals sell as pure-bred animals for breeding purposes they may bring very much higher prices than these. It is clear, then, that livestock offers the farmer a better market for his feeds than do the feed markets.

But why should the animal require 5 or more pounds of feed to make 1 pound of gain in live weight? Why ask this question? Is it not enough if the animal pays a good price for all it eats? No! The important thing is not how much one can get out of his business but what he can do to surpass his neighbor, the grain farmer, and at the same time to better the world, leaving his farm to his successor in a better state of fertility than when he obtained it.

The interesting part of all this, however, is that these animals on the farm pay a good price for all they eat and then turn right around and give a large part of it back in the form of manure. This enables one to grow more grain and hay, to feed more livestock, to buy more land, to grow more feed, to feed more livestock, etc.

The business transaction of these farm animals might be compared to that of an elevator manager, who, having bought of a farmer a load of wheat, paying for it in cash, at once ordered the farmer to reload a large part of his wheat to take home with him. It might be added that a farmer so treated, who would haul his restored grain into his yard and leave it there, would not differ much from the man who leaves his manure pile lie in the yard from year to year.

An elevator man who would do the thing outlined above would be considered a pretty good fellow. Nevertheless, farm animals are doing just the kind of thing described right along. They not only return much of what they eat but the part they return is greatly improved. What would one think if he sold 100 bushels of oats and after getting the money for it, would get 40 bushels of wheat in addition? Livestock not only gives back four-fifths of what it eats, excepting energy, but it makes more useful the part it gives back, by the introduction of bacteria.

The value of these germs to soil fertility has already been mentioned. The alimentary track of the farm animal is a bacteria factory. Germs develop here by the hundreds of millions and when they get into the soil along with the manure, which furnishes mineral plant food direct, they work night and day liberating and gathering plant food so that plants grow much better and sell for more money. Thus it is that the livestock farmer grows richer and the grain farmer after the first few years grows poorer.

LIVESTOCK NECESSITATES THE GROWING OF FORAGE CROPS

Livestock on the farm necessitates the growing of forage crops. These are the cheapest feeds and most farm animals, to do well, must have them. Such feeds also become cover crops for the soil. They protect the soil bacteria from the heat and light of the sun during the hottest part of the day as well as during the hottest part of the season, thus enabling the bacteria to live and multiply. Grain farming or summer fallowing does not provide such protection.

Crop Rotation.—Livestock farming also necessitates crop rotation. In order to produce livestock successfully one

should have corn fodder and several kinds of hay, as well as a variety of grains. This calls for the sowing or planting of different crops on a given piece of land every year for a period of years.

Different plants are made up of different combinations of chemical elements. A crop will take out of the soil so much of a certain substance in a season that the same crop ordinarily will not do so well the following year. The partially exhausted substance thus becomes the limiting element, and if the same crop is continued the yield grows smaller from year to year. Under a good system of rotation, however, the crops of one season draw more heavily upon substances that the previous crop has used the least of. One crop, also, may leave a waste product in the soil which acts as a poison to a like crop but not to a different kind of crop. Moreover, by a wise choice of crops for a rotation, some of the elements taken out of the soil by one crop may be in part restored by another. This supplemented by manure keeps the soil fertile.

Cultivation.—One of the principal operations in agriculture is the cultivation of the soil. As mentioned in Chapter I, soil is improved by the movement of soil particles. This refines the soil and liberates more of the material out of which the particles are made for plant food.

By keeping the surface loose, cultivation also checks the evaporation of water. Of course, the surface soil becomes very dry, but the loose portion which extends below the extremely dry part does not allow the water to rise from beneath and escape into the air by evaporation. The capillary action is broken. This simply means that the soil particles are so far apart that the water cannot rise between them as it rises in the fibers of a lamp wick.

In order that plants may grow upon any soil there must be present a considerable amount of water. When a soil is loose it will hold more water than when it is hard. A loose soil also allows water which falls on the surface to soak in. This prevents the washing away of the best particles of the soil. Though a loose soil breaks capillary action, rain on a loose soil packs it enough to restore capillarity. Of course, a very coarse, sandy soil does not possess much capillarity, neither

does it hold much water. Water runs through it as through a willow basket.

Aeration is another important advantage in cultivation. The air fills the spaces between the loosened soil particles and this brings oxygen to the roots of the plants. Oxygen is an important plant food just as it is important to animal life.

Cultivation also kills weeds. The importance of this is well recognized.

In almost any system of livestock farming in nearly every part of the world where livestock is grown, corn is used as one of the principal feeds. If corn is to be grown successfully it must be cultivated. It must also be cultivated during the summer. This is beneficial to the soil in all the ways mentioned, and especially in the killing of weeds and in the preservation of bacteria.

Summer fallowing is beneficial because the soil is cultivated, but when the soil is cultivated in the corn field it is doubly beneficial because the shade from the corn plant protects the bacteria in the soil. Therefore, a crop of wheat may yield as much after a corn crop as after summer fallowing. The corn crop is thus clear profit.

Humus.—The value of humus in the soil was discussed in Chapter I and need not be repeated here. It furnishes plant food, produces a sponge for holding water and allows more bacteria to develop. Livestock farming puts more humus into the soil than does grain farming.

The grass and legume crops leave more roots in the soil than most grain crops and these as well as corn shade the soil during the summer to prevent the burning out of the humus in the soil by the sun.

Leguminous Plants.—With a system of livestock farming, also, it is possible to introduce more leguminous plants, such as clover, alfalfa, soy beans, and peas. These, to put it popularly, take nitrogen, one of the principal plant foods, from the air and leave some of it in the soil for the next generation of plants. The nitrifying bacteria, as they are called, live upon the roots of the leguminous plants and for their own life take nitrogen from the air. Then when they die, the nitrogen is available for other plants. These bacteria

keep growing and dying all the time. And when the leguminous plant dies or is plowed under so as to kill the roots, all this nitrogen becomes available for succeeding plants. Thus, as already intimated, the livestock farmer has a way of making his soil richer.

Sometimes it is argued that the grain farmer can do the same kind of thing by sowing clover in his rotation and cutting it for seed. This is all right, if he will put back the clover straw. But if he had some livestock to which to feed this straw he would get good pay for it and still have most of it left to put back upon the soil.

Erosion or Soil Washing.—In many sections of any agricultural country the land is so hilly that with grain farming a good deal of the surface soil washes away. Gullies and ditches are formed materially injuring a field for agricultural purposes. In livestock farming a considerable portion of the farm must be kept in pasture and hay meadows. In these there is enough sod produced in a large measure to prevent such soil washing.

RETURNS MORE CERTAIN

Weather conditions are a more important factor in grain farming than in livestock farming. The crop is never sure until it is harvested and threshed. With a variety of crops, danger to one does not mean danger to all. With livestock farming there is also considerable risk. The lives of the animals may be threatened, but with proper care the danger is slight.

Wind.—Windstorms are very often a serious menace to grain farmers. When grain is approaching maturity and a windstorm comes up, especially if it is accompanied by a rain, the grain may be lodged badly. This happens more often with good grain on account of its rank growth. When grain is thus lodged, much is lost because it cannot be harvested by machinery. If storms come early in the growth of a crop, its development is seriously checked.

Storms will also lodge the livestock farmer's grain, but that which the harvesters fail to get the stock can readily gather up. A considerable part of the crop of the stock farmer, also,

is in the form of grass which is not as easily damaged by storms. Corn, again, is not so seriously damaged by storms as are the small grains.

A dry wind, because of the evaporation of the moisture and the blowing of the soil, does more damage to the grain farmer than to the livestock farmer.

Hail.—Many a grain farmer has had his work for the year brought to naught by a hailstorm. This is especially true with the small grains. Corn is not so easily damaged by hail, and pasture and other forage crops grown by the livestock farmer are seldom if ever ruined. The damage done him by hail is really very slight.

Heat and Moisture.—It takes heat, light, and moisture to make all plants grow. But too much heat, especially if accompanied by an excessive amount of water, frequently causes large damage to grain crops by way of rust and blight. This, again, is not the case with pasture and forage crops.

Wet weather very often interferes with the seeding and harvesting of the grain crops but, as a rule, is favorable to hay and pasture crops.

The absence of water, also, as in a drouth, is very harmful to the small grain but not to the same degree to some forage crops, like alfalfa and clover, or even to corn.

Insects.—The various kinds of insects such as plant lice, chinch bugs, grasshoppers, army worms, etc., are more injurious as a whole to the crops grown by the grain farmers than to those grown by the livestock farmer.

NATURE OF FARM PROBLEM

The livestock farmer in one sense is a manufacturer. He takes the grains produced by the grain farmer, or by himself, and converts them into a higher-priced material. He makes a finished product out of the raw material. This enables him to get larger returns from his farm. Under some conditions this requires more labor but the more labor one can employ profitably the better off he is. Some people calculate their profits by the number of men they can employ.

A few examples to illustrate the difference between grain and livestock farming may be of value. In these estimates

the feeds used are considered to be worth 1 cent per pound, which seems to be a fair average considering that this includes both roughages and concentrates and that the farmer thus has a market for these products right at home.

A 1500-pound horse at the rate of 6 pounds of feed for 1 pound of live weight can be produced on 9000 pounds of feed, which will cost \$90. *Nebraska Bulletin*, No. 130, shows that a three-year-old horse, weighing 1218 pounds, can be produced at a cost of \$54.42. Assuming that the interest on the investment of stock, fencing, and buildings, and the depreciation in value of these, plus the labor expended in caring for the animal is 40 per cent. of the cost of the feed, a horse at maturity costs \$126. Such a horse can easily be sold, if the proper kind has been produced, at \$200. This means a profit of \$74 on the transaction, besides saving of labor in hauling the feed stuffs to market and in harvesting a considerable portion of it. The colts in pasture do the harvesting under the condition above mentioned without any expense to the farmer.

A 1000-pound mule produced under the conditions mentioned above would cost about \$90 and can easily be sold at present prices for \$200, yielding a profit of over \$110 on the feeds required to produce the one individual.

A good cow can be maintained for a year in a high state of production on about \$40 worth of feed. Her product in calf and butterfat or milk may range in value from \$75 to \$100 a year. Taking the average figures and the labor, interest, etc., at 60 per cent. of the value of the feed, such a cow returns a profit of \$23 a year more than the grain farmer obtains.

A ewe can be maintained annually, where a moderate-sized flock is kept on the average farm and the sheep are allowed to gather what would otherwise go to waste, at a comparatively small cost. Sheep do not need expensive shelter in winter, they eat largely of rough feeds, and can be carried through without very much labor. A ewe will produce a lamb, and sometimes two, and an annual fleece which will sell for considerably more than is required for its production.

An 800-pound beef animal at 8 cents a pound is worth \$64. To grow such an animal at 6 pounds of feed for each pound of live weight, allowing 25 per cent. of the cost of the feed for

incidental expenses, costs \$50, leaving a margin profit of \$14.

A 300-pound pig can be grown at from 4 to 5 pounds of feed for each pound of gain. A pig, therefore, costs in round numbers about \$16 after allowing 25 per cent. for incidental expenses. Such a pig at 7 cents a pound is worth \$21 and returns a profit of \$4 directly over and above the feed consumed.

The grain farmer, with every crop he sells, disposes of considerable plant food. If he continues this for a sufficient time, he reduces the productive capacity of his soil to such an extent that farming ceases to be profitable.

The plant food in the soil upon which the plants grow is similar to a bank account. When it is once drawn out, it is gone and plants will not grow till the stock of plant food is returned to the soil. To get an object lesson of this, one needs only to take a trip to some of the older States. Here he will find farms on which it is just as impossible to grow crops without fertilizers as it is without seed. Thus, while grain farming may be profitable so long as there is an abundance of plant food in the soil, leaving out of consideration the fact that the soil is being robbed, the farmer really impoverishes himself to the extent that he is unable to return the necessary plant food to the soil in the form of fertilizers. He is then obliged to abandon his farm or leave a heritage to his children that is a burden on their shoulders.

Again, if a grain farmer burns his straw or cornstalks, he destroys one of his most valuable assets—such stuff as decay converts into humus to become plant food and to loosen and aerate the soil, get oxygen into it, and furnish conditions favorable for the work of bacteria in liberating and preparing plant food.

Carl Vrooman, Assistant Secretary of Agriculture, in *Farmers' Bulletin* No. 704, says:

“The farmer who sells his crops at the elevator is robbing his own soil, his own purse, and his own children—selling their birthright for a mess of pottage. The farmer who not only does this but also burns all his cornstalks and straw, reminds one of the burglar who takes all the valuables he can carry off and sets fire to what is left.”

To illustrate the difference in the amount of plant food sold from the farm in feeds and in its equivalent of animal product, take the following. A 300-pound pig with ordinary feeding can be produced on about 1200 pounds of food of the equivalent of barley and about 1200 pounds of skim milk. These contain 29.76 pounds of nitrogen, 11.88 pounds of phosphoric acid, and 8.04 pounds of potash. The commercial value of these is: nitrogen, 15 cents a pound; phosphorus in the form of finely ground raw rock, 2 cents a pound, and in the form of acid phosphate, 6 cents a pound; and potassium, 6 cents per pound. If it is fair to take the average of the two figures for phosphoric acid, the fertilizer value of the three substances contained in the feeds needed to produce a 300-pound hog, is worth \$5.42. The 300-pound pig contains 5.3 pounds of nitrogen; 1.96 pounds of phosphoric acid; and 0.414 pound of potash with a fertilizer value of \$0.90. The rest of the elements in the feeds consumed by the pig are returned to the soil in manure, making a saving to the farm of \$4.52. If a farmer produces 150 hogs a year for twenty years the saving in this item alone is \$9040.

B. F. Harris, chairman of the Agricultural Commission of the American Bankers' Association, in an address before the Illinois Livestock Breeders' Association at Springfield, as printed in the *Chicago Daily Farmers' and Drovers' Journal* of February, 1915, said:

"The average return of the grain and hay farms of the United States is \$7.72 per acre, while the livestock farms average \$11.42 or 48 per cent. more than grain farms, though many livestock farms have poorer or less improved land.

"Illinois grain farms average \$10.60 per acre and her livestock farms \$12.55, or 18 per cent. advance. In Missouri the average is \$7.69, and \$9.55, or 24 per cent. advance. Iowa, \$8.88 and \$13.17 or 48 per cent.; Kansas, \$4.79 and \$5.26. An exhaustive survey made by the government of some 700 Indiana, Illinois and Iowa farms found that of the 273 of these operated by their owners, 194 were livestock farmers and 70 crop farmers.

"The livestock farmers averaged 189.5 acres, 37.3 acres being in permanent pasture; average investment, \$33,222; average labor income, \$755. The crop farmers averaged 161.1 acres, of which 14.5 acres were permanent pasture; capital invested, \$27,532; average labor income, \$28. The livestock men had a larger acreage and more capital and were receiving a much higher labor income. The average income of the crop farmers was \$28, per farm; that of the livestock men, \$755, or 27½ times

more than grain farmers. This wide difference in favor of livestock farmers holds true in each of the States.

"Each farm must be more of a factory—selling less crops and more meat, milk, butter and eggs. There are \$161.22 of soil-fertilizing elements in the feed we ship off the farm which, if fed, would produce a ton of beef, and then only \$12.99 in fertility would leave the farm with the beef. There are about \$7.22 of fertilizing constituents in a ton of bacon, but when we sell the feed instead of the hogs, we lose \$97.31 in fertility—in farm assets. A ton of butter carries away but 6 cents from the farm fertility, while selling the feed required to produce the ton carries away \$374.67.

"The utilization of these facts has helped make prosperous and doubly fertile farms and fields of Denmark, Germany and other wise nations. They do not sell their farms by tons and pounds, but sell the crops and finished products that carry away the least fertility.

"In 1913 the South exported to Germany, Denmark, Belgium the Netherlands, and Great Britain, 1,138,000,000 pounds of cottonseed meal and cake—each pound taking away just so much of our permanent fertility and adding it to Europe's, and the same is true of our Northern flaxseed oil meal cakes. If these European folk can pay freight and charges thousands of miles away and make a profit, why can't and don't we?

"A man who does not raise or feed some livestock, who does not have a large proportion of colt-raising mares among the horses, who does not have a manure spreader working on schedule or a few sheep to clean up, is not a real farmer and is not getting more than a fraction of the returns he would otherwise get."

Interest in Farm Life.—Man was created in the image of God. Next to him are the animals of the world. These include the farm animals. There is nothing on the farm that will create such universal and such deep interest in the child, in the family, and even in the farmer himself as the farm livestock. Many a man has been inspired to nobler deeds and to higher ideals by coming into contact in an interested way with animals.

Why is it that in modern times many a well-to-do person has put aside his automobile and has gone back to the horse for pleasure purposes? It is simply on account of the relationship that exists. There is no relationship or connection between a man and a dead machine that touches the real man or the spirit. But once a man is connected up with a horse by means of the reins, touch, sight, thought and voice, he gets a response. It is in this that man finds something worth

living for. The same relationship exists between man and all the live animals. All this creates interest and enthusiasm, and without these success cannot be achieved. Contentment and happiness are also necessary to success in any work. If a man is not happy and contented in any work, he will give up such work and take something else even at half the salary. Work in which one can be interested and enthusiastic and in which contentment and happiness prevail, leads to a higher development. Man under such conditions will grow and develop all the possibilities with which his Creator endowed him. Thus livestock farming will result in social and political reform. It will help to develop a higher type of manhood and aid in the betterment of the world generally.

The Man.—The type of man needed for livestock farming is worthy of consideration. The livestock farmer must necessarily be a grain farmer. As a rule, most of the feeds fed to livestock are grown upon the farm. In addition to this he must know animal husbandry. He must be familiar with the history of breeds so as to know what will result from breeding work. He must know the types within the different breeds. He should also know the type that is likely to be in demand in the future. It takes time to develop a herd of animals and if when developed it is not in demand it has little value.

The farmer must also know the different feeds; what they are composed of and what results they will give when fed to animals under different conditions.

It is a well-known fact that many good herdsmen in this country are of foreign birth, often Scotch or English. Such men are brought over especially for this work because they have been both bred and trained for the work of caring for and feeding animals. Great Britain has for centuries been known as a livestock country. It takes more time to develop a livestock man than to develop a herd of livestock.

A most excellent contribution to this topic appeared in the *Breeders' Gazette* of June 17, 1915, entitled "The Master Breeder." It was by Dean Davenport, of the College of Agriculture of the University of Illinois, and is given herewith. Dean Davenport said:

“What manner of man should the breeder be? What instincts, what qualities of mind, what temperament should he possess in order to succeed in the breeder’s art? What are the ideals and what the capacities of the born breeder of livestock whereby he achieves constructive results? Such is the question and what shall the answer be?

“Anybody can buy and sell livestock. Anybody can speculate in values. Anybody can traffic in pedigrees and show-ring records. Anybody can raise livestock so far as increasing numbers are concerned, but only the master breeder can so compound the subtle qualities of animal life and so foster and finish the product as really to contribute something new to the animal art of his time. It is perhaps worth the attempt to analyze and to define, as best we may, the qualities that characterize the master breeder as distinct from the one who merely traffics in what others have accomplished.

“First of all and fundamental to constructive results, in the herd and to the highest satisfaction of the mind, the breeder must belong to the rather rare class that may be called lovers of animal life. The landscape artist is passionately fond of the out-of-doors; the musician is as sensitive to sound as the artist is to sight; the breeder’s response is to life in animal form.

“I do not now refer to that intellectual appreciation of the economic value of good livestock, admitted without argument even by the census taker and the statistician and accorded by thinking men everywhere. I do not have in mind that voluble enthusiasm for conventional type or pedigree that characterizes many a professional dealer, but I mean that instinctive love for living things that amounts almost to a passion with the few who possess it; which the man feels and the animal understands, but that we may not define.

“This love of life expresses itself in a thousand subtle ways—in tone of voice, in accent, in manner, and in every movement. This is what keeps the stockman with his creatures on stormy days, even after nothing for their comfort remains to be done. He ‘just likes to be with them,’ and they with him. No man quite knows why, but so it is and that is enough. Only the man who feels this thing can ever realize the highest satisfaction and the most substantial success as a breeder. Be he ever so successful in reproducing numbers and in buying and selling he will never be a constructive breeder unless he has that in his make-up which responds to animal association.

“This man must also be an artist, with the artist’s eye to detect details of form and structure and with the artist’s ability to create mental pictures out of the best that he has seen in all animals. Thus is his ideal type built up. If he cannot do this he is working in the dark, a ship without a compass, an architect without a vision, a builder without blueprints or specifications. With this vision he has an ever-present guide to progress, a yardstick with which to measure both success and failure, an absolute standard for achievement. And yet he must look beyond his type into the characters that compose it. As the artist must note details of rock and tree, of stream and sky, so the breeder must fix

his attention upon the details that make up his ideal and learn to handle them separately, because the type as such is too complicated for selection and is never accurately reproduced. The type is, therefore, a dream, the separate characters are the realities.

"This man must also be an accurate critic, unerring in his judgment of his own animals as if they belonged to the veriest stranger. This quality, while not incompatible with the two already mentioned, is so different from either as seldom to be found united in the same individual. Difficult as it is, the breeder must cultivate this quality, and while I doubt whether the greatest breeders are the best judges of animals, yet every constructive breeder must be an impartial and fairly competent judge, at least free from prejudice, lest he deceive himself with an inordinate love of his own achievements and rest contented with what others have surpassed.

"He must needs have a good memory for details, this breeder, because, in spite of records, much must be carried in the mind, and animals long since dead must be compared point by point with living specimens and with each other in order to determine matings and decide whether and where progress is being made.

"A statistician he must surely be. That is to say he must step aside from the study of individuals and study the history of detail characteristics, and he must study animals in the mass. In no other way can he be satisfied as to whether he is making real progress forward or only multiplying animals that revolve around a center, presenting not a progressive but only a shifting standard. Among cows and speed horses the records are absolute and questions of this character answer themselves, but in general breeding so many details must be carried in the eye that the breeder must submit his mental pictures and his intellectual judgment to the same statistical methods and reasoning that he would apply to columns and tables of figures, dealing with other general questions.

"For above all, this breeder is to be constructive. No breeder can be accounted great who simply preserves what has been gained before, difficult as this may be of actual accomplishment. The real breeder is not an imitator. He is an inventor as truly as is a mechanician; a designer as truly as is a great musician, sculptor, or painter, and his theme is something new and better than was ever done before. Not all his attempts will be successful any more than they are in music or painting, but perfection is the ideal, and occasional failure together with much hard work is the penalty we all pay for really constructive results. Breeding of this kind is seldom popular and never spectacular, and that is one of the reasons why it sometimes succeeds, for premature popularity has cut off some of the most promising attempts of constructive breeding of all times.

"He will need persistence to a degree, because the higher his ideal the more difficult of accomplishment; his ideal will advance as he advances. He will fail many times, and will see numerous alluring bypaths that promise rosy traveling and lucrative results. 'This one thing I do' is the motto for the breeder who aspires to be really great. To be sure,

the decision should be made in view of all the facts and conditions, and the materials should be judiciously chosen, but once the plan is decided upon it should be carried out as faithfully as the builder follows the plans of the architect, remembering that he cannot build a cathedral by reconstructing a factory.

"Withal he must be instant in using the possible single opportunity of a lifetime. Great chances in breeding do not offer themselves daily, and when the breeder finds himself with promising and effective material on hand he needs must be quick to use it to the best advantage before it is gone forever. Few stockmen realize how rapidly the herd will change its entire personnel, and many a man has failed because his herd was gone before he saw his opportunity. It is not that breeding results can be short-circuited, but it is that often plans need to be reconstructed in order to secure the desired end by altered methods, for it is the end and not the method that counts for success.

"Courage is one quality that must go into the compound of this man who is to be a constructive breeder, for it is only a question of time, if he is really doing things, when he will be brought face to face with the alternative of inbreeding or of abandoning his line of effort. So true is this that no man should begin a course of constructive breeding unless he has the courage to 'go the limit' when this time comes. Beating about the bush at a juncture of this kind, while animals are growing older day by day, is like holding a conference on ways and means when the house is afire. The conference should have been held before and plans made in advance. The issue of inbreeding, like a fire hazard, is always to be counted upon. It may not come but it cannot be left out of the reckoning.

"After all these artistic and perhaps in the minds of many fanciful qualities, it seems prosaic to mention that this breeder must have sound economic sense and know when and how to thin down numbers, particularly if a period of depression overtake him in the midst of things. Many a herd has been undermined and many a breeder ruined by mere numbers which he allowed to accumulate only because he did not have the economic judgment to realize that in dull times herds may eat their heads off and all to no purpose. How to preserve the nucleus of the herd under the most trying conditions is an economic problem that is always in prospect just ahead, and one which the breeder should be ready to meet at all times.

"Judgment he must have to select from all that is available the comparatively small amount with which he is to do his work. This judgment he must use when tempted to waver from his ideal in response to the demands of fashion and the lure of temporary gain. He must rely upon it too in checking his own impulses and in refining or altering his ideals in accordance with changing conditions or available material. He is not to confuse stubbornness with conservatism, nor an inconstant mind with a progressive spirit. This judgment he will invoke from time to time in measuring his own ideals against the ideals of others, lest he labor in vain in perfecting a thing that the world no longer needs or will

buy. Breeding history contains many pathetic instances of men who have labored with more courage than judgment in building up herds that nobody wanted.

“Last of all the breeder must be manager in the best sense of the term. He must deal with large numbers. No man can succeed with small herds, no matter how highly selected; indeed, the more highly selected the less the chance of reproducing the same excellence before the animals are gone. If a man could own the best pair living he certainly could not expect to produce a pair equally good during their lifetime, for, in this direct sense, like does not produce like. While mere numbers do not count unless there be quality, yet numbers the breeder must have, and the larger the numbers of really useful animals the greater his chances of success. This manipulation of the breeding values involved in large numbers, together with the inevitable buying and selling, the handling of labor, and the estimation of values all call for those business qualities generally spoken of as good management.

“These are the qualities which, compounded with plain, old-fashioned honesty, will make the master breeder—able to create new values in live stock as well as to retain the best of all that have gone before it.”

CHAPTER III

FARM ANIMALS

There are different classes of animals on the farm such as ruminants, carnivora, omnivora, etc. Ruminants are animals like cattle and sheep, which eat large quantities of coarse feeds and have a place to store away this coarse and bulky material. After they have finished eating, as a rule, they lie down, bring this food back to the mouth, and chew it thoroughly. After ruminating or chewing this material a second time, it goes back to the last compartment of the stomach to be digested. The large part of the stomach where the food is stored is called the paunch. In addition to the two parts of the stomach mentioned, ruminants have two other compartments, four in all, which makes it a very good kind of animal because it can eat coarse feeds such as corn fodder, hay, straw, grass, etc.

Carnivora are animals like the dog and cat that eat meat largely. Omnivora or omnivorous animals are those like the hog which eat almost anything. The omnivora eat foods that might otherwise go to waste.

Nature of the Farm Animal.—From the structural standpoint the animal body is made up of bones, lean meat, fat meat, glands, hide, hair, horns, hoofs, etc. The bones are hard substances to give the body form, furnish protection to some of the organs, and to allow the animal to walk. The lean meat is made up of muscles attached to the bones, which by means of their power to contract under control enable the animal to move about. Fat meat is simply a store of material for future use as food in case the regular food supply is shut off. The hide, hair and horns give protection and the hoofs give it a wearing surface upon which to walk.

From the functional standpoint the body is composed of its

different organs, systems, etc. Limbs, muscles, and all functioning parts are, of course, of great importance. The digestive system with its numerous glands, prepares the food. The respiratory system brings in good air and takes out bad air. This, then, supplies oxygen and takes out carbon dioxide. The circulatory system embracing the heart and blood vessels is simply a means of carrying digested food and the oxygen to the different parts of the body, and of bringing back the waste products so that they can be thrown off. The carbon dioxide, as stated above, is thrown off by means of the lungs and the urea goes out by way of the kidneys and bladder in the form of urine. The urine is simply water with the urea dissolved in it. The heart is a force pump which forces the blood through tubes or the blood vessels. The blood is a body tissue or a medium by means of which the food and waste products are carried. The regulative system controls the temperature of the body. In winter when the weather is cold heat must be generated and the body kept warm, and in summer when the weather is warm there is sometimes too much heat in the body, because of the work done inside and this must then be taken out and thrown off. This is done by means of the evaporation of the water on the surface and also by radiation and conduction.

Processes that go on inside of the body, aside from digestion and circulation, are called metabolism.

The nervous system centers in the brain and thence permeates all parts of the body. The brain is the center of exchange between communications from different parts of the body, and between the body itself and the exterior world. The nerves are the wires carrying the messages. There is perfect harmony between all the parts of a normal animal body. If any one part wants anything of another part or organ a communication is sent to "central" (the brain) and it sends a message to the other part to do the necessary work. For example: An animal increases the amount of work done. This calls for more action in the cells and results in more waste products. It also requires more oxygen. By the proper messages sent back and forth the heart begins to beat faster and the respiration is accelerated.

FEEDING

The subject of feeding in connection with farm animals is one of great importance and will be discussed more in detail later in connection with the different classes of animals. At this point, however, a few general principles are taken up, such as apply to all animals under all conditions.

Maintenance.—Every living animal must eat a certain amount of food for maintenance. The animal machine must be kept running and the body temperature must be kept up. This takes feed and before the animal can do work, make meat, milk or wool, it must have enough feed for maintenance. Of course, the animal can do these things for a short time upon stored-up fat and from the material of which its body is made, but that is bad economy. The animal machine has an advantage over the mechanical machine like the steam engine. The former can do work by using materials of its own body while the latter cannot.

The amount of food an animal requires for maintenance may vary from about 20 per cent. of what it eats to the whole amount. The mature animal uses everything it eats for maintenance and work while the growing animal uses part of its food for growth. The young animals, in order that they may grow, must have enough food to supply what is needed for maintenance and something additional for growth. If young animals are required to work, they must either eat more than enough for mere maintenance or grow less rapidly.

What would one think of a livestock farmer who fed his animals only enough for maintenance. Yet many a farmer carries his animals through the winter in a way that leaves them lighter in the spring than they were in the fall. He could not do worse if he hired a threshing machine in the spring and kept it running all summer in order to do his threshing in the fall. It is worse, indeed, because an animal under such conditions would become stunted and might never recover the full use of its bodily functions. At any rate, it would take a long time to bring the animal back into condition so that it could make gains or do work.

The rule then should be to feed animals as much as they can use to good advantage, because the more they eat the smaller

the percentage of maintenance becomes. Suppose an animal requires 2 pounds of feed for maintenance. If it is fed 2 pounds it will not grow or make gains at all. Suppose then it is fed 4 pounds. It will then have 2 pounds of feeds for growth. But, if you feed it 2 pounds more you will increase the ration by 50 per cent., and you will increase the productive part of the ration by 100 per cent. This is an important principle that should not be forgotten.

Size.—In feeding farm animals and especially the meat-making animals, size is of considerable importance. By size is meant the possibilities indicated by the animal itself or by its ancestors. The large steer, large sheep or large hog are not the most desirable kinds on the market. But the matter works out like this: A 200-pound hog, which is one of the popular kinds on the market, can be made more quickly and more economically from 600-pound ancestry than from 300-pound ancestry. The younger an animal the more economically it produces its gains in live weight and the more rapidly it grows. This is true because it eats the most, in relation to its size, at this time. The machine also is in the best working order. It is true, however, that a small, rapidly growing animal does not put on so many pounds a day, because it is small, as a larger animal that does not grow quite so rapidly. This makes it possible to be able to feed animals beyond the babyhood stage.

To consider further, it is admitted without any hesitation that animals grow till they are mature and then stop growing. This stoppage in their growth is not sudden but gradual. Therefore, the closer to maturity an animal is fed the more slowly it grows and, therefore, the larger is the part of its feed which goes to maintenance. The principle applies to cattle and to sheep as well as to hogs. And it is clearly evident that the size of the breeding stock from which we produce our meat-making animals is a factor of considerable magnitude. Heavy draft horses, also, are worth more per pound than light draft horses.

Inheritance.—Animals are not made in a year or in a generation. It takes a long time to breed and develop a really good type. The characteristics of the parents are

transmitted to the offspring. The parents may even adopt certain characteristics and then transmit these to their offspring. The offspring of parents that have been injured by improper feeding, care, etc., will not be such good feeders as the offspring of ancestors not thus mistreated. This should put a man on his guard, either when he is buying or breeding animals for his feedlot.

Regularity in Feeding.—The animal body is a machine that runs itself. It gets into habits and if the animal is to do well these habits must be conformed to. On account of this fact an animal should be fed regularly, at the same hours each day. Every observing man has noticed that when the regular mealtime comes along considerable hunger is apparent. If the meal is not taken this hunger disappears in part even though the need for food is greater after mealtime than at mealtime when the meal was not taken. When the regular mealtime comes the machinery of digestion and metabolism is set in motion. If the food is not there to be worked upon there is a waste of digestive fluids and a loss of energy together with a weakening of the body generally. If then a meal is taken late it cannot be so well digested or used. The good stockman, therefore, feeds his stock regularly.

QUALITY

Quality is one of the most important and one of the most frequently misused of all the terms that are dealt with in animal husbandry. The term is frequently used to designate everything in an animal that is good as distinguished from everything that is bad. The term, however, has a very definite meaning. Quality really refers to the fineness of grain of the body tissues and especially of the muscle fiber. If this is fine the animal is fine throughout. So we judge fineness of quality or good quality by the fineness of hair and bone and smoothness of skin.

Fine or good quality in an animal is the same as fine or good quality in an orange or in a piece of cloth. Good quality in an animal means a fine muscle fiber, and this means lots of muscle cells. This again results in lots of power in the horse

and in a large proportion of lean meat of fine grain and good flavor in the meat-making animals.

It is clear from this that an animal of fine or good quality is a high-power machine and can do more work of any kind than an animal of coarse quality. Labor or meat, milk or wool are produced better by the animal with quality than by any other.

Delicacy.—Quality must not be emphasized to such an extent that other points just as valuable are forgotten. If this is done an inferior animal results. An unbalanced animal of little merit may be one with lots of good or fine quality and not enough size or constitution.

WEALTH OF FLESH

The term "wealth of flesh" was introduced by Amos Cruickshank, the famous early English livestock breeder who ought by right to be called the father of improved livestock. By this term is meant thickness of covering of lean meat. This is a valuable point in all the animals of the farm.

Since the muscle cell is the seat of action and power in the animal body, a thickness of covering of lean meat or muscle gives the horse more strength, the meat-, milk- or wool-making animal more power to make its particular product. It also furnishes a larger amount of lean meat in proportion to bone and fat. This is what practically all consumers of meat are looking for. One very seldom sees or hears of a person going to a meat market and buying meat because of the fat they get. As a rule when people buy fat meat it is because they are too poor to buy the lean.

The way to tell when an animal is well covered with lean meat is to observe it when it is not fat. The entire body of the thick-meated animal is well covered. The back should be broad, the hips and ribs well covered, the side and flank thick and firm, and the flesh generally elastic to the touch, not soft and flabby. If the flesh of an animal is made up of too much fat it is either soft and flabby or firm and not elastic.

When an indentation is made in the carcass of an animal after death there is a tendency for it to remain. This is similar to hard fat on a living animal. Soft fat can be thrown

into waves by a sudden motion. Lean meat has a characteristic firmness and elasticity.

Breeding for Lean.—When an animal is born it is endowed with or has the possibility to develop a certain amount of muscle or lean meat. With proper feeding, care and exercise this can be developed. After it has been developed, no more can be produced. More feeding will produce more fat but no more lean meat. How then, can this characteristic of our farm animals be improved? Only by breeding.

In order to get this "wealth of flesh" or thick covering of lean meat one must use sire and dams that have this characteristic, and then keep on selecting animals that are the best developed in this respect. Along with this, of course, must go feeding, care and environment.

CONSTITUTION

If an animal is to be a good and profitable animal it must be healthy, strong and vigorous. That is, must be of good constitution. It should be able to resist disease and everything else that has a tendency to destroy life, and it must also be able to consume and put to profitable use large quantities of feed.

Since the chest cavity is the power house for this animal machine, it must be well developed. This cavity contains the heart and lungs. A capacious chest cavity indicates a good constitution. The chest cavity should be broad and deep. The width also should be carried well up and well down. Constitution is determined by noting the spring of the ribs of an animal, also the depth of the chest. The ribs should be well sprung out from the backbone behind the shoulder and should carry this fullness well down toward the elbow of the front leg. The front legs should also be set well apart. The chest should be deep so that when looking at the animal from the side the chest wall is well down. As a rule, it should be down even with the underline of the belly.

Some people measure constitution with a tape line, but this is obviously not the best way. An animal may have lots of fat on the outside of its ribs, giving it plenty of heart girth, but such a condition does not mean a good constitution. An

animal may have a diamond-shaped chest, which would show a good measurement for heart girth, but this would not indicate as good a constitution as if the chest were more nearly oval as **O**. Only the "eye of the master" determines the value of an animal.

This matter of constitution like the covering of lean meat or muscle is an inherited characteristic and is produced by breeding. It can be developed by feeding and environment only to the extent determined for the animal by its ancestors.

It is said that one out of every seven persons that die is taken off by consumption or human tuberculosis. At the same time it is said that no one can walk in the streets of an ordinary city without being exposed to the disease. The germs of this disease, or tubercle bacilli, are so prevalent that they are floating in the air. Tuberculosis also is a contagious disease. It is one of the most, if not *the* most, dreaded malady to which the human race is subject. Why is it then that only one out of seven people is killed by it?

When man was created provision was made for destroying foreign germs as they were taken into the body. This is done by the white blood corpuscles or phagocytes working with other agencies. In animals, men included, that are strong constitutionally and are healthy and vigorous the work of destruction is comparatively easy, but even such animals may contract disease when the germs are introduced in large numbers. Under ordinary conditions man is strong enough. Consequently only one out of seven dies with the disease while all of them probably inhale the germs.

Farm animals that are bred to be strong in constitution and so fed and handled that their strength increases as they grow, are much more likely to be free from disease than others. But this is not the main point. The principal consideration in this connection is that such animals are better feeders and producers and make more money for their owners.

LENGTH OF BODY

All farm animals should be of good size, be good in quality, have a good covering of lean meat, and be good in constitution. And all except the horse should be long in body. The pur-

pose in growing such animals, excepting the horse, is to make meat, milk, or wool, and to reproduce their kind.

People who buy the meat from such animals are willing to pay more for the parts that come from the back, sides and rear parts of the animal. Thus the longer the animal is in the body the greater will be the proportion of high-priced meat and the smaller will be the proportion of cheap meat. The front part of the animal from the rear of the shoulder forward is the cheaper part of the carcass.

Constitution and Capacity.—Length of body also has a bearing upon the capacity for consuming feed and, therefore, upon constitution. If the body is long there is plenty of room back of the chest for the organs of the abdomen and these do not crowd the heart and lungs.

If any animal is to do well it must eat plenty of feed. If it is to eat lots of feed it must have large capacity in its digestive apparatus and this means a long, broad and deep middle piece. The power house or chest cavity containing the vital organs must also be large.

As to the influence of length of body upon reproductive capacity the following written by the author for the *Breeders' Gazette*, Feb. 14, 1912, may be of interest:

“Correlation of Type and Prolificacy in Hogs.—The accompanying Figs. (6, 7, 8) show three Poland China gilts, together with their first litters at the time the gilts were about one year old. While the gilts are pure breds, the pigs were sired by a Chester White boar. These three gilts were litter mates and during the winter of 1910–11 were taken to the judging room and placed in accordance with the breeding-hog scorecard used at the Illinois Experiment Station. They were then given herd places in the way they were placed in the judging room and put into the breeding herd. They were all bred to the same boar and all farrowed within a comparatively short time.

“The gilt that was placed first or (No. 1), Fig. 6, as will be seen, farrowed a litter of nine pigs. The one that was placed second (No. 2) Fig. 7, farrowed five pigs, while the one that was placed third, Fig. 8, farrowed one pig. This seems to have been a very marked difference in prolificacy, and part of it



FIG. 6.—Type vs. prolificacy. Poland China gilt No. 1.



FIG. 7.—Type vs. prolificacy. Poland China gilt No. 2.

may have been accidental, but there undoubtedly was correlation between type and prolificacy. In other words, gilts that are selected according to the proper standard or those that are the best individuals from the standpoint of type seem also to produce the largest litters.

“Another illustration of this same point is brought out in Figs. 9 and 10. These show seven Chester White gilts when



FIG. 8.—Type vs. prolificacy. Poland China gilt No. 3.

they were approximately one year old, together with their litters. One of these litters was sired by a Berkshire boar, and the rest were all sired by a Chester White boar. These gilts were also placed in accordance with the mentioned standard of excellence. Nos. 1, 2, 3 and 4, gilts shown in Fig. 9, farrowed a total of 35 pigs and raised practically all of them; while Nos. 5, 6 and 7, three gilts shown in Fig. 10, farrowed a total of 11 pigs, and four of these were farrowed dead. Nos. 1, 2, 3 and 4 (Fig. 9) and two of the gilts in Fig. 10 were all litter mates. One of the pigs in Fig. 10 was from another litter and from an unprolific strain, and she farrowed only one

pig. Barring this one, the other two gilts from Fig. 10, which were litter mates to those of Fig. 9, farrowed 10 pigs or an average of five per sow; while the four gilts of Fig. 9 farrowed



FIG. 9.—Type vs. prolificacy. Chester White gilts Nos. 1, 2, 3 and 4.

an average of almost nine pigs. This again is a striking illustration showing the correlation between type and prolificacy.



FIG. 10.—Type vs. prolificacy. Chester White gilts Nos. 5, 6 and 7.

“Granting again that part of this may have been accidental, the difference seems to indicate a tendency for sows of the correct type to produce larger litters than those that are not

so good individually. Furthermore, the poorest individuals as shown in the figures cannot be considered as very inferior."

Length of body, then, is worthy of consideration.

The Horse.—While the meat-, milk-, and wool-bearing animals should be long in body, the horse should be rather short. It should be short in the back with good length in the belly. The back should be short so as to give more strength. A long stringer, joist or board is more easily broken than a short one and so the horse with a short back is stronger than



Fig. 11.—A type of young animal that has good prospects for the future.

one with a long back. The underline or belly of the horse should not be too short. With length here, there is more room for feed. There is also more room for the feet. If the body is too short underneath there is danger that the hind feet will come into contact with the fore feet while the horse is in action.

FORM

An animal should also be well put together, well balanced, sound, and of the form required for its class and type. It

must be remembered that the young of all animals, except the pig soon after birth, do not have the same form as the mature and finished product. They are more rangy and upstanding. The accompanying illustration is a good example of a young animal with good prospects of a fine finished specimen.

CONDITION

By condition is meant the workableness of the machine and the amount of fat carried by the animal.

When an animal is out of condition it is in worse shape than an old worn-out automobile or a broken-down threshing machine. Worn-out and broken-down mechanical machines, can, with a little time and some expense, be repaired, but when an animal is out of condition it takes a long time to get it back into running order. It requires feed for maintenance, time, labor, etc. Even then an animal may never get back into as good "shape" as it was before.

Lack of condition or disorder of the animal machine is brought about by sickness, disease, lack of feed, too much feed, improper housing, etc.

To determine an animal's condition, appearance and handling qualities should be observed. An animal that is in good condition will have a glossy and sleek appearance, the hair and skin will be clean and smooth and the animal will be bright, active and happy. By handling qualities are meant pliability and looseness of skin. This simply means that the skin is in good working condition. And if the skin on the outside of the animal is in good working condition then the skin on the inside, which is the inside of the digestive tract and does the work of digestion, is also in good order. The relationship between these two is clearly evident. The inside of the digestive tract and the outside skin are one continuous structure or tissue.

Condition is also indicated by the amount of fat an animal carries. An animal may be in breeding condition as when it carries just enough fat to produce the best kind of offspring. Or it may be in market condition and have fat enough for the market requirement. Of course, animals vary a great deal

in both of these fields. Some are very fat and others are very lean, both for market and breeding purposes.

TEMPERAMENT

By temperament, frequently spoken of as nervous temperament, or nerve force, etc., is meant the power and willingness to do things. No matter how large or good a farm, factory, or other business one has, if it is to do business in the right way there must be a capable man in charge. This is the "power behind the throne" and the business will not go without this factor.

So it is with the animal body. The operator and driver of all the activities of the body is the nerve force centered in the brain and communicated to all parts of the body by means of the nerves. This factor must be well developed so that the animal can drive the forces of its body with vigor and action. Temperament or nerve force is not nervousness or fretfulness. It is alertness, responsiveness to suggestion, style in carriage, vigor in action, and power in doing the things for which the animal is bred.

The difference in value between different animals frequently is not so much in difference of muscular development as difference in nerve force. It is not intended to minimize the value of muscular development but the two must be developed together. One is just as important as the other.

It is a fact that when a house is on fire two men can carry a piano which at other times it would take four men to carry. Also, two men can hold down an ordinary man while it takes four to hold down a maniac. Cases like these which show extreme nerve stimulus indicate possibilities and also seem to indicate that the lack of productive capacity of animals is due perhaps more often to a lack of nerve force than to other factors.

The indication of well-developed force of this kind are skull capacity for brains and well-developed eyes together with the factors mentioned above.

CHAPTER IV

FEEDS FOR ANIMALS

Feeds are such substances as grass, hay, grain, etc., which animals can eat and from which they can derive some benefit. In order to be a feed, the material must be digestible and in order to be a good feed it must not require too much work to digest it. A poor feed requires almost as much work to digest as the good the animal gets out of it.

Timothy, when cut while still green and tender, makes a good hay, but if allowed to get too old and ripe, the stem becomes hard and woody, the hay made from it is not so good. So also the new sprouts, green leaves and new growth at the ends of the limbs of many trees make excellent feed while the lumber made out of the tree is not classed as a feed under any condition. The author knows of a herd of cows that were herded in the spring of the year in jack pine brush. The jack pines send out new shoots very rapidly. The cattle relished these very much, gave milk and grew fat on this feed. Hay, then, should be cut before it becomes too ripe.

Feeds for animals also are substances that will burn, though sometimes their water content must be driven off before they will burn. Milk roots, grass, etc., are in this class. But all substances that burn are not feeds. Thus wood and coal, which make the best kind of fuel are not feeds. They are not digestible.

Digestion.—Digestion is a process in the animal body by means of which the feeds are reduced to the substances of which they are made. The animal body cannot use a feed such as hay, corn, oats, etc. It must have the materials or compounds of which these feeds are made. Thus, in order to be able to understand feeding one must know something about chemistry. At least, he must know which feeds are good for growth, which for maintenance, which for fattening, etc. The reason that some persons fail as feeders of animals

is because they have the feeds in mind and not the substances of which the feeds are made.

The process of digestion then is simply one of breaking up a feed into its component parts. What the animal wants is protein, carbohydrates, fat, mineral matter, and water. These are the materials or compounds of which feeds are made. They are called nutrients.

PROTEIN

Protein is the substance used by the animal for growth. It is a chemical compound made up of carbon (C), hydrogen (H), oxygen (O), nitrogen (N) and sometimes sulphur. These latter substances are called elements.

Carbon is a solid substance and in its purest form is found in the diamond and also in graphite from which the lead of a lead pencil is made. Coal also is largely composed of carbon. This element also makes up a large part of all plant and animal or organic growths.

Nitrogen is a gas and is one of the elements of air. The other important gas in this mixture, the air, is oxygen. This is the substance that is needed to make a fire burn or to make the food burn in the body of an animal. A bale of hay burned in the body of an animal by metabolism gives off just as much heat as when burned by means of fire in a stove or in the open air. Nitrogen is an inert gas and is mixed with the oxygen to make air.

Hydrogen as such is also a gas, but when hydrogen and oxygen are put together in the right proportions chemically, two parts of hydrogen to one of oxygen, it makes water. Oxygen however, weighs about sixteen times as much as hydrogen.

When these four substances—carbon, hydrogen, oxygen and nitrogen—are chemically combined the result is protein. This protein is used by the animal for growth and also to some extent for maintenance.

Growth.—The lean meat, the glands, hide, hair, horns and hoofs of the animal are made up largely of protein. When the animal body is making these tissues in its body it is said to be growing. From this it is very obvious that if the

animal is to grow it must have enough protein to make the new tissues as well as to maintain that part of the tissues already made.

To feed a young animal that is supposed to grow, upon feeds which contain only just enough protein for maintenance, and then expect it to grow would be like asking a carpenter to build a brick house out of a pile of lumber. It simply cannot be done.

All natural feeds such as the grasses and grains contain some protein. Those that contain the least, such as rice, potatoes and corn, perhaps still contain enough for maintenance. This is a very wise provision of nature. For if God in His wisdom had not made feeds in this way what would not man in his ignorance have done long ago? Many an animal has for days and months been fed on nothing but corn. Except for this provision such animals would long since have starved to death. Nothing else in the feeds for animals can take the place of protein and even if an animal were fed all it could eat of everything else but protein it would starve to death with a full stomach.

Protein may also be used in the animal body for producing heat, energy and fat but these are secondary considerations, for this nutrient. It is both harmful and expensive.

As an example of protein, gluten may be mentioned. The white of egg and lean meat are almost pure protein. Cheese also is largely protein.

Overfeeding.—It is also important that an animal be not overfed upon this most important nutrient. This is nicely illustrated by the following:

Three bunches of pigs were fed by the writer. Lot 1 was underfed, by giving the pigs all the corn and water they could eat. Corn contains only about enough protein for maintenance. Lot 2 was fed corn, middlings, milk and tankage in quantities to make a balanced ration. Lot 3 was fed the same ration as lot 2 but in such a way as to give the pigs more protein. They were given more of the protein feeds and less of the carbohydrates. They were overfed on protein. The pigs were started on these rations at weaning time when they were about two months old and were fed till they were

eight months old. At this time the pigs in lot 1 (corn-fed) weighed 80 pounds per head. Lot 2 (balanced ration) weighed an average of 290 pounds, and lot 3 (overfed on protein) weighed an average of 170 pounds.

In lot 1 the pigs did not grow because they did not have the necessary material for growth. Corn is lacking in protein and also in mineral matter. While this is true for corn as a growing ration, corn is one of the best feeds that can be grown. It must, however, like all other feeds, be properly used. It should be used as part of the growing ration which is supplemented with some protein feed or feeds, and also as a fattening or maintenance ration.

It has been shown by the Wisconsin Experiment Station that heifers fed on a ration of corn and the products of corn, including the corn plant, in a way to give a balanced ration, will develop and perform their functions of reproduction and milk-giving in a normal way. Two other lots of cattle, fed upon rations made from wheat and oats respectively, did not do so well as those fed upon corn. In many cases, the calves came weak and dead. This indicates very clearly that corn is one of the best farm feeds. Many people will also testify to this when they use corn as cornmeal mush, corn bread, corn flakes, etc. And where is the swine grower who is willing to trade corn for an equal amount of any other feed of the same class? Corn is one of the best feeds. But like all other feeds it must be properly used.

In order to avoid overfeeding on protein the proper quantities of the right feeds should be measured or weighed out to the animals. When animals are fed in groups like sheep or pigs the protein feeds, which frequently are quite concentrated, should be thoroughly mixed with the carbohydrate feeds so that an individual, because of the fact that it may get to the trough first or be able to crowd the others out, will not get too much.

The writer's attention was once called to the fact that the largest and best pigs in a bunch had died. Upon inquiry it was found that the bunch of pigs had been fed tankage, clear tankage in a V-shaped trough. Tankage, which is a packing-house product, made of offal from the slaughtering

floor, is very rich in protein. The pigs that were able to get the most of this actually got enough to kill them. The same principle applies to all animals.

Feeding an animal too much protein is similar but much worse than feeding a threshing machine more grain than it can handle. The machine is clogged. So with the animal body. The machinery of metabolism is clogged and the surplus protein material becomes poison. It also seems to be a fact that animals once overfed on protein become more or less permanently injured.

Protein Feeds.—As said above, all feeds contain more or less of all the principal nutrients. Those feeds which contain considerable protein are classed as protein feeds. There is no fixed law classifying the feeds. But as good a rule as any would be to classify those as protein feeds which furnish as much of this nutrient as the animal needs to supply its needs, or even more than that amount.

If an animal gets as much of each of the nutrients, protein, carbohydrates, fat, as well as mineral matter and water as it needs for the purpose for which it is being fed, it is said to have a balanced ration.

The most important home-grown protein feeds available to the farmer may roughly be named as follows: milk, alfalfa, clover, flax, soy beans, cow peas and Canada field peas. Those of a commercial nature are bran, oil meal, tankage, cottonseed meal.

Alfalfa and clover are roughages or coarse feeds so sometimes animals such as growing pigs cannot eat enough of these to furnish the required amount of protein. For mature animals, these feeds furnish too much protein. This fact should be kept in mind in providing pasture for animals.

CARBOHYDRATES

Carbohydrate material is the part of a feed or the nutrient like sugar and starch. It is composed of carbon, hydrogen and oxygen. The latter two are always in the proportion in which they combine to make water, namely, two parts of hydrogen to one part of oxygen. Carbohydrate is used in the animal body for furnishing energy and heat, and for making fat.

The animal body cannot make energy; neither can a steam engine. These machines, both the animal and mechanical machine, must have as feed or fuel, the substances that will burn. That is, when oxygen is brought into contact with them under certain conditions, they will break down into simpler compounds and give off the energy stored in them. The conditions under which this happens in ordinary combustion as in a stove or firebox under a boiler, is a high temperature. In the animal body it is the metabolism or the work of the living cell that brings about the transformation to liberate the energy stored in these compounds.

The fact that these substances are chemical compounds of considerable complexity means that they are a source of energy. The animal uses this energy for living, walking, digesting its food, and doing all the internal work called metabolism.

Storage of Energy.—How does this energy happen to be stored in the form of chemical compounds in plants and what is energy? Energy is the ability to do work. So when the steam engine uses fuel it can do work. So, also, when the animal eats feed it can do work. This energy comes originally from the sun. As the grass and all other plants grow they use up this energy as it comes from the sun in the form of heat, light and other rays. It is appropriated by means of the green called chlorophyll. Thus a plant cannot grow unless it is green and it cannot grow unless the sun shines. Of course, plants can grow for a short time on the food stored in the seed or in the tuber. But in order to store food for man or animals, plants must be green and they must have sunlight.

Thus it is seen that plants live to make food for animals and the animal can live because the plant made food for it. The two together make a complete cycle. The plant takes the elements and simple compounds and by means of the energy coming from the sun builds these up into higher or more complex compounds, so to speak, bottling up the energy from the sun. The animal then takes this bottled-up energy in the form of protein, carbohydrates and fat and lets it out. It uses the energy and gives the elements and simple compounds back to nature so that they can be used over again.

Why is a desert so very hot in the summertime? And why

is a plowed field after it has become dry on the surface hotter than an adjoining field covered with green grass? Simply because the grass is taking the heat and other energy as it comes from the sun and bottling it up; storing it in the form of nutrients. In this form it is not perceptible until the material such as the plants themselves or their seeds decay or are burned or metabolized.

The heat from the sun falling upon the plowed field or desert is not thus stored away and simply makes the surface of the earth and the air next to it that much hotter.

Carbohydrate Feeds.—All natural feeds contain more or less of carbohydrate material. But those, as shown previously, which are rich in protein are called protein feeds. On the other hand, those that are not rich in protein are called carbohydrate feeds.

The principal carbohydrate feeds are corn, rye, wheat, barley, oats, buckwheat, caffir corn, speltz, rice, middlings, corn stover or silage, timothy, prairie or meadow hay, straw, etc. The rule to be followed in using these feeds in feeding animals on a farm is first to make as much use of the coarse feeds or roughages as is possible because these are the cheaper feeds. These feeds, however, should not be used exclusively. They are coarse and bulky, occupying considerable space, and on account of their woody nature are hard to digest. This requires considerable energy; consequently the animals fed largely upon roughages cannot do well. This is true because in the first place they cannot eat as much, and second, a large part of their feed goes to digest what they eat. Some persons say that the more an animal eats of certain coarse feeds under certain conditions, as for instance wheat or rye straw fed in summer, the worse off it is. This is true because it requires more energy to digest and metabolize or use the material than they get out of it. Still, farmers generally know that at least in winter some animals can be maintained upon such straws.

The things to bear in mind with these carbohydrates is to feed the animals enough roughages and concentrates to get the desired results. If the animals are to be fattened they should have as much as they can make use of to good advantage. If they are simply to be maintained they should be fed enough to keep up the desired amount of flesh.

FAT IN A RATION

Fat serves the same purposes as do carbohydrates. It contributes to the production of energy, heat, and fat. It might properly be asked, then, why feeds should contain fat and why animals should have fat in their rations.

Fat exists in several forms and has several distinct characteristics. Oil is used in the bearings of machinery to keep them from wearing out. It prevents friction. As grease, it is used to prevent a wagon's axles from wearing out, and to prevent unnecessary noise. Different fats have different melting points. That is, it takes more heat to melt one than another. The fat from a beef animal or a sheep is called tallow and it is a solid under all ordinary temperatures. However, tallow can very easily be melted or made into a liquid by setting it on a hot stove in a dish. The fat from a hog is called lard. This is solid under ordinary room temperatures but may become liquid on a hot summer day. It takes less heat to melt lard than it does to melt tallow. Consequently, tallow is said to be harder than lard. It is also said to have a higher melting point. Oil is a fat that is liquid under ordinary temperatures. The fat of corn is called corn oil. The fat of flax is called linseed oil. And the fat of cotton seed is called cotton seed oil. Thus all plants and animals have a characteristic fat. The cow and the pig may eat the same feed and the one will make tallow while the other will make lard. This is done by the metabolism of the animal body. If the mechanical machine like the binder, the mower of the threshing machine needs fat in the form of oil to keep the machine in better order and keep it from wearing out, may it not also be assumed that the animal machine needs fat to keep it in order? At any rate, it must be assumed that as the all-wise Creator implanted the need of fat in animals it must be given to them in their feeds. The fat is needed to keep the animal body in order as well as to supply energy, heat, etc. And does it not have a lubricating purpose in the animal machine the same as it has in the mechanical machine?

Fat as a Laxative.—When an animal becomes constipated, which means simply that the bowels do not move freely enough, oil is given as a laxative. This facilitates the move-

ment of food and waste through the digestive tract. This, however, is not the only principle upon which a laxative works. The animal body is built like a compound machine. It is made to handle a certain amount of protein, carbohydrates, fat, mineral matter and also water. When it is fed the amounts of each of these substances that it can handle to the best advantage it is said to have a balanced ration. The amounts range, in order of quantity, as follows: water, carbohydrate, protein, fat, and mineral matter. Now then, if the machine is fed more of anyone of these substances than it can make use of, the material must be thrown off. It is waste matter and must be expelled from the body. Thus it is that if one wants to cause a movement of the bowels a dose of salts or oil is used. That simply means that more of these substances is introduced into the machine (digestion and metabolism) than can be taken care of and the material is discharged. On the same principle, an overdose of protein will bring on scours.

It is a well-known fact among farmers that when the carcass of an animal is left in the hog lot for the hogs to consume at will, it will cause the hogs to scour. This is caused by an oversupply of protein in the lean meat. The scouring may also be caused by the fat in the carcass. While these substances are good feeds if properly used they become harmful if improperly used.

Use of Fat.—It is a well-known fact that children do not like fat as well as grown-up people. That is, young folks cannot use as large a proportion of fat in their feed as can grown-ups. This is true because growing children need more protein while grown-ups, having ceased to grow, do not need so much protein and can make use of a larger proportion of the energy-, heat- and fat-forming substances such as fat and carbohydrate. It is also known that the natural and best feed for all young animals, including children, is milk which is a protein feed. It is also rich in fat.

One of the important considerations in the feeding of calves appears here. When a change is made from whole milk to skim milk the fat content of the ration is reduced. Good feeding requires that when the butterfat is taken out

of milk on account of its high price, some other material containing fat must be substituted.

Concentration of Fat.—One of the principal characteristics of fat as a feed is its concentration. A given amount of fat will yield two and one-fourth times as much energy or heat or allow the animal to make two and one-fourth times as much fat on its body as an equal amount of carbohydrate. Thus when an animal is on a fasting diet, which means that it isn't being fed anything, it is using the fat from the body to yield energy and heat, and a small quantity goes a long way. So also a man who is putting in long hours at hard labor can get along better by eating considerable fat. In this way he can carry with him, in his stomach, a larger supply of energy and can work longer without getting hungry or tired.

The poor people in various sections of the world, as, for example, the southern part of the United States or parts of continental Europe, who are too poor to buy the high-priced lean meat, buy the cheaper fat meat. A pound of fat pork can be bought for less money than a pound of lean meat and it is worth as much as two and one-fourth pounds of the latter on an equal basis of dry matter for heat, fat and energy production. But lean meat always contains much more water than fat meat. Thus the poor man who buys fat meat gets three or four times as much for his money as the more wealthy individual who buys lean meat.

In feeding farm animals the fat part of the ration is too frequently overlooked. While in the ordinary feeding tables there is no separate classification of fat feeds, there are some of the protein as well as carbohydrate feeds that are rich in fat. By a proper selection of feeds, therefore, this part of the ration can be pretty well controlled.

Fat Feeds.—The natural farm feeds rich in fat are flax, soy beans, whole milk, corn and oats. The first two are especially valuable from this standpoint. They are also protein feeds. These two feeds should be used in limited quantities on account of their protein content as well as their fat content. The former is more harmful than the latter when fed in excess. When too much fat is fed the material simply passes out in the form of scours. This, as everyone knows, is harmful.

An interesting point in connection with fat as a feed for animals is the fact that a farmer can grow much more wheat, oats or barley per acre than he can of flax.

As shown previously, when a plant grows it requires energy from the sun in the form of heat, light, and other rays. As also shown previously, fat is a much more concentrated substance than protein or carbohydrates. An acre of soil gets just so much energy from the sun and no more. Flax, therefore, which is very much richer in fat than the other feeds mentioned cannot produce as many bushels per acre as these other crops which contain less fat and more carbohydrates and protein.

MINERAL MATTER

Mineral matter is material like salt, lime, ashes, iron, soil particles, etc. When plants grow they take up some of the chemical elements which are in the soil. These are used by the plants in doing their work and are then deposited in the cells and tissues of the plant.

Animals also need mineral substances. But animals have greater need of these mineral substances than have plants. They need these materials not only for the digestion, absorption, resorption, etc., but they need them also for bone construction.

While the mineral substances, and there are a number of them, compose the smallest part of the ration, they are, at the same time, among the most important parts. It cannot be said that one of the substances, water, carbohydrate, protein, fat or mineral matter is more important than any other because they are all needed. The animal cannot do well unless they are all present in sufficient amount. In fact, the animal machine would refuse to work altogether, if any one of them were left out.

Animals can get along without mineral matter in their daily feed for from one to six months, but during this time they are using substances of this kind previously stored in the body. They, therefore, grow constantly weaker. They get weaker in bone and weaker generally and if the mineral substances are not supplied they will become ill and die. Many

animals on farms die and their owners do not know the cause, because the minerals are such a small part of the ration they are sometimes forgotten. While all natural feeds contain some of this material they usually do not contain enough.

Salt is perhaps the most important of the minerals needed. One of the best ways to feed salt is to keep it before the animals in a trough or box where they can get it at all times. If they have not had salt for a time care should be exercised not to give them too much at a time till they get used to it. If they eat more than a limited amount it will, as already said, cause scours. In the case of pigs it will also cause death. Other mineral substances that can frequently be used to advantage are ground limestone, or air-slaked lime, bone meal, hardwood ashes, and charcoal. These can be fed in the same manner as salt.

Animals can get along for several weeks without protein or carbohydrates. But during such time they use the protein tissue, muscle, glands, etc., and the fat tissue from their bodies. They can perhaps also get along without fat in the ration for a long time because the carbohydrates will in part take the place of fat. But no animal, except the camel, can get along more than a few days without water. Most animals have very small storage capacity for water and a great deal is needed.

From all of this it can readily be seen why it is so much more difficult to feed babies and young animals than older animals. The very young animals have not yet had time to provide stores of the materials named for possible emergencies.

WATER

Water makes up the largest part of the ration for most farm animals. It is used to soften the feeds eaten so they can be more easily masticated and swallowed, to assist in digestion, to carry on the work of transportation, to enter into the tissue as a part of the structure and to help regulate body temperature.

As a Solvent.—Digestion, as already shown is a process of solution. If sugar is put into a glass of water it is dissolved. So, also, is it dissolved in the stomach. To be sure, there are various digestive agents in the body, such as saliva, gastric

juice, etc. These, as well as water, take part in digestion, but these alone, without water, will not digest the feeds.

The digested feeds go out from the digestive tract into the blood vessels. Here, by means of the blood, these materials or digested food particles are carried to their destination. Some of the material goes to the cells direct to be used while the rest of it is taken to places of storage to be used between meals.

As a rule, a meal is digested in about two hours. During this time the cells can be supplied direct. But at the same time the balance of the meal which is sufficient to last till the next period of intake, is stored. The liver is one of these storage places.

When to Drink.—The transportation work, or the carrying of the digested food particles, is done by means of the blood stream. The blood is largely water and is forced through the tubes or blood vessels by means of a force pump, the heart. The work of the heart is heavier at, and soon after, mealtime than at any other time of the day. From this it is clearly evident that water has its greatest use in the body at and soon after mealtime. Experimental evidence by competent authority also shows that best results are possible when considerable water is consumed at mealtime. In fact, with many farm animals and with some men, all of the day's supply of water is consumed at mealtime. This is considered by the author to be the best time to drink water.

The food, however, should not be washed down by means of the water. But the water should be taken at intervals during the meal as well as immediately before and after the meal. At times also, especially after big meals, it is advisable to allow another drink an hour or two after eating. When water is introduced into the stomach it sets the whole machinery of digestion in motion. This then will complete the digestion of the meal and allow the stomach to have a rest before the next meal.

From the foregoing can be seen what happens when water is taken between meals. The digestive system will not get the necessary rest. The stomach needs rest as well as any other organ of the body. A man spends about one-third of his life

in bed and rests considerably during the other two-thirds. Even the heart takes a rest after every beat. So also the stomach or rather the digestive system as a whole needs a rest after digesting a meal.

It is a custom of many workmen to take a drink about every half hour during the day. This is a bad practice because it keeps the digestive system in a constant state of work and uses up or rather throws out into the digestive tract and wastes the digestive enzymes. These are the active principles in the digestive juices that aid in digestion. Then when the next meal is eaten there is neither the necessary energy nor enzymes to digest it. People who thus misuse themselves frequently use their horses with more consideration than they do themselves. Their horses are watered only at mealtimes when they should be watered.

Water is very often erroneously taken on a hot day between meals. It is taken for its cooling effects which is not a good policy. The advice frequently given, to take a little oatmeal with water between meals, is good advice. So also is the habit of eating a lunch when one takes a drink between meals. This does not mean that it is a good thing to eat and drink between the regular meals. People very often eat too much. But when a drink is taken it starts the flow of digestive juices and if some food is taken at the same time these are not wasted but used. It is expended upon the food and this is appropriated. Under such conditions less need be eaten at the next mealtime. But, of course, it is better to give the stomach a rest between meals. From this it is also seen that one large drink is better than several small ones. A drink is a drink in starting the digestive machinery, and a small one is as bad as a large one.

Transportation.—The transportation or circulatory system of the body is built on the same plan as a city water supply system or as Mr. Rockefeller's pipe line system for carrying oils from one part of the country to another. It is the most economical system of transportation.

Besides carrying the digested food particles out to the cells where they are used the circulatory system also brings back the waste products of metabolism to the points of excretion.

In this sense the circulatory system is similar to a stove pipe and chimney which take the smoke and gas from the stove or furnace out to the exterior. The blood carries both solid and gaseous waste products from the cell. The gaseous product or carbon dioxide is brought to the lungs and there expelled with the same air which brings in the oxygen.

The solid waste products such as urea are taken by the blood from the cell to the kidneys. These act as a sieve and strain out these substances and then dissolve them in some water. This solution is sent down to the bladder where it is stored for periodic expulsion as urine. This is done by means of contraction of the muscles around the body and the relaxation of the muscle about the neck of the bladder. If this bladder muscle fails to work or becomes exhausted the animal will drip urine constantly.

Body Temperature.—Water is also used for regulating body temperature. When the work is hard or when the weather is hot an animal perspires or sweats. When the animal works there is considerable energy expended within the body and this results in heat. On a hot day also there is a surplus of heat in the body. All this must be taken out so that the body or rather the protoplasm in the cells may not be cooked. The difference between a normal cell and an overheated cell is much the same as that between a raw egg and a boiled egg. Overheated cells mean death to an animal. They are a source of danger, also, in case of a high fever.

The animal body maintains practically a constant temperature. Then when it has more heat than it can get rid of by other means it sends water to the surface in the form of perspiration or sweat to be evaporated on the surface. This takes up a great deal of heat and helps to keep the body temperature at the right point.

AIR OR OXYGEN

Nothing has thus far been said of air which furnishes the oxygen needed by the body. Air is not usually considered a food and it is not a drink.

How long can an animal live without food or water? Sev-

eral weeks without food and several days without water. But how long can it live without oxygen? Only for a few minutes. It is assumed, however, that the animal will take care of this part of its nourishment itself by means of its power of respiration. But how about the animal that is bred with a small lung capacity or is weak in constitution? Breeding counts, then, in providing an oxygen supply.

Animals are sometimes kept in places and under conditions which prevent their getting a normal supply of oxygen. If the ventilation is poor, if too many animals are kept in a given space, if animals pile up so as to prevent proper breathing, if they eat too much and check respiration, if they become bloated so that the diaphragm presses against the lungs, a lack of oxygen may result, and animals may suffer.

Exercise.—The most important feature of exercise, in the opinion of the author is in the influence upon respiration. By exercise the organs of respiration are developed and more oxygen is taken in. Thus the value of a pasture, with some animals at least, is more to furnish oxygen than to furnish feed.

Fire.—Oxygen is as important to the animal body as it is to fire. If a piece of cardboard is laid on top of a smooth topped lamp chimney the light goes out at once. The draft is stopped and no oxygen comes in to support the flame. There can be no fire without oxygen. Fire can be kept up in a stove only as long as there is oxygen passing into the stove and coming into contact with the fuel. A blast furnace develops heat enough to melt iron, but this high degree of heat is caused by burning coke, which is almost pure carbon, under forced draft, which gives a large quantity of oxygen.

Metabolism.—The foregoing illustration serves to show the importance of oxygen in ordinary combustion. It is just as important in metabolism in the animal body. And any lack of development of chest capacity or any environment which hinders the abundant intake of pure air is a serious menace to animals. So, on the other hand, the man who provides his animals by breeding and environment with this power and ability to obtain an abundance of oxygen has a lead over his fellow farmers who pursue a different course.

CLASSIFICATION OF FEEDS

All feeds are good in their place but at the same time all feeds may be bad when improperly used. The better the feed the more easily it may be misused.

Feeds may be misused by feeding too much roughage to animals primarily adapted to concentrates, by feeding too much concentrate to ruminants, or by feeding too much or too little protein or of the other nutrients including mineral matter and water.

The different classes of feeds are roughages, concentrates, green feeds, dry feeds, and liquid feeds. The differences indicated by this classification are physical and do not take into consideration the chemical differences given previously, namely, protein, carbohydrate, fat, and mineral matter. Each one of the classes, according to the physical characteristics contains several different feeds or kinds of feeds under the chemical classification.

Roughages.—Roughages are feeds like corn stover, corn silage, hay, straw, grass, etc. They are bulky and more or less difficult of digestion. They are bulky because they contain a good deal of undigestible matter or water. They are hard to digest because they contain much woody substance called crude fiber.

The hays, including alfalfa, the clovers, vetches, peas, beans, etc., are protein roughages. They should be used as largely as possible to furnish protein which, as shown previously, is the material needed for growth. Protein is the most expensive part of a ration and can be furnished most economically in the form of roughages grown on the farm. These feeds, or some of them, should be used with all young and growing animals such as colts, calves, lambs, and pigs. They should also be used as a large part of the roughage in rations for cattle, especially dairy cattle, and also for sheep. Wheat bran as a commercial feed is also a protein roughage.

Concentrates.—The grains and seeds are classed as concentrates or concentrate feeds. They are feeds that are largely digestible and do not contain large quantities of water. They are the expensive feeds of the farm but must be fed to animals

in addition to the roughages to make them do well. These feeds do not occupy very much space for the amount of nourishment they furnish to the animal, and therefore are called concentrates.

The protein concentrates from the standpoint of home-grown feeds are flax, peas, beans and milk. The latter, however, on account of the large quantity of water it contains is not always a concentrate. The principle commercial protein concentrates are oil meal, cotton-seed meal, tankage, meat meal, gluten meal, etc.

Green Feeds.—Green feeds are sometimes also called succulent feeds. Such feeds are nature's production. They are the legumes, grasses, corn, weeds, roots, potatoes, etc. Since these are nature's feeds they are best adapted to all-purpose feeding. There is nothing better than a good pasture containing a variety of plants which the stock will consume.

The question might be asked here, why do farmers feed grain to their livestock while they are on pasture? While good pasture is the natural feed, good livestock is not a purely natural product. Man has taken a hand in the development of the farm animal. He has lived up to his God-given command and has exercised dominion over the animals. These have been improved so that they cannot do their best on pasture alone. They are no longer wild animals in nature like the wild horse, the buffalo, and the razor-back hog.

The digestive capacity of the improved farm animal is not large enough and the power of digestion is not great enough for it to get enough for good and profitable production out of roughage feeds alone. This being true, the feeds for our best farm livestock for their best work must include the grains or concentrates as well as the roughages.

Green feeds are valuable for several reasons. As a rule they are easily digested, contain lots of water, and also are rich in mineral matter. These are three very important factors in livestock husbandry.

The green protein feeds that should be used for young and growing animals are alfalfa, clover, peas, beans; while young rye and rape are also quite good in this respect. Timothy, bluegrass, meadow grass, sorghum, and corn contain more of

the carbohydrates. They are good for mature and working animals. Also good as part of a ration for growing animals.

Dry Feeds.—Dry feeds are the green feeds with the moisture removed. The water is driven off by evaporation. All of the nutrients remain. During the process some of the carbohydrate material may change to more woody-like substance. This makes the dry feed slightly less digestible than the green feed from which it is made. This, however, is not a big factor when the hay is made in time.

Liquid Feeds.—Skim milk is a protein liquid feed and whey is a carbohydrate liquid feed. The latter is the by-product of cheese-making. From this most of the protein in the form of casein has been taken out in making the cheese. The dry matter of skim milk is largely protein, the fat having been taken out.

Artificially prepared liquid feeds such as slop for pigs or soup for man may be made either protein or carbohydrate as the one in charge desires.

Liquid feeds are specially valuable for the amount of water they contain. As shown previously, water is one of the most important parts of the rations of all animals. It is generally assumed that the appetite of an animal for water is a safe guide as to the water requirement of the animal, or the amount of water needed in the metabolism of the animal body. This, however, is not always the fact in the case.

It is undoubtedly true that in the winter in a cold climate many animals do not drink water enough. The cold checks the appetite for water and not so much is consumed as the best working of the internal mechanism demands. This being true, liquid feeds such as slops for hogs become very valuable. They supply the required amount of water. Many cases can be pointed out in any cold country where the difference between profit and loss is determined by this point in feeding alone. Many persons also feed slop to their cows and bran mashes to the horses. The animal body, with too little water, is like a wagon running without enough grease.

OTHER FACTORS IN FEEDING

Variety.—As seen thus far, feeds are simply an aggregate of nutrients most of which are digestible but some of which are

not digestible. The latter pass out of the digestive tract in the form of feces.

Other nutritional properties of different feeds play an important part. Investigators have shown that some animals will do well on certain feeds and not on others, even if they are given the same amounts of the different nutrients.

As, according to the Bible, man lives not by bread alone, so animals do not like to live upon a single feed. A variety of feeds made up into a ration is more appetizing. Such a ration is also more likely to furnish the minor substances, such as the amino acids and other peculiar substances which are not classed as nutrients and are not always recognized but which are an important factor in animal nutrition. Therefore, variety in a ration should not be forgotten.

Winter Feeding.—As is generally recognized, farm animals are handled with less trouble and expense in summer than in winter. They also do better in summer. Since the winter temperature is so much lower than the animal body it is more difficult to maintain the normal body temperature which is about 100 degrees Fahrenheit. To assist an animal in maintaining this temperature it is usually put into some kind of a barn or shed. Different animals and also animals for different purposes require different kinds of shelter.

The dairy cow loses considerable heat each day in the form of warm milk. This milk is taken from her at the body's temperature. The water and feed entering into this milk as a rule must be brought up to the body temperature. This requires an enormous amount of heat. It takes more heat to raise the temperature of a given amount of water to a certain degree than it does to heat the same weight in iron to an equal degree. From this it is evident why dairy cows need better barns than beef cattle.

In the summer time animals on pasture or at large have the opportunity to gather various kinds of legumes, grasses, weeds, water and minerals. These furnish variety which is so important. They also furnish protein and the different mineral substances all of which are very important to the well-being of the animal. This factor is largely wanting in winter unless it is artificially provided. In winter, also, the animals

do not of themselves drink as much water as in summer, and this also becomes a serious handicap. If, however, these factors are provided for, animals can be made to do as well in winter as in summer. To be sure, it will cost a little more in winter than in summer but a man cannot handle farm animals at all if he does not have them in winter as well as in summer.

Palatability of a Ration.—In order that a ration may do an animal the most good it must not only be a combination of good feeds but it must also be palatable. The desire of an animal for something from without to supply what the metabolism needs in the form of dry matter is called appetite. If there is a call from within for water it is called thirst. When there is a demand for food resulting in hunger, which is simply a call for some necessary substances to furnish material for energy, heat, growth or fat production, the animal is said to have an appetite. The call is from the cell within by way of the nervous system to the organs of digestion and ingestion. The important part of this phenomenon is that when an animal is hungry or has an appetite the digestive system and everything else that has to do with the handling of this feed is ready for work. If the feed is palatable or the animal likes it, it does the animal the most good. Palatability is secured by regularity of feeding, by feeding digestible feeds, by not feeding too much. Feeds are also made palatable by making proper combinations and by feeding such feeds and in such forms as the animal likes.

Changes in Ration.—One feed may be just as good as another or one may be better than another, according to conditions. The animal body is subject to habit. An animal may not be doing as well as it should and a change in the ration or environment may be indicated. The new ration may be much better than the old one but if the change is not properly made it will for a time be harmful rather than beneficial. If the change is properly made from an inferior to a superior ration the improvement is at once perceptible. The animal must be one that is in good condition and be able to respond to good treatment. A run-down animal like a worn-out automobile will not work right no matter how well it is treated.

A ration should be changed slowly and gradually. A sudden change may upset the metabolism. It takes time for the digestion and metabolism to become accustomed to new feeds and to different combinations. From one to four weeks should be allowed to make a change in a ration. Four weeks is better than one.

Ear corn thrown to pigs not accustomed to it will be left untouched for a time although they have had ground corn and other similar grains. Pea straw was at first left untouched by a certain band of sheep, but after a time was greatly relished and made a very good feed. It has been shown experimentally that it takes about a month for an animal to make the best use of a new ration.

In spite of these facts, which are not so well known as they should be, many persons provide variety in the ration for their animals by feeding first one thing and then something else. This is especially true in summer when the stock is on pasture. They may be grazed on timothy, bluegrass, clover, alfalfa, soy beans, rape, etc., in succession for periods of two or three weeks each. They are left on one feed almost long enough to become accustomed to it and then they are changed to something else. Under such conditions the animal machine is always getting ready to do something and is never allowed to get down to real work. How would a farmer get along who spent all his time in sharpening the sickle and never got to cutting his crop?

The best way to get variety, however, is to provide a number of feeds and feed these simultaneously all the time. These feeds must make a balanced ration. Then there will be no craving for something else.

Pasture.—A good pasture is always made up of a variety of plants, including both the legumes—clover or alfalfa—and the grasses—bluegrass, timothy, orchard grass. A pasture containing nothing but legumes will furnish too much protein for mature animals and one containing only grasses will not have enough protein for young and growing animals. A permanent pasture as a rule contains a variety of plants. This not only furnishes variety and a balanced ration for the animals but also uses the large variety of plant foods in a given

soil. The soil will thus yield more and not become exhausted so soon.

Number of Feeds per Day.—It was shown previously that the stomach and digestive system generally need a rest between meals. The question then arises how many times a day should an animal be fed? Man eats from two to five or six times per day. Most people feed their animals two or three times a day and as a rule such feeding is good practice, but young animals should be fed more frequently.

The young of all farm animals take their feed quite frequently from their mothers. Suppose a young animal before weaning gets its daily ration in five to ten portions, and immediately after weaning is allowed to take its daily feed in only three equal portions. The change would be too sudden. This would be the case, also, because a young animal cannot eat as much at a time as a grown animal.

Young animals have feeds that are more easily and more quickly digested than the feeds fed to the older ones. The digestive apparatus, therefore, gets its needed rest and the animal also gets the nutrients needed for rapid and economical growth. But the young animal is not able to store up as much material for future use. It, therefore, must be fed frequently. A well-developed and well-fed cow can live six months without salt because it uses during this time the salt that was stored in the body from previous feeding. The calf does not have this store of material, therefore must be fed more often. The cow also will do better if fed more regularly, that is more often with respect to all the necessary ingredients of a balanced ration.

Many mature farm animals are fed successfully twice a day, and this is enough. Some, such as the hard-working horse or dairy cow are fed three times a day. Young animals should be fed three times and the very young ones five times a day. Of course, there are always allowances to be made, as when they have pasture, hay, or other feeds before them at all times. It is not best to have hay before the animals all the time, but that will be discussed later.

Grinding Feeds.—Grinding does not add anything of value to any feed as far as the feed itself is concerned. Sometimes people buy ground alfalfa and because it costs them a big price

they use it as a concentrate or grain. But this feed contains just as much crude fiber or undigestible material whether it is ground by a mill at great expense or whether it is ground by the animal for nothing. Alfalfa is a roughage whether it is ground by either process.

The nutritive value of most grains is not changed by grinding. Sometimes, however, there are small hard seeds and grains which cannot be masticated very well by the animals. These should be ground. If not ground, they will pass through the digestive tract without being assimilated. Under such conditions, the animal gets no good from them. At other times, the animals' teeth are so poor that they cannot do a good job of grinding. Under such conditions, also, the feeds should be ground.

The value of grinding feeds would, therefore, be doubtful, were there not other considerations to be taken into account.

By grinding, it is possible frequently to make a ration more palatable, which, as shown above, is an important factor. The different feeds are mixed. This not only makes the ration more palatable, but gives a more even distribution when animals are fed in groups like sheep, beef cattle, stock cattle, and hogs. This is especially important with the protein feeds. It is very harmful to feed too much of this nutrient and if the feeds are not properly mixed so as to dilute the protein, some of the animals in the group may get too much.

Grinding grain also makes it possible to feed water. If animals do not drink water enough in winter, if the grains are ground into a fine meal and mixed with the water the animals will take as much as their metabolism needs for the best working.

Cooking Feeds.—Cooking, like grinding, does not add anything of value to a feed. Still, there are some who say that 1 pound of cooked feed goes as far with them in feeding their stock as 2 pounds of uncooked feed. This, however, comes about through the feeding of more water, more protein, a better variety, etc.

The American experiment stations have long since demonstrated that cooked feed is no more valuable for livestock feeding than uncooked feed. But as shown above, under

certain conditions it may prove, by means of external factors, to be much more valuable. These factors, however, may as a rule be provided by proper mixing.

Cooking will, however, destroy disease germs as in milk or weed seeds in grain. If ground grain, especially if it is not ground fine enough, is cooked, it will mix better with water and make a more uniform slop and thus be better. But with proper grinding (fine grinding), and with the proper mixture of grains and water, cooking becomes almost a valueless operation and the added expense need not be incurred on the average farm.

In a cold country in winter, water should frequently be warmed to make it more palatable and to reduce the drain on the animal heat needed to warm it to the temperature of the body. With a few feeds, also, like potatoes and pumpkins fed to hogs, cooking is of advantage. These are carbohydrate feeds adapted to fattening animals. Hogs, however, do not need very much water, and such feeds are very rich in water. By cooking them, therefore, some of this water is driven off. If a little ground feed is added it reduces the water content still more, and also makes a better variety. Cooking such feeds will also make the starch more digestible.

Soaking Feeds.—Soaking feeds in water from one feeding time to the next or even longer is sometimes advocated. This practice may be considered in much the same light as cooking. It adds water and softens the grain to some extent but under some conditions this practice becomes decidedly harmful.

Soaked grain is usually fed wet or in the form of a slop. When thus fed to pigs it is frequently swallowed whole. A pig may not masticate its slop but simply gulp it down. If the soaked grain is swallowed whole it will be of no value to the animal. It goes through undigested. If grain is not ground fine enough, soaking may help out.

CHAPTER V

ANIMAL BREEDING

The breeding of farm animals is a subject which is not always given enough consideration, especially by the general farmer. From the standpoint of the man who makes a business of breeding animals which are for sale for breeding purposes, it is frequently overemphasized. The breeder is likely to lay more stress upon breeding than upon feeding.

Feeding and breeding cannot be separated. The two go hand in hand. The animal breeder must feed his animals and the feeder in the majority of cases breeds for the feed yard.

THE MAN

The work of livestock breeding, perhaps, depends more upon the breeder than does any other phase of agriculture. He should be bred for and developed a livestock man. Of course, anyone can undertake livestock work but success will depend upon the character of the man. The most highly developed breeder has sufficient knowledge of the laws and principles of breeding, coupled with observation to improve the animals and types with which he is working. He is able to supply animals for breeding purposes. These animals should be so good that the man who buys them for use in his herd, stud, or flock for producing meat or work animals can improve his herd from the meat and work standpoints.

The livestock farmer, on the other hand, should be able to go to the livestock breeder and buy a sire for \$100, \$1000 or \$10,000 and use him in his herd, stud, or flock and make money on him. For example, if a bull is bought for \$500 he ought to make enough improvement in his offspring, for whichever purpose they are bred, to let the livestock farmer who bought him get back the money he paid for him and then a substantial profit besides, during the natural life of the sire.

If the livestock breeder cannot produce and sell animals like this he is not fulfilling his mission, or else he is selling his animals at too high a price. Thus there is a place, and a good place, for both the livestock breeder and the livestock farmer.

The part that one's ability as a judge plays in successful livestock breeding is nicely brought out by W. E. Spicer in the *Breeders' Gazette* of Sept. 7, 1916. He says:

"To be a judge of animals is not only the first but it is also the most important qualification of the master breeder and improver of livestock. I care not what other qualifications and advantages a man may possess, if he is lacking in this one respect, he is a failure as a breeder, so far as improvement of the breed is concerned. Every other qualification is subordinate to this one faculty. To judge is like a chord, a prelude to a masterpiece. A man should be receptive as well as creative to be a success. To attain these higher rungs of the ladder one must have both ability and application to get above mediocrity.

"It is said that Raphael, the great painter, was once asked to define art in a single sentence. He spent a year in endeavoring to encompass that great proposition in one sentence. Finally he evolved this: 'Art consists in the ability to see.' It applies to the common things of life as well as to the greatest efforts. If the eye does not see the picture before it is painted the hand will never paint it. Without the ability to see the meaning of the things he does, a man is robbed of half his power and a large portion of his reward. To define the art of judging, it consists simply in an ability to see.

"Every one of us is responsible for his voluntary acts. Then the quality of one's herds reveals his ability as a judge. It is infallible evidence of his ability as a judge. A man to be a successful improver of a breed of animals must be able to see beyond the surface of things. He must know not only the strength, but he must also know the weakness of the animals he has in hand. Such a man must possess a deep sense of penetration into the knowledge of animal nature and the powers of reproduction, and must be a student of nature's laws that govern and influence the offspring. He will be a man of keen observation and thought, and a seeker after truth and knowledge. Every animal has its individuality. Its character is indelibly stamped on it, an infallible guide to the man who can read the indicator correctly. And every great improver of domestic animals has had this faculty strongly developed. But few men are blessed by nature with an endowment of this faculty. Right here is the stumbling block, which amounts to a stone wall which most breeders never surmount—their inability to see and read correctly the indicator on their animals. While I do not wish to discourage anyone, it is useless to hope to reach any great degree of success above mediocrity without this ability to see.

"As to the impartial and fairly competent judge, you may give him

the best animals of the breed and he will not only fail to work any improvement with them, but he will fail to maintain the high excellence already attained. In a very few generations the herd will come down to fairly good animals, just on a par with his fairly good judgment. The herd is sure soon to show his judgment or lack of judgment. 'By their fruits ye shall know them,' and the product of their skill is the only infallible guide of breeders' real judgment. Our backward track is strewn with hundreds and thousands of cases of men who were fairly competent judges, who bought high-class animals and who failed to maintain the excellence in their descendants. If a man knows not when the features are right or wrong, what are his chances for improving them?

REPRODUCTION

In order that animals may reproduce there must be a male and a female. Each of these provides one of the two essential parts in the process of reproduction.

The female produces the egg which is like the hen's egg only very much smaller and has no hard shell. This is produced in the ovary which lies in the body near the backbone at about the "small of the back." It is supposed that the period of heat is the time when these eggs ripen and pass down to the womb. It is not known how many eggs pass down each time but as a rule more than one. This is true at least in those animals which produce multiple offspring.

The womb is a pear-shaped organ in the rear part of the abdomen. Its neck lies back into the vagina which opens to the exterior by means of the vulva. The womb is simply an organ in which the fœtus or new unborn individual develops. It can also develop in the abdominal cavity but the womb is the natural place and was made for that purpose.

The real live or vital part of the egg is the nucleus, a small part in the center or elsewhere in the egg. The balance of the egg is food material for the new individual when it starts to grow as a new and separate individual.

The male animal produces the other half of the necessary part of reproduction. This is called the sperm cell. These cells are produced in the testicles, which are glands. When an animal is castrated, these glands are removed. The animal can then no longer be used as a sire. As these sperm cells are produced they pass up into the body and are stored for

such time as they may be needed. This is at the time of service when the sperm cells of the male are deposited in the vagina of the female. They are usually deposited in large numbers but only one is needed to fertilize an egg. These sperm cells look a little like tadpoles. They have tails by means of which they can move and thus get into the opening through the neck into the womb and there meet the egg cell from the female. When these two meet and the conditions are right they combine and form the new individual. This then develops from two cells which unite and make one cell and then this grows by cell division. Next there are two cells, then four, eight, sixteen, thirty-two, sixty-four, etc.

At first this new individual lives upon the food contained in the egg. After a very short time, however, it attaches itself to the wall of the womb and absorbs food from it. The afterbirth or placenta is only the connection between the foetus and the womb of the dam.

The foetus or new individual is an entirely independent individual. It has its own life, metabolism, blood circulation, etc. But it cannot use its lungs to purify air for its own metabolism, consequently, it sends its blood stream by means of the navel cord to the placenta or afterbirth which surrounds the entire foetus and attaches to the interior of the womb. Here the blood is spread out thinly, as in the lung of the animal after birth, and is purified. The impurities are taken out and oxygen is taken from the blood stream of the dam and put into the blood stream of the foetus. These materials are passed through the walls of adjoining blood vessels, those of the dam and of the foetus. Thus there is no direct blood connection between the dam and its offspring.

As the foetus grows the womb must enlarge. At birth when the foetus has been expelled the afterbirth is also expelled and the womb then again contracts to its normal size. The foetus is expelled by means of the contraction of the muscles of the womb and of the abdomen.

HEREDITY

A new animal has its inception or beginning when the sperm cell of the male and the egg cell of the female unite. This is

called conception. At this time the future of the new animal is determined. It has inherited all it can and henceforth only gets nourishment from the dam. This new individual has inherited the right to be something similar to its ancestors, or to be an animal of the same species. This is heredity.

Ancestry.—A newly conceived individual comes half from its sire and half from its dam. These in turn owe their existence and their characteristics to their sire and dam. Then, the farther back one goes in the generations of the ancestors of a certain individual the less is the influence of each.

The sire and the dam are each supposed to be directly responsible for one-half of the characteristics of a given offspring, the four grandparents one-fourth, the eight great grandparents are responsible each for an eighth and so on back. Each of the ancestors, however, in the entire pedigree no matter how far back one goes is supposed to have some influence on any particular offspring. Sometimes this may be so small that it is not noticeable. A pedigree is simply a tabulation of the ancestors of an individual in their regular order. It is usually written thus:

$$\text{Offspring} \left\{ \begin{array}{l} \text{Sire} \\ \text{Dam} \end{array} \right\} \left\{ \begin{array}{l} \text{Sire} \\ \text{Dam} \\ \text{Sire} \\ \text{Dam} \end{array} \right.$$

Sometimes a pedigree is written out by enumerating only part of the sires or part of the dams. That is, going farther with one or two lines of the ancestry and not the whole or all the lines. This is manifestly unfair as an inferior line may be left out when these have as much influence as the good individuals in the pedigree.

VARIATION

It is frequently noticed that there is a marked resemblance between the children of a family; also sometimes between the children and one or the other of the parents. When certain characteristics of one parent become visible to the exclusion of those from the other parent, it does not mean that those not showing are not there. It simply means that they are not

visible. But they are there and will manifest themselves in the offspring next time just as the others or those that appear on the surface. The noticeable characteristics are called dominant and those disappearing are called recessive. Both exert their influence on the next generation.

Resemblance and Difference.—Frequently there is a marked resemblance between the members of a family. At other times there is also a marked difference. One thing is very pronounced and also very important in this connection, namely, that with the exception of some twins there are no two individuals in a family or elsewhere that look alike. There is always some variation. Sometimes this variation is small and sometimes it is great. It is not all one way either; it is on the side of improvement as well as on the side of retrogression. That is, some of the offspring, are better and some are not so good as their parents. The division is also about half and half, a small number deviate or vary widely on either side and a much larger number vary much less from the average of sire and dam. This is illustrated by drawings by the author in his book, "Swine," page 108.

At first thought it may seem that if half of the offspring from any parents or in any large herd are inferior to their parents, this would be a bad thing in animal breeding. But it is the breeder's only salvation. If half of the offspring are poorer than the other half are better and it is by means of this better half that all improvement in animal breeding is made.

SELECTION

According to the law of variation, then, some of the offspring are better and others are poorer than the parents. Some of the offspring are considerably better than the ancestors and an occasional one is very much better.

The breeder who wishes to make improvement in his animals selects these better ones or the ones that have the variation according to his idea of improvement and mates these for his future animals. These then produce offspring which revolve about themselves as a center and produce both poorer and better individuals from their standpoint. Thus it is that improvement is made. And this improvement may be made

in any or all lines within the realm of animal variation desired by the breeder.

The first point in this process of improving animals is that there must be variation. This is always present in all animals. The second point is that the breeder must be able to see these and select the animals for mating that have desirable variations. This again brings in the ability of the man in charge in a very prominent way and it must not be overlooked that the value of a breeding herd depends upon this ability of the breeder. With this consideration in mind, it can readily be seen why an improved pure-bred animal, provided it has been properly bred, is better than a native or scrub.

Breeding in nature is done at random and there is no selection or mating according to man's idea of improvement. These animals in nature do mate frequently on a basis of improved strength and vigor and consequently we have some valuable characteristics well developed in nature's normal animals. The American broncho is not set up as an ideal horse, nevertheless it has wonderful endurance. The moose is not the standard beef animal but can live in a climate and subsist on feeds which would be certain death in a very short time to the modern improved beef cow.

An inferior pure-bred animal sometimes called a pure-bred scrub is one whose variation deviated toward the lower level or toward inferiority. Such an animal is the worst kind of a scrub because it has these characteristics well fixed by breeding and will produce inferior offspring.

Many times people buy a pure-bred animal at a "long price," comparatively speaking, just because they get a piece of paper or registration certificate with it. If this animal has been well selected it is all right but if it has not been well selected it is all wrong. Such an inferior pure-bred animal is not so good for livestock work as a grade or scrub animal that has been better selected.

Value of a Sire.—The value of a good sire is frequently underestimated. Altogether too frequently he is purchased because he is a pure bred, because someone wants to sell him or because the buyer has not the ability to select a good one. It is a common saying that the sire is "half of the herd."

Yes, in a way he is more than half of the herd. He is responsible for half of the characteristics of all the offspring. One sire can be used to every 20 to 100 dams. Therefore, sires can be much more closely culled than dams and the sire should be much better than the average of the dams in any herd. In this way he is responsible for more than half of the improvement that is made. If he is improperly selected, retrogression in a herd will be rapid. As an individual the sire is only one in a herd but as an influence he is by far the better half.

As an illustration, suppose that a bull will sire 40 calves in a herd a year for four years. This will make 160 calves and suppose that each calf on account of the good characteristics of the bull is worth only \$10 more than a calf by an ordinary bull. This is easily possible from the farmer's standpoint and will make the bull worth \$1600. From a breeder's standpoint a sire frequently adds \$25, \$50 and even \$100 to the value of each of his offspring.

In selecting animals for a breeding herd, both sire and dam should be well developed in the points mentioned in Chapter III; namely, in quality, wealth of flesh, constitution, length of body, form, condition, temperament, etc. If the dams are weak in any particular point the sire should be selected to be especially strong in this respect.

ENVIRONMENT

There are three principal factors in dealing with animals, namely, breeding, feeding and environment. The latter includes all the conditions to which the animal is subjected not included in the other two. Environment, therefore, includes such factors as shelter, pasture or range for exercise, as compared with confinement, temperature of surroundings, humidity of air, dryness of soil, topography of country, shelter for stock, etc.

Environment like breeding and feeding is a factor of importance. The condition under which animals are kept may be so abnormal as to result in ill health and even death in a comparatively short time. As an example of this, the question of thumps in pigs may be mentioned. If pigs are kept confined

without exercise for more than two or three weeks after birth they are likely to get this disease, and some almost invariably die. Sometimes whole litters die. Like results are likely to occur with other animals, but, of course, death does not always come in the same form.

Environment or the influence of surrounding conditions may also act more slowly and extend through several generations. Then it is said that the stock "runs out" and new blood must be introduced. But this is caused by either one of the three above-mentioned factors, namely, breeding, feeding or environment. The animals may be kept under conditions which are not favorable to improvement and then they go back. Such conditions in time will reduce them in general usefulness to a point at which they will no longer be able to fulfill their purpose.

In furnishing an environment for farm animals two main points should be kept in mind. (1) The animals should be kept under conditions that are as nearly normal or as to those of nature as possible. (2) These natural conditions should be modified to fit the improved rather than the wild animal.

Acquired Characteristics.—The characteristics infused into animals by several generations of environment, feeding and breeding become fixed and are transmitted to a greater or less degree to the offspring. Thus, the man who uses the right kind of a sire may get from 10 to 20 per cent. more gain on his animals than he would if he used the wrong kind of a sire. Furthermore, he may not himself be in position to produce the right kind of a sire.

The characteristics that animals acquire owing to environment, etc., may be either good or bad. On this account, the author always makes it a practice to study first the environment under which the animals were developed, then the feeding, then the type and conformation, and finally the breeding or pedigree. In buying an animal on pedigree alone there is only a rare chance of getting a good one. The above-mentioned factors may all be on the wrong side with their influence. As shown, previously, one-half of the offspring are below the average and again the breeder frequently keeps the best ones for his own use.

With all this in mind, it may readily be seen what a power for good is the animal that has all the right factors. Any man who can combine all such factors in the right way has a license to be an animal breeder of the very first rank. He has a very valuable heritage.

BREEDING PRACTICE

Everyone who knows anything about livestock is more or less familiar with the different phases of breeding, namely, ordinary breeding, line breeding, out-crossing, close breeding, in-breeding, cross breeding, and grading. Any kind of breeding means the mating of sire and dam so as to produce offspring. When the breeding of the animal is mentioned it takes into consideration all of the animals in the pedigree or all the ancestors on both sides of the pedigree or of sire and dam.

Ordinary breeding consists of the mating of animals of similar characteristics and as good as can be had, without very much if any relationship between sire and dam.

By line breeding is meant breeding animals along the same general line, with some relationship between the ancestors.

Out-crossing refers to the mating of animals not at all related and sometimes also different in type and characteristics but of the same breed.

Close breeding is a degree closer than line breeding and is sometimes defined as the mating of cousins.

In-breeding is the mating of animals of the closest relationship, such as mating parent and offspring or brother and sister.

In cross breeding, animals of different breeds are mated.

By grading is meant the use of a pure-bred sire on dams that are not pure bred. Animals produced by the first one or two crosses are called just grades. When a pure-bred sire has been used constantly and for three or more generations, the offspring are still grades, but may be called high grades.

The first offspring from a pure-bred sire and scrub dam is half pure bred. The next cross, or when this so-called half-blood is again mated with a pure bred, will be three-fourths pure, the next seven-eighths, the next one fifteen-sixteenths, and so on.

In the ordinary practice of breeding, in-breeding and frequently also close breeding are generally avoided. This is considered a delicate problem which only the best breeders should meddle with. It is generally held that offspring produced by mating relatives are likely to be inferior by being smaller, weaker, deformed, etc. In the human family this is a question of such importance that national laws and popular opinion prevent marriages between relatives.

In-breeding brings together and combines similarities and, therefore, fixes characteristics from sire and dam that are similar. As shown previously, these may contain characteristics of an inferior kind in a recessive or invisible form. When related animals are mated these weaknesses are combined and intensified in the offspring. This will result in inferiority. If, on the other hand, related animals that are mated are made up of all strong and no weak points that are visible or invisible, these will also become fixed and the result will be a very good individual.

Since nearly all animals are affected with weaknesses in-breeding should not generally be practised. It can and should be practised, however, if the proper kind of individuals can be mated. This again requires extraordinary ability on the part of the breeder.

As in-breeding is supposed to produce debility, so cross breeding is supposed to produce vigor. Whether this is true is not yet a settled question. In experience, good pure-bred animals are just as good for meat or work animals as good cross-bred ones. It is also generally known that cross-bred animals cannot successfully be used for breeding purposes. This being true it becomes a fact that by cross breeding one destroys all the improvement and excellence of careful and painstaking work previously done. Thus, there is nothing to be gained and everything to be lost by cross breeding.

A Pure Bred.—A pure-bred animal is one that is recorded. That is, its name, together with its date of birth, breeder, owner, its sire and dam, etc., are on record in the office or publications of the breed association. With some breeds there are several registry associations. Most associations at the present time require that both sire and dam of the

animal to be registered shall be pure bred, or on record. Thus it is impossible to bring any new blood into the breed. And no matter how good or how high a grade animal one has, it cannot be registered.

During the early time of the history of the breeds the rules were such that a good grade animal with a certain number of crosses of pure blood could be registered. But as the associations became older and the number of pure-bred animals larger and the number of grades smaller, the rules were gradually changed so that now in the main, only animals with pure-bred ancestors on both sides can be registered. This in the main is right. But one of the best dams ever seen by the writer was a non-registered one and she could not be registered. In cases like this, the work of the registry associations might be improved, if these good animals could be recorded. This might be done by inspection, by a breeding trial, etc.

Some of the registration associations also have rules to the effect that animals must be registered before they reach a certain age. Thus by oversight or neglect some of the best pure-bred animals may become non-eligible.

GESTATION

The period of gestation is the time during which the foetus develops in the womb of the dam. It is the time from conception to delivery and varies with different animals. With the mare it is about eleven months. The cow carries her calf about nine months and a week. The ewe drops her lamb about five months or 152 days after service, and the sow farrows about 114 days, or three months, three weeks and three days after she is bred. At the time dams are bred they should be in good condition physically and should be kept gaining rather than losing during the period of gestation.

Sometimes one hears it said that the young in the womb of the dam, or the foetus, is subject to various influences. That is, it may be influenced by the fact that the dam previously was bred to a different kind of a sire, or that the dam, while the foetus is being developed, has unusual experiences by sight, hearing, sensation, etc. But most of the best authorities agree now that such are not the facts and that the foetus

develops according to the inherent tendencies which it received at conception. And that the womb of the dam is only a dwelling place for the foetus and a means for it to get nourishment.

BREEDING FOR SEX

The subject of sex determination has long been a popular subject for experimentation and discussion. A great many theories have been advanced by which it has been said that the sex of the offspring could be determined, but practically all of them have been disproved or found not to hold good.

The latest theory brought out in this connection has not as yet had time to be disproved or to be found untrue and also agrees with some earlier statements. This is based on the age of the sperm cell (time after discharge from male) when it unites with the egg. It is generally understood that sire and dam are mated or the dam is bred, at the time of the period of heat. This is the time, as stated previously, when the ripened egg comes to the womb to be fertilized. It is not always known during what part of the period of heat the eggs come down but sometimes it is said that it is during the last part. The time may vary with different animals. If the dam is bred during the last part of the period of heat, when the egg is in the womb ready to be fertilized and the sperm cell deposited by the male unites with it at once, while it is still fresh, the offspring is supposed to be a male. But if the dam is served during the early part of the period of heat and the egg has not yet come down the sperm cell from the sire will become stale. If the egg is fertilized by a stale sperm cell (but, of course, before it dies) the offspring is said to develop into a female. Sperm cells may live a day or more in the womb of the female.

According to this theory a fresh sperm cell will produce a male and a stale sperm cell will produce a female. Or if the breeding is done during the latter part of the period of heat the likelihood of getting males is greater and if breeding is done during the early part of the period of heat the offspring will be more largely females. On account of probable variations in indefinite factors it can be clearly seen that with animals at least it would be impossible to produce all males or all females.

But if the theory is correct, it ought to be possible with due care to modify the proportion of the sexes in the offspring.

Sex determination is also a family characteristic. Sires or dams from families that run strong to either sex may be depended upon to produce a larger proportion of that particular sex in their offspring.

STARTING A LIVESTOCK FARM

In starting a livestock farm it is well to remember the importance of the sire as mentioned previously. Consideration should also be given to environment, nature of country, location, etc.

The Herd Sire.—Since the sire plays such an important part in any herd of cattle, horses, sheep or swine, great care should be exercised in selecting him. A herd sire may be purchased while he is young or he may be purchased when he is old. To select and buy a good young sire requires more ability than to select one when he has come to maturity. But in buying a young sire one saves on express charges and if the buyer has the ability he may be able to get an extra good one that might not later be available. In buying young sires also one takes chances that he may not develop into as good an individual as he promises in early life. There is also more chance of losing him by accident or death.

In buying an old and tried sire one has a record of performances to go by which is a sure index of what he can do. An old sire also is large enough to allow more than the best-trained man to recognize his points of excellence. Many times such a sire is available from a small herd where he can no longer be kept on account of in-breeding. Buying an old sire from a small herd is a good way sometimes to get a good sire. But on the other hand, good breeders usually keep their good sires or else sell them at prices that would be prohibitive to beginners.

Many times a group of breeders get together and form a community breeding association. This association then buys a sire for common use. This is an excellent practice because it reduces the expense per farmer and enables them to buy a better individual than one man alone could afford. Some

agreement, of course, is made among the members of the association as to the manner of keeping and the time of using the sire.

After a man once has a start in the livestock business one of the best ways to get a good sire is to produce him. This, of course, cannot always be done, but when it can be done it is a most excellent practice.

Granting that a man has a certain amount of money to put into a livestock business, in starting he should put a considerable portion into a good sire. Then he should get one or more pure-bred dams and put the rest of his money into good grade stock. The latter may as a rule be picked up in almost any locality where one starts. Of course, if a man can afford to start with pure bred so much the better. But it takes more than a few individuals in a herd to make a business of sufficient magnitude to make it worth one's while and good grades are just as good for ordinary purposes as inferior pure bred.

Even if a man should decide to go into the business of livestock breeding and aim primarily to sell stock for breeding purposes, he could not start in a large way because he would first need to work up a business and a reputation. He would also have to develop a herd capable of attracting attention. All this takes time during which he would have to be doing business with the meat markets. This can be done to good advantage with grade dams and a good pure-bred sire. Many times also a man needs to get experience which can be had with grades more cheaply than with pure bred.

Environment.—The general importance of environment has already been discussed. There are few, if any, places in any country where livestock cannot be kept profitably, but there are some places that are better than other places for this kind of agricultural endeavor.

A climate that is not too hot nor too cold is better than one that goes to both extremes. Humidity also is an important factor. Too much dampness, especially in winter, is very severe on all classes of livestock. Where such conditions prevail it requires a little more care and expense to keep the animals comfortable.

An open prairie country is not so good as a wooded country. The timber affords shade in summer and protection from cold winds in winter. A rolling or hilly country is also better than a level country, because there is better drainage and better exercise for the animals; possibly, also, more protection from winds.

The nature of a soil together with the humidity of the climate is of very great importance. Some soils produce grass well and others do not. In some places also the grass is much more nutritious than in others.

Another factor to be considered is the size of the pasture to be provided. Growing animals and breeding stock need considerable exercise. Consequently, a large pasture is always better than a small one.

Location.—A livestock farm should be well located with respect to the markets. It is true, of course, that livestock products can be marketed more cheaply and more advantageously than grain products. But the closer to market the better. This fact is especially true for the man who is in the pure-bred business. Such a man generally makes frequent trips to the railway station with crated animals and when the distance is too great it is hard on the animals and also increases the expense. A livestock breeder also has many visitors who come to inspect his stock and these must be furnished transportation to and from the farm.

CHAPTER VI

HORSES

The universal question that comes up in connection with the farm is horsepower both for work and for travel.

The horse is a machine used by man to appropriate to his own use the energy stored up in plants. The horse eats these feeds and uses the energy to develop power for his master. This brings out one of the most important phases of the horse industry, namely, exercise.

HORSE ENVIRONMENT

Since the horse is valuable only as it can develop speed and power it is of the utmost importance that its environment be such that these be developed.

Colts.—It is a well-known fact that all young animals, as they are growing, need exercise. It seems to be true that the energy of feeds cannot all be used for growth and that some of it needs to be worked off in the form of exercise. If this is an important factor with all animals, and without doubt it is, then it is doubly important in the care of colts. These animals should be developed especially with respect to their powers of locomotion, and for this exercise is very important. Whoever has seen colts is familiar with their ability and willingness to run. The mother very frequently is decidedly worried for fear her baby will get lost. Exercise may be provided as the owner sees fit. But perhaps the most economical as well as the best way is in a good large pasture. This is necessary not only for the colts but also for the mature horses and especially the brood mares.

Work Horses.—What is the purpose of the long period of training in preparing for a horse race or a prize fight? To develop the muscles for the work that is to be done. This training may start a long time before the event, and the longer

the better. It may begin even generations before. It can be understood, therefore, how important it is that a horse should not be confined to a barn without regular and systematic exercise.

When horses are at hard labor it is best not to turn them out for the night. They need the night to rest. It is a good practice, however, to let them out into the yard for a short time in the evening when they come in from the field. This gives them a chance to roll and limber up so that they will eat better and feel better. When horses are not at work, however, they should not be allowed to stand in the barn unless they are exercised. Even during the winter horses should be given the freedom of a yard except possibly on the coldest and stormiest days. They should not, however, be exposed to cold rains.

Fences.—It should be remembered that horses frequently paw at a fence, and if the fence is made of barbed wires which are too close to the ground, there is much danger. Many a horse has been ruined by getting its foot across a barbed wire and then pulling. When the pull is a little sidewise or along the wire as it usually is, a severe gash is usually cut at the back of the hoof and pastern. In order to avoid accidents like this a woven wire may be used. A woven-wire strand with a few barbed wires on top is good. If an all-barbed-wire fence is made the lower wire should be put as high above the ground as possible.

Housing.—A horse barn should be built especially to provide comfort and health for the horses and economy of labor for the help. It should be well ventilated and well lighted. The windows also should not be too close to the heads of the horses. When a horse stands with its head toward a window which is in the wall above the manger, where the manger is attached to the wall, there is too much variation in light. Under such conditions when the horse has its head up its eyes are in the bright light. When the head is down in the manger, the eyes are in the dark. Thus, there is a constant changing for the eyes from light to dark and *vice versa* which is very bad for these most important organs.

A horse barn need not be made especially warm. Very

often one sees horses and dairy cows kept in the same barn. This is not right. The horse does not need so warm a barn as the dairy cow. A combination barn where both are kept in the same part is either too warm for the horses or too cold for the cows.

The barn on the farm of August Wentzel, Polk County, Minnesota, is the best horse barn for farm purposes that has come to the notice of the author. There is a wide alley in the center, wide enough for hitching and unhitching horses, and for driving through with a manure spreader. On each side of this alley is a row of stalls facing out. In front of each row is an alley for feeding. This is wide enough to allow the feeder to work easily, and the windows are far enough away from the horse not to blind it.

The barn has sufficient mow room for the storage of hay and straw and also bins for several thousand bushels of oats. The grain comes down in spouts at the center of the barn which makes feeding handy. The hay also is thrown down chutes into the feeding alley. The barn is provided with box stalls, harness room, and screen doors and windows. The screen doors and windows keep out the flies and mosquitoes. Provision is also made for hanging work harnesses immediately back of each team.

A horse-barn floor should be such that the horse has a smooth and nearly level place to stand. There probably is no better floor than mother earth but this kind of a floor is not always kept in order. In such case, it may be advisable to provide something artificial. The material to use is the one that comes nearest to providing natural conditions and that can be provided at the least cost.

THE FEEDING OF HORSES

When the subject of horse feeding is mentioned the first thing that enters one's mind is oats. This grain is primarily a horse feed.

Concentrates.—Oats are considered a concentrate yet they contain considerable roughage in the form of the hulls, which are largely, if not altogether, indigestible. On this account oats are not too concentrated. Oats also are made up of a

good combination of nutrients, having considerable protein besides the carbohydrates. They are also especially valuable on account of their richness in fat and mineral matter. Thus it is seen that oats makes a pretty well-balanced ration.

Besides, oats seem to give horses life, vim, activity, and power.

Corn is probably next in importance as a feed for horses. This grain, however, is more of a fattening feed and lacks the nerve stimulus. Barley is also used to some extent but this is not so well relished as is either oats or corn.

To supply a laxative and also a little more protein wheat bran is frequently used. This is very often fed as a mash once or twice a week to help keep the bowels in order. Sometimes it is also fed dry regularly as a part of the ration. To obtain more protein for the growing colt oil meal is frequently used. This is what is left from flax after extracting the oil. From this it seems that ground flax would also be good both as a source of protein and as a laxative.

Roughages.—Since the principal concentrated horse feeds are of the carbohydrate nature, the variation as between feeding colts and work horses is primarily in the roughage part of the ration. Timothy hay is primarily a horse hay. It is a carbohydrate roughage and is adapted to feeding work or mature horses. Such animals need only enough protein for maintenance and can develop energy or do work to the best advantage and most economically on carbohydrate feeds. These, as a rule, also contain enough protein for maintenance.

When it comes to feeding colts, however, timothy hay should not be used. Leguminous hays like alfalfa, clover, pea hay, etc., all of which are protein feeds and furnish the material for growth, should be substituted.

Mineral Matter.—It is common knowledge among farmers that horses frequently eat the bark off trees; also, that many times when poplar saplings are cut and left in the yard the horses eat off the bark. Sometimes, also, in the spring of the year horses are seen to go onto a plowed field and eat dirt by the mouthful. All this is simply an indication of the requirement of mineral matter by the metabolism. These substances must be had or the internal machinery will not work right.

Horses should always have salt before them, and, if they will eat it, bone meal and finely ground limestone. Hardwood ashes may also be offered.

Water.—One of the most important parts of the ration for the horse as well as for other animals is water. The manner in which water is given, however, is not always given due importance.

Water should be taken when the feed is in the stomach to aid digestion. It should also be used for heat regulation, etc. Horses should not, however, be allowed to drink when they are very warm as when coming in from hard work. This may cause various disorders.

After horses come in from work if they are “warm” they should be allowed to cool off and then be watered before they are fed. They should again be watered after eating and before they go out to work. It has recently also been found to be good practice to water them the last thing at night before going to bed.

Manner of Feeding.—Roughages are cheaper feeds than concentrates, as has been shown, and should, therefore, be used as largely as possible. No greater mistake, however, is made in horse feeding than to give the horses all the hay they will eat. Many farmers keep their horse manger crammed with hay all the time. The horses in turn keep their stomachs and bowels crammed likewise. This makes horses look like stuffed toads, and very materially lessens the value of the animals, and wastes hay.

Horses should be fed definite amounts of hay as well as of grains. For ordinary purposes, 1 pound of hay and 1 pound of grain for each 100 pounds of live weight is considered to be about right. For driving horses or draft horses at hard work, more grain and less hay should be used. When horses are not working so hard more hay and less grain should be used. In winter horses can be well maintained on hay alone. Many horses are also “wintered over” on straw with just a little grain.

The horse is primarily a work animal and uses its feed for developing energy. Therefore, the amount of feed should be apportioned according to the amount of work done. A com-

mon mistake is to feed horses a uniformly high grain ration on Sundays and rainy days as well as on work days. This frequently results in azoturia, which very often is fatal, and in other troubles. A good rule to follow, then, is to cut down the ration and especially the grain part on days when the horses are not at work. Of course, horses that are very much worked down and are thin in flesh can stand a little extra feed occasionally on days when they are idle. But they should not be allowed to stand in the barn at such times and become stiff.

THE CARE OF HORSES

With environment and feeding, two of the most important matters have been provided. There are a few other points that should not be overlooked.

Fitting the Harness.—Harness for a horse should be fitted well at all points, especially the collar. This should fit the neck perfectly. A sweatpad is frequently used to produce a fit, and, as is sometimes said, to make a softer contact with the shoulders. It is a great deal better, however, to have a collar fitted without a sweatpad than with one. The sweatpad is too warm and not easily enough cleaned. There is nothing better than a good leather collar well fitted and kept perfectly smooth and clean.

A collar should always be cleaned at night when it is removed from the horse. At this time dirt on its face is soft and can easily be rubbed off. A wisp of hay or a sharpened piece of soft wood, followed by a piece of cloth, to leave a smooth polished surface, are good for this purpose. Great care should be exercised not to roughen the face of the collar.

Sometimes as horses become thinner during a season of hard work the collars become too large. If there are several horses on a farm the difficulty can be remedied by getting a new collar for the smallest horse and shifting collars from the smaller to the larger animals.

Feet.—A horse's feet should always be kept clean and well trimmed. Shoes are necessary only when the feet are tender or worn down too much, or to prevent slipping. When shoes are used they should be reset about once a month.

When horses are not shod the feet should be kept trimmed to proper length at all times. This is especially true with colts. Serious trouble in after life may follow neglect, and materially lessen the value of the horse.

In nature horses do not stand upon dry and hard floors as is frequently the case with domestic horses. If the feet are inclined to become too dry, the horse should be allowed to stand and work in a place that has more dampness. Horses should always be kept in a clean and comfortable place and should be kept clean by currying, brushing and wiping. In the spring horses should be given extra care. They should not, after being idle all winter, be given hard labor suddenly. They come out of the winter soft and should be prepared for the hard work of spring beforehand. They should be trained for the work they are to do.

Proper environment and feeding with good care will as a rule keep horses in good health. If, however, they should get sick or contract diseases they should be given extra care and be kept warm. In addition to this, the ration should be reduced and a physic administered. Salts or raw linseed oil may be used for this purpose. If such treatment does not produce desired results, a qualified veterinarian should be called in.

TYPES OF HORSES

In studying different types or kinds of horses there are two that are of outstanding merit. These are the draft type and the roadster type.

The draft type of horse is broad, heavy and blocky. There are many kinds of draft horses ranging from light through medium to heavy draft types—from 1300 pounds to 2000 pounds. A heavy draft horse weighs 1600 pounds or more. Other things being equal, namely, quality, conformation, etc., the heavier a draft horse the more it is worth. The price is determined by the market centers like Chicago, where horses are bought in large numbers for city work. A light draft horse may not bring any more on the market than at the rate of 10 cents a pound while a heavy draft horse may easily sell for as much as 20 cents a pound. A heavy horse is worth more because it can pull a heavier load.

The kind of a horse a farmer should adopt for his farm will depend somewhat upon the farm and the farmer. A small hilly farm might be able to use light horses to the best advantage but as a rule a farmer ought to grow horses to sell as well as to use on his own farm. And the larger and heavier they are the more they will bring on the market.

In selecting a horse either for work or for breeding purposes, it should be selected for conformation, quality, soundness, ambition, etc.

DRAFT HORSE CONFORMATION

The main points to be given special consideration are length of back, length and position of croup, width of body, depth of chest, thickness of muscles, slope and shape of shoulder, depth of body, length of leg, cleanness of limbs, slope of pasterns, character of feet, and head and neck.

Back.—The back of a horse, that is, from the rear of the shoulder to the front of the hip joints, should be short. The reason for this is to give it strength. The horse is a pulling machine which has considerable strain on the back and the longer the back is the more likely it is to give away. A long bridge span or a long joist will not carry as heavy a load as a short one. So a horse with a short back is stronger than a horse with a long back.

While the back should be short to assure strength, the underline of the body or belly should be comparatively long. This will give more room for the internal organs and feed and also prevent the hind feet from coming into contact with the front feet while the horse is in motion.

Croup.—The croup is the upper part of the horse's body from the points of the hips to the root of the tail and the pin bones. This should be well muscled and not too steep. That is the rear end should not be too low. There should be a nice gradual curve from the back up over the croup back to the tail. The horse should not look as if it had been flattened out at this part.

The croup should be well muscled because here are located some of the principal muscles that have to do with locomotion. These are attached by means of cords and tendons to

the bones of the limbs. As the muscle contracts, it shortens and causes the bone to move in the direction of the pull. The thicker, therefore, the muscle on the croup, the more power can be exerted by the horse.

Width of Body.—The reason for width of body is the same as for thickness of muscles on the croup. It gives the horse more muscular tissue which is the real object for which the horse exists. This width of body should, of course, not be in the form of fat but of muscle and should give plenty of room on the inside for vital organs and digestive capacity. The latter can easily be determined by noting the spring of rib or levelness and distance from backbone to which the ribs extend, also the width of the underside of the body together with thickness of body wall.

Constitution.—A horse must also have a good constitution. This is indicated by depth of body at the chest together with width of body at and to the rear of the shoulders. This is the power house of the "machine" or the "factory for developing energy" and no factory or other plant can do more work than its power house will allow.

This is a matter of such importance that a spectator may go to a horse race and be able in a large measure to pick the winners by their depth of chest. Of course, however, the driver, training, experience, etc., must be considered, but the constitution of the horse is one of the biggest factors.

Thickness of Muscles.—The muscles should also be strong, heavy and well developed at the thighs, quarters, gaskins, arms and forearms.

The thigh of a horse corresponds with the ham of a hog. This should be heavily and thickly muscled so as to give power. These muscles and all muscles work the same as the muscles of the croup described above. They are attached to the object they are intended to move and by contraction cause motion. The quarters are the lower back and inner parts of the thighs. Thus, looking at a horse from the side the thigh should be broad, well extended back and well down toward the hock. That is, the horse should be deep, broad and thick at the thighs.

Looking at the horse from the rear, the split in the crotch

should not come high but the muscling should come well down both on the outside and the inside of the thigh.

The gaskin is that part of the hind leg next to the body or immediately below the thigh. It should be broad (rear to front) and heavily muscled. The arm of the horse extends from the point of the shoulder back and down to the elbow. The latter joint is in the front flank at the upper part of the front leg and above the underline of the body. The forearm extends from the elbow to the knee. The whole of the arm and all but the lower part of the forearm should be heavily muscled.

The arm also should be comparatively short and as nearly horizontal as can be had. The reason for this will appear under the discussion of pastern. The arm should be long. A long arm has a long muscle and a long muscle has greater power of contraction than a short one.

Shoulders.—The shoulders of a horse have a bearing surface for the collar. This bearing surface should be heavy enough, or, rather, should extend out far enough to prevent the collar from slipping back onto the body. The shoulder of a horse serves the same purpose in a way as does a man's head. A certain man, asked, what was the purpose of one's head, answered, "To keep the collar from slipping off."

The shoulder should also be smooth and even. A great many horses have a thickness in the upper part of the neck and shoulders. This makes it difficult to fit the collar. Under such conditions the upper part of the collar is wider and there is more motion from side to side as the horse walks. This chafes the neck and makes it sore. And a sore neck may lead to fistula, which is a very serious ailment. Even an ordinary sore neck may incapacitate a horse for work.

The shoulder also should be well sloped. That is, the upper part should be farther back than the lower part. If a plumb line is dropped from the upper part of the neck where the collar rests it should fall back of the front leg. Sometimes this slope is so great that this line will fall to the rear of the leg a distance about equal to the width of the leg at the forearm next to the body.

The purpose of this slope is very obvious. In hitching a

horse, the rear end of the trace is as a rule attached to a point that is considerably lower than its point of attachment at the hame. For pulling a heavy load the hitch is as low and as close to the horse as possible. This gives the horse a chance to lift. And his lifting power is his greatest power. It is constantly being developed by holding up or lifting its body. With this in view, it can be seen that with a proper slope to the shoulders the pull will come at right angles to the front surface of the shoulder where the collar rests. This is the way it should be. When the shoulder is too nearly vertical there is too much pull or pressure on top of the neck which lessens the power of the horse and also causes sore neck. Improper care and handling will also cause sore neck.

Length of Leg and Body Depth.—It is frequently said that a draft horse should be “low set.” By this is meant that the length of its legs should not be too great for the depth of its body. An “upstanding” horse is one whose legs are rather long and whose body is not very deep. The distance from the ground or floor to the under side of the body at the chest, which is the length of leg, should be equal to the depth of body at the chest. This is the vertical dimension just back of the front legs. A horse that is too upstanding cannot develop as much power as it should and a horse that is too close to the ground cannot develop enough speed in either the walk or the trot.

Cleanness of Limbs.—The upper part of the limbs should be well muscled, but from the hocks and knee down the legs should be as free from muscle and fat as possible. The hock is the joint at the middle of the hind limb and the knee is at the middle of the front leg. The purpose or function of these joints is to give flexibility to the limbs. The leg should bend freely at these points, therefore, should be as free from fleshiness as possible.

These parts, however, should be large and strong but should be bony and tendonous. The tendons from the muscles above pass down here and these together with the bones and skin over them should constitute the joints.

The hock should be wide from rear to front because a wide hock is stronger than a narrow one, as a wide joint is stronger

than a narrow one. The knee should also be quite wide in front from side to side.

The cannon is the part of the leg from knee and hock to the fetlock joint. This is the joint next below the knee and hock. The cannon bone is the front part of the cannon and the back part is the tendon passing to the foot. This tendon passes over pulley-like arrangements at the back of the joints mentioned above. This gives width and strength to the cannon, which should be wide and of even width.

The length of limb from knee and hock up, as already said, should be long so as to give lots of power to the muscles in this part. The cannon or part of the limb from these joints down contains no muscles and therefore should be short. This is simply a place where power is transmitted from the parts above to the parts below, therefore it should be short. The difference in the proportionate length of these two parts of the leg can be noticed in comparing well-bred horses with grade or scrub horses.

The Pastern.—The pastern of a horse is the sloping part of the limb below the cannon. This should be strong and should have considerable slope. Both the length and slope of this part are greater in horses of the roadster type than in those of the draft type.

The purpose of the slope in the pastern is to give the horse elasticity in its gait. This slope acts like a cushion and prevents jar to the horse. Imagine a man walking on his heels with the balls of his feet up. He would soon be shaken to a "frazzle." So it would be with a horse if all the bones in the limbs were set on end in a straight line. The horse then would have no value whatever. But with the slope of the pastern and the nearly horizontal position of the bone from the elbow to shoulder, together with the slope of the shoulder the horse has an elasticity in its gait that makes for a long life of ease, pleasure and ability in doing its work.

What is the difference between a farm "plug" and a well-bred saddle horse as a means of obtaining pleasure and comfort in riding? It is very great and the difference lies very largely in the difference of the position of these bones and the different kind of training these horses get.

Feet.—A horse is no better than are its feet. No matter how well-built a horse is from the feet up, if the feet are poor, the horse is no good. It must have its feet to walk upon and if it cannot use its feet it cannot walk. A horse that cannot walk cannot be used.

The feet should be deep, broad, oval, wide at heel, of hard and tough material, and of fine quality. The hoof is the outer or hard part of the foot which encases and protects the sensitive parts within. It also gives a durable surface.

The hoof should be of good size and as nearly oval as can be had. The heel should be wide and high but not so high as the front part of the hoof. The entire hoof or foot from top to bottom should be high or deep. The bone is in the center and with a deep foot there is more room for attachment between bone and hoof. This makes a stronger foot.

If the foot is shallow, the horse is said to be flat-footed and there is a tendency for the bone to push through and assume part of the pressure on its end. This causes tenderness and pain. A horse with such feet cannot do much work.

The sole of the foot should be concave or hollow, making the center higher than the outside. This gives it more strength, just as a concrete arch is stronger than a flat slab of concrete. A dark-colored hoof also is harder and will wear better than a white one.

The frog of the foot is the projection extending down from the rear middle part of the sole. This should never be cut off or disturbed. It acts as a cushion and aids the slope of the pastern and other bones to give elasticity as the foot comes into contact with the earth or road bed in traveling. The frog should be large and well developed.

Head and Neck.—The head of a horse should be lean with capacity for brains and should show much intelligence. The neck of a draft horse should be thick and well developed with considerable arch or crest; that is, a fullness or curvature on the upper side. This gives added weight to the front end of the horse.

This added weight in front is very important because as the horse pulls there is a tendency for the front part to lift up. This is true because the attachment of traces to hames is

considerably above the earth where the feet rest and because most of the power for pulling is developed in the hind quarter. The horse is really a pushing machine. It pushes itself along with its hind legs. Thus, by increasing the weight of the front end of the horse it can draw a heavier load. A well-developed front quarter also aids in this.

It is said that if a team pulling a load of grain in sacks up a hill, becomes stalled, it can be helped out by means of this



FIG. 12.—At ease. A horse of the roadster type.

principle. If some of the sacks of grain are taken from the wagon and put on the backs of the horses they can take the load up. This gives added weight to the front end of the body and prevents it from lifting up.

THE ROADSTER TYPE

Everything that has been said above about the draft horse is true of the roadster, except as to the comparative length of the legs, width of body, and crest on neck.

Size and Weight.—In size, the roadster type of horse is almost the equal of the draft type but it is much lighter.

By size is meant largely height but weight includes total amount of matter. These are two entirely different things. A draft horse may measure 16 to 18 hands (1 hand equals 4 inches) high and a roadster horse from 15 to 17 hands. But a draft horse weighs from 1600 to 2000 pounds while a roadster weighs only from 900 to 1200 pounds. One of the principal differences between the two types of horses then is their width.



FIG. 13.—Ready for action. The same roadster type horse as above.

The roadster type of horse is built to develop relatively more speed and less pulling power than the draft horse. To get this, a greater relative length of leg is needed. The greyhound is one of the speediest of domestic animals, and at the same time is one of the longest legged. The length of leg in the roadster horse is more than the depth of its body.

The pastern in the roadster is also longer and has more slope than in the draft horse. This gives more elasticity which is needed. The roadster's feet come down harder and oftener than those of the draft horse.

The roadster is not so wide in body nor so heavy in neck because it does not need to pull such heavy loads. Furthermore, a wide-bodied horse cannot travel so fast or economic-

ally as a narrower one. Everyone knows that a chicken could beat a duck in a race. The legs of a duck are farther apart and it goes with a wabby motion. With the legs set so far apart the body must be thrown over so as to maintain the balance in changing from one foot to another. This takes time and energy. In order to maintain its constitution, the roadster, therefore, must have the deeper chest.

Walk, Trot and Pace.—When a horse walks, it lifts up and sets down its feet in regular order and with a uniform beat.



FIG. 14.—A team of heavy roadsters.

That is, there is the same time between the impact with the ground between every two strokes. Starting with the right front foot first the left hind foot comes up second in the walk then the left front foot and finally the right hind foot.

When the horse trots, the diagonal feet come up and are put down at about the same time. That is, the right front and left hind feet go together and *vice versa*. In both of these motions the feet should be lifted from the ground with a snap, and with good flexibility at knee and hock. The feet should come up so that the sole is plainly visible from the rear.

It should then be carried upward and forward so that it comes well above the ground, and then be set down, not toe first or heel first, but flat.

A pacer is a horse that moves both legs on one side forward at the same time. This makes it necessary for the horse to wobble a little but at the same time it saves motion in its legs. These are not bent so much. To many people the pace is not agreeable but it is just as fast a gait and possibly a trifle faster than the trot. Since the horse, however, does not lift its feet so high and goes rather stiff-legged it is not so good a gait for rough roads or when there is sand or snow on the roads. Sometimes horses pace on account of poor conformation. The croup may be too steep or the underline too short. Under such conditions the horse will forge (hit front foot with hind foot) when trotting. This is prevented by pacing.

Horses of all kinds but especially of the roadster type should be strong in nervous temperament. Their work sometimes calls for extraordinary exertion or long endurance. Also, their action should be quick, snappy and vigorous. The only way these things can be obtained is by a strong, well-developed nervous organization.

PONIES

Ponies are simply small horses, and they are as a rule built more like a draft horse than a roadster. There are various breeds and kinds of ponies ranging all the way from small horses of 900 pounds to the small Shetland pony, weighing about 300 pounds. There is even a great variation in Shetlands in size. Some are much smaller than others. The small ones as a rule are preferable.

Origin.—The Shetland pony comes from the Shetland Islands. These are comparatively small islands in the cold regions north of Scotland. The soil there is not of the best. On account of these facts, the horses simply do not grow large and are called ponies. With good feeding and care, the Shetland pony grows larger. But on account of the influence of ancestors, which is called breeding, it takes time to make

large changes. And it would take a long time to develop a heavy draft horse from a Shetland pony.

Object of.—Small horses can be used for light work, as for riding and driving, especially on the paved streets of a city. If a small horse can do one's work, there is considerable saving in feed and in barn room.

The child and the pony are especially well adapted to each other. The pony is small and can be handled better by the child, and there is not so much danger of injuries to a child by a pony as by a horse.

COACH AND OTHER HORSES

Other types of horses range between the roadster and the draft horse. Foremost among these is the coach horse. This is about midway between the roadster and the draft horse and is about the same height as a roadster type, but it is of a heavier build. At the same time, it is not so heavily built as a draft horse.

The coach horse is especially well developed in knee and hock action. It lifts its feet high so as to give it more style. This kind of a horse is used especially for pleasure driving in the parks of large cities. There is a gradual variation, indeed, in horses, from the smallest pony to the heaviest draft horse. But the pony, the roadster, the coach horse and the heavy draft horse are the outstanding types.

MULES

A mule is a cross between a Jack and a mare. It is a pure hybrid and will not breed. It is characterized by having long ears, small feet, a rather narrow body, and not so much hair on its tail as a horse.

The Jack is the male of the ass family. The female of this family is called a jennet. This family of the horse tribe is a native of Africa and Asia. The beast of burden at the time of Christ was the ass.

During recent years, mules have sold for more money than horses. This is peculiarly interesting because the mule is primarily a work animal and is not much used for pleasure driving. But as the mule does not breed, it costs more to

produce him. Besides the mule is considered to be a better work animal than the horse. It is not built so much for looks as for work. It does not have so much of a covering of fat and is not so smooth or well rounded. It is made more for business.

The mule is not so subject to disease, sickness and injury. It will withstand rough treatment better than the horse. It also seems to know how to keep itself in better condition, in its eating and drinking.

The mule, again, is better able to withstand hot weather than is the horse, which is a big advantage because much of the hard work of the farm comes during the hot part of the season. This factor is not of such importance in the north but is of great importance in all southern countries.

BREEDS OF HEAVY HORSES

There are different breeds of horses in most of the different types.

Grades.—Perhaps the most common of all horses is the grade horse. Grade horses, sired by good pure-bred stallions out of sound mares, with the desirable characteristics outlined above, are as good for work on the farm as are pure-bred horses. The main thing in the farm work horse is to get size, weight, quality and conformation. If one is able financially to have pure breds, so much the better. He may be able to sell the offspring from these at an advanced price. But even with pure breds it is important that they be selected for size, weight, quality and conformation. Of course, grade mares should always be bred to good stallions, and, preferably, to good sound pure-bred stallions.

Percheron.—The Percheron breed of horses originated in France and is one of the most popular breeds in the United States at the present time. This breed presents all the colors, but blacks and greys are in the majority.

The Percheron is a draft horse of good size, quality and general conformation. It has good action both in walking and in trotting. They are likely to be weak in the croup and cannons. The rear end of the croup is too low and the upper



FIG. 15.—Percheron mare, working condition.



FIG. 16.—Aged Clydesdale stallion, working condition. Note muscling of breast and slope of shoulder.

part of the cannons are frequently too narrow from rear to front. Such a leg is not as strong as it should be.

Clydesdale.—The Clydesdale comes from Scotland. It is also of various colors with chestnut or sorrel and black predominating. This horse is an extra high quality horse with good conformation and good action. It is also very good in feet. The weak point of this breed is its lack of internal



FIG. 17.—Grade Clydesdale mare. Good croup but straight shoulder. Not trained for show.

capacity, and, sometimes of size. It is, however, strong in the cannons and strong in the croup.

The Clydesdale is characterized by long hair at the rear of the lower part of the cannon and fetlock. This, it is maintained in Scotland, is an indication of good quality. In wet and muddy countries, however, this is a handicap as the hair gathers mud and dirt, but if this would induce better care of the feet it might be a good thing.

Shire.—The Shire is an English draft horse of the heavy type. It looks, and is built, much like the Clydesdale but is

larger and more sluggish. The Shire also is characterized by having rather poor feet. It is somewhat flat-footed. As a heavy draft horse for city draying the shire is very popular.

Being somewhat slow and sluggish, the Shire is not in so much demand on the farms of the United States. The ability of a draft horse to go rapidly at a walk is a very important



FIG. 18.—Shire stallion. Show condition. (Hildebrand.)

factor in farm work. The value of this is self-evident. Both the Clydesdale and the Percheron are good in this respect.

Belgian.—The Belgian horse comes from Belgium. It is also a heavy draft horse. It is characterized especially by its compactness of build and heavy body. But its legs are somewhat light and the feet not very good. Roans and bays are the principal colors. It is a good horse of the heavy draft type.

BREEDS OF LIGHT HORSES

Among light horses there are several breeds of importance. Many of these trace their origin to the Arabian horse. This is a horse of extraordinary endurance and from the standpoint of quality and conformation is of the very best. It comes largely from the Arabian desert.



FIG. 19.—Belgian stallion. Show condition. (Hildebrand.)

Thoroughbred.—The thoroughbred is a breed of horses coming from England. It is the extreme of the roadster horse type, being quite leggy and “high-strung” nervously. The breed was made to be used in running races. Nearly everyone is familiar with such races. They are run with a jockey riding the horse. This used to be the popular sort of a horse race in England. In the United States as a rule one or two

of such events are "tacked on" to a race meet composed primarily of trotting and pacing races, in which the horses are hitched to sulkies.

The gait of a thoroughbred in a race is the gallop. In this one front foot is raised first and then the other in quick succession, and, following this, the hind feet in a similar manner. Part of the time all four feet are off the ground at the same time.

The thoroughbred breed was made by crosses of the Arabian on the light horses of England, several centuries ago. This horse is also used at present for breeding other horses of the light harness type, as for instance, the American trotter.

The word thoroughbred is very often misused. It is used in place of the word pure bred. It should be remembered, however, that a thoroughbred is the English running horse.

American Trotter.—The American trotter is a product of the United States. It was bred largely from the English thoroughbred and American and other light horses. The type of this horse in its ideal form is as described previously in the roadster type. This horse is used for the trotting race and for general road work for driving purposes.

The saddle horse is the same in type and appearance as the trotter but is trained to saddle work. These are bred to have long sloping pasterns and an easy gait. They are then trained to go easy under the saddle.

Saddle horses have several gaits. Their walk and trot are the same as for all horses but very easy so as not to jar the rider. The canter is a modified gallop. This has been softened down so as not to be so jerky. The horse also does not throw itself so much but goes more like a rocking horse. There is not so much time from the instant the hind feet leave the ground till the front ones come down. And these do not come down so hard. There are also several other easy gaits to which these horses may be trained.

Hackney.—The hackney is a good representative of the coach type, already mentioned. It is an English-bred horse but was bred for many years along a uniform line and according to a given ideal. It is therefore a horse that will breed true to type. Extreme variations have been largely dimin-

ished by this method of breeding. The hackney is also a horse that is noted for its style, quality and conformation. It is a well-made horse and is especially sound.

There are several other breeds of coach horses as the Cleveland bay, another English horse, the French coach horse,



FIG. 20.—Hackney stallion. Show condition and well trained.

and the German coach horse. These, however, are not so uniform in their offspring.

HORSE BREEDING

Horse breeding does not differ from breeding of other animals. The instructions set forth in the chapter on breeding should be followed. Horses should be selected and mated for their offspring in accordance with the idea one has in mind

for his ideal. If heavy horses are to be produced, heavy horses must be mated. If roadster horses are wanted, coach horses cannot be mated. It should always be remembered that like produces like but at the same time there is considerable variation so that like does not absolutely produce like.

The Brood Mare.—The brood mare should be as good as possibly can be had. She should at all times be well exercised. There is no better place to produce colts than on a small farm where the mares do the regular farm work. They should be handled carefully, however, so they do not become injured. Heavy pulling, rough work and backing heavy loads should be avoided while the mare is in foal. Backing a load is unnatural work and brings undue strain upon the abdominal muscles. This may cause premature discharge of the foetus.

Mares in foal can be kept at light work right up to the time the colt is born. At foaling time it is best to have the mare in a box stall and have an attendant with her. After the colt is born the navel cord should be firmly tied with a strong string about an inch from the body of the colt and then cut off about an inch below the point where it is tied. After cutting the navel cord it (the part left on the body of the colt) should be bathed in some disinfectant; for instance, a 3 to 5 per cent. solution of carbolic acid. If the navel cord is not disinfected there is danger of infection, which has killed many a good colt. The attention just mentioned is about all that need be given except in the case of a weak colt, which should be helped onto its feet to get its first meal.

If a mare is in good condition she will as a rule come in heat about nine days after the colt is born. After this and at other times the periods of heat are about three weeks apart. But mares do not always come in heat in winter. The spring of the year is the natural time. A colt is carried about eleven months by its dam. This is the period of gestation.

After foaling the mare should be allowed to spend her time with the colt for a few weeks and then she may be put to work again. The colt may be allowed to follow the mare in light work but should not be allowed to walk all day on a road or in a soft field until it is well able to do so. A better practice is to keep the colt in a box stall and return the mare as she comes

from work. The mare, however, should not be worked too hard. She should not become very warm from her work. And when she comes in from work with an udder full of milk part of this should be milked out before she is turned in with the colt.

The Colt.—A colt may be weaned when it is from four to six months old and then should be fed as all young animals should be fed. It is a growing animal, so should have alfalfa, clover, or pea hay, wheat bran or oil meal for protein. Then it should have oats or oats and corn mixed as a concentrate with all the water it needs and plenty of salt and other minerals. Exercise should not be forgotten at this time as this is one of the most important factors in the life of the colt. A good pasture makes excellent feed.

The horse colts, except such pure bred's as may be reserved for breeding purposes, are as a rule castrated when they are one or two years old. If castrated at the younger age, they give less trouble in handling and there is less loss in case one should die as a result of the operation. But if they are allowed to reach the age of two years before castration they are thought to develop a little more weight in the front quarter and develop more "life" and ambition.

The Sire.—The stallion that is selected to be used upon one's mares should be of the very best. He should possess all the good points to the highest degree and should be entirely free from all unsoundness, such defects as spavin, ringbone, curb, sidebones, defective eyes, etc. They are defects that are likely to be transmitted to the offspring.

Blemishes are simply scars such as wire cuts that may mar the looks of a horse or injure his capacity for work, but they are not transmissible characteristics.

CHAPTER VII

CATTLE

Cattle are cloven-hoofed, four-legged animals of the species of ruminants. They are of the bovine family. Ruminants eat a large proportion of coarse feeds such as grass, hay, corn fodder. These, being difficult to digest, are chewed and moistened enough to be swallowed and then are stored in the paunch, a large compartment of the stomach made for the purpose. Here the feeds, being mixed with saliva from the mouth, are softened and partly acted upon by the digestive enzymes. After the cow has swallowed enough she rests from external labors, and, bringing the swallowed feed from the paunch back to the mouth little by little she chews or masticates it thoroughly, and then reswallows it. This time it goes to the true stomach where digestion is completed.

Because of all this, these animals are able to eat and make good use of feeds that man and even other animals could not use. High-priced animal foods for man may be produced, therefore, on comparatively cheap feeds.

Great care should be exercised as to proper breeding. That is, the cattle should be descended from the right kind of ancestors, and they should be developed under an environment and fed upon feeds so as to produce health, vigor and vitality. The type of animals, desired should also be well kept in mind.

The environment should at all times allow plenty of exercise and the feed should contain enough protein, mineral matter and water for normal development. A stunted animal or one that has suffered for the want of food should be considered much as a worn-out automobile.

Length of Body.—The cow should always be long in the body; long both in the middle and in the hind quarters. The reason for this is that all the high-priced meat is along the upper

part of the sides and the back of the carcass from the shoulder to the rear end. The long conformation also gives more room for generative organs and for feed.

Feeding.—Cattle are well adapted to the use of coarse feeds or roughages, but improved cattle are not like natives and must be fed some concentrates or grains if they are to do well. The young animals also, as the calves and yearlings, must have more protein for growth than the older ones. Variety in a ration, palatability of feeds and regularity in feeding must all be given due consideration.

Breeding.—The principles of breeding discussed previously should be observed in cattle breeding. The length of time a cow carries her calf, or the period of gestation, is about nine and one-third months. The cow comes in heat every three weeks when not in calf, except the first few weeks after calving.

At calving time a cow should be in good condition but immediately before calving her ration should be reduced and she should be brought back to feed gradually after calving. At this time, also, she should be kept warm and comfortable.

CHAPTER VIII

THE DAIRY COW

The dairy cow is an animal machine for making milk. This machine takes in feeds like hay, grass, and grain. From these she extracts the nutrients, protein, carbohydrates, and fat or ether extract, and also some mineral matter and water. Mineral matter and water are also taken in other forms than regular feeds. All of these materials, and perhaps some others which have thus far avoided detection, but are a part of the feeds eaten, are taken to the living cells of the animal body where they are put together in the form of milk. Thus, milk-making is a function of the living animal cell. Manufacturers have thus far not succeeded in making milk by artificial means.

Milk.—Milk is a combination of water, fat, casein, albumin and salts. It contains as a rule from 3 to 7 per cent. of fat. The amount of protein as a rule (casein and albumin) is a little smaller than the amount of fat present. Where milk is run through a separator or is skimmed the fat and some of the milk serum are taken away from the rest of the serum. Thus, cream contains 25 per cent. of fat, more or less according to the gauging of the machine.

Butter.—Butter is the fat of the milk with a little salt and water in it. To make butter the cream is allowed to ripen or to sour a little. This forms an acid which acts upon the casein in the milk serum in such manner as to free the fat globules to some extent. The ripened cream is put into a churn and tumbled around to make the fat globules come into contact with one another and stick together. When enough stick together, the mass separates from the milk serum. The latter is then known as butter milk. Thus, butter forms like rain. When it rains the fine dew drops come together to form rain drops. When butter is made the fine fat globules of the milk or cream are pounded together into larger grains and then there is butter.

Cheese.—Cheese is also made from milk but this is made largely of the protein of milk (casein and albumin). This material is coagulated or solidified by heat and an enzyme or acid. As this solidifies it also incorporates some of the fat. Thus, a full cream cheese which is made from whole milk is better than cheese made from skim milk.

Constancy of Milk.—An interesting thing about the composition of milk is that the milk from a given cow is of constant composition. That is, a cow giving 4 per cent. milk will give about 4 per cent. milk all the time. The same is true of a cow giving milk of any other percentage of fat. This is a very important fact to remember when it comes to feeding a cow.

FEEDING COWS

Protein.—If a cow gives 100 pounds of milk a day—and there are a few such cows in the country—and this milk is 4 per cent. butter fat, she will give nearly 4 pounds of protein each day. Under what conditions, then, will this cow be able to make the 100 pounds of milk per day? Only when she is getting the required amount of protein in her feed; that is, 4 pounds, and enough in addition to this for maintenance.

It is very plain, therefore, that if a cow is to make 100 pounds of milk a day she must have in her daily ration about $4\frac{1}{2}$ pounds of protein. What would happen if this amount of protein were reduced to $2\frac{1}{2}$ pounds, or if 2 pounds were taken away? She could then make only 50 pounds of milk per day. She would not drop down suddenly from 100 to 50 pounds of milk because she would use some protein from her body. But this would gradually weaken her and injure the milk-making machine. Nothing else takes the place of protein. This simply emphasizes the importance of feeding the proper amount of protein to milk giving cows.

The principal protein feeds, as shown previously, are clover, alfalfa, pea hay, peas, flax, wheat, bran, oil meal and cottonseed meal. One of these legumes, either green or in the form of hay should constitute at least one-half of the roughage part of the ration of a dairy cow, and one of the protein concen-

trates should make up from one-tenth to one-fifth of the concentrate part of the ration.

Water.—One hundred pounds of milk contains about 87 pounds of water. Besides the water needed to supply this, the cow needs an additional supply to aid digestion, circulation, perspiration and heat regulation. It has been shown by investigation that for every pound of milk a cow gives she needs 3 or 4 pounds of water. The cow giving 100 pounds of milk per day then requires about 400 pounds or 1 barrel of water each day. Suppose then, that on account of cold weather, cold water or inaccessibility to water this much is not obtained. What is going to happen? Well, the machine must be operated first. And then if there is any water left milk can be made. And no milk can be made without water. Milk is always of a definite composition. If the amount of water consumed is reduced by one-third, the amount of milk may be reduced by two-thirds.

The importance of an abundant and constant supply of water is, therefore, well recognized. Furthermore, there is no way for the cow to store much water in her body for future use. Consequently, she must have water regularly and constantly.

In a cold country, it is advisable to warm the water for the cows, but if well water is used fresh before it gets too cold and is given to cows in a warm barn there may be no necessity for warming it. The frequency of watering also is of considerable importance. The oftener a cow drinks the colder may be the water. Under ordinary conditions there is always some surplus heat in the body. If a little water is taken at a time this heat can be used to raise the temperature of the water to that of the cow. But if a large quantity of cold water is taken in at one time it will require a great deal of heat to warm it and this will require more heat than the cow has available so she will be obliged to make heat to warm the water. And while she is doing this she cannot be making milk. A large quantity of cold water may also chill a cow to such an extent to injure her otherwise.

See to it, then, that the cow gets plenty of water, that this is taken frequently (two or three times a day at least), and that the water is not too cold.

Mineral Matter.—What was said above in regard to protein and water also applies to mineral matter. Cows should have salt before them at all times. If they desire other minerals these should also be supplied.

Other Factors.—In addition to the feeds mentioned the cow should be fed timothy, meadow, millet or prairie hay, corn silage or corn fodder, corn, oats and barley. This is for variety and for energy and heat production. Enough should be fed at all times to keep the cow in good flesh and at the highest possible point of production.

A cow should be allowed to go dry about six weeks. During this time she should be fed enough to keep her in good condition and give her considerable flesh at calving time. She will then with good care at calving, give the largest quantity of milk of which she is capable.

Since the act of giving birth is difficult, requiring considerable energy and reducing the cow in vigor and vitality, she cannot eat large quantities of feed immediately after calving. The feeding, therefore, should be limited at first and gradually increased. Several weeks time should be consumed in getting the cow up to full feed. During this time she is using the store of food in her body for making milk. After this period of two or three weeks, however, the cow should be fed enough to keep up her milk flow to the highest point possible but not enough to fatten her.

Since a cow must be fed in accordance with the amount of milk she gives, since all cows do not give the same amount of milk, and since all cows in a herd do not freshen at the same time, it is necessary to practice individual feeding. This is usually done by giving the cows all the roughage they will clean up and then varying the grain part of the ration in accordance with the amount of milk they give.

A cow has two functions: (1) that of making milk; and (2) that of making fat on her body. The amount of work she will do relatively in these two lines depends on how she is built (upon her breeding for generations). If she is a good dairy cow she will give relatively more milk; if she is inclined to be a beef cow, she will give less milk. Even some well-built dairy cows do not give as much milk as their appearance

would indicate. When such cows are fed more than a certain amount they will use this extra feed for fat production. This should be avoided, since a cow that gets too fat loses materially her efficiency as a milk-making machine.

A good dairy cow, whose nerve stimulus for milk-making is well enough developed, will make milk of all the feed she can consume. Her limit for feeds is determined by her power of digestion and metabolism. Thus it is that dairy cows, for best work, must be fed individually.

In feeding a cow, the factor of maintenance previously discussed must not be forgotten. The first feed is always used for maintenance and the more a cow can eat, digest and use to advantage above the amount needed for maintenance the better and the more profitable she is.

For feeding cows there is nothing quite so good as pasture containing an abundance and a variety of grasses and legumes. This is nature's best feed and if this is supplemented with the necessary mineral substances, water and grains for concentrates, she will, indeed, be well cared for.

THE COW IN OUTLINE

In discussing the conformation of a cow the author has in mind the points he would take into consideration were he to start a herd of dairy cows on his own farm. In starting a herd, great care should be exercised in selecting the herd bull. The bull should be a pure bred and a very good individual. One or two pure-bred females, possibly a heifer calf and a bred heifer should also be purchased. These must also be of a high standard of excellence. The balance of the herd would be selected from the grade stock of the country, but they would be selected for dairy conformation. When so selected they will undoubtedly be good producers and when bred to a good pure-bred bull will produce a very high class of dairy-bred heifers. A dairy cow is valuable only for what she can do. But the correlation between what she looks like or her conformation and her productivity is so accurate that one can always distinguish a good one from a poor one by her looks.

Capacity.—Length of body is important in the dairy cow

as well as in the beef animal, as her carcass is used for beef when she is through with her work of milk-making. But the dairy cow is primarily a milk-making machine. Consequently, she must be capable of eating, digesting and using a large quantity of feed. This means that she must have great internal capacity. She must have a long, deep and broad middlepiece; or as it is sometimes expressed, she must have a large "bread basket." A cow must first be maintained and the more she can eat above maintenance the more profitable she is.

Along with this, it is important that a cow have a good constitution. The cow in other words, should be deep and broad in chest as well as in the middle.

She should also be long from the hip points to the rear and should have great depth in the hind quarters. This allows more room for reproductive and milk-making organs. It also indicates strength, vigor and robustness.

From the side a cow should be deep in front, deep in the middle and deep in the hind quarters. From the rear, she should also be broad—broad all over the rear. The hips should be far apart. This again makes more room inside for the development and delivery of the calf as well as for the udder. The hip points also should be prominent, enough so that a hat can be hung on them.

Udder.—The udder of a cow is a gland where the milk is made. It is not a bag as it is frequently called. A bag is a receptacle or container in which materials are stored or transported. While the udder of a cow stores some milk its primary function is milk-making. And a large part of the milk is made at the time the milking is being done. Since the udder's function is the manufacture of milk it should be large. A large machine can always do more work than a small one of equal quality. The udder also should be made of glandular and not fatty tissue. It should have a large attachment with the body; that is, it should extend well up in the rear toward the tail and come well forward under the body. The udder also should be well developed in all four of its quarters so as to be uniform and symmetrical. The teats should be of sufficient size for good handling and should be set well apart.

The udder should not be "baggy." That is, it should not have a small attachment to the body and be long or deep vertically. This kind of an udder not only troubles and inconveniences the cow in travel but it is not so good a machine from the functional standpoint. A cow with such an udder should not be driven rapidly and by no means be chased by a dog. The same is true, in fact, of any cow.

The feeds are digested in the stomach. Here the blood vessels gather up the food particles such as protein, carbohydrates, fat, mineral matter and water and carry this material back to the udder. These blood vessels go back into the abdomen of the cow then into the udder. The larger, therefore, the attachment between udder and body the better is the opportunity for these blood vessels carrying material for milk making to get to their destination. A good udder is one of the big factors of a good cow.

Milk Veins.—The blood after it has discharged its load of material from which milk is made by the gland cell must go back to the abdomen to get a new supply of material. Thus it must be kept in motion constantly to bring material to the cells of the udder. These cells do the actual work of making the milk.

In order, therefore, that there may be ample provision for the blood to flow from the udder back to the body of the cow, the milk veins must be well developed. These are the tubes running forward from the udder, one on each side, between the skin and the body wall toward the front legs. They are on the outside of the abdomen. These veins should be large and it is said that they should also be crooked rather than straight. At any rate, they must be large so as to make ample provision for the blood to flow back from the udder to the body.

Milk Wells.—These milk veins go back into the body and there must be a hole through the body wall. These holes are called milk wells or sometimes "wiers." Wier is an irrigation term. A wier gives a means of measuring water flow. So the milk wells or wiers measure the flow of blood from the udder. And the flow of blood is an index of the amount of milk that is made by the udder. The size of the milk well can easily be determined by feeling with the fingers when the cow is

giving milk. Sometimes there are several milk wells on a side. The more there are the better is the cow. In a very good cow, if the flow of blood had to go through only one hole, it would have to be so large that there might be danger of the intestines falling out against the skin and pressing this out. This then would be a rupture. Consequently a cow with several milk wells is considered better than one with only one well.

In this connection, it might be asked, why is the milk vein on the outside of the body? and why should the milk well be located well forward? Why is not the milk vein on the inside of the body? The answer to these questions is simply this. A good cow must eat lots of feed and this bulk of material is heavy. With this weight on the inside of the abdominal wall there is so much pressure that blood could not flow through a tube even if it were situated here on the inside. This also explains the forward location of the milk wells. These must be far enough forward in a good cow to get in front of the area of great pressure caused by the paunch full of feed.

Withers.—The withers of a cow include the upper part of the shoulders and the front part of the back. A good dairy cow is rather thin and sharply built at this part. A beef cow is broad and thick here. This thinness or sharpness of the dairy cow is another indication of a good cow.

The udder is at the lower and rear part of the body. Here the cow that is bred and developed for milk making does her work. If this is true, the upper part of the body will naturally be neglected and become lean. Thus, the good dairy cow is lean generally and not thick and broad at the withers. If a person carried a strong healthy arm in a sling, before many years such an arm would become very small and very weak.

The neck should also be lean and light. This gives it the appearance of slimness and makes it look long. The head also is lean and fine.

Lack of Ribs.—The ribs of a cow should be well sprung out from the backbone and should also be long to give the cow plenty of internal capacity for organs and for feed. Moreover, a good cow has fewer ribs than a poor cow.

A good horse should be "closely ribbed up" toward the hip.

That is, his hind quarters should be set close up on the middle. This gives the horse strength. In handling a horse, there should be very little space between the last rib and the hip. But with a cow this space should be large. Ordinarily, a cow should be divided into three parts about equal, as follows: (1) from rear of shoulder blade to last rib; (2) from last rib to hip; and (3) from hip to rear end. In other words, a cow should have a long hollow space in front of the hip.

In good cows the last rib is sometimes only a short stub. At other times it is entirely gone. This makes a long hollow space in front of the hip and is an indication of a good cow. But how? The purpose of the ribs is to make a cavity within for the internal organs. Or to hold the weight or pressure of the body itself off of the internal and vital organs. The ribs also assist in respiration.

A good cow eats lots of feed. And where the paunch is full it extends upward and sometimes comes up higher than the back bone itself. This takes the pressure off of the last ribs. If, then, these ribs have no work to do they will in time gradually disappear. Thus it is that a cow that is minus a few ribs or has a long hollow space in front of the hip is a good cow. It simply means that her ancestors have been eating lots of feed and lots of feed means lots of milk.

Nerve Force.—In order that a cow may be a good milk cow, she must have a well-developed nervous system. She must have a strong nervous organization. A cow with this development is not too narrow in the head and her eyes should be large and prominent. A well-developed, large, bright and active eye is an indication of nerve development. But this factor is the most difficult of all to judge. Of all the factors that have to do with milk production this is least understood. It is on this point that the judge will sometimes go astray. He is not always able to pick a very good cow from one that is not quite so good though he can always pick a good cow from a medium or poor cow. And this can be done just by observation and handling as discussed above.

Quality.—Quality is of just as much importance in dairy cows as it is in any other animal. The cow should be of fine quality yet not so fine as to be delicate. Fine quality means

more muscle and gland cells to do the work for which the cow is kept.

Size.—The matter of size in dairy cattle is of importance. A large cow is a large machine and can do more work than a small cow. To be sure, a large cow requires more for maintenance than a small cow, but her relative maintenance requirement is no larger and possibly is smaller. A large cow can be sheltered and cared for cheaper considering her product than a small one. When cows or their offspring are sold for beef, size is a matter of considerable importance. Taking all these things into consideration, a large cow is worth more than a small one of equal quality, conformation, etc.

A cow should also have a long slim tail, straight legs, and good feet, a large strong mouth and large open nostrils. The value of all these points are self-evident.

SHELTER FOR COWS

In summer, except possibly in the most northerly countries, the cattle should be supplied with shade. The kind of shade that is best perhaps is large trees on a hill or knoll in an open field. Here the cattle can be out of the hot sun and be where the circulation of air is the best. If this kind of an environment cannot be had, the next best thing should be provided. This may be either shade from trees in a grove, timber lot or natural forest, an artificial shed built for shade or even access to a barn.

There should also be protection from cold rain and cold winds in the spring and fall. A shed or barn will answer the purpose for this. For protection from winds there is nothing better than a timber lot or section of forest.

The Dairy Barn.—A barn is necessary in winter to help maintain body temperature in the cow. The cow has a temperature of about 100 degrees Fahrenheit. This is the same in winter as in summer. In the summer it is the problem of the animal body to get rid of excess heat resulting from internal work. In the winter a barn is necessary to prevent loss of heat too rapidly. Under such conditions, the cows can use their feed for making milk, while if they are obliged

to live in a cold environment too much feed is used for heat production and less is available for milk-making.

A barn for cows should be roomy, well ventilated, and well lighted. Some cities, where milk is sold by dairymen, have ordinances requiring barns with these things well provided for. The barn should not be crowded and the air therein should at all times be fresh and wholesome. Any system of ventilation that will help keep the air fresh and pure is all right. At the same time, the barn should not be too cold neither too warm.

A good plan is to have two rows of cows facing the outside walls. There should be a wide alley in the center and a narrower alley for feeding in front of each row of cows. These alleys are next to the outside walls. Here then in front of the cows should be located the fresh-air intakes and the windows.

The wide alley in the middle, behind the cows, allows for wagon or manure spreader to pass through and take out the manure and bring in the bedding. When cows face toward the center, as barns are sometimes built with a wide manger for both rows of cows to eat out of, there is danger of the cow on one side inhaling the air that the cow on the other side exhales.

A barn must be so built that it will fit the needs of the farm and the farmer where it is built. It should also be built economically and so arranged that the work can be done easily.

MILKING

Milking should be done under sanitary conditions as nearly as possible. The barn should be absolutely clean and if the floor can be washed beforehand so much the better. Dusty hay should not be fed just before milking. This causes dust to float in the air which will settle into the milk.

All foreign matter should be kept out of the milk. This may be in the form of, or may contain, dirt, disease germs, or other bacteria that make milk unhealthy, sour, or rancid. Bacteria grow rapidly in milk; it is warm and contains all the necessary food materials for germs. The barn, then, should be free from bad odors and dust and the udder should be washed and wiped dry. The body of the cow in the region

of the udder should also be kept scrupulously clean. It should at least be brushed before milking.

The milker should wear clean clothes and wash his hands before milking each cow. The milk stool which is handled as a rule with the same hand with which the milking is done should also be clean. Sometimes milkers fasten the stool to their body with a strap so as to avoid handling it. In up-to-date sanitary dairies the milkers wear white laundered suits.

Bacteria.—Bacteria are very small living organisms. They are so small that many of them can live in a particle of dust that floats in the air. These are found everywhere. As these germs get into the milk they grow, and they grow very rapidly in warm milk. One of the waste products of these germs is like an acid and it is this that makes milk taste sour.

It is practically impossible to get milk from a cow without getting some of these germs into it. But the thing to do is to get as few into it as possible, and then as far as possible to prevent those that do get in from growing and multiplying. This is done by cooling.

Milk should be cooled as soon as it is drawn from the cow. If it is to be separated, this should be done first and then the cream should be cooled immediately. Milk and cream that are thus handled will keep sweet for a long time. Sometimes one hears it said that a thunderstorm makes cream sour, but this is perfectly ridiculous. It is true, however, that cream sours more readily at the time of a thunderstorm. But such storms come in spells of hot weather and it is the hot weather that makes the bacteria grow and these make the milk sour. The same cause produces the thunderstorm, namely, warm weather.

If milk and milk vessels are not kept absolutely clean, germs of contagious diseases such as typhoid may also get into them. This will start epidemics of disease. To kill any germs that may be in milk it should be sterilized. This consists of heating it to a boiling temperature. Milk may also be pasteurized. By this process it is heated to 145 degrees Fahrenheit and kept there for about ten minutes and then cooled rapidly. This kills most of the germs present in milk and makes it keep much longer. But both sterilizing and

pasteurizing give the milk a flavor that many people do not like. Consequently, it is not popular. If milking is done under sanitary conditions and proper care is taken afterward the milk will keep well.

Vessels in which milk is kept must always be clean. A milk pail should first be rinsed in lukewarm water. Then it should be scrubbed with warm water and soap, a brush being used. After this it should again be rinsed, and then it should be scalded with hot water or steam. Finally it should be inverted so the neck or opening is not obstructed, in a place where the air is pure and wholesome. This will allow it to drain and the air to circulate in it. Pails, cans or other vessels should not be wiped after scalding as this again introduces germs.

The Mental Connection.—The act of milking is one of considerable importance. The cow is a living machine with a highly developed nervous organization. This machine must be properly handled or it will not work right. There should be complete harmony between the milker and the cow. The cow should be handled with kindness and good judgment. If the milker hits the cow with the milk stool, kicks her or swears at her, harmony is destroyed and the cow does not give as much milk as she otherwise would. As said before, a large part of the milk is made during the time the cow is being milked and if she is not properly handled she will not do her best.

In this connection it might be asked what is the purpose of the orchestra at a dinner or what is the purpose of the after-dinner speech at a banquet. It is simply to get the mind into a proper attitude for the digestion of the meal. So also it might be advantageous to have an orchestra in a dairy barn at milking time. At any rate, some milkers say that cows will give more milk when the milker is whistling, than when not. Some even say that certain cows become accustomed to certain tunes and will do their best only when these tunes are reproduced for them.

It is also known to milkers that a cow will give more milk when she is milked rapidly than when she is milked slowly. This is thought to be on account of the stimulation produced by rapid milking. Most cows are milked twice a day. Heavy

milkers should be milked three times and some very heavy milkers should be milked four times a day.

Manner of Milking.—A person's hands and the cow's teats should always be kept dry during milking. Some people milk with a wet hand and thus wash off any dirt that may be on the hands or udder into the milk.

The best way to milk is to take the whole teat into the palm of the hand, then close the fist with upper or forefinger first. This will force the milk out. After getting all that is available by this means, stripping should be resorted to. This consists simply of stripping the teat with forefinger and thumb.

The milker should seat himself at the right side of the cow and should use a stool with three legs. A one-legged stool requires too much of the attention of the milker to keep his balance. The two front teats should be milked first and then the two rear ones.

The cow should always be milked thoroughly clean. That is, all the milk should be taken that can possibly be had. It has been found by testing that the last milk, or the strippings, are always richer in fat than the first milk. Thus, if a cow is not milked dry, the best part of the milk is lost.

The Milking Machine.—Some years ago milking machines were invented. At first they did not prove very satisfactory. But during recent years the machines have been improved to such an extent that they are more satisfactory than they were previously. Nevertheless, many cows do not seem to respond to the mechanical machine as well as they do to milking by hand. The milking machine makes it possible to milk more cows, in a given time but it seems that in order to get the most satisfactory results the cows must be selected and bred for machine milking.

HOW TO GET A GOOD COW

A good cow can sometimes be bought but as a rule the best cows are bred on the farm. Good cows usually are not for sale and when they are for sale the price is such that the average man could not afford to buy them. Sometimes dairy-men "sell out" and so dispose of the good cows as well as of poor ones. At other times cows or heifers that will develop

into good cows are sold before their valuable characteristics are recognized, but if a man goes to buy such a cow it implies that he has better judging ability than the seller. This may be true sometimes when there is considerable difference in ability in favor of the purchaser. But the breeder or owner who knows his animals always has the advantage of the man who comes in to buy.

While it is necessary to buy cows in starting a herd, the aim should always be after the start to breed one's own stock as far as possible. This, of course, does not apply to the herd sires but should apply to the cows. The principles relative to breeding previously discussed should be observed. The sire as well as the dam should be as good as possible and the environment and the feeding also should be such as are conducive to improvement. When the calf is born it has all the possibilities for development that it will ever get.

The Calf.—The fortunes of a cow, be they good or bad, are all in a calf at birth. The calf, however, must be properly fed and cared for. A calf should always be left with its mother till it is perfectly dry. The mother as a rule licks it. The calf also should have the first milk. This acts as a corrective and puts the bowels of the youngster into proper condition. The material that has collected there during foetal development will be passed out so that the digestive apparatus will be in proper condition for work.

The custom among dairymen differs as to how long the calf should be left with its dam. Some allow it to get just the first milk and others leave the calf with its mother several days. This, however, is immaterial. Some even take the calf away before it has had a chance to suck at all. They then milk the cow and give the first milk to the calf. The sooner a calf is taken from its dam the more easily it can be taught to drink and the longer it is allowed to suck the more difficult this task becomes.

The young calf, however, should always be fed sweet fresh milk about as warm as it comes from the cow and this should be fed out of a clean pail. As a rule, the milk from a fresh cow is not used for dairy purposes for three or four days. This is used to feed the new calf. After this period it is better

perhaps to feed the calf a mixture of milk from several cows. This will avoid feeding either very rich or very poor milk to any one calf. There is considerable variation in the richness of milk from different cows.

The calf should be kept in a clean box stall and well bedded. This stall, or, better, a pen, should be well lighted, well ventilated, and large enough to let the calf take exercise. A number of calves can be kept together, but at feeding time they should be put into stanchions. These stanchions should be arranged along an alley to make feeding as convenient as possible. Each calf should be fed out of a separate pail so that it may get its proper amount of food. Calves should be left in the stanchions till their mouths become dry and the taste of milk disappears. If this is not done they will be tempted to suck each other, which is a bad habit.

Milk is the normal feed for the young animal but the calf should not be kept on milk alone very long. The calf soon learns to nibble a little at hay and good hay should be kept before it at all times. After a few weeks it will also learn to eat oats and then this should be fed in addition.

One of the main considerations in calf feeding, however, is the water. Milk alone will give best results for a comparatively short time. Then water should be added. Just how much water is needed is not known. This has not as yet been worked out scientifically. There are several ways to feed water. One way is to set water before the calf in a pail as soon as it gets through with the milk. It then has the taste of milk still in its mouth and will, as a rule, drink some water. Another way is to mix the water and milk. The water, however, should not be too cold.

In the warm part of the year calves should be kept in a pasture. But this should be well supplied with shade and should furnish a variety of fresh grasses. Calves should not be exposed too much to flies. A fly repellent can be used or the calves can be kept in a dark barn through the day in fly time.

The amount of milk fed to calves should vary with different calves. A large strong calf should be fed more than a small weak one. From 8 to 12 pounds of milk a day at first is con-

sidered a good feed. This might be increased to from 18 to 24 pounds when the calf is several months old. At first a calf should be fed at least three times a day but later it can be fed twice a day.

A calf should have whole milk till it is several weeks old, and then, to avoid feeding expensive butter fat, skim milk can be substituted. The change from whole milk to skim milk, however, should be made slowly and gradually. At least a week, and, better, two weeks, should be allowed for this change. The skim milk should be fed warm, as the whole milk is fed.

A mistake commonly made is that skim milk is thought to be of little value because it has been skimmed. On this account some people feed more of it. As a matter of fact, skim milk is richer in protein than whole milk. This is true because the fat is taken out by skimming and the protein is left. And protein is likely to cause harm when too much milk is fed. But skim milk is an unbalanced ration. Some material like ground flax, which is rich in fat, should be added. By adding such a feed the total dry matter is increased, and water is also needed to keep the ration balanced. Both corn and oats are good calf feeds because they are comparatively rich in fat but not so rich as flax.

A well-balanced ration for calves can be made from the feeds grown on the farm. It is not necessary for the farmer to buy calf meals. While many of these are all right and give good results, they are as a rule very expensive. They frequently contain imported materials and with the manufacturer's and transportation charges added they cannot be sold cheap. The farm is the place where these things should be produced.

Weaning.—While a calf is being fed milk, containing protein, the hay and grain fed in addition need not be of any special kind but should be varied. A mixture of several hays and grains, or of several grasses in the pasture, is best. All of these, however, should be of extra good quality and be palatable to the calf. Legumes are not necessary at this time as the calf gets its protein in the form of milk.

When the calf is weaned or when the milk is removed from

the ration, care should be exercised that the calf be not stinted on protein. It cannot grow so fast as it should without a sufficient amount of protein. The protein roughages, such as clover, alfalfa, or peas, either green or in the form of hay should be used. These should be supplemented with a variety of grains, such as oats, corn, ground wheat or wheat bran and a little ground flax, oil meal, or cotton-seed meal. If the protein roughages above mentioned are not available, and timothy, bluegrass, millet, corn stover or silage are to be fed, more protein should be fed in the concentrate form. This is done by increasing the flax, oil meal, or cotton-seed meal.

Great care should be taken to give calves plenty of exercise, water, salt, and other minerals if the calves want it. The calf becomes valuable as a cow, only as it is properly bred and second as it is properly fed and developed.

The Veal Calf.—Sometimes the veal calf makes an important adjunct to the dairy business. Good veal calves are obtained from the large or fleshy breeds, or are obtained by using a beef bull. The feeding then should be such that the calves can both grow and fatten. The best veal, undoubtedly, is made by allowing the calf to suck a good cow but this is rather expensive. If the calf cannot be allowed to suck on account of the expense, it should be fed as outlined in the foregoing but be extra well fed with skim milk, grain and hay.

In a herd of cows, the first milk from the cows, before the milk is good for dairy purposes, may be used for the veal calves, along with some skim milk. Sometimes after a calf has been fed on skim milk it is again fed whole milk for a time before it is sold. This puts on the finishing touches and makes the calf sell for a better price. Calves are sold for veal at anywhere from six to twelve weeks of age.

BREEDS OF DAIRY CATTLE

There are several breeds of dairy cattle but to try to say which one is best would be like telling a man which woman he ought to take for a wife. All the breeds of cows have their advantages and their disadvantages. The principal breeds are as follows: Holstein Friesian; Jersey; Guernsey; Milking Shorthorn, and Ayrshire.

Holstein Friesian.—The Holstein Friesian breed is popularly spoken of as Holstein. This breed originated in northern Europe and especially in Holland and Denmark. It is well adapted to cold climates. These cattle are black and white, the patches of the two colors being rather large. They are a large breed and carry considerable flesh. The calves of this breed are large, grow rapidly and make excellent veal calves.

The Holstein breed is noted for its ability to consume and use to good advantage a large amount of coarse feeds or roughages. They must, of course, have grain in addition. But since the roughages are the cheaper feeds, if they can use more of this kind of material, it is to their advantage. Holsteins also are noted for giving a large quantity of milk but this is not very rich in butter fat. The yield of butter, however, is large on account of the large amount of milk. This gives more skim milk for feeding purposes.

The Holstein cow is so large and carries so much flesh that when she is through with her work in the dairy she is worth something for beef. Sometimes the milk of this breed is not rich enough to come up to the standard required by the retail milk trade. In such cases part of the milk has to be skimmed and the cream put with the rest of it so as to make this richer.

Holstein milk and cream is not so yellow as that from some other breeds. This is because of coloring matter put in by the cow and the small size of the fat globules, and not to the small amount of fat present. The fact that the fat globules in this milk are so small is an advantage when milk or cream is handled over rough roads. It does not churn as easily. On the other hand, the milk is more difficult to skim and the cream more difficult to churn. These factors are of relatively small importance, however.

Jersey.—Jersey cattle come from the Isle of Jersey north of France. The climate is mild and the cattle are not always so robust and vigorous as might be desired.

Jerseys are usually fawn-colored but sometimes red and white with the colors well blended. The muzzle, tongue and end of tail or switch are usually black. Jerseys are rather small and very lean and angular. They are the ideal of the extreme dairy type but are sometimes thought too delicate.



FIG. 21.—Holstein bull. Show condition.



FIG. 22.—Holstein cow after milking. Farm condition.

The Jerseys, however, give very rich milk which is of a good yellow color and of large-sized fat globules. On this account cream from this milk churns easily and the milk is popular for city trade. The producer, however, may give the consumer more than he pays for and thus decrease his revenue. This, however, may be remedied by standardizing. Part of the milk is skimmed and the skim milk put with the balance of the whole milk.



FIG. 23.—Jersey cow. Good farm condition.

Jersey cows are very economical producers but must be well fed with a large proportion of concentrates and must be well cared for. They do not have a large heavy carcass to carry around so can devote more of their energy to milk production. But when slaughtering time comes there is not much of a carcass to sell for beef. The calves also do not make good veal unless they are sired by a beef bull.

Guernsey.—Guernsey cows come from the Island of Guernsey near the Island of Jersey. This breed is much like the Jersey. They are much the same in color except that



FIG. 24.—Guernsey cow. Good constitution. (Photo from Jean Duluth farm, Duluth, Minn.)



FIG. 25.—Ayrshire cow. Good length of body.

they do not have the black points and have more yellow and white. The Guernsey is larger and not quite so delicate as the Jersey. Otherwise they are much alike.

Ayrshire.—The Ayrshire cow comes from England. It is of medium size and red and white spotted. Sometimes it is nearly all white. Ayrshires are not so popular in this country as the other breeds mentioned.

THE SILO

The silo is an appliance on the farm for preserving green feeds in the succulent form. The universal feed for the silo is the corn plant.

Silo Feeds.—By this term is meant feeds that are adaptable for silo filling. Mention is frequently made of clover, alfalfa or other hay crops for the silo, but these feeds do not keep well in a silo and can be stored much more economically in a barn or shed in the form of hay. Making silage of a feed does not add anything to its value. It only preserves it and in the case of the corn stalk makes it more palatable. The hays, if properly made are palatable, easily preserved, and are entirely consumed.

The advantages of putting corn into the silo are as follows: (1) The corn stalk on account of its pithy and dry nature is made more palatable. This is pressed down and moistened so the cattle can eat it with a relish. (2) The tough outside part of the stalk is also softened. (3) During the latter part of the winter corn stover becomes dry, hard and many leaves are lost. In the form of silage it is well preserved throughout the winter. (4) In case of an early frost, corn can be cut and put into the silo without losing leaves or loss in palatability. (5) The corn is gotten off the field so this can be used for other purposes and the feed is also available during bad weather in winter without inconveniencing the feeder.

The disadvantages of the silo method of feeding are as follows: (1) Cost of silo and filling machinery. This should also include interest, taxes, insurance, depreciation, repairs, operating expenses, etc. (2) Hauling in from the field, with high-priced labor at summer wages, the large amount of water in green corn. Corn at this time is about 70 per cent. water.

The shock corn after drying contains 30 per cent. or less of water.

Harris, who was quoted previously says: "Most feeders are now aware of the fact that the silo will make from 20 to 25 per cent. more beef or mutton by saving the waste of corn stalks, or stover, and preserving its maximum feeding value." To offset this one has the added expense of the silo. Taking all things into consideration, it looks to the author as if the silo should not be the first adjunct to the livestock farm. While it is a good thing, there are other things that are more necessary in getting started. After one has a start and can afford it and wants to increase the productive capacity of his farm, the silo is in order.

It is sometimes said that silage is especially valuable on account of its succulence or on account of the fact that it contains considerable water. But water is water and the water in the corn stalk is no better than the water in the well. The latter can be pumped more cheaply than the former can be hauled from the field.

Time to Cut Corn for Silage.—Some people in the Northern States grow a southern or fodder corn for silage or fodder purposes. This is planted thick and produces no ears. By this means a large amount of a roughage is produced per acre. But this is not the best kind of feed on account of the immature stage at which the corn is cut.

The corn plant is a machine in itself which develops for the purpose of making the ear. When immature corn is put into the silo, the plant is destroyed before it has had a chance to do that for which it was developed. Scientific investigations also have shown that an acre of corn will do the most work or make feeds for animals the most rapidly immediately before and up to the time the corn on the cob becomes dented and glazed.

To take this reasoning a step farther, the corn stalk is the least digestible and the corn grain the most digestible of the corn plant. Again, as pointed out previously, improved cattle must have a liberal allowance of concentrates in their rations. Besides, the corn plant is a carbohydrate feed. If, therefore, the corn is allowed to grow well toward maturity and if then

some protein roughage is fed along with the corn silage, a better-balanced, more digestible and a more economical ration is produced. The rule to keep in mind, therefore, in regard to planting corn for the silo is to plant the largest corn that will come to maturity in the given locality. The time to cut the corn for the silo is the same as that for corn to be put into the shock to be husked later. This is when the kernels are dented and glazed and when the lower leaves are dry.

Filling the Silo.—There are only a few necessary precautions in regard to filling the silo. It should be filled rapidly and the corn be well distributed and well packed. A man, preferably of heavy weight, should be kept in the silo while it is being filled to distribute and tramp the cut corn. It should be especially well tramped around the outside.

Kind of Silo.—There are two principal types of silos, the pit or underground silo and the above-ground silo. The former can be built only in a dry country where there is not too much water in the soil. This, at times is somewhat dangerous on account of poisonous gases settling in them. Before going into a pit silo, one should let down a lighted lantern. If it goes out, there is danger. Under such conditions a current of air should be forced into the bottom by means of a fan.

By far the most common type of silo is the above-ground silo. This is built in many different ways. The kind of silo one builds is immaterial except for himself and for his own farm. A silo, however, should not be built too wide but should be built high. It has been said that adding 10 feet to the height of a 40-foot silo doubles its capacity. A silo should never be built so wide that in using the silage it cannot be taken down fast enough to prevent spoiling. Silos range from 12 to 30 feet in diameter and from 30 to 75 feet in height. A good dimension is 16 feet in diameter and 40 feet in height.

Use of Beef Bull in Dairy Herd.—Calves from inferior cows when sired by a dairy bull will not make good dairy cows and have very little value as beef animals. If then, inferior cows are bred to a good beef bull, the calves will make good beef animals and this will add considerably to the income from the dairy herd.

The objection is at once raised that one cannot afford to keep two bulls. But with the practice of community breeding this is easily possible.

MANURE

The manure from the dairy herd is one of the sources of profit from the dairy farm. It is by saving this and putting it back on the land that the fertility and productiveness of soil is maintained.

Manure should be handled with the least expenditure of labor. Perhaps the best way is to haul the wagon or manure spreader into the barn, load the manure and take it directly to the fields. It should be spread evenly and not too thick. In hilly regions it is thought this leads to the loss of too much of the fertilizing constituents through washing. But these are made soluble only by warm weather. So when the snow melts in the spring or the early spring rains come little harm is done. Even if some of the fertilizer did wash away, the loss would not equal the cost of an extra handling if the manure were left till summer. Besides, there would be loss in strength in exposing the manure to the weather in the yard.

TUBERCULOSIS

Cattle and especially dairy cows are subject to tuberculosis, a disease similar to tuberculosis in the human family. It is thought by many that the disease may be transmitted from cattle to the human and especially to children. If this is so, it is most likely to happen by drinking milk from infected cattle.

All cows that have tuberculosis do not have the disease in the udder but when they do get it in the udder there is danger in using the milk. Milk from such cows should either not be used at all or should be pasteurized or sterilized before it is used. Pigs also are subject to the disease and get it very easily by drinking tuberculous milk.

Tuberculosis is a germ disease. The germs (tubercle bacilli) may be inhaled or may be ingested (taken with the food). If the resistance of the body is not strong enough to withstand these germs, they will lodge in the lungs or the intestinal wall,

or get into the blood and be carried to other parts. Where one of these germs lodges and starts to grow it forms a colony. This produces a swelling. The germs continue to grow on the outside of this swelling. Finally the germs in the interior of the swelling die and produce pus. Sometimes pus dries. The disease consumes the tissue of the animal and gives off poisonous products.

Tuberculosis will destroy an animal in time and will spread from one animal to another in a herd. Great care should be exercised in buying animals that are tested and free from the disease. A dairy herd also should be tested every year to make sure that it is free from the disease. If any animals are found that react to the test (have the disease), they should at once be disposed of or isolated from the rest of the herd.

Different States have different laws for disposing of tuberculous animals. Some States kill them and pay a fixed sum. The State livestock sanitary board, if there is one, should be consulted. At any rate, tuberculous cows can be sold on the regular market for slaughter where they pass government inspection. Only about one-tenth or less of tuberculous cows are entirely condemned as unfit for human consumption. The disease is often light and confined to the lungs and intestinal glands which are destroyed. Where the disease has spread through the entire carcass, the whole is condemned, and it is used for the manufacture of fertilizers. Valuable breeding cows that have the disease can be kept for breeding purposes by keeping them isolated.

Tuberculin Test.—There is no cure for tuberculosis. The tuberculin test is a means of testing cows for tuberculosis to detect the presence of the disease. The test is usually applied to cattle by veterinarians but anyone can apply it. The agency employed is tuberculin. This is prepared from the germs that cause tuberculosis, the tubercle bacilli. These are cultivated artificially and then an extract is taken and this is treated with a solution of carbolic acid. Tuberculin is entirely free from tubercle bacilli or any other germs, and can be obtained from the State livestock sanitary board or from commercial firms.

In performing the test, cows are kept under normal condi-

tions and their average temperature is obtained by taking temperatures at 10:00 a.m., 2:00 p.m. and 6:00 p.m. and averaging these. In taking temperatures the thermometer is inserted in the rectum. The thermometer should be left in about two minutes. If an operator uses several thermometers he can test a large herd at once. The same evening the cows are inoculated with tuberculin at the rate of 2 cubic centimeters for each 1000 pounds of live weight. The cows are inoculated from 8:00 to 10:00 o'clock in the evening. The tuberculin is injected under the skin with a hypodermic syringe. The point selected for the injection is back of the shoulder or at any other place where the skin is loose and there are plenty of blood vessels underneath. The needle of the syringe should be put through the skin so that the point is free underneath. The material is absorbed by the blood and carried throughout the body. If the cow has tuberculosis this tuberculin will cause a fever.

Temperatures are taken the following day at intervals of two hours beginning at 6:00 a. m. If the temperature rises during the day and falls again toward evening and if the rise is 2 or more degrees or if it goes to 104 or 105, an animal almost certainly has the disease. It must not be forgotten, however, that the fall in temperature above mentioned is necessary. Sometimes cows are kept under abnormal conditions or again they may be sick otherwise so that the temperature goes up. But this would not be an indication of tuberculosis. To get a reaction the cows must be kept under normal conditions, must be in normal health and there must be a rise and a fall in temperature. But the fall as a rule is not back to normal by the close of the day.

When the test is properly carried out it is almost absolutely accurate. But sometimes when cows are in advanced stages of the disease they will not respond to the test. Also, one test should not follow the one preceding for four or more months.

It is said that dishonest people sometimes keep their cattle "plugged." This means that they keep injecting tuberculin into them at intervals of four months or less so that they will not respond to tests by State officials or others.

The test does not give any indication as to the stage of the disease. A cow in which the disease is just starting may react like one in which the disease is well advanced.

During the first stage of the disease no one can make a diagnosis by physical means. After the disease has become well advanced a cow may show a lack of thrift or may even lose flesh. She may or may not cough. These symptoms may also result from other causes.

Upon postmortem examination a tuberculous animal will show tubercles in the lungs, along the intestines, in the glands along the intestinal wall, on the inside of the chest cavity, in the glands of the neck or in some of the other body glands. These tubercles are enlargements, inflamed around the outside, with pus in the center. Sometimes this is soft and sometimes it is hard but always it has a gritty nature when cut through with a knife. This grittiness is due to limy substances left by the germs. The pus is caused by germs dying on the inside of a tubercle for the want of food.

Milk from tuberculous cows should not be fed to calves or to pigs, except after pasteurization or sterilization. Pigs are very easily infected and the disease works very rapidly with them. The author knows of 40 fall pigs that died of this disease by January. Cattle may live several years and in fact may sometimes have the disease and die of old age. Animals that are strong constitutionally and are well fed will not contract the disease as readily or succumb as quickly as those that are not so strong.

ABORTION

Another disease which causes great losses among dairy cows is contagious abortion. This is also a germ disease. The germ in this case lives and works in the vagina and causes the foetus to be expelled.

This disease may be carried by the bull or by cows coming into contact with each other so that the germs get from one to another. Litter or manure may also carry the germs and spread the disease. Before buying animals or using a herd bull from another herd one should make sure that the herd is free from this disease.

If the disease gets into the herd the infected cows should be thoroughly isolated and well washed and disinfected. The washing and disinfecting include the exterior parts and extend well into the vagina. The sheath of the bull also should be disinfected after each service. Cures for this disease have not as yet been well worked out and prevention is of primary importance. In case of an infection, however, State authorities might be asked whether they know of a cure.

Sometimes cows throw their calves from accidental injury. This must not be confused with contagious abortion. If one loses by abortion two or three calves for which he cannot assign a cause, contagious abortion should be suspected, and the precautions named above should be taken.

SHOULD COWS FRESHEN IN SPRING OR FALL?

It seems that the natural time for animals to give birth to young is in the spring of the year. Some animals have their young only at this season but the domestic cow can be bred to have her calf at any time during the year.

Spring Freshening.—The advantages of freshening in the spring are as follows: (1) The weather is warm and not much shelter is needed. (2) The cows can go out on pasture which is the best kind of an environment for milk production. (3) Dry cows can be wintered in a cheaper barn than cows giving milk, because as a cow gives milk she loses heat in the form of warmth of milk. (4) The calves can go on grass which is the best kind of feed in addition to milk.

Fall Freshening.—When cows come fresh in the fall, the advantages are: (1) The cows give more milk during the winter when the price for dairy products is higher. (2) When the cows go onto pasture in the spring they increase their milk flow and thus give a larger total quantity of milk during the year. (3) The cows are dry during the hottest part of the summer when the flies are bad and there is the greatest rush of work on the farm. (4) Neither the cows while they are in milk nor the calves when they are small are exposed so much to flies and mosquitoes. (5) The most milking is done in the winter when labor is cheap.

It seems to the author that, under present conditions, when more cows come fresh in the spring than in the fall, there is more opportunity for profit from the winter dairy than from the summer dairy. To be sure a better barn is required but the other factors more than overbalance this.

BUILDING UP A HERD

It should be the aim of every one in the dairy business constantly to build up his herd. This is done in two ways: by buying better bulls, and by disposing of the inferior cows. The value of a good sire has been discussed. The inferior cows are culled out by means of the milk test. For this purpose the Babcock test is largely used. Some cows may give a large quantity of milk poor in fat and others may give less milk but richer milk, so the only way to find out whether a cow is worth keeping or not is to test her.

Tests should be made in every herd in the country. Investigation has shown that about one-third of the cows in the herds of the country are non-producers. That is, the cows eat as much as or more than they return in the form of milk.

To make the test accurately the cows' milk should be weighed at every milking. This is very easily done by hanging the pail with the milk on a spring balance in going from the cow to the can where the milk pail is emptied and then recording the weight on a sheet handily arranged for the purpose. Once each month for three days the milk from each cow is well stirred and sampled. This is put into a bottle with some preservative and at the close of this period the whole is tested. The testing may be done at home by the farmer himself or by a regular employee of a testing association or by a creamery.

For practical purposes good results can be obtained by weighing the milk for about three days of each month when the samples are taken. This should be at a fixed time each month.

A testing outfit may be purchased from any creamery supply house. A small outfit can be had for a few dollars. To make the test weigh or measure out 18 grams of milk and put this into the test bottle. Then measure out 18 grams of sulphuric acid and pour this into the same bottle in such a

way that it will run down the side of the bottle. The acid being heavier than the milk will go to the bottom of the bottle. Next mix this by giving the bottle a rotary motion till the casein is well dissolved. Following this, put the bottle into the tester and turn for four or five minutes. Then add enough hot water to bring the fat well up into the neck of the bottle so that it comes within the graduated part of the neck. After this turn two minutes more and then take the bottle out and read the per cent. of butter fat. This can be done by subtracting the figure beneath the fat column from the figure above. But as a rule a pair of dividers are used. Place one point at the upper and the other point at the lower end of the fat column. Then place one point at zero and note on what figure the other point falls. This gives the reading.

To build up a herd, cows should also be selected for constitution, size, vigor, capacity, udder, etc.

DUAL-PURPOSE CATTLE

Dual-purpose cows are those that give a lot of milk and at the same time when they are slaughtered furnish a lot of beef. All cows give milk and make beef. The dairy cow has been bred to devote the most of her energies to milk-making while the beef cow is busier in making meat. Both of these two types of cows do all the work they are capable of doing. How then is a cow going to do both? Simply by being big enough to do both things at the same time. This is the first and main consideration of a dual-purpose cow. She must also be backed by good milk records. If she is a large cow and is well built from the standpoint of dairy conformation and at the same time carries plenty of meat on her ribs and back she ought to be pretty good for both purposes. But it goes without saying that such a cow cannot do either job as well as either of the two specialized types of cattle.

The breeds that may be used for this dual-purpose work are the milking shorthorn, red polled, and brown Swiss. The last comes from Switzerland and the other two from England. The brown Swiss are brown and yellowish, the red polls are red and the shorthorns are red, red and white, roan and white.

The milking type of shorthorn cattle was developed by Thomas Bates, of England. These are frequently spoken of as Bates cattle or rather Bates shorthorns. Not many of this type of cattle have as yet been introduced into the United States. American shorthorns up to the present time, on account of Western range conditions, are mostly of the beef type. Interest in milking shorthorns is growing, however. This is because fewer beef cattle are being produced on the



FIG. 26.—Red polled cow. Dual-purpose type. (Photo from Jean Duluth farm.)

Western range and more on the farms of the country. The range cow, because she was not milked, could not give more than enough milk for her calf. The general farmer frequently wishes to milk his cows as well as to raise young stock, either to sell as feeders, or to finish for market himself. Milking shorthorns or other dual-purpose cattle are better adapted to this than the strictly beef type of Scotch shorthorns. The red polled breed is well adapted to this kind of work because it has always been bred for dual service.

BLOAT IN CATTLE

When cattle graze on fresh green clover or alfalfa they frequently bloat. This is caused by a fermentation of the material in the paunch which causes gas. This gas distends the paunch and may burst it or may kill the individual by pressing against the lungs and interfering with respiration. This may kill the animal by suffocation.

To prevent bloating animals should be accustomed to such feeds as cause bloat gradually, and then be kept on them continuously. Frozen legumes are dangerous in this respect and should be used with care.

A case of bloating can be remedied by puncturing the paunch with a trocar or a jackknife so as to allow the gas to escape. The opening is made in the hollow space in front of the hip on the left side. In such a case the after-treatment must be such as to allow the wound to heal.

In the *Breeders' Gazette* for June 24, 1915, D. J. Healy and J. W. Nutter, of the Kentucky experiment station, discuss a recent remedy they have worked out for this difficulty. They say:

"For the present we strongly recommend for acute bloating 1 quart of a 1½ per cent. solution of formalin, followed by placing a wooden block in the animal's mouth and gentle exercise if the animal can be gotten up. Formalin is a trade name for a 40 per cent. solution of formaldehyde gas in water and may be obtained at any drug store for 40 cents a pint. One-half ounce of formalin in 1 quart of water makes the proper solution with which to drench the animal.

"Lad's Oona bloated badly on white clover June 13, 1913. She was drenched with 1 liter of water containing 40 cubic centimeters of formalin; a block of wood was at the same time placed in her mouth, thus keeping it open. At the end of twenty minutes she had entirely recovered. No bad after-effects followed this treatment. Valentine's Valentine 2nd bloated badly on white clover May 23, 1915. She was drenched with 300 cubic centimeters of a 4 per cent. solution of formalin, and a block of wood was placed in her mouth. At the end of twenty-five minutes she had entirely recovered. No bad after-effects followed this treatment. These and four other cases of clover bloat were promptly and thoroughly relieved by the administration of formaldehyde."

Bloat affects sheep similarly and they should be handled in a similar manner. With both sheep and cattle, however, prevention is of greater importance than cure because the animals may be dead when found.

CHAPTER IX

BEEF CATTLE

A dairy cow is a cow that gives milk and makes beef. A beef cow is one that makes beef and gives milk. Both cows do both things, but one is better at one thing and the other at the other.

Most all of the advice given as to the dairy cow also applies as to the beef cow. The latter should be of good size, constitution, quality, capacity, length of body, etc., but in the withers where the dairy cow shows general leanness and sharpness, the beef cow should be fleshy, and broad and thick. The beef cow should be heavily meated everywhere, but especially on the back and the upper part of sides or ribs. These are the parts from which the high-priced cuts come and should be well filled with lean meat of fine quality.

The udder or milk-making organ of the beef cow lacks the development of that of the dairy cow. This frequently becomes one of the handicaps of the beef cow; often she does not give enough milk to raise a good calf. For many beef calves used for show purposes a nurse cow to help furnish milk is provided. In breeding beef cattle the cow should at least give milk enough to raise a good calf.

Sometimes calves are "doubled up." Two calves are put with a cow and the other cows are milked for dairy purposes. Extra calves may be bought and put with a cow. This may add greatly to the profit obtained from a herd.

Dairy cows have the advantage of more economical production and of greater returns per unit area but suffer a disadvantage in comparison with beef cattle in that they require more labor and more expenditure for shelter.

One man can care for and feed many times more beef cattle than dairy cattle. Beef cattle are not milked daily in winter, so do not lose so much heat. They, therefore, need less shelter. They have calves which do the milking, but these

usually come in the spring and milk only during the summer, so that the beef cow is dry during the winter. Beef cattle also carry more fat and are fed more of the fattening feeds which also produce more heat.

It seems, therefore, that the advantages of one just about balance the advantages of the other. Consequently it remains a matter of individual choice or possibility, as to whether beef or dairy cattle shall be kept on one's farm.

The necessity of livestock on a farm is very apparent. Dairying is especially adapted to older sections of the country where labor is plentiful and not too high in price; also to farms where there are several children whose profitable and judicious employment not only adds to the revenues of the farm but also to the highest development and proper habits of the children. Where the conditions do not favor dairying, beef cattle should by all means be adopted.

Mature beef cattle are fed either a maintenance or a fattening ration. The former is used when the cows are just being wintered and the latter when they are being prepared for market. In this they differ from dairy cattle.

Beef calves are usually allowed to run with their dams till they are about six months old. At the same time, they should have grass, or in winter, hay and grain. They should have salt and water at all times. The weaning should be gradual to a good ration of hay or grass and grain, with salt and water. The protein feeds must be supplied here the same as with dairy calves. Exercise should be given at all times.

Baby Beef.—By baby beef is meant beef from young cattle that are put on the market before they have come to maturity. Such cattle must be especially well fed from calfhood until they are sold. This is at about eighteen months of age. They must be "crowded" or fed all they can eat, all the time. They must be made both to grow and fatten at the same time. They cost less to produce than older beef cattle. This is true because a young animal always makes cheaper gains than an older one. But if they are sold too light the capacity of the machine as a whole has not been reached on account of its small size. The animal has been cut off before it has reached the end for which it was developed. When such calves are



FIG. 27.—Shorthorn bull. Beef type. Show condition.



FIG. 28.—Shorthorn cow. Beef type. Show condition but a little patchy.
(Hildebrand.)

born in the spring and sold at eighteen months of age they are "carried over" only one winter. This is a point in their favor as less money is spent on shelter for them.

Feeder Cattle.—Many sections of the country are primarily adapted to the production of forage crops. There are only a few places in any country where grass or hay alone will make cattle good enough to be in good demand at the market centers. In such places the grass is especially abundant and exceedingly good. In other places beef cattle must have grain in addition to their roughages. Out of this circumstance has



FIG. 29.—A group of shorthorns. University of Illinois.

grown the trade in feeder or stock cattle, and the cattle-feeding business.

Feeders or stock cattle are cattle that have been pretty well grown and are purchased by the cattle-feeder and fattened. Handling such cattle is largely a fattening proposition, calling for corn and other fattening feeds. Both growing and fattening cattle are legitimate and occupy an important place in the cattle industry, but it seems that for the average general purpose farm cattle can be grown and finished at the same place with the largest amount of profit. Cattle then can be fattened with due regard for the way in which they were bred and grown. Besides, this plan means a great saving in transportation charges, dealers commissions, etc.

The rules for feeding growing animals apply to the fattening of animals, except that less of protein and more of carbohydrate feeds are used; also less roughages and more concentrates.

BREEDS OF BEEF CATTLE

There are different breeds of beef cattle, all of which are good. The choice of a breed, therefore, is largely a personal matter. The breed is not the most important thing. The first consideration should be that the cattle are properly bred, fed, and cared for. The standard breeds are the shorthorn, polled Durham, Aberdeen Angus, Hereford and Galloway.

Shorthorn.—The shorthorns include a strain of cattle that have both dairy and beef characteristics. Consequently are called milking shorthorns or dual-purpose cattle. Here, however, only the beef type of shorthorns is to be considered. This breed from the numerical standpoint is the most popular. They are a good all-round beef animal well adapted to modern methods of farming. Shorthorns are red, red and white, roan and white. They were developed in Great Britain many years ago by breeders of exceptional ability. Among these may be mentioned the Colling Brothers, Bakewell, Bates, Booth and Cruickshank. They were brought to the United States at an early date and have been popular here ever since.

Polled Durham.—The polled Durhams are simply an offshoot of the shorthorn breed. They were developed without horns. This strain was developed in the United States and originated from native cattle outside of any breed. Such native mully cows were bred to shorthorn bulls and the offspring were not eligible to registry in the shorthorn breed so the Polled Durham Registration Association was started. These cattle are called single-standard polled Durhams.

Later also were found hornless individuals among shorthorns and these were also developed. These are eligible to registry in both the shorthorn and the polled Durham associations, and are called double-standard polled Durhams.

Aberdeen Angus.—This breed of beef cattle originated in Scotland. It is also an old well-developed breed of beef cattle and is especially noted for the fine quality and large proportion of lean meat produced. Cattle of this breed have been the most persistent winners in the fat-stock shows of this country.

Aberdeen Angus cattle have no horns and are black. They are very strong in these characteristics, and this, together

with their good quality, makes them very valuable beef animals. A bunch of grade or mixed cows of all colors and



FIG. 30.—Aberdeen Angus cow on pasture.



FIG. 31.—Hereford cow on pasture.

all types can be bred to an Aberdeen Angus bull and practically all of the calves will be black and hornless. They will

also be of good beef type and good quality. This saves the work of dehorning and gives one a fine bunch of uniform beef calves even from dairy cows.

The Angus is not quite so wide in the back and hips as the shorthorn but is very thickly fleshed all over the body with a fine quality of flesh. They are also rather fine in bone. Hence they dress out well when slaughtered. They are not quite so large as the shorthorns.



FIG. 32.—Galloway cow. (Hildebrand.)

Hereford.—The Hereford is an English breed of beef cattle having horns, a red body and a white head. The white also extends back on top of the neck and on the under side of the neck including the dewlap and lower parts of the legs. There is also some white on the under side of the body.

In conformation this breed is very broad in the back but formerly were somewhat light in the hind quarters. In this, however, in late years, there has been considerable improvement. The Herefords are also an old well-developed breed and are especially well adapted to grazing. On this account

they were extensively used on the Southwestern ranges. They are good beef cattle for all purposes. The Herefords are large and well developed in constitution. They also have a good quality of flesh.

Galloway.—The Galloway breed originated in Scotland many years ago. It is hornless and black like the Aberdeen Angus breed but has a much heavier coat of hair. This is a valuable characteristic because it gives these animals protection from cold in winter and from flies and mosquitoes in summer.

The breed is also strong in transmitting its hornless characteristic and black color to its offspring. Calves will feed out as a uniform bunch in color and otherwise. They, therefore, make a good appearance on the market and sell to good advantage. The hide of the Galloway is valuable as it is used for making fur coats, robes, etc. This breed also is well developed in length of body and length of hind quarters.

The Galloway is somewhat small in size, but it will stand coarse feeds. The Galloway can perhaps "rough it" better than the other breeds mentioned. But, on the other hand, it is said by some that they will not respond to good feeding as well as the others. This, however, can be improved in time.

CHAPTER X

SHEEP

Sheep are four-footed ruminating animals. They are cloven-hoofed like cattle and their meat is used as food for humans. These animals belong to the ovine family. Meat from the mature sheep is called mutton and from the young it is called lamb.

Sheep weigh from 100 to 400 pounds per head, liveweight. Since they are ruminating animals they can use a large amount of roughage in their rations. The principal distinguishing characteristic of this class of animals is that their outside covering is wool instead of hair. The value of wool as a material from which cloth is made is well recognized. A wool garment is warmer, softer and lighter than one made of cotton.

WOOL

A hair or cotton fiber is smooth, cylindrical, fine and proportionately long. It is usually straight but sometimes bent somewhat so as to give the appearance of curliness. A wool fiber is of about the same diameter and length as a hair, but instead of being straight or curly has what is called a crimp. This is a waviness like . The finer this crimp or the shorter the waves the better the wool.

A piece of cloth or a garment made from wool is soft, light and warm. It is soft because the fibers do not lie so close together on account of the crimp. When pressed together it has resiliency and recovers its normal shape. This is also owing to the crimp and the elasticity of the fiber. It is light because on account of the crimp in the fiber not so many fibers are needed to make a piece of cloth of a given thickness.

Warmth.—The warmth of a wool garment again lies in the crimp. This makes the garment light and porous and encloses within its borders a large amount of air. It is the air that

makes it warm. Air is a non-conductor of heat and if this layer of air within the piece of woollen cloth can be kept quiet it will keep the heat of the body inside. This is the function of a garment in regulating body temperature. It keeps heat from leaving the body.

Shrinking of Wool Garments.—The fact that a wool garment shrinks may be explained as follows: A hair is like a straight smooth rod or tube. But wool is smooth one way and rough the other way. When drawn between the thumb and finger one way the wool fiber feels smooth and the other way it feels rough. This is because it has projections extending outward in one direction. These may be compared with the buds on the branch of a tree in the spring. It is easy to run the hand over the branch one way, but running the hand the other way one strikes the bud obstructions. A hair or cotton fiber is perfectly smooth both ways.

When a wool garment is washed, it is heated in the water. This causes the fibers to expand and in expanding they hook up on each other a little farther. Upon cooling the fibers contract again and the garment is that much smaller. When the garment is rubbed, as on a washboard, it makes these points hook up still further and makes the garment shrink worse. When the garment is old and worn so that many of the points or hooks are worn off, it will not shrink so badly. A wool garment made of combing wool, where the fibers are all laid in one direction, will not shrink.

Yolk.—Most wool is naturally white but contains more or less yolk. This is an oily discharge from the skin to keep the wool fibers soft and glossy. This yolk in the wool collects dirt and dust and frequently gives the sheep a dirty appearance. Some breeds have more yolk and look dirtier than others.

Fleece for Shelter.—Wool is a good protector from cold. The sheep, therefore, which has a heavy covering of wool is well able to withstand cold weather. This is very valuable to the farmer as he spends less for shelter for sheep. It is also good for the sheep as they can get out in winter and take their normal amount of exercise without suffering from the cold. Even in cold northern countries, a shed open to the

south is sufficient shelter for sheep. What they do need, however, is a dry place and protection from cold winds.

OTHER CHARACTERISTICS

Dual-purpose Nature.—Sheep in a sense are dual-purpose animals. They yield annually lambs and wool. A good average farm flock ought to shear about 10 pounds of wool per head which at 20 cents a pound is \$2 for wool. Ewes very often drop twins and sometimes triplets. An average of $1\frac{1}{2}$ lambs for each ewe can be raised without very much difficulty. At the rate of \$4 or \$5 a head for lambs, an income of \$8 a ewe is easily possible.

Hothouse Lambs.—Most breeds of sheep breed only in the fall. Their period of gestation is five months, hence the lambs are dropped in the spring. Early spring lambs and fall lambs that are well fed and prepared for the holiday and early spring markets are called hothouse lambs. These can be sold in the larger cities at a comparatively high price. Such lambs may attain one-third the weight of the mature sheep and sell for from two to four times the price per pound of mature sheep. This is a very profitable side line in sheep husbandry for those who are in a position to handle it.

Care of Sheep.—The droppings of sheep are comparatively dry and hard. This makes it necessary to clean out the sheep shed only once or twice a year. The manure may then be loaded on the wagon or manure spreader and hauled to the field. On account of the nature of the droppings also very little bedding is needed. Sometimes enough stubble is left from the hay that is fed to answer this purpose.

Sheep need water at all times but are very economical in its use. They need much less relatively than the other farm animals. This makes the work of feeding and caring for sheep very light. This, together with the fact that sheep are ruminants and can use a large proportion of roughages, and that they do not need expensive shelter, make sheep among the most profitable of all farm livestock. To succeed with sheep, however, one must be adapted to the work and must have a fondness for the animals, which must be handled with care and kindness and the feeds should be clean, sweet and

wholesome. Water troughs and hay racks should also be kept scrupulously clean.

Eradication of Weeds.—Sheep are known as weed eradicators. They are very fond of weeds but should not be fed weeds exclusively. Because of the liking for weeds, however, sheep are very valuable assistants in cleaning a farm of weeds. They need the minerals found in weeds for the manufacture of wool. A small band of sheep on a farm will more than pay for their keep in this way. The income from the flock may, therefore, all be profit.

Lambing Time.—At lambing time the ewes should be given careful attention. If the lambs come during cold weather the ewes should be kept in a warm place till the lambs are several days old. When the lambs are born they should be assisted to get their first meal. If they get this soon after birth, they will then as a rule take care of themselves. Sometimes it becomes necessary to change lambs from one ewe to another if one ewe has triplets and another only one lamb. In such a case, one of the triplets should be taken while the "one lamb" is still fresh and wet and the two well rubbed together. The mother of the one lamb will not then recognize the stranger so readily and will be more ready to adopt it. When a lamb dies a strange lamb is readily adopted by being put into the hide of the dead one.

Weaning.—Lambs should be allowed to run with the ewes till they are three or four months old. When the lambs are weaned the ewes should be kept on scanty dry rations for a few days so they will dry up without contracting udder troubles. The lambs should be well fed on growing feeds, both roughages and concentrates.

Trimming Feet and Shearing.—The feet of sheep should be examined once a year and if they have grown out too long should be trimmed. The shearing is done as a rule only in the spring of the year when the weather is warm. Sometimes sheep are sheared in the fall, but this robs them of their coat which they need for protection and the yield of wool is no more than when they are sheared only once per year.

Parasites of Sheep.—Sheep are subject to parasites. The sheep tick looks something like a wood tick and affects sheep

externally as lice affect other animals. Ticks can be removed by dipping. Commercial sheep dips can be used for this purpose. This material, diluted with water according to directions, is put into a deep and narrow vat and the sheep are driven through. An incline is provided so the sheep can be slid into the solution without injury. It is said that three dippings at intervals of fourteen days will clean a farm and the sheep of this parasite.

Internal parasites such as worms are more difficult to dispose of than ticks. Turpentine, gasoline and other similar remedies are frequently used but prevention is better than cure. To avoid internal parasites sheep should not be kept on the same pasture two years in succession. Lambs also, when weaned, should be put into a pasture that had no sheep on it the same or the previous year. Where the winters are long and cold some of these parasites as they are developed outside of the sheep freeze to death. Thus a cold northern country that has a dry climate is especially well adapted to sheep.

SHEEP FEEDING

The feeding of sheep is not very different from the feeding of cattle. First of all, sheep should be well fed. In summer when the ewes are on good pasture they do not need any grain and can raise good lambs too. In winter most ewes have no lambs with them and can be wintered on hay alone, but they will do better if they have a little grain in addition.

When hay alone is fed to sheep it should be of good quality and preferably of a leguminous variety, such as clover, alfalfa or pea hay. A variety of hays is also better than just one kind of hay. Lambs during the fall and winter should be well fed on leguminous hay and grain. They are growing animals and should have some of the protein concentrates as well as protein hay. Oats and corn are good carbohydrate feeds. To these a little bran, oil meal or ground flax should be added. Aside from the flax, the grain may be fed whole or ground, just as the sheep like it best.

Salt and water should be before sheep at all times.



FIG. 33.—Shropshire buck. Breeding condition.



FIG. 34.—Shropshire ewe. Show condition.

Dwarf Essex rape sown in the spring makes excellent sheep pasture after it comes up and has a good start.

When sheep are kept in a woods pasture they do considerable work in clearing the land. They eat the sprouts, young shoots and leaves as high as they can reach and this helps to clear out the underbrush.

Goats.—For clearing land Angora goats are sometimes recommended in preference to sheep. These animals are similar



FIG. 35.—A farm flock of Shropshire grades.

to sheep but they have hair (mohair) instead of wool. This mohair is in considerable demand. But both for fleece and carcass goats are not so profitable as sheep. Neither sheep or goats will eat bushes and weeds exclusively unless they are forced to do so. They will take some grass in preference but like a variety and will eat both.

For goats a good high fence is needed. There should be no brace posts on the inside of the fence to aid the goats to climb out.

TYPES AND BREEDS OF SHEEP

Most of the improved breeds of sheep of the present day trace their origin to England; though some came from Spain and some from France. There are two principal types of sheep, namely, the fine wool sheep and the mutton sheep.

FINE WOOL SHEEP

Fine wool sheep were the first of the modern types of sheep to be developed. They trace back almost to ancient civiliza-



FIG. 36.—Oxford ewe. Fitted for show.

tion and came to us through the southern European countries. Spain is especially noted for the production of this kind of sheep. The United States also had a prominent part in the development and improvement of these animals.

Sheep of this class produce a large amount of high-class wool. The wool is fine in fiber, good in crimp, dense in fleece,



FIG. 37.—Southdown ewe.



FIG. 38.—Dorset horned ewe. (Hildebrand.)

and contains a large amount of yolk. When they were developed there was not much demand for mutton, but there was a great demand for good wool.

In order to make the wool-producing surface as large as possible, in these sheep, wrinkles in the skin were sought in breeding. Consequently they have great folds of skin about



FIG. 39.—Merino ram, B type. Medium wrinkly. (Hildebrand.)

the neck, lower hind quarters, and lower parts of sides. The energies of these sheep are mainly consumed in wool-making.

In shearing, the skin is drawn tight on the part of the body where the shearing is done. The wrinkles, therefore, do not interfere with shearing. The fiber of the wool as a rule is not more than 2 or 3 inches long.

In later years, some of the sheep of this type have been bred to produce more mutton consequently they have fewer

wrinkles and produce less wool. There is, then, almost a gradual blending from this type to the other types of sheep.

The breed name generally used to designate this type of sheep is Marino. There are the Spanish Marino, American Marino, Delaine Marino, and Rambouillet or French Marino. There are also various shades and modifications of these, which



FIG. 40.—Merino ewe, A type. Very wrinkly. (Hildebrand.)

are not so very wrinkly and are better for mutton than the former.

MUTTON SHEEP

In recent times mutton has come more into demand and sheep have been developed to produce mutton as well as wool. With mutton sheep the income from lambs and carcasses is greater than the income from the sale of wool. It is the aim

with this type to produce as much and as high a quality of both mutton and wool as possible.

Shropshire.—Among the most popular sheep in the United States today are the Shropshire and the Shropshire grades. Shropshires are noted for being all-round good sheep. They are good for both mutton and wool. They are also good for



FIG. 41.—Rambouillet ewe.

producing lambs. The lambs also come strong and the ewes are fairly good milkers.

The number of lambs produced by any breed is largely a matter of breeding and care. The author has heard from reliable sources of 14 ewes (breed not mentioned) producing 34 lambs. While this is an exceptionally large number, Shropshires ought easily to produce 150 per cent. of lambs. Or with good breeding and care 175 per cent.

The Shropshire is a dark-faced sheep and is well covered with wool on both face and legs (pp. 183 and 184).

Oxford Down.—The Oxford sheep is noted for its size. It is a little larger than the Shropshire but much the same in other respects, although the larger a sheep the less active it is.



FIG. 42.—Cheviot ewe.

A large sheep is adapted to a level country where grass is abundant, while a small sheep is better adapted to a country that is hilly.

Southdown.—The Southdown is an especially well-developed mutton sheep. Southdowns have a thick covering of a fine quality of lean meat. But they are not so good for wool pro-

duction. Neither are they so good in lamb production or in the strength and vigor of the lambs produced as some of the other breeds. They are dark brown or mouse-colored in face and on legs.

Dorset Horned.—The Dorsets drop lambs in the fall. On this account they can have lambs twice a year and the fall



FIG. 43.—Cotswold ewe. One of the long-wooled breeds. (Hildebrand.)

lambs can be finished as hothouse lambs for the holiday trade. This breed is good in milk flow and produces good lambs. Both sexes among Dorsets have horns. These grow spirally on the side of the head. The sheep are white in face and on legs. They are not so well covered with wool as most other breeds.

Other Breeds.—The Hampshire Down breed is much like the Shropshire and the Oxford breeds. The Cheviot is a white-

faced breed with no wool on head or the lower part of the legs. The Leicester, Lincoln and Cotswold breeds are the largest of the breeds with the possible exception of some of the Oxfords. They have very long wool fibers. The wool is so long that it sometimes hangs down the side of the sheep in locks.

CHAPTER XI

SWINE

Swine are omnivorous animals. They eat all the different kinds of feeds. They eat animal and vegetable feeds, good feeds and spoiled feeds, concentrates and roughages. They eat everything but are primarily adapted to concentrates and thrive with sound wholesome feed and clean quarters as well as any other animals. Swine occupy a place on the farm that cannot be filled by any other animal. While they can get along sometimes under conditions that would be fatal to other animals, they respond to good treatment as well as any of the other animals of the farm.

The young animals of this family are called pigs. After they are weaned they go by the name of shotes and after they reach considerable size (about 100 pounds) they are called hogs. The words "pigs" and "hogs" are also sometimes used in a general sense including both old and young. The male of the family is called a boar and the mature female is called sow. A young sow is called a gilt or gelt. A barrow is a male pig after castration provided the operation was performed before it became too large. If a male pig is castrated after it has attained considerable size it is called a stag.

A stag is sold on the market with 80 pounds off, or is docked 80 pounds. This custom started many years ago. The reason is that there is some waste in the shields and sheath. As a matter of fact, there is not much waste and when hogs were selling at 10 cents per pound, stags sold for more per pound than barrows. Even at present, with the price of hogs at 7 cents and 8 cents a pound, stags are bought in the country at the same price as other hogs with 80 pounds off. A sow that shows pigginess is docked 40 pounds.

The shield of a hog is a thickening and hardening of the skin on the side of the hog over the shoulder. This is for protection in fighting. Hogs fight by striking each other with

their tushes. These as a rule are found only on boars and should always be cut off. To do this, a pair of bolt clippers can be used and also an ordinary pair of nail pincers. The tushes are usually diamond-shaped and if they are nipped on each side with a pair of pincers, being brittle, they will break off. Sometimes people knock them off with a hammer but this is cruel treatment. Sometimes, also, they are cut off with a meat saw.

In going among boars and especially at shows where there are strange hogs, one should always be on his guard. A boar may strike at a person and cut his leg. Such injuries are very dangerous. They may result in blood poisoning and should be treated at once by a competent physician. The wound should be well sterilized and disinfected. If the tushes are kept cut off, this danger does not exist.

Boars used to be sold on the market as such but at a greatly reduced price and without any dock. Some people have made considerable money in buying boars on the market, castrating them and then feeding them a while and selling them again as stags. But in recent years it has become more difficult to ship hogs out of the yards at the market centers and an embargo has been placed upon the slaughter of boars for human consumption. Boar meat is strong and not relished by anyone. Boars should always be castrated when through with service on the farm and then be fed several months and sold as stags.

THE HERD BOAR

The herd boar like the herd bull or any other sire is more than half the herd. He must be well bred, well developed, well fed, and well cared for.

In starting a herd or in introducing new blood, or again when a better boar can be bought than can be produced on the farm, one should buy. One who is producing hogs for the pork market should buy his boars from a person who specializes in pork stock but the boar should be well selected. A poor purebred may not be so good as a good grade. One's ability as a judge counts here. A boar should be selected for his own good characteristics as well as for those of his ancestors. He

should have masculinity well developed and in other respects should conform to good swine type.

In buying a herd boar, it is a good plan to buy a boar pig. The express charges then will not be so high, and if one has ability as a judge he can also get a pig that will develop into a good hog. If one is not a good judge, he may do better by selecting a larger animal and paying the difference in express charges. Frequently, also, farmers have good boars that must be disposed of to avoid in-breeding and these can be bought or traded for very reasonably. When the herd boar is bred on the farm he should be just as carefully selected as when he is bought outside.

HOW TO GET A GOOD SOW

A good sow as against a poor one means the difference between profit and loss. A good sow is bred, developed, fed, and made. She may sometimes be bought but as a rule is bred on the farm. Such sows usually are not for sale. They are too valuable to their first owner.

Gilts or young sows do not as a rule farrow a maximum litter the first time. The first litter is usually raised before the sow's own development is complete. If she suckles six pigs, say, the six teats suckled will develop. The remainder will become dormant. In future years, therefore, the sow will be able to raise just as many good pigs as she had in her first litter. There are occasional exceptions to this rule but it is one of the most important points in the production of a good sow. She should be asked to raise a full litter at first.

In order to do this, a number of sows should be bred to farrow as near the same time as possible. Then when the sows farrow the good ones that are to be kept in the herd should be given full litters. This applies especially to young sows. Pigs should be taken away from sows that are to be sold for pork after weaning, or from old sows and given to the good young sows. Or if all the sows are young and all good, all the pigs can be taken away from one and distributed among several others. A young sow, then, if she is to be kept as a brood sow, should be made to raise either a full litter or none at all. Sows so handled may farrow more pigs in their second, third

and fourth litters and be able to raise them. It may be objected that a young sow or gilt cannot raise eight, ten or twelve pigs and do it well. If she has been well developed and if she and her pigs are well fed, she can do it.

The day this was written the author had a young sow, selected as a future brood sow, that farrowed eight nice large pigs of uniform size. She had twelve good teats, consequently four pigs were taken from a sow that had farrowed a few days previously and given to the good sow so that she had twelve pigs to raise. The sow from which the pigs were taken was to be sold for pork.

Young or Old Sows.—Some people make it a practice to raise their pigs from young sows and then fatten and sell them along with their pigs. This practice has its handicaps. There is a tendency for the vitality of the stock to run down and a much larger number of sows must be kept to produce a given number of pigs. Some may be non-breeders and others poor milkers, poor mothers, poor feeders or producers of inferior offspring.

The smaller the percentage of sows selected each year for the breeding herd, the better these are and the better will be their pigs.

In order to keep the cost of maintenance down on old sows they should be made to raise two litters a year. This can be done even in northern Minnesota. If only one litter a year is raised it is still better to keep the old sows as long as they do good work. This may be till they are six or eight years old. Such sows can be carried through the summer on good pasture after weaning their spring pigs.

HERD MANAGEMENT

One of the first considerations in making a place for the swine of the farm should be to give them plenty of exercise. In summer this can easily be done by giving them a large pasture. They should be allowed to graze on this and not be fed so much that they will not go out to graze. The environment also should be such that they can go out.

In a warm country or where it gets hot in summer, hogs cannot go out into the sun. The pig does not perspire, conse-

quently cannot keep down body temperature and is readily overcome by heat. The best kind of an environment then is a large pasture that is well supplied with shade for protection from the hot sun

When a hog does become overheated it may die very soon and suddenly, but if it can be taken in hand before it is too late it should be put into a cool shady place. A little water may be sprinkled on its snout or may be poured on the ground for the hog to lie in. Water should never be poured on its head or back when in this condition. This might kill it outright

If hogs do not take sufficient exercise normally on pasture, a little corn or other feed may be put out at different places in the pasture each day so they will go out and look for it and thus get exercise. In winter the sleeping place may be set away from the feed trough so the hogs will be obliged to walk; or they may be allowed to go from the hog house to the horse barn or cow barn and there work over the manure for exercise.

Exercise is very important, especially for the young pigs, the growing shotes, and the breeding stock. The fattening hogs do not need it so much. If fattening hogs are well fed they will not take too much exercise even if they are in a pasture. Exercise is especially important in swine because they are not especially well built for it and are inclined to neglect it.

Hog Cholera.—The author believes that it is on account of environment, breeding, feeding and care to which hogs have been subjected in recent decades, that they are so subject to cholera. They have been bred without sufficient regard for constitutional development, have been fed too much of fattening feeds, often have not had enough water or mineral matter, have not been supplied with sanitary living conditions, and have not been required to take enough exercise. As long as hog cholera is prevalent a few words about the disease is not out of order.

Hogs taking the disease appear droopy, their ears lopping and their tails hanging straight down. They may or may not cough and may be constipated or have scours. Constipation

may be followed by scours with an offensive odor to the discharge. They will also be inclined to crawl into the straw. When driven out they appear weak and sometimes walk with a wobbly gait. The skin on the tenderer parts of the body may also be red in spots or speckled inclining more to complete redness.

To make sure, however, whether a hog has cholera, in order to protect the rest of the herd, a postmortem examination should be made.

The sick animal, after slaughtering, should be laid on its back and cut open as for dressing. The head should be partly cut off just back of the jaw bones. By cutting in here some glands about the size of hickory nuts are found. In a healthy hog these are of a light flesh color but in a hog afflicted with cholera they are enlarged and inflamed. In a cholera hog there may also be well-defined red areas in the lungs. The interior of the body may also be red speckled, and the membrane surrounding the kidneys, cut on one side and peeled off, may show the kidneys speckled with fine red spots. Sometimes they are badly speckled like a turkey egg and sometimes there are only a few red spots. These may also be very fine. The enlarged and inflamed glands in the neck, the reddened areas in the lungs and the speckled kidneys are, as far as known at present, a sure indication of hog cholera.

When the disease starts in a herd the sick ones should at once be entirely isolated. The well hogs should at once be treated with the hog cholera serum. This can be had from a State institution or from commercial manufacturing companies. The State livestock sanitary board should be consulted, if there is one. As serum is only a preventive it need not be used on the sick hogs.

There are two methods of vaccination, the "serum only" method and the "double treatment." By the former the hogs are treated with serum alone. Serum is the blood from a hog that is immune from cholera and then has been treated with a large amount of cholera blood. In preparing the serum some of the clot is taken out of the blood. In giving the double treatment the serum is used but in addition to this the hogs are at the same time inoculated with a little virulent hog

cholera blood. This starts the disease and the serum counteracts it so that only a mild case of the cholera is developed. Recovering from this, the hog is thought to be immune for life. With the serum only method the hog is protected only for a few weeks.

If the serum only treatment is administered at the time the hogs treated have it in their bodies the effect is the same as that of the double treatment. But this is sometimes difficult to determine and one is never altogether safe in trusting to this method of treatment. The hogs may be protected for a few weeks and as the germs live longer than this on the farm the disease may break out again. By using the double treatment before the hogs get sick one is safe. The treatment whether single or double is expensive. The larger the hog, the more it costs. In general it costs about a dollar a head.

The best way is to prevent the disease by breeding, feeding and caring for the hogs in such a way that they will be strong enough constitutionally to resist it. In Canada the manufacture, sale and use of hog cholera serum is prohibited by law. In the United States many herds have demonstrated the power to resist the disease by going through an epidemic without injury. In the author's experience it was shown that cholera takes the weak specimens of a herd while the strong ones are left. Therefore, if the herd is all strong there should be no trouble with the disease.

Shelter for Swine.—Shelter should be provided for swine in summer in the form of shade; in winter for protection from the cold.

A hog house should be convenient for those who have the care of the hogs, should keep the hogs dry, protect them from cold winds, and be warm. It should be so placed that the sun may shine into the pens where the young pigs are in the spring and the fall. Any kind of a house that supplies these conditions from a straw shed to an expensive structure of architectural beauty is all right.

A hog house designed by the author is discussed in his book "Swine" published by the *Breeders' Gazette*, of Chicago. This is built facing the south with windows so arranged that the sun will shine into the pens on both sides of an 8-foot alley

running through the middle. The roof on the south part is flat and the windows throwing the light to the north side are in the wall to the south of the alley and extending up from the roof over the south row of pens. This roof is 6 feet on the outside or 7 feet next to alley from the floor. The inside of the house is provided with wire partitions so as to allow free circulation of air and to keep the hogs in view of each other and of the attendant. The building is 30 feet wide and is ventilated by windows and doors.

Time to Breed.—Sows should be bred so as to bring their pigs at the desired time. The period of gestation is about 114 days. The spring pigs should come as early as possible so the fall litter, when one is produced, will not be too late. The fall pigs should have a good start when cold weather comes.

With early spring pigs better shelter is needed than with those that come a little later. It is a good plan to have the old sows farrow early and then farrow again in the fall and to allow the young sows or gilts to farrow later in the spring and then rest up during the rest of the year and finish their own growth. Those that do not prove good should be fattened and sold.

Black Teeth.—When pigs are born they have two long brown or black teeth on each side of both upper and lower jaws. These should be cut off as soon as the pigs arrive. This can be done with a pair of molar forceps, pincers, etc. If these teeth are not removed the pigs in fighting for a place at the udder will injure themselves which may give the pigs a severe setback. Or they may irritate the dam so that she refuses to allow them to suck.

Ear Marks.—Pure-bred pigs should also be marked as soon as born. This can be done by clipping nicks in the ears with pinchers made for the purpose. Clipping helps to identify the pigs afterward.

Castration.—Castration is best performed on pigs when they are from four to six weeks old. This will give the wounds a chance to heal before the pigs are weaned and will result in the least setback. It can be done at this time with the least work. Pigs that are to be used as boars should be reserved.

Castrating can be performed at any time and even on an old boar without any danger. A cool day should be selected in summer when it is not too muddy or too dusty. In winter a warm day should be selected. After the operation, which should be performed with hands and knife well disinfected, a little of the disinfectant solution should be put into the wound. A 3 to 5 per cent. solution of the coal tar dips or of carbolic acid is good for the purpose.

In castrating a pig ruptured in the scrotum the skin only is opened after the intestines have been pushed back into the abdominal cavity. The membrane containing the testicles is worked out through this opening and drawn out several inches. It is then firmly tied and cut off below the place wheré tied. The string is left long enough to hang out.

Weaning.—Pigs may be weaned early or late. But in the author's experience two months was found a good age. The best plan is to leave the pigs where they were before weaning and to take the sow away. The sow should be put on scanty feed for a few days to let her dry up without udder trouble, and the pigs should be fed three times a day for a time at least. The feeding should be slowly and gradually changed.

The pigs should be fed for about a month before they are weaned. They will learn to eat when they are about a month old and should then be fed. They can at this time eat along with their dams and enough trough room for the purpose should be provided. A growing ration should be used at this time for sow and litter and afterward with the litters.

Scours.—When pigs are properly fed they do not get the scours. But if they do have the trouble, they should have a physic and be fed out of well-cleaned and disinfected troughs. Salts, castor oil or raw linseed oil may be used. While the pigs are still with their mothers these materials are fed to her. Later they are given to the pigs direct.

Thumps.—This is an ailment of small pigs and is caused by a lack of exercise. A sow and her litter may be left in a pen safely till the pigs are about two weeks old. Then they should be taken out and given more range. If they are kept confined much longer than this there is danger of thumps. The symptoms are a jerky motion in the sides in breathing similar to

heaves in a horse. There is no cure and the difficulty should be prevented with exercise.

Lice.—Sometimes pigs are troubled with lice. These are best removed by dipping the hogs in crude oil. The hogs are driven through a dipping vat nearly filled with water with a layer of the oil on top. Coal tar dips are also used but are not so effective as the crude oil. An oil spray or rubbing with oil is also good. In some of the European countries a crude castor oil is used. This is poured with a can along the back of the hog. As it works its way down the side of the hog the lice are covered. This kills them by covering their breathing pores.

Worms.—When hogs are wormy they look unthrifty and sometimes cough. Wormy hogs should be properly fed, their ration containing mineral substances. A crop of pumpkins grown in summer and fed to the hogs in the fall is not only one of the best and cheapest feeds to be had but will also remove worms. Commercial worm remedies are also available but prevention with minerals and pumpkins is preferable.

Rooting.—By rooting hogs not only get mineral substances but also palatable feeds. If pastures are destroyed by this habit it may be prevented by putting rings into the snouts of the hogs. The single rings are best.

Abortion.—Occasionally hogs are afflicted with contagious abortion similar to that in cattle. The disease should be treated as in cows. Constitution and vigor should be used as a preventive. Isolation and disinfection are helpful. The worst cases should be disposed of. Hogs become immune to the disease in time.

Tuberculosis.—Hogs are subject to tuberculosis. The disease works much more rapidly with hogs than with cattle and can be prevented by not feeding tuberculous feeds. Milk from tuberculous herds and from creameries should be guarded against. It should be sterilized.

Hogs contract tuberculosis only by ingestion, by taking the germs into the digestive tract. This makes it easier to fight the disease with hogs than with cattle.

Marketing.—Hogs should be marketed whenever they are in fit condition. In other words, they should be fed with the time at which they are to be marketed in mind. When a hog

has once been finished it can no longer be fed profitably and should be sold.

Hogs may be sent to market directly from the farm, may be sent through a shipping association or may be sold to country buyers or shippers. When hogs are shipped in summer it is a good plan to put a few cakes of ice in the center of the car to prevent overheating. A car should not be too heavily loaded in warm weather.

Grinding Feeds.—When corn is used as a feed for hogs it can be fed to advantage either whole or ground. Grains like oats, barley and rye are better ground. There are other fine hard seeds that should also be ground. When feeds are ground for pigs they should be ground into a fine meal.

Grinding is resorted to frequently to induce the pigs to drink more water in winter. Finely ground feed in warm water will give pigs the water they need in winter when they are not likely to take as much as they should.

By grinding and mixing, certain concentrated protein feeds can also be better distributed among the animals in a herd.

TYPE IN SWINE

Swine are meat-producing animals and should be long in the body, especially from the shoulder to the rear. All of this part of the carcass is high-priced meat and the more of this that can be had in proportion to the part in front, the more valuable is the hog. Swine, like cattle or sheep, should be good in constitution, quality, covering of lean meat, size, etc.

Strength and vigor are necessary to enable a hog to resist disease and to grow rapidly and economically. The quality should be fine but at the same time not fine enough to produce delicacy.

Swine are considered as the fat-producing animals of the farm. Nevertheless when one goes to the meat market to buy a piece of meat it is bought for the lean it contains and not for the fat. Hogs, then, should be bred for as much lean as possible. Fat can be put on by feeding to the extent desired in any case. Size is of importance as it enables one to produce pork more economically.

There are two principal types of swine, namely, the bacon

type and the fat or lard type. The former is well developed in lean-meat production and is sold before it gets very fat. The latter naturally produces more fat and is also fed to be fatter.



FIG. 44.—Tamworth sow. (From "Swine" by author for *Breeder's Gazette*.)



FIG. 45.—Large Yorkshire boar.

The tendency, however, even in lard hogs is to breed those that produce more lean.

Vigor and Breeding.—Two of the most important points in swine are vigor and breeding. By breeding is meant especially the influence of feeding and environment of the ancestors.

Pigs seem to be very plastic. Characteristics seem to be acquired very readily and also transmitted to the offspring.



FIG. 46.—Large Yorkshire sow, two weeks before farrowing.



FIG. 47.—Berkshire boar, showing length of body.

Therefore, if one's hogs are to do well they should be from ancestry that were strong and vigorous and that grew rapidly and economically.

BREEDS OF SWINE

In swine the matter of breed is of very secondary consideration. The principal considerations are size, vigor, breeding and feeding. The man should choose the breed he likes best—



FIG. 48.—Berkshire sow. (From "Swine" by author for *Breeder's Gazette*.)



FIG. 49.—Chester White sow. (From "Swine" by author for *Breeder's Gazette*.)

can work with to the best advantage, just as the artisan chooses the material he prefers.

The smaller breeds on account of lack of size seem gradually

to be disappearing. The principal breeds in the United States today which may be considered as standard are as follows: Tamworth, Large Yorkshire, Berkshire, Chester White, Hampshire, Poland China, and Duroc-Jersey.

Tamworth.—The Tamworth breed is of the bacon type. These hogs have rather long legs, a long snout and are a large breed. They are not very broad in the body, which is char-



FIG. 50.—Hampshire (thin rind) sow. (From "Swine" by author for *Breeder's Gazette*.)

acteristic of the bacon type. They are red in color and as far as known are a direct decendants of the wild boar. They are, therefore, a pure breed in every sense of the word. Tamworths came into existence in Great Britain and have been an improved breed many years. The breed is a good one for those who like the bacon type.

Large Yorkshire.—The Large Yorkshire breed of swine was developed in England. The breed was made by crossing hogs of southern Europe of high quality on large coarse pigs of England. The breed is of the bacon type. It is also long in legs but medium in snout. The ears are upright or forward

leaning and the color is white. This is a good breed of hogs for bacon production and is extensively used in Canada and other bacon-producing countries. The animals are longer in body than the Tamworth and not quite as wide in ham or long in rump. They furnish the standard Wiltshire side to the bacon trade.

Berkshire.—Berkshires are an old improved breed from England. The breed was developed by crossing highly im-



FIG. 51.—Poland China sow. (From "Correspondence Course in Swine Husbandry," by author for Correspondence College of Agriculture, Fort Wayne, Ind.)

proved hogs from southern Europe on large coarse hogs of England. The southern hogs used for this purpose were the Neapolitan, Siamese and Chinese. These probably date back to ancient civilizations.

The Berkshire is a black hog with six white points. These are the four feet, the tail and parts of the face or snout. While this is the characteristic color, sometimes some of the points named are black. The ear of the Berkshire is upright or forward leaning and the snout rather short and blunt with some dish in the face.

This breed belongs to the fat or lard type but is characterized as a long-bodied, lean-meat hog. The hogs develop a large amount of lean and are frequently used for bacon production. They are very active. This is one of the oldest and most highly improved breeds of swine and therefore one of the best. It must, however, be kept under proper conditions. There is in this breed a tendency to revert to the original types consequently breeding is somewhat difficult.

Chester White.—The Chester White breed was developed in Pennsylvania. It is a white breed of the fat or lard type.



FIG. 52.—Duroc-Jersey sow heavy in pig.

Its snout is medium and the ears tip over at the point. It is a popular breed. It was made up by a mixture of several breeds which were originally brought over from Europe by early immigrants.

Hampshire.—The Hampshire breed came from Europe or England at an early date, but was developed in its present form in the United States at a very recent date. It is black with a white belt around the front part, including the front legs. The breed shows considerable variation between the lard and the bacon types.

Poland China.—For many years the Poland China was the most popular breed of swine in the United States. It was developed in Ohio under corn belt conditions and is a composite of many other breeds and types. This mixture was so great and the blending of the characteristics of the different types so

complete that when the breed was brought out in the finished form it was in reality a new breed. It was a new breed adapted to the most highly developed corn- and hog-producing section of the world.

This breed is not over half a century old. As time went on, however, too much stress was laid on quality and early maturity. This resulted in small size, high cost of production and low prolificacy. On this account the breed fell into disfavor.



FIG. 53.—Duroc-Jersey sow in thin breeding condition.

At the same time, a few breeders kept in mind the value of size, and developed the large-type Poland China. About three or four years ago this stronger type of the breed became suddenly very popular and crowded the medium or fine type of Poland China out of the field. The Poland China has the fancy ear, two-thirds erect and one-third drooping. The snout is medium and rather straight and pointed. The color is black in the main with some white. One faction of breeders try to limit the white to the six points, feet, snout and tail, while others accept hogs with white spots on the body.

Duroc-Jersey.—The Duroc-Jersey was developed in the eastern part of the United States. New Jersey had red hogs called Jersey Reds and in New York there was a red hog called Duroc. Finally these got together and were called Duroc-

Jersey. This breed is red in color and belongs to the fat or lard type. It is a popular hog with the farmer as it is well suited to average conditions and when well cared for is a rapid grower. It is coarse in quality, however, and does not produce as high class a product as some of the other breeds. But in this respect rapid improvement is being made. Duroc-Jerseys have a rather heavy, straight snout and somewhat heavy ears. These should be partly erect with the points tipping forward and outward.

In producing young, all the breeds are good if properly selected and handled. They should be selected from prolific strains with good constitution and good length of body.

SWINE FEEDING

It used to be thought if a man was no good for anything else he could still be a farmer and if he could do nothing else on the farm he could feed hogs. There is some truth in this but at the same time there is no class of animals on the farm where scientific feeding and handling can be used to any better advantage than with swine.

Swine will eat most anything and everything but thrive best on concentrated feeds. They can make good use of the by-products from the dairy herd, of the kitchen slop, and of spoiled and otherwise waste grains. On this account a few hogs on a farm are very profitable. From the standpoint of economy of production also the hog is very good. It is about equal to the dairy cow and has the advantage of requiring less labor.

In feeding pigs it must not be forgotten that the young animals and the breeding stock need a great deal of exercise. The next thing in order should be plenty of mineral matter such as salt, bone meal, ground limestone, or air-slacked lime, hardwood ashes, and charcoal.

These materials are needed for bone construction and in digestion and metabolism. Hardwood ashes, or if these are not available, a small amount of a weak solution of concentrated lye, may be used to neutralize the acids produced in digestion. The charcoal is an absorbent and its function is not entirely known but it is very much relished and must serve

a purpose. Hogs should have sufficient water and, as growing animals, they need protein. Too much protein, however, is harmful.

Milk is a protein feed but the pigs should not be given as much of this as they will eat. For young pigs after weaning a good ration can be made by taking half milk and half water and putting enough of a mixture of ground grains into this to make a thin slop. The grains used in such a case should be corn, barley, rye, oats, etc. If no milk is available, some peas or oil meal can be used to supply protein. But these should be only from one-third to one-fifth of the grain mixture.

Tankage is a packing-house product and is very rich in protein. A 40 per cent. protein tankage can be used about as peas. But a 60 per cent. protein tankage must be used in smaller quantities. Mature hogs do not need much protein so should be fed more on the carbohydrate feeds.

Hogs are very fond of grass and the legumes such as alfalfa, clover, peas, vetches, etc. In winter they will also eat a good deal of the legume hays. They should be given as much of this roughage as they will eat. Wheat bran is a good roughage for mature hogs that are being maintained and is also good as part of a ration for growing pigs. Wheat middlings are good for all purposes.

Pigs up to about five months old will eat too much concentrate if they are given all they want. They should then either be fed less or be given more roughages. In feeding some pigs experimentally one time, the author was threatened with prosecution by the humane society because it was said that the pigs were being starved. These same pigs, however, weighed 300 pounds per head when they were eight months old.

Brood sows should be fed according to the amount of work they do. If they raise two litters a year or large litters they need to be fed more freely than if they raise only one litter or small litters.

CHAPTER XII

POULTRY

The subject of poultry husbandry is one of almost universal interest. Poultry and poultry products are handled on a large scale in a few parts of the country, but most of the poultry is handled as a side line by farmers or others. Many times the women of the farm look after the poultry interests.

A large poultry farm well managed is undoubtedly profitable but a large flock cannot be handled after the manner of a small flock on the ordinary farm. Under farm conditions the labor in caring for poultry does not as a rule cost very much. Such labor is performed by children or other members of the family at odd times. The feed requirement of the farm flock is slight. Many times during the summer a flock can live upon feeds that are picked up and that would otherwise go to waste. This makes farm poultry keeping very profitable.

The farm poultry not only is a source of pleasure and profit but it supplies the farmer constantly with fresh eggs which, as everyone knows, are much better than stale ones. Eggs cannot even be hauled a few miles on a wagon as when going to market without reducing their value in flavor, palatability, etc. The poultry house in the country also serves as the farmer's market for fresh meats.

The fact that fowls do not grind their feeds in the mouth, but in the crop makes it necessary for them to have grit. This helps to grind the feeds eaten.

Fowls are bred, fed and given an environment similar to that of the farm animals. Most classes of poultry are noted for their activity, consequently must be given a wide range so that they may get an abundance of exercise. This is especially true for the breeding flock and for the young birds. Fowls as well as animals if they have been properly bred and developed can be fattened in small enclosures.

The rest of this chapter was prepared by Prof. C. E. Brown, head of the poultry department, University of Minnesota, Northwest School and Experiment Station, Crookston, Minn.

THE IMPORTANCE OF EXERCISES FOR FOWLS

All classes of fowls require a certain amount of exercise to keep them in good health. Many poultry keepers appear to forget this, especially in winter when the fowls are confined to pens. As a rule their method of feeding is to scatter the food on the bare floor or feed it from troughs thus enabling the fowls to eat it quickly with the least amount of effort. A safer rule to follow when feeding, and one which should keep the birds in excellent condition, is to compel them to scratch in deep dry straw for all whole grain fed, or in other words, about two-thirds of the ration should be fed in the litter. Ducks and geese, which naturally do not scratch, require roomy yards and a pond or trough to supply them with the necessary means of exercising.

FEEDS AND FEEDING

If we would but stop to consider what fowls live on when at liberty during the summer months the problem of feeding would be very much simplified. On their daily rounds, they secure grain food, vegetable food, meat food, grit and water, all of which must be supplied in a clean, wholesome condition when they are confined to houses and yards if we would have them healthy and thrifty.

Grain.—Wheat, which is one of the best grains for poultry, is probably the most popular with poultrymen in the northern part of the United States from the fact that corn is not yet extensively grown in these parts. Fowls of all kinds relish it.

Wheat bran is much used in mashes and is often fed by itself dry, from a food hopper. It helps materially in adding bulk to the ration. Shorts is also much used in mashes and is splendid as a mixture for boiled vegetables or cooked meat.

Corn, which is more extensively fed to poultry than any other grain, is much relished by them. Care must be exercised in feeding it as it is heating and fattening. It is best adapted to winter use. It is fed whole, ground and cracked.

Oats, from its composition, should be an ideal poultry food. But owing to the large amount of hull, fowls do not relish it like other grains. However, its palatability can be wonderfully improved by soaking it in water for several hours or by allowing the grain to sprout.

Barley, either whole or ground, is successfully fed by many poultrymen. Although it is hard and carries a large amount of hull, it is quite often ranked next to wheat in feeding value.

Buckwheat is much thought of in some localities as a food for laying hens. And from its close resemblance to corn in fattening properties makes a fine addition to a ration for fattening fowls.

Millet seed, though small, is excellent chicken feed but must be fed in small quantities on account of its richness. It is splendid when mixed with other grains, as a chick food.

Meat Foods.—Meat foods are usually the most expensive poultry foods. They are given as a substitute for the worms and insects which form the natural summer food for fowls when on free range. Best results in egg production, or growth in young stock cannot be obtained unless some animal food is given. Even when fowls are on free range it often pays to feed them a small amount.

There are many forms in which animal food can be supplied to poultry. Skim milk and buttermilk are among the best and most economical of these. Commercial beef scraps, butcher scraps, green cut bone and cooked refuse meat are also excellent but as a rule are difficult to obtain and are expensive.

Green Feeds.—When fowls are on free range they eat an abundance of green food in the form of grass, clover, weeds, and roots. This must be supplied to them in winter or when they are shut in pens and fenced in small bare yards. Cabbage, mangels, turnips, rape, clover hay, and sprouted grains are among the many forms of green food available for poultry and should be fed judiciously once every day.

Grit and Oyster Shell.—All classes of poultry require grit and oyster shell. They have no teeth, therefore they must be supplied with coarse sand or crushed rock in some form to aid digestion. Oyster shell is required more particularly by laying hens. They require a large amount of lime for use in forming

egg shells. Lime can best be supplied as crushed oyster shells or clam shells. These can usually be purchased at reasonable prices from local grocery men or dealers in poultry supplies.

Feeding Laying Hens.—The general rule for feeding hens for egg production is to give them three meals a day. A mixture of whole grain is scattered in deep litter on the floor in the morning and evening. At noon a wet mash is given or if the dry method of feeding is practised the task of feeding the noon meal is dispensed with as the mash is fed dry from hoppers kept filled and open at all times. Green food is given at noon and grit, oyster shell and water are kept constantly before them.

Feeding Chicks.—Little chicks should not be fed until they are at least forty-eight hours old. Nature provides them with a portion of the parent egg within their systems to sustain life for several days. They should be fed sparingly at first and often. Some poultry men recommend feeding every two hours during the day for the first week, alternating with a wet mash and a cracked grain mixture. After that the number of meals per day is lessened gradually until at the age of three weeks three feeds a day are given, cracked grain morning and night and mash at noon. This latter practice is continued until the chicks are ready for winter quarters in the fall when a gradual change is made to a ration suitable to mature fowls.

FATTENING POULTRY

It is a wasteful practice to sell poultry without fattening them. Buyers always pay a premium for well-fleshed fowls. As a rule ten days or two weeks of liberal feeding is all that is necessary to put most fowls in first-class condition. Chickens are either fattened in crates made for the purpose or in small pens. Each method has its successful advocate. If fed in crates they are given a mash composed of ground grains moistened with milk. When fed in pens they are usually fed whole or cracked grains and some form of animal food. Care must be taken in either case to feed sparingly the first day or two, after which they should be fed all they will eat up clean three times a day until fattened. Turkeys, ducks and geese are almost always fattened in pens and yards and require about the same length of time to fatten as chickens.

THE INCUBATOR

The numerous styles of incubators manufactured today are so well perfected that the selection of one is largely a matter of personal choice. There are two types offered for sale, the hot-air and the hot-water machines. The hot-air machine appears to be the favorite among most poultry keepers owing chiefly to the fact that there is practically no limit to its life of usefulness. The hot-water machine, though highly recommended by many, is apt to give trouble sooner or later, through leakage unless the water pipes are made of high-class material. When operating an incubator the manufacturer's directions should always be closely followed as he knows best the requirements necessary for a successful hatch with his particular make of machine.

The Brooder.—The advice regarding the selection of a brooder is similar to that of an incubator. There are many good makes and all of them will rear chicks provided the operator is careful in following the accompanying directions. A brooder is an economic necessity when chicks are raised in large numbers due to its saving of labor and when a no sitting variety of fowls is kept its services are indispensable.

THE SITTING HEN

A great deal of the so-called trouble with sitting hens is that we do not understand them or have not the patience or perseverance necessary for success. When a hen becomes broody she should be gently removed, preferably in the evening, to a quiet place where a good roomy nest has been prepared for her. This nest should be at least 14 inches square and 6 inches deep. It should be filled with about 4 inches of fine dry earth slightly hollowed and lined with a small amount of chaff or fine hay. Then when the hen is placed on the nest she should be set on a few stale or china eggs for a day or so or until she takes kindly to her new surroundings after which the good eggs may be given to her. She should be thoroughly dusted with insect powder at least twice during the hatching period to destroy all vermin upon her. She should be let off the nest for a few minutes each day for food and water.

CARE OF EGGS FOR HATCHING

It is important when saving eggs for hatching to keep them in as perfect condition as possible. For this reason they should be gathered often during cold weather to prevent freezing or chilling. They should be kept in a cool place free from bad odors of any kind and the temperature should range below 70 degrees Fahrenheit and above 40 degrees Fahrenheit. If kept in a temperature above 70 degrees they deteriorate rapidly. From ten days to two weeks is as long a period as it is safe to hold them before setting and during this time they should be turned daily.

PRESERVING EGGS

Eggs are usually preserved in the summer months when they are cheapest and are held till cold weather sets in or until the price goes up. There are numerous methods for preserving eggs but probably the most successful of all of them is what is known as the waterglass method. This consists in dissolving one part of waterglass (sodium silicate) in nine parts of water which has previously been boiled. This liquid is poured over the eggs which have previously been placed in earthenware jars or tubs. For best results the eggs should be strictly fresh when placed in the solution and they should be stored in a clean cool cellar.

POULTRY HOUSES

One of the chief essentials to success in poultry keeping is the possession of a suitable poultry house. This should be economical of construction, convenient, comfortable, dry, well lighted and well ventilated. Improper housing affects the vigor and vitality of fowls. This is seen in small egg yields, poor hatches and weak chicks. Therefore, they must be kept in a healthy condition if they are to be profitable.

Location.—A poultry house should preferably face south. It should be located on rather high ground where good drainage can be assured, otherwise if the site is not a dry one it should be made so by under drainage or by grading so as to run the water away from the building. It must be remembered that dampness is always fatal to fowls.

Foundation.—The foundation is best made of concrete as it is more durable and economical in the long run than any other form of construction. It should be made deep enough to prevent animals burrowing beneath and gaining access to the inside and high enough to prevent surface water from running into the house. The walls should be heavy enough to support the building placed upon them.

Floors.—There is a diversity of opinion among poultry men as to which is the best floor for a poultry house. Some prefer earth, some wood, and others concrete floors. Earth floors to be satisfactory must be protected by rat-proof foundations, they must be graded high enough above the outside level of the ground to make them dry, and on some soils that are very moist several inches of crushed rock, cinders or coarse gravel must be filled in below the surface of the floor to break up capillary attraction which is the cause of moisture coming up from below. Wood floors are not lasting, they are difficult to keep clean and sanitary and are apt to harbor rats and mice beneath them. Concrete floors, if made smooth and if the grading beneath them is made the same as we have described for an earth floor, no doubt will prove satisfactory. There will be no difficulty about them being cold if kept covered with a little earth or straw.

The Walls.—The walls should be made tight. They should be high enough so that the ceiling will not be so low that a person doing the work would have to stoop. The construction of the walls will depend upon the climate in which they are to be erected and also upon the amount of protection afforded from winds, by trees or other wind breaks. In most parts of the United States single board walls are sufficient for the comfort of the fowls but in cold sections where low temperatures and high winds prevail double walls must be used.

The Roof.—There are several good types of roofs in common use, namely, the shed roof, the gable roof, the combination roof, and the semi-monitor roof. The shed roof is the most popular style of any and is easiest to build. The gable roof provides a large garret space which is often filled with straw, making the house warmer and dryer. The combination roof is a type midway between a shed roof and a gable roof and

is supposed to combine the good features of both. The semi-monitor style is commonly used on houses that are extra wide and where a central alleyway with pens on each side is desired. The upper windows light the rear pens and the lower the front pens.

Ceiling.—It is seldom desirable to ceil the roof of a poultry house because of the extra cost entailed. This is especially true of the shed-type house. However, in building the gable or combination roof it is necessary to use tee beams to strengthen it. In this case unless the ceiling is boarded the fowls are apt to use these beams for roosting. When straw is stored in the attic for the purpose of keeping the house dry it can be made much more effective if the ceiling boards are spaced an inch or two apart to permit the moisture-laden air to circulate freely through the straw.

The Windows.—A safe rule to go by when planning the windows in the house is to allow about 1 square foot of glass to every 16 square feet of floor space. Too much glass makes a house cold at night and too hot during the day. The position of the windows is very important; they should be high and placed up and down, rather than horizontally and low. They should be placed high enough so that on the shortest day of the year the sun will shine well up on the north wall. This will insure a plentiful supply of sunshine for the fowls during the time they are confined to their pens on account of winter weather.

Ventilation.—Most poultry houses when properly built do not need ventilators. The large amount of air space in a poultry house makes the systematic change of air so uncertain and unsatisfactory that many experienced poultrymen who once used so-called scientifically planned ventilating systems have gone back to the use of the windows. The amount of fresh air being regulated by opening or closing the windows according to the temperature outside. On cold stormy days or nights coarse muslin or burlap is placed over the open space in the windows to prevent drafts and also the snow from coming in. During warm weather sufficient ventilation can be obtained by removing the windows.

The Roosts.—The roosts should be placed well away from

the windows to avoid drafts. For this reason the north side of the house is usually the place for them. They should be placed at the same level to prevent crowding of the fowls which is so customary, where they are arranged at different levels. A platform should be placed under the roosts to catch the droppings, far enough below to permit cleaning without re-



FIG. 54.—Barred Plymouth Rock rooster. (Kaupp.)

moving the roosts. The working rule for roosting space is to allow 6 to 8 inches for each fowl with the roosts placed 12 to 15 inches apart.

The Nests.—The nests should be convenient for gathering the eggs and should be removable for cleaning and disinfecting. They must be somewhat dark to prevent the hens scratching the nesting material out and thus breaking and eating the eggs.

In constructing the nests one should allow from 12 to 15 inches head room and the nests should be about 14 inches square and 6 inches deep. It is a good policy to make large

rather than small nests. Hens like large nests and they should be deep enough to prevent the eggs from being rolled out but not so deep that the fowls will break eggs when getting into the nest.

Alleyways.—Alleyways are objectionable for the reason that they occupy much valuable floor space which might be utilized for more fowls or in giving those usually kept more room. It is a mistaken idea to think that they always save time in opening and shutting gates because in many instances



FIG. 55.—Pen of Barred Plymouth Rock hens.

the attendant has to go inside the pens anyway to do the feeding and look after the hens. Unless the feeder goes in among his fowls occasionally they become nervous and timid and he cannot keep in close touch with them, as is possible if he walks through the pens while going his daily rounds.

The Dusting Box.—Dusting is as beneficial to the fowl as bathing is to the human being. By dusting, fowls scour off the scurf and scales from the skin and rid themselves of vermin. A good dusting box should be provided for every flock more especially when they are confined in their pens. A good place

for a box of this kind is before a south window where the sun can shine directly into it. Dry fine sandy loam or road dust or sifted coal ashes make splendid dusting material.

Food Hopper.—Food hoppers should be constructed to prevent fowls wasting the contents as much as possible. They should be made with rather wide deep-slatted troughs and suspended on a platform a foot or so above the floor. If the hoppers are made with sloping top to prevent chickens roosting on them the task of keeping them clean will be materially lessened.

Drinking Vessels.—Drinking vessels should be of a style



FIG. 56.—White Plymouth Rocks.

easy to clean and keep in a sanitary condition. One of the best types in use and a cheap one is a galvanized or enameled kitchen pan 4 inches deep and wide enough for the purpose required. The drinking vessel should be protected from dust and litter by a slatted cover and also should be raised above the floor similar to the food hoppers.

The Size of Poultry House.—The working unit for estimating the size of a poultry house is the number of square feet of floor space required for each fowl. A safe rule to follow when figuring the capacity of a house is to allow from 5 to 8 square feet of floor space for small flocks of 25 fowls or less and from 4 to 5 square feet of floor space for fowls for larger flocks.

MITES AND LICE

Mites and lice are two different kinds of vermin which infest poultry. The mite lives in the cracks and crevices of the poultry house and attacks the fowls while they are roosting. It lives by sucking the blood from the fowl. The louse lives on the body of the bird and gains its living by feeding on the scales and scurf of the skin or plumage. Mites, unlike lice, cannot be effectively destroyed by dusting the fowls with in-



FIG. 57.—White Leghorns.

sect powder or by providing them with a dust bath. They must be attacked in their haunts by spraying or brushing a liquid preparation such as kerosene or whitewash or some good disinfectant.

TYPES AND BREEDS OF POULTRY

The American Standard of Perfection recognizes over 100 breeds and varieties of poultry but for convenience sake we shall classify them as to utility, namely, general-purpose breeds, egg breeds, and meat breeds.

General-purpose Breeds.—Chickens coming under the heading of general-purpose breeds may be described as hardy, active, thrifty fowls of medium size and weight, capable of

putting on flesh and producing high-class market eggs economically. They are usually marketed at the age of five to seven months when they should dress when fattened from 5 to 7 pounds in weight.

Egg Breeds.—The so-called egg breeds of chicken are small active hardy fowls, which mature quickly, make excellent broilers when dressed at the age of ten or twelve weeks, and are very prolific layers of large white eggs. They are often



FIG. 58.—Rhode Island Red hens and pullets.

spoken of as non-sitters though a small percentage of them do sit and make excellent mothers.

Meat Breeds.—The meat breeds of chickens consist of the largest fowls. As a rule they are classed as fair layers of large brown eggs. They are splendid sitters and mothers and on account of their abundant plumage are capable of withstanding extreme temperatures of cold without materially affecting their egg yield. In sections of the country where capons are in demand, the meat breeds are considered the best for the production of this class of dressed poultry.

Classification.—The principal breeds of chickens may be summarized as follows: General-purpose hens, Plymouth Rocks, Wyandottes, Orpingtons, Rhode Island Reds, Hou-

dans; egg breeds, Leghorns, Minorcas, Hamburgs, Red Caps, and Andulasians; meat breeds, Brahas, Cochins, Langshan, Tavoralle.

TURKEYS

Turkey raising is one of the most profitable branches of the poultry industry. In the newer sections of the United States where abundance of range is available and where diseases are not established turkeys grow and thrive to a wonderful degree.



FIG. 59.—Bronze turkeys. A small farm flock. (Photo from Earl Horswill, Black River Falls, Wisconsin.)

However, for many years, breeders experienced great difficulty in raising them to marketable age due to the fact that diseases are so prevalent. Indeed, in many localities the industry is almost at a standstill. The United States Department of Agriculture and the Experiment Station at Rhode Island after exhaustive experiments and investigations recommend that in infected districts turkeys should be reared on new or cultivated ground, with plenty of range. Where this advice has been put into practice fair success has been attained.

Of the eight or ten varieties of turkeys commonly bred in the United States the bronze appears to be the most popular owing chiefly to its large size and hardiness. The White Holland, a medium-sized turkey, is probably next in popularity. It is noted for its docility and on markets where a smaller bird is in demand it finds a ready sale. The Naragansette, Slate, Black, Buff and Bourbon Red varieties as yet are bred in comparatively small numbers by farmers though they are quite popular with fanciers.

Housing Turkeys.—Turkeys do not need as warm houses as chickens. In fact, they seldom thrive as well as they do when roosting in the open. Even in very severe winter weather the common practice of many of our leading turkey breeders is to allow the breeding turkeys to roost in a good thick grove of trees or to build a shed with the south side left open. In the northern sections of the country, more especially in the prairie sections, turkeys should be provided with shelter to protect them from the cold winds and blizzards. Their feeding and scratching grounds should be littered with straw to induce them to exercise and as a protection for their feet in zero weather. They should never be housed or fed along with other fowls as they are so apt to injure them through fighting.

Feeding Turkeys.—When turkeys are at liberty in the summer time they require very little grain. Some breeders feed only enough to keep them from wandering away too far from the buildings. During winter the usual practice is to feed a mixture of whole grains twice a day with water and grit within reach at all times.

Feeding Young Turkeys.—Young turkeys will not eat for the first day or two, hence they should be kept quiet during that period. When feeding commences a good practice to follow is to feed them similar to the method of feeding little chicks excepting that the young turkeys require more green food and need not be fed more than three or four times a day.

DUCKS

The duck industry of this country has developed wonderfully in the past twenty-five years. In the New England States and the Central States many large commercial duck plants

have been established where thousands of ducklings are reared for the market every year. These are hatched and reared artificially and are usually killed and dressed at twelve weeks of age.

Among the many popular varieties of ducks are the Pekin, the Aylesby, the Raven, the Cayuga, the Indian Runner, and the Muscovy.

Feeding Breeding Ducks.—Breeding ducks are usually fed on ground grains and mill feeds mixed with water or milk. Some duck raisers boil vegetables and other food for them but



FIG. 60.—Pekin ducks.

this is unnecessary as they do just as well on raw foods. Whole grain is often fed and ducks appear to thrive on it but they do much better and it is more economical if fed ground. They require plenty of green food every day as well as grit, oyster shell and plenty of water for swimming and drinking.

Feeding Ducklings.—Ducklings should be fed entirely on soft food and like other young stock should not be fed before they are at least twenty-four hours old. The first few rations should consist of bread moistened with milk or water or hard-boiled egg mixed with four times its weight of dry bread. After this a good poultry mash fed three or four times a day should be given. It is important to keep drinking water close by at feeding time as they require plenty of it along with

their food. Except in the case of rearing ducklings as breeding stock, they should not be allowed to swim as it has a tendency to keep them lean. Green food and grit should be fed daily to the ducklings provided they are not on free range.

GEESE

Unlike the duck industry, the rearing of geese in large flocks has not met with the same degree of success. It is true there are numerous large ranges devoted exclusively to the culture of geese but by far the greater bulk of the goose crop comes from the small flocks of the farms of the country. Geese are raised economically as they live almost entirely by foraging.

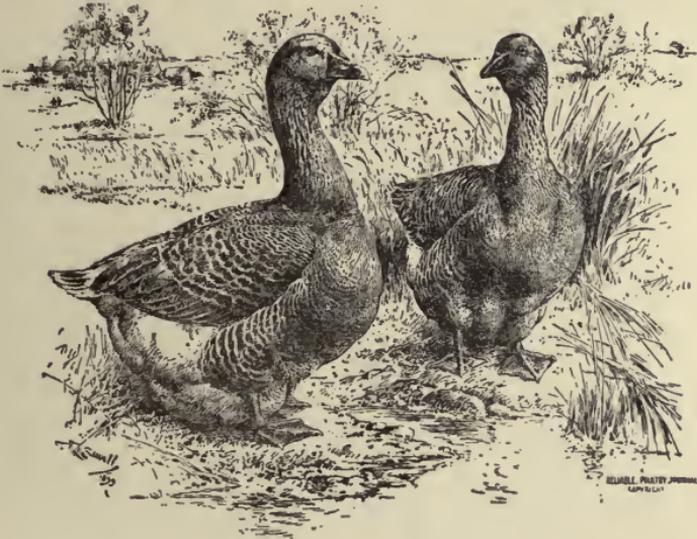


FIG. 61.—Toulouse geese.

The most common breeds of geese are the Toulouse, the Embden, the African and the Chinese.

Feeding Breeding Geese.—Breeding geese when kept in confinement should be provided with plenty of green food and not too much grain or they may become over fat. They require grit, oyster shells and water for drinking and swimming. These should be in constant supply. While on range the geese require little or no attention provided the pasture is good and only during the laying period would they be benefited by a small amount of grain each day.

Feeding Goslings.—Young goslings should be kept quiet and comfortable for two or three days, then they should be given a little soft food such as bread soaked in milk or water or a mash similar to that fed little chicks. At the end of a week's time if the weather is favorable and pasture is good they will thrive splendidly on the green food alone. Grit and plenty of water must always be within reach for them.

GUINEAS

It is only within recent years that guineas have been considered as of any importance beyond that of protecting the barnyard flocks from the ravages of hawks and crows and to this day many farm flocks are considered incomplete without the addition of a pair or more of these screeching birds. Whether the protection they afford extends beyond the mere fact that they sound a note of warning to the poultry keeper or his flock has always been a matter of doubt in the mind of the writer who has been a close observer of these fowls for many years.

The rearing of guineas as a commercial undertaking has not yet developed to any marked degree, though a constantly increasing demand for dressed fowls and eggs of the variety should open a wide field for enterprising poultrymen.

There are two varieties of guineas, the Pearl and the White.

PEAFOWL

The peafowl, generally supposed to be a native of India, belongs to the Grouse family and has long been domesticated. It is bred usually by people who admire the wonderfully brilliant plumage of the cock. The flesh is much relished by many but no great demand for it has ever warranted its being bred in large numbers for market purposes.

The male is almost as large as the bronze turkey and from tip of beak to end of tail he measures about 6 feet. The female is much smaller and of modest plumage. The male is often credited with being troublesome in the poultry yard, killing young chickens and ducks and even mature fowls.

PIGEONS

While pigeons are not usually mentioned when speaking of various kinds of profitable farm stock, still the possibilities of making them profitable are so marked that we believe we are warranted in a brief discussion of them.

There are numerous varieties of pigeons bred by fanciers but experienced breeders who rear them and sell them as squabs recommend only two varieties, the Homers and the Runts. These two breeds are usually crossed with the idea that the cross produces a finer quality of dressed product. The squabs are usually marketed when they weigh from $\frac{1}{2}$ to $\frac{3}{4}$ pound each. At these weights the producers realize from \$3.50 to \$10 per dozen for them.

Pigeons should be housed away from other stock. A loft or upstairs room, free from drafts and comfortably warm, makes an excellent coop for them. The interior equipment should consist of nests, perches, drinking and bathing fountains. About 2 square feet of floor space should be allowed for each adult bird. If the birds are to be confined in flight yards then twice as much ground space should be allotted each bird in the yards.

The manner of feeding pigeons is not unlike that of other classes of fowls. A variety of grains is usually fed. Cracked corn, wheat, oats, millet and buckwheat and other small seeds are used. A small supply of salt and grit should be kept before them at all times. As the squabs are fed by the old birds it is essential that the parents be well fed. The floor of the coop should be well covered with clean dry sand. This makes an excellent place for scattering the food.

CHAPTER XIII

SCIENTIFIC SWINE FEEDING

This discussion is based largely on research work by the author at the University of Illinois. It is a summary of, and somewhat similar to parts of earlier publications by the author, namely, "Swine," published by the *Breeder's Gazette*, Chicago: Illinois agricultural experiment station *bulletins* and *circulars*; and "A Correspondence Course in Swine Husbandry," published by The Correspondence College of Agriculture, Fort Wayne, Ind.

The principles outlined in this chapter apply to the feeding of other animals, once the necessary amounts of nutrients have been determined.

EXPLANATION OF TERMS

Nutrients.—The ingredients or compounds of a feed such as protein, carbohydrates, and ether extract or fat, and also mineral matter and water.

Digestible Nutrients.—Those portions of the nutrients that are absorbed in the alimentary tract and not passed out in the feces.

Coefficient of Digestibility.—The per cent. of a feed or of a nutrient that is digested. The total quantity eaten minus that appearing in the feces divided by the total quantity gives the coefficient of digestibility or the per cent. digested.

Concentrated Feed.—A feed that contains a comparatively large per cent. of digestible nutrients and a comparatively small per cent. of undigestible material, or in other words a feed that is not bulky.

Roughage.—The opposite of a concentrate. A bulky feed, or one containing a relatively large proportion of undigestible material.

Metabolism.—This is the process by which food is built up into living matter, and by which living matter is broken down

into simpler products within a cell or organism. The process goes on after the food is digested and taken into the system.

Protein.—Nitrogen compounds that are used in producing and maintaining the lean meat or muscle tissue and to a lesser extent the bone tissue of the body. Bones also contain considerable ash or mineral matter.

Crude Protein.—Total nitrogen compounds ($N \times 6\frac{1}{4}$) or what is frequently called protein. This includes the true protein and the non-protein. The latter cannot be used by the animal as a substitute for protein.

Factor of Waste.—When a pig is fed more than a certain quantity of nutrients, especially protein, it does not use the excess as economically in producing gains in live weight. The portion lost on account of this less economical use is what is here termed the factor of waste. An animal given too much protein establishes a more or less permanent habit of waste.

Feeding Standard.—A feeding standard is a statement of the quantities of the various digestible nutrients necessary for the development and maintenance of an animal. As the term is used in this volume, it includes water and mineral matter.

NATURE OF SWINE-FEEDING PROBLEM

Swine feeding is a process of construction and maintenance. As far as construction is concerned it is similar to the building of a house. Certain amounts of different kinds of material are necessary. The amounts of these vary considerably, being large in some cases and small in others, but the materials that are present in small amounts are just as important as those that are present in large amounts. So it is with a hog and with other animals.

During the growing period of an animal both construction and maintenance are required. As soon as a given amount of body weight has been produced it has to be maintained and an additional amount is being produced at all times during the growing period. For the best results material must be brought in that can be used by an animal in the building process. An animal must make bone, lean meat or protein tissue, and fat meat or non-nitrogenous tissue.

It is true that an animal can substitute to some extent and

use different nutrients or materials for different purposes, but this substitution is by no means unlimited. An animal cannot use anything else in place of protein, mineral matter, or water. The substitution, therefore, applies only to carbohydrates and fat, and, as seen by the writer, this is only applicable to the use of these materials after they are digested, absorbed from the digestive tract, and taken into the circulation. Since these two different materials are handled in the processes of digestion and absorption by entirely different parts of the mechanism in the body, it is clear that best results can be obtained only if the proper amount of each is being fed.

The animal body as a whole, therefore, in the use of its food materials is somewhat similar to an imaginary threshing machine that would be made to thresh oats, wheat, beans and clover seed all at the same time. If the largest amount of work is to be done by such a machine it must be fed to the fullest extent in all parts. That is, if only beans and wheat are being threshed and the oats and clover seed parts of the machine are allowed to run empty, maximum results will not be obtained. The parts of the mechanism of the animal body that are not in use apparently also seem gradually to lose their powers and later in life are not able to do the required amount of work.

During the growing period an animal is necessarily developing a considerable amount of protein material in the form of muscles as well as in the bones and other tissues. The bones, however, are largely (two-thirds, in the mature animal) composed of mineral matter, therefore, a large quantity of material that can be used for this purpose must also be supplied.

After the structure is once made and the animal has attained its full growth a given amount of material is always necessary for maintenance. That is, the animal body is a living machine and is constantly using up material. For this purpose a small quantity of protein is absolutely necessary. More, of course, can be used, but a minimum requirement of protein supplemented with carbohydrates and fat with water, is more economical. In these respects the animal body as a machine is quite dissimilar from a mechanical machine. As soon as a piece of work is done an engine will not use any fuel for main-

tenance. The animal body uses material not only while it is doing actual work—putting on gains in live weight or doing labor of various kinds, but for maintenance at all times.

This being true, it emphasizes the fact that the quicker a pig can be brought up to a desirable market weight, other things being equal, the less feed will be used for maintenance and the more economical will be the gains made. Furthermore, as an animal gets older it gradually loses its power to eat and digest large quantities of feed, consequently the factor of maintenance becomes a gradually more important factor as the animal grows.

MINERAL MATTER

A pig must have a certain amount of mineral matter, wood ashes, for example. In an animal this material is used for two purposes, for bone construction and for the general metabolism or working of the machine, as for instance, digestion, absorption, circulation, etc.

Those mineral substances that are gritty, or those that have very sharp edges and corners, assist in destroying worms in the digestive tract. Since mineral matter is used very largely in bone construction, it is clear that a pig during the growing period should have more of this material than after maturity. During the latter time only enough is necessary for maintenance or that which is used in the general metabolism or work of the animal machine.

Sources of Mineral Matter.—Practically all feeds contain some mineral matter but the amount present in different feeds varies greatly. Other sources of mineral matter for swine are the soil itself and the materials pigs are able to get when they roam about on pastures. Pigs may eat some of the soil which supplies various mineral substances. They may eat pebbles, stones, insects, weeds, herbs, etc., all of which may supply an abundance and a great variety of mineral matter. This being true, it is much more important to look after the mineral supply of pigs in winter than it is in summer. If pigs are kept in close confinement the mineral ingredients must be very carefully supplied.

Importance of Mineral Matter.—The absolute amount of mineral matter necessary is not very great, nevertheless, as previously stated, the importance of it is just as great as that of any other of the food nutrients.

Babcock of Wisconsin has shown that a well-grown animal, as for instance a cow, can live and do its work fairly well for a period of six months without any mineral ingredients at all in its ration. At the end of that time, however, the animal will suffer greatly, apparently "go to pieces" very suddenly, and will recover just as quickly when the missing material is again supplied.

Young and growing pigs, if given rations deficient in mineral ingredients or in other necessary substances, will very soon show marked evil effects. Mineral ingredients are among the most important in a ration for swine.

Swine should at all times, therefore, have free access to salt, charcoal, ground limestone, bone meal and hardwood ashes. If the latter are not available small quantities of a weak solution of concentrated lye fed in the slop will be found helpful.

PROTEIN

An animal may be fed as much as it will eat of all other nutrients but if protein be omitted from the ration, it will die, even with a full stomach. Examples of protein material are white of egg and lean meat. Protein as well as mineral matter is used in much larger quantities during the growing period than after maturity, when only enough is necessary for maintenance. Protein is used by the animal body for the development and maintenance of protein tissue—lean meat, part of the bone, glands, blood, hide, horns and hoof.

While it is true that the mature animal can use protein material for other purposes it cannot do this as economically for energy, heat and fat production as it can use carbohydrates and fat. This being true, the amount of protein fed to swine should be limited in accordance with the ability of the animal to use it for the proper purpose. A pig has greater powers of consumption and digestion, especially of protein and also other nutrients, than it has powers to use these materials after they are digested and absorbed from the digestive tract.

Since the pig can eat and digest more protein and under certain conditions more of the other nutrients than can be used to the best advantage in the body tissue and elsewhere, there is created what the author calls the "factor of waste in animal metabolism." When the habit of waste has once been formed it seems to persist. This being true, it is a matter of considerable importance that the pig should not be overfed on protein or not be fed more than it can use for construction and maintenance.

Factor of Waste Illustrated.—To illustrate protein metabolism as it applies to the factor of waste, suppose that a young man from the country, with economical habits, goes to the city to take up his life work, receiving a salary at first of \$50 a month. He may be able to live on about half of this or \$25 a month, spending about \$15 per month for room and board and \$10 a month for clothes and incidentals. This will allow him to "lay by" \$25 a month in a bank. As time progresses and the young man becomes acquainted with others, he will gradually take up the mode of living of his associates, will go into more and better society, wear better clothes, board at a more expensive place, live in a better room, and spend more for transportation in going to and from his work, etc. This will increase his living expenses so that the \$25 a month set aside at the beginning will be cut down. Before very long the total receipts from his salary will equal his total expenditures, which will result in zero as far as increasing his bank account is concerned. In order now further to increase his bank account, his salary must be raised, say to \$75 a month. This, for the time being, will again allow him to set aside \$25 a month, but with time his expenses will increase also, so that before many months he will again have established an equilibrium between his income and expenditures. In order to allow a further increase in his bank account his salary must again be increased to, say \$100 per month. This process may go on indefinitely. This illustrates the tendency in the animal body, under prevailing conditions of feeding toward nitrogen equilibrium.

If a pig requires 0.1 pound of protein a day for every 100 pounds of live weight to supply its normal protein metabolism

and is getting 0.5 pound in its ration, it will be able to store up in its body 0.4 pound provided there is no waste. However, on account of the tendency of the animal body to establish nitrogen equilibrium, this 0.4 pound that at first was used to increase the store of protein and thereby add to the live weight will gradually decrease. After feeding 0.5 pound for some time there will be a tendency to establish nitrogen equilibrium so that the animal body will be excreting more and storing less protein in its body. In order further to increase the store of protein of the body, it will be necessary to increase the amount fed.

Suppose now that the pig has come to a point of nitrogen equilibrium by eating 0.7 pound of protein for every 100 pounds live weight daily. As it gets older the pig normally eats a smaller quantity of feed per 100 pounds live weight daily, which naturally also decreases the protein supply. In order to show what will take place under these conditions, the illustration above mentioned will again be taken up at the point at which it was left. Grant that the young man has come to a monetary equilibrium when he is receiving a salary of \$100 a month. If now his salary is cut down to \$75 per month, what will take place? Having become accustomed to living at the rate of \$100 a month, he will on his reduced salary, at least for some time, draw on his bank account to supply the deficiency. But knowing that his bank account under these conditions will eventually disappear, he may gradually accustom himself to living less extravagantly, finally reaching an equilibrium at \$75 a month. This then will reduce the factor that is drawing upon his bank account, and if he is of an economical disposition he will reduce his living to a little less than \$75 a month, again enabling him to add to his store in the bank. The amount he can save, however, will not be so great as it was at the beginning of the period when his salary was increased from \$50 to \$75 a month. This is true because it is a difficult matter to reduce the expense of living to the point at which it was before extravagant habits were formed. If now, his salary is reduced to \$50 a month, or to the point at which he started, the same process of drawing on his bank account to supply the deficiency will be repeated, and it will be with very great difficulty

that he will return to his former basis and be able to lay up any of his salary at all. The same thing apparently takes place in the protein metabolism of the pig.

The pig being accustomed to metabolize for maintenance and waste 0.7 pound of protein a day will, for a time, when the supply is reduced, use more for these purposes than is received, consequently will reduce its store of protein tissue in the body. However, after being fed a reduced ration for some time, the factor of waste will gradually be reduced, the pig again reaching a point of nitrogen equilibrium. This may be continued, but under normal conditions it will never be possible to bring the pig back to a point where it will be able to use for making protein tissue as much of the protein of its food as it was able to use before it was fed the maximum quantity.

It has been found that the influence of high protein feeding will, under normal conditions, continue in the metabolism of the pig indefinitely and that the factor of waste is reduced with very great difficulty. Consequently, a pig after having once been fed an excess of protein, is not as economical a meat producer as it was before. Only an extended period of feeding on a materially smaller quantity of feed and especially protein will improve but not restore it to the original basis.

The amount of protein that is necessary in developing pigs is as follows:

For Market Pigs.—The following figure applies to market pigs that are started at two months of age and are to be finished when eight months old. It shows the amount of digestible crude protein required by the pigs daily for every 100 pounds live weight, according to the data determined, for maximum and most economical production.

In this as well as in succeeding figures the vertical spaces indicated by the top row of numerals represent weeks. The second line of figures gives the age of the pigs by months. The left hand or beginning space represents two months of age and the right or close, eight months. The horizontal spaces indicated by the numerals at the left refer to crude protein, carbohydrates, ether extract, and water. These numerals represent the amounts in pounds that are to be fed every day for every 100 pounds of live weight. In each case the amount is calculated upward from the base line.

The curve for protein above starts at 0.6 pound at the beginning of the experiment and rises to 0.7 during the first seven weeks. Following this it declines to 0.6 during four weeks; then maintains a level of 0.65 for seven weeks. After this the greater part of the nitrogenous feeds are removed from the ration during four weeks. A little of some protein feed, however, is fed to the close as pigs will do better if they have more protein than is found in corn.

The form that this curve takes, however, should not be taken as absolute but should be modified to suit the length of the feeding period. The writer feeds pigs for six months, from

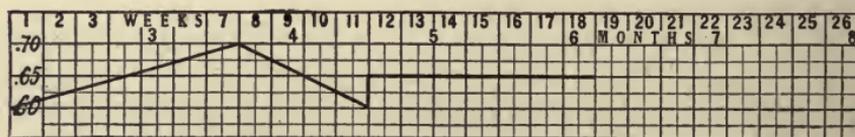


FIG. 62.—Protein requirement of market pigs.

three to eight months of age inclusive, according to this formula. Thus the pig is eight months old at the close of the feeding period. The last eight weeks is considered as the fattening period and the first eighteen weeks the growing period. This growing period is divided in the middle by a period of four weeks during which the protein curve drops for the purpose of reducing the factor of waste. With a short growing period a continuous increase during the period would be all right but when a comparatively large quantity of protein is fed for a considerable length of time under practical conditions the factor of waste apparently becomes so great that feeding becomes relatively more unprofitable.

For Breeding Pigs.—In order to develop pigs to the best advantage for breeding purposes the following guide should be used.

The same comments apply to this curve as to the one preceding. The difference as will be seen is that pigs being developed for breeding purposes should have less protein than those that are fed for market.

The amount given as best for the development of market pigs to produce the largest and most economical gains up to

eight months of age seems to develop in the pig a factor-of-waste which since it is more or less permanent becomes a hindrance to a pig that is being grown and developed for breeding purposes, because it checks its growth, brings it to early maturity, makes the pig a less economical feeder later, and seems also to produce a tendency in the pig to transmit to its offspring the same characteristics.

In a certain experiment, a bunch of pigs fed a ration of corn and water in a dry lot attained a live weight of approximately 80 pounds at eight months of age. This was owing to a deficiency of both protein and mineral matter. In another ex-

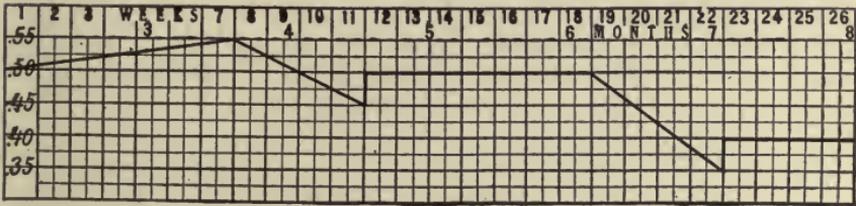


FIG. 63.—Protein requirement of breeding pigs.

periment where mineral matter was supplied in the form of charcoal, salt, air-slacked lime, bone meal, and hard wood ashes, the pigs attained a live weight of 140 pounds. Pigs that were fed a balanced ration attained a weight of 290 pounds at eight months of age. Still another bunch, fed exactly as those mentioned just preceding, except that they received more protein, made only 170 pounds of total live weight at the same age. They had an excess of protein.

Illustration.—To illustrate further: Suppose a field of wheat in the shock is to be threshed with a steam thresher and sheaves of wheat are to be used with which to fire the engine. The wheat used in the engine for fuel represents the feed used by the pig for maintenance and energy for digesting and assimilating its feed and for excreting waste products. The grain that goes into the sack represents the gains made; the grain that blows over, the waste; and the straw, the feces. When the machine is run empty the wheat used as fuel in the engine represents the actual quantity of feed used for maintenance.

The factor of waste is absent under such conditions. As grain is fed into the machine, more fuel is required in the engine; some to handle the material that is being fed into the separator, some to run the machine itself.

When grain is fed into the separator only in normal quantities, the effectiveness of the machine is greatest; that is, under these conditions, more of the grain is saved. As the machine is crowded toward the limit of its capacity, more grain is left in the straw, and more passes across the sieve because a larger part of the sieve becomes clogged, allowing a smaller quantity of grain to pass through into the sack or wagon. More grain is also required to furnish the necessary fuel in the engine. When the amount of grain fed into the separator is again reduced, the machine gradually becomes more effective; that is, as a smaller amount of grain is fed into the separator, less fuel is required in the engine, more grain is threshed out of the straw, and more of the material that has clogged the sieve is saved. But it takes time for all of the material that has become lodged in the meshes of the sieve to shake out so as to allow the machine to become as effective as it was at the beginning. A thresher is more effective when not crowded to its fullest capacity, and it is also more effective when the moderate quantity thus handled is approached from below rather than from above. In pig feeding, however, the factor of waste apparently can never be entirely eliminated when once established, as in the thresher.

Sources of Protein.—The sources of protein on the farm for swine feeding are alfalfa, clover, milk, soy beans, peas, oil meal and tankage. The latter two are commercial feeds and while they are good and profitable at moderate prices, they should not be resorted to except when home-grown feeds are not available.

Alfalfa and clover are roughages and furnish both protein and bulk. This in itself is a very important consideration because a ration containing some bulk is better than a ration made up entirely of concentrates. Bulky feeds make it impossible for the young and rapidly growing pig to get sufficient protein therefrom for maximum and most economical growth. On this account it is necessary to add to the ration some protein in the form of a concentrate or of the other nitrogenous

feeds mentioned. The pig that is fed corn, for instance, on a clover pasture will make fairly large and economical gains but such a ration can be materially improved by the addition of a little of some nitrogenous concentrate.

Distribution of Protein.—Another factor of considerable importance in considering the ration for swine is the proper distribution of the protein feeds. Every pig must get its share. Furthermore, a herd should be made up according to the age and size of the pigs and should be fed accordingly.

Where a bunch of eight or ten pigs are fed out of a common trough, the most rapid eaters get the most feed, consequently too much; the slower eaters do not get enough. Moreover, the pigs that are eating an excess gradually become "filled up" so that they lose their appetite and then go "off feed." When they do this, they eat less, leaving the rest for those that eat slowly and in turn these get too much. The result is that all the pigs in the lot, even though the entire bunch is fed the proper quantity, will get an excess of protein at some time which will result in a high factor of waste and in a smaller live-weight gain. This difficulty is increased to the maximum when the feed or feeds furnishing the greater part of the protein are fed separately and in a concentrated form. The larger the number of pigs that are fed together, the greater also the difficulty of getting a proper distribution of the feed. This difficulty is reduced to a minimum in a practical way, when all the feeds of the ration are ground into a fine meal and thoroughly mixed with the proper quantity of water, and when pigs of equal size and condition of health are fed together. In such case all the pigs in the bunch come to the feed at the same time.

It has been found that by feeding pigs in individual stalls and weighing the feed for each pig separately larger gains can be produced during the growing period. The explanation of this is that when pigs are fed in individual stalls each pig gets its requisite amount of nutrients, protein especially. The practicability of this manner of feeding, however, has not yet been determined.

When changes of more than a very minor nature are to be made in rations and especially in the protein of the ration

they should be made gradually, both in the feeds used and in the total quantity of the digestible nutrients contained therein. It takes time for a pig to become accustomed to changes so that it will eat, digest and assimilate the new ration as well as the old one, hence the more gradually such changes are made the better will be the results produced.

Protein for the Breeding Herd.—It is well known that hogs older than those just referred to need much less protein. Good results have been obtained by feeding mature hogs 0.20 and 0.25 pound daily of digestible crude protein for every 100 pounds of live weight, and those ranging from two years down to eight months of age from 0.25 to 0.35 pound. It does not seem to be necessary to feed much more during a period of gestation than at other times.

CARBOHYDRATE

In point of quantity the carbohydrate part of the ration is the most important. It comprises anywhere from three-

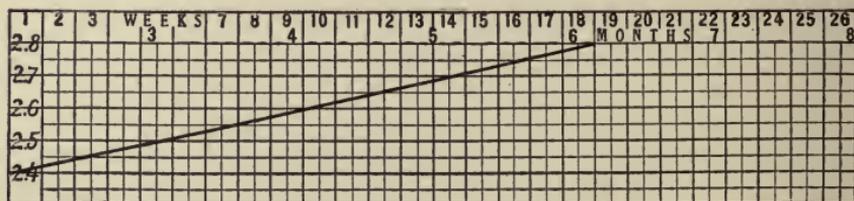


FIG. 64.—Carbohydrate requirement of market pigs.

fourths to nine-tenths of the dry matter part of the ration. Carbohydrates are used in the animal body for the production of energy, heat and fat. The amount needed by swine of the different ages depends upon the purpose for which they are fed.

For Market Pigs.—The pig that is being grown and fattened for market to be finished at eight months of age requires the following amount.

The foregoing figure shows the amount of digestible carbohydrates required by a pig daily for every 100 pounds of live weight. It will be noticed that starting with the pig at two months of age, when usually weaned, the amount should be

2.4 pounds of digestible carbohydrates daily for every 100 pounds of live weight. After this as indicated by the line the amount is gradually increased during the following eighteen weeks when the amount is 2.8 pounds. The carbohydrate line, as given, was most definitely worked out for the first eighteen weeks of the feeding period. During the last eight weeks the pigs are as a rule put on nearly full feed on a ration that is primarily carbohydrate feeds.

If pigs do not get enough exercise or are reduced in vitality by inheritance or improper feeding they will not be able to take the above-specified quantity of carbohydrate and should be fed less.

For Breeding Pigs.—The pig that is being grown for breeding purposes needs a smaller amount as shown in the following figure.

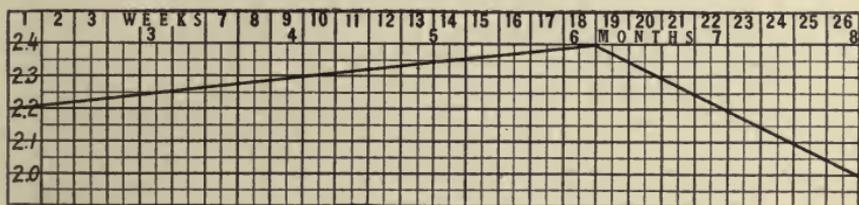


FIG. 65.—Carbohydrate requirement of breeding pigs.

It is seen from this that the breeding pig gets somewhat less carbohydrate than the market pig. While a breeding pig should be in thrifty vigorous condition and carry considerable fat it need not be so fat as a market hog.

Perhaps the best guide as to the amount of carbohydrates for mature hogs is the condition in which it is desired to keep them. A brood sow, for instance, that has been much suckled down can use a considerable quantity of this material until she has reached a proper state of fatness. After this the quantity must be reduced so as to prevent her becoming too fat.

Neither a growing pig, a fattening hog, nor a mature hog should ever be put on full feed. A pig should always leave the trough with an appetite for more.

A sufficient number of feeds should be used in the ration to furnish variety. While a balanced ration could be made up,

so far as protein and carbohydrates are concerned, by using simply corn and soy beans or any other nitrogenous concentrate, the ration is better if it contains three or four feeds instead of only two. Still more feeds is presumed to make the ration still better. The greater the number of feeds in a ration the greater will be the probability of supplying what the pig needs.

ETHER EXTRACT OR FAT

Fat or ether extract is used, after it has been digested and absorbed, for practically the same purposes as carbohydrate. Nevertheless, to get the best results, it is necessary to supply ether extract or fat in the ration to the extent that the animal is able to take care of it. In a general way, a pig can use about one-tenth as much of fat as it can of carbohydrate.

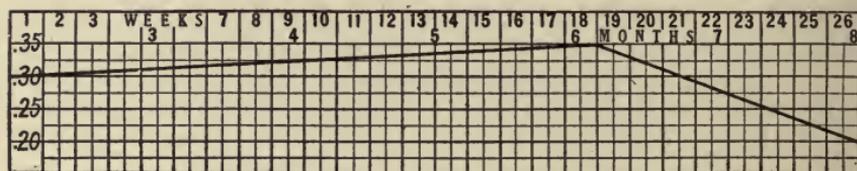


FIG. 66.—Ether extract requirement of pigs.

While all normal farm feeds for swine contain some fat, rations in general do not contain enough of this substance. The soy bean, which has already been mentioned in connection with protein, is also rich in ether extract or fat, consequently serves a double purpose in a ration. This being true, it is a very valuable feed. If feeds are available for the control of this part of the ration the above chart will serve as a guide.

This curve has not as yet been so thoroughly established as the others shown but is believed to be approximately correct.

WATER

About half of the weight of the body of a pig is water. Water is used also in digestion and in metabolism. It has been clearly shown that a given definite amount of water will produce largest and most economical gains for marketing and is best for breeding. It has further been shown that the

appetite of a pig for water is not a safe guide as to the amount of water that is necessary. If a pig has free access to water and is given dry feed or a thick slop, it will not drink water enough in winter. In the hot days of summer in a warm climate when a pig is kept in a lot that does not have very much shade it will drink too much. Either condition will prevent a pig from making the largest and most economical gains. The winter problem, however, is by far the more important of the two. It has, therefore, become necessary to feed a certain definite

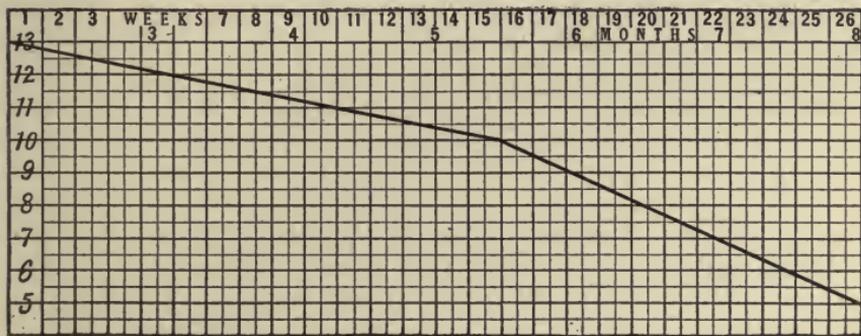


FIG. 67.—Water requirement of market pigs.

quantity of water in accordance with the age of the animal and the purpose for which it is being developed.

For Market Pigs.—The amount of water necessary for the growing and fattening pig that is started at two months of age and finished for market at eight months is given in the following: The pig for market should have 13 pounds of water daily for every 100 pounds of live weight at two months. This is gradually reduced during the following three and one-half months or sixteen weeks to 10 pounds. Following this it is reduced at a more rapid rate to 5 pounds at eight months of age. At this time the pig should be in prime condition for market.

For Breeding Pigs.—Pigs intended for breeding purposes are not fed to carry so much fat as those that are fed for market. Consequently they require more water. The amount necessary from available data at present is shown in the following:

In this chart the curve starts at the same point as in the one

before but instead of being reduced to 5 pounds is reduced to only about 9 pounds.

Mature hogs used for breeding have been worked with in practice in a general way and as far as the writer has been able to observe need approximately from 8 to 10 pounds of water daily for every 100 pounds of live weight.

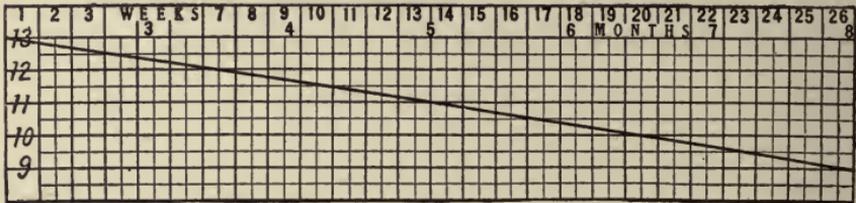


FIG. 68.—Water requirement of breeding pigs.

EXERCISE

Exercise is very important in the swine-growing industry. This is especially true with young and growing pigs and with those that are being developed and used for breeding purposes. It should begin at a very early age.

The sow with her litter may be kept in a comparatively small pen until the pigs are about two weeks old. At this time they should get out where they can have range. If they do not take exercise of themselves, they must be compelled to take it, though exercise is not so important for pigs being fattened for the market. If a pig has been properly born and handled up to weaning time it can be put into a comparatively small pen and be finished for market without difficulty. If, however, this plan is followed for several generations, a breeding herd is made practically useless for pork-production purposes. A long series of experiments has shown this.

BULK IN RATION

By feeding pigs a bulky ration during the early part of their life when their capacity for eating feed is greater than their ability to utilize the digested material, the appetite may be satisfied, the digestible nutrients held down to a proper

point and the capacity for feed largely retained. These are important considerations because later in life pigs naturally eat a smaller quantity for every 100 pounds of live weight and less than they might utilize. The substitution of concentrated for bulky feeds later in the life of the market hog is, therefore, advised.

Furthermore, by the introduction of a roughage, digestion is somewhat retarded, making a smaller excess of digestible nutrients available at any given time. This limits the factor of waste and increases the efficiency of the ration, making possible larger and more economical gains. The amount of roughage fed may easily be overdone, as a pig has only one small stomach and cannot be expected to obtain more than a part of the nutrients necessary for large gains from feeds of this character.

Bulk in a ration is a desirable factor during the growing stage and especially during the earlier part of it. It is also a necessary consideration for breeding hogs. Clover, alfalfa and other green feeds are bulky, consequently, in so far as bulk may be furnished by feeds of this character, they answer the purpose very well. For winter, finely chopped clover or alfalfa hay also answer the purpose to some extent, but these have the disadvantage, when fed in slop, of having pieces of cut stems that are more or less sharp and may injure the digestive tract because the pig does not always masticate feed in this form. To overcome this, clover and alfalfa should be fed in a form that they will require their thorough mastication. This may be done by chopping the clover and alfalfa as fine as possible in a fodder cutter, wetting it with steam or hot water and mixing a little meal with it. This mixture should be fed before the grain part of the ration is given. If bran is used as a roughage it may be mixed into the slop.

CLASSIFICATION OF FEEDS

A few of the most common swine feeds are given herewith. The digestible nutrients named are from various sources. Some are from analyses by the Illinois station, some from the work of Armsby of Pennsylvania, and some from general feeding tables such as are given in "Feeds and Feeding" by

Henry. In these tables from which this is made up, however, water and mineral matter are not considered as digestible nutrients, while in the following table they are so considered.

CARBOHYDRATE CONCENTRATES

Dry Feeds

	Digestible nutrients per 100 pounds				
	Water	Crude protein	Carbo- hydrate	Ether extract	Mineral matter
Corn.....	13.0	7.0	66.0	3.0	1.4
Rye.....	11.6	8.1	69.7	1.3	1.9
Barley.....	10.9	8.3	64.8	1.6	2.6
Wheat.....	10.5	8.9	69.2	1.7	1.8
Oats.....	11.0	8.4	48.3	4.2	3.0
Kaffir corn.....	9.3	7.8	57.1	2.7	1.5
Rice.....	12.4	4.8	72.2	0.3	0.4
Germ meal.....	8.1	9.0	61.2	6.2	1.3
Hominy chops.....	11.1	7.5	55.2	6.8	2.5

Green Feeds

Potatoes.....	78.9	0.5	16.4	0.1	1.0
Artichokes.....	79.5	2.0	16.8	0.2	1.0
Sugar beets.....	86.5	1.1	10.2	0.1	0.9
Mangel wurzels.....	90.9	0.1	5.7	0.1	1.1
Turnips.....	90.5	0.2	6.5	0.1	0.8
Pumpkin (field).....	90.9	1.0	5.8	0.3	0.5

According to the observations and work of the writer it seems advisable also to classify water as a nutrient and to assume, since the pig requires more than is present in ordinary feed stuffs, that the entire quantity is digestible. Hence, in the foregoing table the entire water content is given under the head of digestible nutrients. The mineral matter, included in the table under this head, is also the total ash content of the feeds as obtained from composition tables.

NITROGENOUS CONCENTRATES

Dry Feeds

	Digestible nutrients per 100 pounds				
	Water	Crude protein	Carbo- hydrate	Ether extract	Mineral matter
Flax seed.....	9.2	20.6	17.1	29.0	4.3
Soy beans (grain)....	10.8	29.6	22.3	14.4	4.7
Canada field pea (grain).....	10.5	18.0	59.8	0.6	2.6
Cow pea (grain).....	14.8	18.3	54.2	1.1	3.4
Tankage.....	7.0	48.0	.....	12.0	11.7
Meat scrap.....	10.7	66.2	0.3	13.7	4.1
Blood meal.....	8.5	52.3	.....	2.5	4.7
Oil meal o.p.....	9.2	27.5	32.8	7.1	5.7
Oil meal n.p.....	10.1	29.3	38.7	2.9	5.8
Gluten meal.....	8.2	21.6	43.0	11.9	0.9
Dark feeding flour....	9.8	13.5	61.3	2.0	4.3
Red dog flour.....	12.0	14.0	66.0	2.0	3.3
Wheat middlings.....	12.1	11.4	54.5	3.4	3.3
Wheat shorts.....	11.8	12.2	50.0	3.8	4.6
Buckwheat middlings.	13.2	22.0	33.4	5.4	4.8
Buckwheat shorts....	11.1	21.1	33.5	5.5	5.1

*Liquid Feeds**

Skim milk.....	90.6	2.9	5.2	0.3	0.7
Buttermilk.....	90.1	3.9	4.0	1.1	0.7

* Under certain conditions these may become roughages.

NITROGENOUS ROUGHAGES

Dry Feeds

Alfalfa hay.....	8.4	7.0	37.3	1.4	7.4
Clover hay (red).....	15.3	5.4	38.2	1.8	6.2
Wheat bran.....	11.9	10.2	41.2	2.9	5.8

Green Feeds

Alfalfa.....	71.8	3.0	11.2	0.4	2.7
Clover (red).....	70.8	2.2	14.8	0.7	2.1
Cow pea.....	83.6	1.8	8.7	0.2	1.7
Soy bean.....	75.1	3.2	11.0	0.5	2.6
Vetch.....	85.0	1.9	6.6	0.2	1.4
Clovers other than red.....	.....	.....	.....	.....	.....
Canada field peas....	84.7	1.8	6.9	0.3	1.3

CARBOHYDRATE ROUGHAGES

Green Feeds

Rape.....	84.5	1.5	8.1	0.02	2.0
Bluegrass.....	65.1	3.0	19.8	0.8	2.8
Oat fodder.....	62.2	2.6	18.9	1.0	2.5
Rye fodder.....	76.6	2.1	14.1	0.4	1.8

The green feeds that are specified under the head of carbohydrate concentrates contain a great deal of water. It is quite evident that if these were fed in large quantities, so that a pig was compelled to take more water than its system demanded they would become roughages in the sense that the pig would be compelled to take more bulk in the form of water than would normally go with the proper quantity of nutrients other than water. This would have a tendency to distend the capacity of its digestive apparatus. An excess of water, however, would have a detrimental effect upon the pig.

The liquid feeds specified under the head of nitrogenous concentrates may likewise be considered either as concentrates or roughages.

The nitrogenous roughages are given under two subject heads, dry feeds and green feeds. The dry feeds are roughages because of the large quantity of crude fiber they contain. The green feeds also contain the crude fiber but relatively less than the dry feeds because they at the same time contain a large quantity of water. This water plays an important part in the metabolism and may take the place of water that is fed as such in connection with dry feeds.

The carbohydrate roughages are all in the form of green feeds and may be considered, in so far as water is concerned, as green feeds under the head of nitrogenous roughages.

SELECTION OF FEEDS

Feeds should be selected primarily to furnish the proper quantity of digestible nutrients in a palatable form as follows: Water, protein, carbohydrates, ether extract, mineral matter, and bulk. While some feeds may have values other than their digestible nutrients, if a pig is properly fed, these are of minor importance. Home-grown feeds should be used where possible, but where these are not available commercial feeds may be substituted. While many of the commercial feeds are all right and as good perhaps as those that may be grown on the farm the profit in general is greater from home-grown feeds. Furthermore, the supply of commercial feeds is limited and available only to a comparatively small number of feeders.

The carbohydrate feeds in general must be used to make up the carbohydrate part of the ration and the nitrogenous feeds to furnish the bulk of the protein. All carbohydrate feeds contain some protein and most all nitrogenous feeds contain some carbohydrate; consequently in the selection of the feeds for a ration they should be combined in such quantities that the proper amount of digestible nutrients is supplied.

Water is found to a greater or less extent in all feeds. Those classified as dry feeds usually contain only a small quantity—from 8 to 18 per cent.; other feeds such as liquid feeds and succulent feeds contain as high as 85 or 90 per cent. of water. Since, however, these sources of water—excepting liquid feeds—are not sufficient, pigs must be fed water directly.

A pig under five or six months of age apparently cannot assimilate as much as it can digest; consequently best results are obtained if it is not fed more than it can finally use for the construction of body tissue and for energy and heat production. In order to limit the nutrients to the amount that the pig can most profitably use, roughages may be introduced into the ration at this time. These serve a double purpose, as already explained.

METHOD OF CALCULATING A RATION

Suppose that a bunch of pigs is two months old and weighs 685 pounds. The foregoing charts show that at this time the pigs require daily for every 100 pounds of live weight 13 pounds of water, 0.6 pound of digestible crude protein, and 2.4 pounds of digestible carbohydrate. Multiplying these quantities respectively by the total live weight, namely, 685 pounds, and pointing off the proper figure, it is seen that the pigs will require a total of 89.05 pounds of water, 4.11 pounds of digestible crude protein and 16.44 pounds of digestible carbohydrate a day. Suppose that alfalfa, corn, barley, skim milk, soy beans and water are to be used to make up this ration. With a table like the following, specifying the amounts of digestible nutrients present in these feeds from 1 to 9 pounds inclusive, a ration may be accurately calculated.

From this table tenths of pounds, units of pounds, and tens of pounds may be added to the ration by reading the quantities of nutrients correctly with respect to the decimal point. To get tenths read with the decimal point one place to the left and for tens of pounds one place to the right. The use of the table eliminates multiplication at each operation.

Pigs two months old can use but a limited quantity of a roughage like alfalfa, consequently in making up this ration not much can be used at this time. Relatively more should be added as they get older. Suppose that corn and barley are to be used in the proportion of two parts of corn to one part of barley and that but a limited amount of skim milk is at hand. In order to make up this ration, then, the following is evolved:

The total amount of nutrients required for each day as shown above for the bunch of pigs weighing 685 pounds is as follows:

Water	Protein	Carbohydrate
89.05	4.11	16.44

These are obtained by first putting down the desired amount of each roughage (alfalfa), with its water, protein, and carbohydrate, then the carbohydrate concentrates, corn and barley, and then the skim milk. Have enough of these so that

the carbohydrates when added will be nearly equal to the required quantity. Next list the nitrogenous concentrate, soy beans, in sufficient quantity to bring the protein as well as the carbohydrate up to the required amount. If the result does not come out right the first time, it can easily be adjusted by the use of the table. When this is done add sufficient water to make the required amount.

	Pounds	Water	Protein	Carbohydrate
Alfalfa.....	0.9	0.072	0.063	0.333
Corn.....	10.0	1.300	0.700	6.600
Corn.....	3.0	0.390	0.210	1.980
Corn.....	0.3	0.039	0.021	0.198
Barley.....	6.0	0.660	0.480	3.900
Barley.....	0.7	0.077	0.056	0.455
Skim milk.....	40.0	36.400	1.200	2.000
		38.938	2.730	15.466
Soy beans.....	4.0	0.440	1.200	0.880
Soy beans.....	0.6	0.066	0.180	0.132
		39.444	4.110	16.478
Water.....	49.6	49.600		
		89.044	4.110	16.478

The above-mentioned quantities of feed, then—namely; alfalfa, 0.9 pound; corn, 13.3 pounds; barley, 6.7 pounds; skim milk, 40.0 pounds; soy beans, 4.6 pounds; water, 49.6 pounds—should be fed to these pigs for one day when they are two months old.

In order to get the increase specified by the charts an estimate must be made as to what the pigs will weigh at the close of the week. Suppose that it is estimated that the lot will gain 65 pounds during the week, making its total weight at the close of the week 750 pounds. This estimated live weight should then be multiplied by the quantities given by the charts for the age attained. The results will be as follows:

Water	Protein	Carbohydrate
12.8	0.615	2.42

Multiplying these by the estimated live weight the following is obtained as the requirement of nutrients at the close of this and the beginning of the following week:

Water	Protein	Carbohydrate
96.0	5.2275	18.15

To get these quantities take the total amount of nutrients fed at the beginning of the week and add enough feeds to make the nutrients amount to the quantity stated. Proceed as above, namely, add the roughage first, the carbohydrate concentrates next, then the nitrogenous concentrates and lastly the water. By so doing the following will be obtained:

	Pounds	Water	Protein	Carbohydrate
Brought forward...	....	89.044	4.110	16.478
Alfalfa.....	0.7	0.056	0.049	0.259
Corn.....	0.8	0.104	0.056	0.528
Barley.....	0.3	0.033	0.024	0.195
Soy beans.....	3.0	0.330	0.900	0.660
Soy beans.....	0.2	0.022	0.060	0.044
		89.589	5.199	18.164
Water.....	6.4	6.400		
		95.989	5.199	18.164

These quantities of nutrients correspond very closely to those calculated as the requirement of nutrients at the time.

The quantities of feeds used to get the additional nutrients should be added to those fed at the beginning of the week and the totals will be the quantities to be fed at the close of the week. By adding these the following are obtained:

Alfalfa 1.6; Corn 14.1; Barley 7.0; Skim milk 40.0; Soy beans 7.8; Water 56.0.

This is the total quantity to be fed for each day at the close of the week.. The quantity of feed on the first day of the week

then may gradually be varied to that fed on the last day. Thus there will be a gradual increase fed from day to day.

The average weight for the week may also be taken to calculate the ration and then this uniform quantity may be fed during the week. This simplifies matters considerably and in practice proves entirely successful.

To determine the quantity of feed necessary for a bunch of pigs at any time between the ages of two months and eight months the same method is followed. The vertical lines in the figures indicate the age of the pigs and stage of the period of feeding. The point at which these intersect with the line for the various nutrients indicates the amounts of the nutrients in pounds as specified by the horizontal lines. Multiply these quantities by the total live weight and proceed as before.

As is clearly evident this method of feeding is intended for pigs that have been well fed from the time they learned to eat. If a feeder has a bunch of pigs that have not been fed well it may be necessary, in order to get the best results, to start back a little farther than at the point in the chart indicated by the age of the pigs in question. Thrifty lean pigs need to be fed a little more. This is accomplished by adding a little to the weight used in calculating the ration.

In order to furnish variety in the above-calculated ration, corn and barley are used, both being carbohydrate concentrates. The proportion of these two feeds may be governed to some extent by the amounts available. Skim milk is a feed of the same class as soy beans.

The alfalfa is used primarily for furnishing bulk, and also protein. At the beginning of the period, the pigs, two months of age, will not be able to use a very large quantity of this. As they grow, however, during the next two or three months they will be able to take more and the quantity in the ration should be increased so that the appetite of the pigs is nearly satisfied. After the pigs are four or five months of age, it will be necessary gradually to decrease the alfalfa or other roughage in order to make room for the gradually increasing quantity of the protein and carbohydrate nutrients. The reduction in the amount of water will also help to make possible the increase in protein and carbohydrates.

SUGGESTED APPROXIMATE RATION

If a swine feeder does not have the inclination to follow the method of feeding outlined above and will be satisfied with results according to his practice, the following suggested approximate ration may be used:

POUNDS OF FEED PER 100 POUNDS LIVE WEIGHT PER DAY

	Age of Pigs in Months						
	2	3	4	5	6	7	8
Ground corn (fine).....	2.6	2.8	3.0	3.2	3.3	3.0	2.6
Soy beans (ground fine)....	0.8	0.9	1.0	0.6	0.8	0.4	0.4
Skim milk.....	6.0	6.0	6.0	6.0	6.0	0.0	0.0
Water.....	6.6	5.1	3.8	2.6	1.4	5.5	4.0

This kind of ration necessarily does not carry with it so much meaning as does one specially calculated because there probably are no two farms where the same feeds are available in the same proportion. By using different feeds and different quantities of the same feeds, however, an infinite number of combinations may be made, all of which may be good.

In the ration suggested, if the feeds mentioned are not available substitutions may be made. If corn is not available, rye, barley, wheat, rice, etc., may be used. If soy beans are not at hand peas may be used but the quantity must be increased as peas do not contain as much protein. Peas would also increase the carbohydrates, hence the corn would have to be correspondingly decreased, or these may be left out and more skim milk added. Some of the protein may also be supplied in the form of clover and alfalfa. If skim milk is not available more of some other nitrogenous feed may be supplied and also more water as milk is 85 to 90 per cent. water.

In mentioning feeds the writer has had in mind suggesting those which may be produced on the farm. If nitrogenous feeds are to be purchased, tankage, oil meal, blood meal, etc., may be used, but it is well to remember that, in general, feeds can be produced more economically on the farm.

OFFHAND FEEDING

Many people are too indifferent in regard to this whole matter even to attempt to feed hogs according to the method outlined. For the benefit of such the following offhand rule is here presented. If milk is available it should be diluted, using one-half milk and one-half water. If then all the corn is ground into a fine meal and put into this milk and water together with all the other feeds used, a very thin slop can be made for pigs about two months old. This slop should have about the consistency of thick buttermilk. If these pigs are to be finished for market at eight months of age the amount of liquid used should be gradually reduced so that the slop has the consistency of a thick mush at the finishing period. If part of the corn is to be fed unground, the slop must be made correspondingly thinner.

If pigs are to be developed for breeding purposes the slop should never be made thick. The breeding herd also should have a thin slop.

The quantity of milk mentioned will furnish about the right quantity of protein during the first part of the period for pigs that are to be developed for breeding purposes. During the latter part of this period the amount of milk should be reduced.

If milk is not available other nitrogenous concentrates should be used, such as peas, soy beans, oil meal and tankage. If the ration contains the proper amount of bulk and water, and the pig be fed what it will clean up readily, the ration might contain three parts of corn to one of peas, six parts of corn to one of soy beans or oil meal and eight parts of corn to one of tankage during the early part of the feeding period. As the pigs grow older they should have less of the nitrogenous concentrates. Other carbohydrate concentrates should also be used in addition to corn as a part of the ration. If clover or alfalfa are available either in the form of pasture or as hay less of the nitrogenous concentrates need be used.

For market pigs a little more of the nitrogenous concentrates should be used during the growing period than is specified for breeding pigs and less during the fattening stage.

METHOD OF FEEDING

It is of primary significance that each pig in the lot should get its proportionate amount of the various feed nutrients, and very great harm results if the nutrients, and especially the crude protein, are unequally distributed among the individuals of a lot. For the sake of equal distribution of this ingredient especially, it is suggested that the grains used be ground and mixed with the milk and water, thus making a slop of all the ingredients except the mineral matter. A little of the corn, however, may be fed whole in order to develop the teeth and to accustom the pigs to feed in this form for purposes later in life when it may be advantageous to use feeds in this form.

The feeding trough should have a swinging panel over it or else be in a separate feeding pen so that the slop can be poured into it without being disturbed by the pigs. When the slop is in the trough and the pigs are all present the panel over the trough may be swung back, or the gate to the extra feeding pen may be opened wide letting all the pigs come to the trough at the same time. Then, if the pigs are of equal size and are not too numerous, a good distribution of the nutrients to the different individuals of the lot will result.

If it is impossible to have the feeds ground it is still possible to distribute the various nutrients fairly well. If the protein is to be fed in the form of soy beans or peas, these may be harvested and stored away together with the vine. At feeding time enough may be weighed or measured out to furnish the proper amount of protein and this distributed over a large feeding floor or on pasture where the pigs can have free access to it. While the pigs are doing the hulling and grinding, each will have an opportunity to get its share. This also presupposes that pigs of equal size and age are being fed together and that they will eat with approximately the same rapidity. If the protein is thus distributed, the corn may be fed in the form of ear corn or shelled corn. If then the right quantity of water is fed fairly good results will be possible. During the winter season, however, when pigs will not drink enough by such practice it is necessary to mix at least a small

quantity of meal with the proper quantity of water to make it palatable. This should then be fed to them in the trough.

Better results are possible when pigs are fed three times a day than when they are fed only twice. When pigs get to the age at which they are called shotes, and get considerable of their feed in the form of green feeds from pasture, the green feeds may serve in place of the noon feed.

From the data at hand and from a general knowledge of the subject, it appears that better results may be obtained by feeding on pasture than by feeding in the dry lot. The amounts of nutrients mentioned in the foregoing are intended for dry-lot feeding and it is thought that if pigs are fed on good pasture that these quantities of nutrients may be somewhat reduced. Nevertheless, one of the most important features of feeding on pasture, and it seems as if it might be the most important, is the exercise obtained by this method. Furthermore, under such conditions pigs are able to utilize more than under dry-lot conditions, and the author has had good success in feeding according to the foregoing formulas on pasture.

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