HUNT & BURKETT'S

AGRICULTURE

FARM ANIMALS

ORANGE JUDD COMPANY

Mankind Reached Civilization by Aid of Agricultural Animals

Hunt and Burkett's Agriculture

FARM ANIMALS

COVERING THE GENERAL FIELD OF ANIMAL INDUSTRY

BY

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WITH NUMEROUS ILLUSTRATIONS OF ANIMALS, METHODS AND PRACTICES

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PREFACE

In preparing "Farm Animals," the authors have sought to treat in detail, not merely the subjects of breeds, breeding, feeding, sanitation, medication and animal products, but to cover the whole field of animal industry. They have followed the general plan as developed in "Soils and Crops," the initial and companion volume of this series. By means of the two books a full teachable course covering soils, crops and animals is now available for use in the schools. Each of these books is complete in itself in its field. No collateral reading has been suggested for pupils, not because the authors wish to discourage such independent effort on the part of the pupil, but because they believe they have included as much subject matter as can be covered wisely in 16 weeks by pupils of high school age.

In the preparation of the subject matter, the attempt has been made to adapt it to the *high school mind;* that is, to pupils between the ages of 14 and 18. It has been assumed that this book, like "Soils and Crops," will occupy 16 full weeks of three recitations each, and that two days each week would be devoted to practicums, or one day to practicums and one day to review of the work of the previous three days. The practicums selected are all possible for high school use. The method of conducting them is clearly explained, and the large number provided will enable the teacher to select such as are best adapted to the school and circumstances. It is particularly desirable that considerable time be used for scoring and judging work in order that the student may be made fully acquainted with the good and bad points of each class of animals.

Each lesson contains a note to the teacher and 15 paragraphs in which are developed the ideas or set of ideas discussed in the lesson text. The authors have endeavored to lead the pupil from the simple and known to the unknown and complex. The purpose is to have the conclusions follow logically from the statements made. This is the laboratory method applied to recitations. Developed in this manner, it does not become a question as to what place in the curriculum the book shall occupy, but rather if it is adapted to the age of the pupil and to the use of the teacher, that an inspiring and hence a successful recitation or practicum may be conducted. The authors believe that both "Soils and Crops" and "Farm Animals" are admirable text books covering the general field of agriculture in all high, agricultural, normal and other schools in which agriculture is taught. In many district schools there are boys and girls between the ages of 14 and 18 who spend four or five months each year studying arithmetic, grammar, history, physiology and descriptive geography. It is believed that these students may wisely recite less on these subjects, using the time for "Soils and Crops" and for "Farm Animals."

Acknowledgments.—The greater part of the drawings used to illustrate the text have been made by Mr. B. F. Williamson, artist of Orange Judd Company, from original subjects and suggestions, or from other sources that expressed the ideas to be brought out. A great many photographs and drawings were furnished by the publishers. The authors acknowledge their thanks to the publishers and to the many individuals who have assisted in supplying illustrations, and their indebtedness to other various sources from which they were procured. Individual credit, on account of the large number, has not been attempted.

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Note to the Teacher.—In this lesson are indicated the steps in development from the amœba, the lowest, to mammals, the highest, forms of animal life. Show in a general way how one form differs from the others immediately above or below it. The lesson starts with locomotion, a power possessed by animals but not by plants or only by those of the lowest orders. The first and earliest forms of life were one celled; then came two-layered animals; then three layered, with a body cavity where traces of the ancestry of the backbone groups are found. Now come the fishes, with their gills; now the amphibia, with gills lost in the adults. From here we reach the reptiles, cold blooded, with true lungs; and then the birds, with their feathers; and finally the mammals, with their hair or fur.

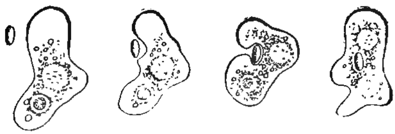
LESSON ONE

SORTING OF ANIMALS

1. Locomotion.—Every living animal eats, breathes, moves, feels, and reproduces its kind. The bodies of farm animals are complexively formed and because of this are able to do various kinds of work. In a modified way plants also eat, breathe, feel and reproduce, but they are unable to move about. Locomotion is denied them. Their roots hold them fast and what growth an individual makes comes from the immediate vicinity in which the roots are attached for food and sustenance. Animals, on the other hand, can and do move from place to place. This advantage is of much consequence in the development of the individual and species.

2. Amœba.—Water is the principal home of the simplest animals. It is an ideal place, as it is easier to swim than to walk. Locomotion starts here. You may not think much about the tiny animals of the streams, ponds and seas which cannot be seen with the eye, but they exist nevertheless. Some of these prefer fresh water; some like best the brine of the ocean; others seek the moist sand of the quiet places, and still others attach themselves to the bodies of certain animals and from them suck their food.

These simplest animals are of one cell only. The amœba, for instance, eats and yet has no stomach; it moves and has no legs; it feels and has no nerves. Indeed, in respect to life as an animal, it does everything that a horse does. In performing its life functions it can take on any shape. It is a cell but without fixed outline. If it is hungry it moves up to an-

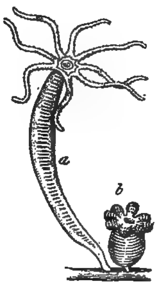


HOW AN AMOEBA EATS

other microscopic plant or animal and gradually incloses it. Thus it is all mouth and all stomach. It keeps growing until it reaches a certain limit of size, when it subdivides and becomes two individuals, each one of which is exactly one-half the size of the original. The two are now the offspring, the parent having disappeared into its progeny.

ONE OF THE SIMPLEST SPONGES

3. Sponges.—As we ascend the scale of simplest animals we come to where there is a community of cells. Animals consist of either one cell or of many cells. Sponges are an example of the latter. In their young state they swim about, but soon attach themselves to some solid substance on the bottom of the sea where they grow and develop. Each animal is practically a stomach in form, yet each cell gathers its own food and assimilates it, and each obtains the necessary fresh air from the water circulating about it. The sponges of commerce are gathered by divers, who pull them up from the ocean beds by means of mechanical devices. Once removed from the water they soon die, only the soft skeleton remaining. This now becomes a valuable aid in man's work.



FRESH WATER POLYP
a, expanded condition; *b*, contracted.

4. Hydra.—Higher in the scale of cellular complexity comes the hydra, in which there is a division of labor. This simple animal has sensitive parts corresponding to nerve cells. A sticky substance is secreted which enables the animal to attach itself to stone or plant for temporary habitation. From tiny projections are thrown out tiny threads, which paralyze an animal that it uses for food. It has a mouth for introducing food into the body; and this food is acted upon by a digestive fluid that prepares it for absorption. The cavity in hydra, in which digestion goes on, corresponds to the cavity inside of a simple sponge.

5. Corals and jellyfish.—The structure of the body is still more complex in the coral and jellyfish. In these animals cells are grouped to do special work. Thus, some cells serve as muscles, others as nerves, others digest the food, and still others are distinct reproductive cells. The sponges were slightly higher in form than the amœba, the hydra than the sponges, the corals and jellyfish than the hydra. And while there is still greater diversity, the same structural and physiological complexity proceeds on up the scale through all the higher forms of animal life.

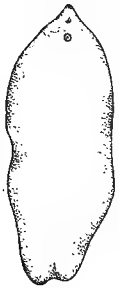
CORALS
At top, red coral; at bottom, mushroom coral.

6. Worms.—There are many aquatic worms that swim. Most worms crawl. They do this by means of successive contractions of successive parts of the muscular wall of the elongated body. They have no legs such as caterpillars have. The common earthworm, the plowman, is one of the higher forms.

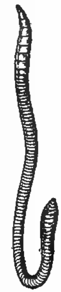
"The earthworm not only dwells in the soil, but is in a sense the manufacturer of soil, since the fertility of the earth depends greatly upon the work of earthworms. They pass the soil through their bodies, digesting the organic particles they find in it, and thereby loosen the soil, reduce it to a state of fine division, and render it more fit to support the growth of plants."

The *tapeworm* draws nourishment through the skin, and therefore has no need of an alimentary canal. The liver fluke is flat. The adult form infests the sheep's liver. There it lays eggs, which after a time find their way into water. Unless a certain water snail takes them up they die. Housed for a while in these snails, the eggs now hatch, escape and finally settle on plants. If eaten by sheep the route is repeated. Great damage is done the sheep industry by these worms in certain parts of the country. An example of thread worms is the dreaded *trichinae,* which infest pork. Leeches also belong to the worm group. In ascending the scale worms are the first great group of animal life in which true land animals are found.

7. Arthropoda.—The *crustacea,* or jointed animals of the water, breathe by gills. The insects, or jointed animals of the land, breathe through tubes in their sides. Crabs and lobsters belong to the first group, and insects and spiders to the second. True spiders have eight legs, whereas the true insects have six. Spiders dispose of their prey by sucking and never swallow solid food. All spiders have poison glands, certain varieties being very venomous. Scorpions and centipedes belong to the spider division. The number of insects is enormous, some authorities placing it at a quarter of a million. Bees, ants, beetles, fleas, locusts, weevils, and the various kinds known as insect pests, all belong to this group.

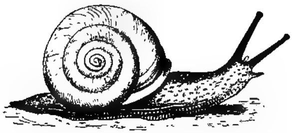

LIVER FLUKE

"We owe the bright colors and the sweet honey of flowers to the selection exercised by insects; they carry the pollen of flowers from one plant to its neighboring kindred, thus securing cross-fertilization for the advantage of the plant, and thereby perpetuating any quality, such as color or sweetness, which has originally attracted the insect to the flower. While a few plants only are fertilized by means of the wind, a vast majority depend entirely upon insects for the cross-fertilization which is so necessary for the production of healthy seeds. If the earthworm has been the plowman, the insect has been the more intelligent gardener, who has filled the world with bright flowers. The insect owes its food to the plant world; the plant world owes health and beauty to the constant ministration of the insect."


EARTHWORM

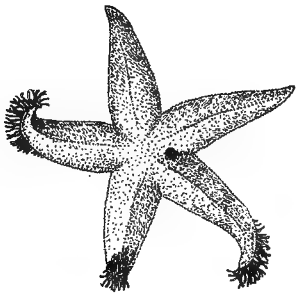
8. Mollusca.—An insect is covered by a hardened skin. In the mollusk, or shellfish, a covering is secreted which lies outside the skin. Just as our skins pass perspiration out to the surface, so the skin of these animals passes to the outside certain substances that the body has taken in from the sea water. As these accumulate the shell is formed. Examples of this group are the snails, slugs, mussels and scallops.

9. Starfish and sea urchin.—These beautiful creatures have prickles on their horny skins. Sea urchins are sometimes called "sea hedgehogs" because armed in this way. The prickles attain their maximum in the sea urchin, but they are well represented in the starfish. In the sea cucumber, also a representative of this group, the shelly needles are greatly reduced.



SNAIL WITH SHELL

10. Backbone animals.—Scientific men speak of animals as either having or not having backbones. Hence, animals are called *Vertebrata* or *Invertebrata.* Careful study has disclosed the fact that all animals are related. The higher forms are linked by gradual steps back to lower forms. There is no aristocracy in creation. Backbone animals from the standpoint of origin have come up out of the ranks of the common people of the animal world. No longer are the family secrets of the higher forms to be kept hidden in the locked closets of ignorance.

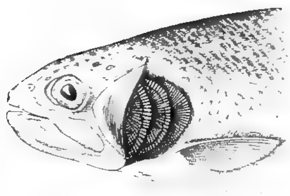


STARFISH

The creatures that connect the backbone animals with the family lines without a backbone are known as *Ascidians,* or the *Chordata.* They possess a structure called the *Notochord,* or a rod down the back. This rod is like the cord that precedes the backbone in the vertebrate embryo. The higher forms of *Ascidians* attach themselves without any sensible form of support. They possess all the organs of life that the higher water forms possess. Their gills are highly developed and contain a special cavity or chamber into which the sea water they breathe is passed.

"The Notochord as a structure, precedes the formation of the spinal column in vertebrates. The spinal column of vertebrates is formed to protect the spinal cord. This protection is, however, an afterthought, so to speak, of the vertebrate structure; the lowest of all vertebrates is quite without it, and in the lower groups of fishes we may trace various steps of its formation. But in these cases where the spinal column is absent or incomplete, there is a large and well-developed notochord; and in the embryo of higher vertebrates, when the spinal column has not yet begun to be formed, the notochord is equally a conspicuous feature. It runs from the region known as the midbrain, to the end of the tail, and lies throughout just beneath the spinal cord. Whatever its original use in the animal body may have been, it undoubtedly acts now as a support to the spinal cord, and indeed to the whole body. Bones do not exist either in the lower vertebrate, or in the early embryo. In the latter they are formed by degrees. The spinal cord and the notochord each begin to be surrounded by rings of cartilage or gristle, which by degrees is changed into bone. The rings surrounding the notochord, however, gradually encroach upon it and obliterate it. The place where it has been becomes the centrum, or most solid part of each vertebra. The notochord at first is continuous, and has no division into successive parts; but when the bony spinal column is developed, it consists of a series of successive vertebræ. Each of them is made up of several parts, which by degrees become consolidated into the vertebræ."

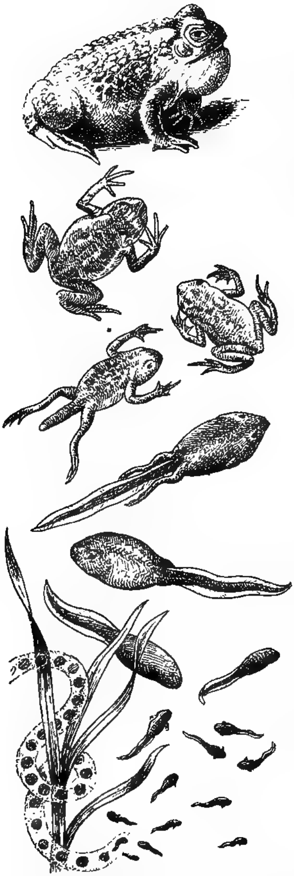
11. Fishes.—These are the lowest forms of backbone animals. All fishes have gills for breathing, both the lowest fish order and the true fishes. The true fishes have scales, limbs and teeth. In some, such as sharks, rays and dogfishes, the skeleton is gristle and does not transform into bone. In nearly all of the familiar fishes the skeleton develops into bone. The kinds of fishes are legion and the shapes, colors, habits and character of many varieties.



HEAD OF TROUT, SHOWING GILLS

The truth about the matter is this: All the higher forms of animals have gills for a time. In the highest vertebrates, such as reptiles, birds and mammals, the gills are never put to use. They exist in the early stages of embryo life, but afterwards disappear, other structures taking their place.

12. Toads and frogs.—Between the fishes and the reptiles are the *Amphibia*, a class of animals that includes, among others, the toads, frogs and salamanders. In amphibia, the body, except in the toads and frogs, is fishlike, though limbs and lungs are present. Toads and frogs undergo a metamorphosis; the young, called tadpoles, breathing by external gills, and at first being without legs. They are adapted both to water and land life. Fishes, you know, are water dwellers, breathing by gills; while reptiles, birds and mammals are air breathers, never possessing gills, except for a short time during the embryo stage.



Development of a Toad in a Single Season

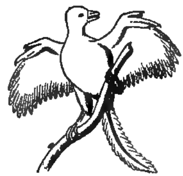
Toads and frogs, even though adapted to water, are obliged to come to the surface to breathe.

13. Reptiles.—These occupy the place between the amphibians and the birds. They are cold-blooded and breathe by lungs. They include serpents, lizards, tortoises and crocodiles. With the exception of tortoises, the reptiles are elongated in form, the body cylindrical, which usually terminates in a long tail. Limbs are not found in serpents or in some of the lizards. In other lizards, rudimentary limbs are observed. The tortoises and crocodiles have limbs fully developed. A peculiarity of reptiles is the shedding of the teeth; but new ones form as fast as the old ones drop out.

CROCODILE

The reptiles are enormous and swallow their prey whole. Serpents, as a general rule, affect moist places in the neighborhood of water, although some are inhabitants of dry sandy deserts. Lizards, for the most part, live in sandy portions of hot and tropical regions. They either burrow in the ground or live in holes of trees or walls. The largest kinds of reptiles are found in the warmer parts of the globe.

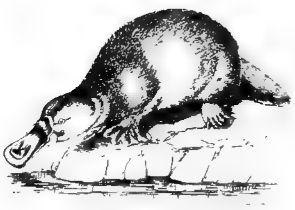
14. Birds.—The step between reptiles and birds is not as great as it may seem. The earliest forms of birds had teeth in their jaws and possessed jointed tails. The reptiles of early times were able to fly. Some birds have claws on their wings, and these suggest another purpose than for use in flying. Birds are warm blooded, more so than any other of the vertebrates. All the other animals below them are cold blooded. Reptiles are considered ugly; but birds, as a rule, are noted for beauty and adornment. Their feathers give birds a distinction that applies to every variety and species.



OLDEST KNOWN BIRD

This ancient bird lived ages and ages ago. It had teeth and a long tail, like reptiles, instead of the horny beak and rudimentary tail of all modern birds. This bird, known by scientists as *Archaeopteryx,* was a little larger than a crow.

15. Mammals.—Animals that suckle their young and produce them at birth were formerly considered set off to themselves. No connecting link had been observed between them and animals that lay eggs, such as birds and reptiles. Yet it is now known that the lowest form of mammals does lay eggs. This is the duck mole, that lives on and burrows in the banks of rivers in Australia and Tasmania. This mammal lays two eggs at a time. The eggs have a yolk. A kindred form, the spiny ant eater, hatches its eggs in a temporary pocket that disappears when the young grow big enough to care for themselves. The step from these to the *Marsupialia*, the characteristic mammals of southern Asia, the opossum of America, and the kangaroo of Australia, is not difficult to cover. The most distinctive character of mammals is their mode of development and of nourishment during the earliest period of life. They are all brought into the world alive.



DUCK MOLE
These animals live on worms and vegetable matter.

The lowest mammals are more closely related to reptiles than to birds. Reptiles are also egg layers.

In the earlier ages man must have attempted to use many forms of animal life. The number of species that he has succeeded in domesticating either for food, clothing or labor has, indeed, been small. Of the numerous types described in this lesson man depends almost exclusively upon animals with backbones and has domesticated in the true sense only birds and mammals.

LESSON TWO

ANIMALS MADE USEFUL

1. Domestic animals.
2. Life cycle.
3. Struggle for existence.
4. Crowd of animals.
5. Way of the wild.
6. Natural selection.
7. Artificial selection.
8. Heredity.
9. Variation.
10. Atavism.
11. Crossing peas.
12. Dominant and recessive characters.
13. Pure-bred races.
14. Scrub stock.
15. Improving the herd.

Note to the Teacher.—In this lesson the contrast of living between the wild and tamed animals is indicated. Also the fundamental principles of animal improvement, both of the breed and the herd, are discussed. An excellent opportunity is offered here for assigned readings and essays covering the important steps of a race from the time of capture in its original haunts to the largest development under domestication. Pupils will do well to get this chapter in one lesson without outside reading.

LESSON TWO

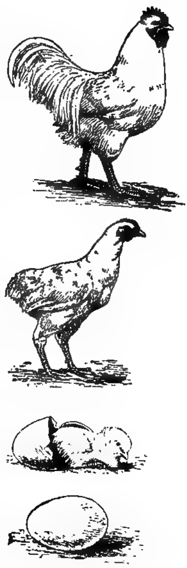
ANIMALS MADE USEFUL

1. Domestic animals.—Dogs, cats, horses, cattle, sheep, swine, goats, the ass and the mule, rabbits, poultry, pigeons and the birds of the aviary for centuries have been in contact with man. They are grouped in friendly confidence around his dwelling. They live for his use and pleasure, and are, more or less, under his direct supervision, being fed and cared for by him. They have played an important role in the civilization of the human race. Without them —especially the dog, the horse, the cow and the sheep—man's development onward and upward would have been slow and uncertain. It is a fact that in those countries in which the problem of domestication did not enter the people ever remained near to barbarism.

DOMESTICATED
Their ancestors were wild and dangerous.

The great drawback of the American Indian was his lack of a beast of burden for certain kinds of fatiguing work.

2. Life cycle.—The higher animals are born or hatch out of eggs; they



LIFE CYCLE

grow and develop; and then die. As a distinct organism an animal begins in an egg. Birth, growth, development and maturity all succeed in due time and in due order. Death inevitably results, either accidentally during some stage of the life cycle, or in the end when maturity is complete. From egg to egg is the life cycle. The three inevitable certainties in the life of every animal are birth, growth and death.

3. Struggle for existence.—Between life and death there is a constant struggle for existence. This is especially true of the wild forms. Animals require food for satisfying hunger, drink for appeasing thirst and abiding places for rest or rearing the young. Their food consists of plants or of other animals that live on plants. Without plants there could be no plant-eating animals; and, without these, flesh-eating species would not be able to exist.

RETURN OF THE FORAGER

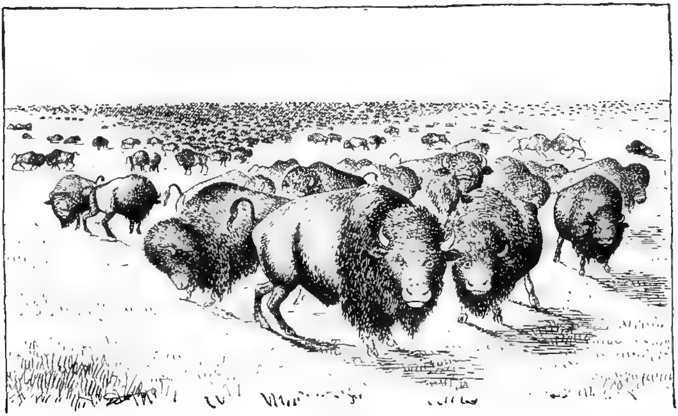
In the wild, life is a continuous struggle for existence.

This struggle for existence is observed in two ways: In the species, as between the sheep of the fields, the stronger securing the best and richest food, the weaker being crowded to the rear or to scanty pastures; and as between individuals of different species, as the wolf or coyote with the sheep, or the hawk or fox with the poultry.

Another condition in this struggle is to meet the changes of the seasons. Vast numbers of wild animals die in winter from cold, or starve when the snows cover the food, or die of thirst when the streams disappear in summer. Thus the number of animals in the wild reaching maturity is but a small part of those that are born.

4. Crowd of animals.—In nature, therefore, a continuous crowding of animal life affects not only the species but the individuals of the species. As the crowding increases the warfare becomes more intense, and this remains until the natural balance obtains again. If the seasons are unusually severe or the enemies gain in strength, some certain species may altogether disappear. This always follows if the death rate exceeds the birth rate. Only those species increase that are favored by strength or environment.

"It is said that at the time of the discovery of America there were no more red men than live today. The severe struggle for food led to war and disease, which in turn maintained the balance between the consuming population and the production of wild animal life



CROWDING OF ANIMALS LEADS TO WARFARE

At one time immense numbers of American bison inhabited the vast areas of the western plains. Why have these animals disappeared?

available for human food. When the number of Indians in a tribe increased, more animals were slaughtered; to meet these new demands it was necessary to search for food at further distances and in new territory, often the property of another tribe. War usually followed, and in the thinning of the ranks of both contestants, the slaughtering of game was lessened, which continued until the supply of game or animal life was equal to the ability of plant life to support it or until the increase of Indian population again caused depletion to the minimum numbers."

5. Way of the wild.—Among the wild there is little sympathy or sentiment. The call of food to meet Nature's demands is always uppermost. Only where wild animals have been subjugated to domestication and raised under environments of a settled husbandry have the higher ideals of civilization prevailed. The ways of the wild are entirely different from those of civilized men. In the wild every other species is an enemy and every individual of the same species a rival or competitor. Hence, life is one long battle in which strength, cunning, instinct and racial characteristics to defend, outwit or escape, are weapons of victory.

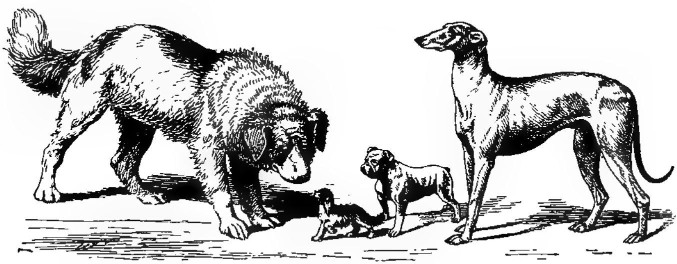
6. Natural selection.—Animals swiftest of foot most frequently escape, while the weak or sick are most often devoured by the attacking enemies. The strong and swiftest satisfy their hunger by overtaking the slowest of the species trying to escape in flight. In the feed lot the weakest are always crowded aside by the strong and vigorous. The wild boar, through natural selection, becomes more fit for wild boar life, the eagle becomes swifter and more capable of killing and tearing his prey, and the wild horse fleeter when the dangerous beasts pursue him. A species unable to adapt itself to its environment is sooner or later crowded out by another species that can do so.

WAY OF THE WILD

Eagles endeavoring to capture the infant deer.

The primitive hog was naturally coarse and ferocious and easily angered, because his protection lay in those directions. He needed a long limb, because he could the more easily escape when the foe was stronger than himself. The longer his snout, the better he could dig for roots; and worms were good to his palate, and wholesome medicine. If his hide was tough and thick, he could better withstand the cold, the thorns, or the enemy's tooth; and the stronger his tusk the better able he was to win the fight.

7. Artificial selection.—Either purposely or unconsciously man weeds out the unfitted and reserves for breeding purposes the strong, hardy, vigorous that best perform their work. He chooses the "best milkers," and in time establishes a line or strain that produces a large quantity of milk. His horses are heavier or swifter than their wild antecedents, because he selected them for work or speed. His hogs are finer in fiber, reach maturity

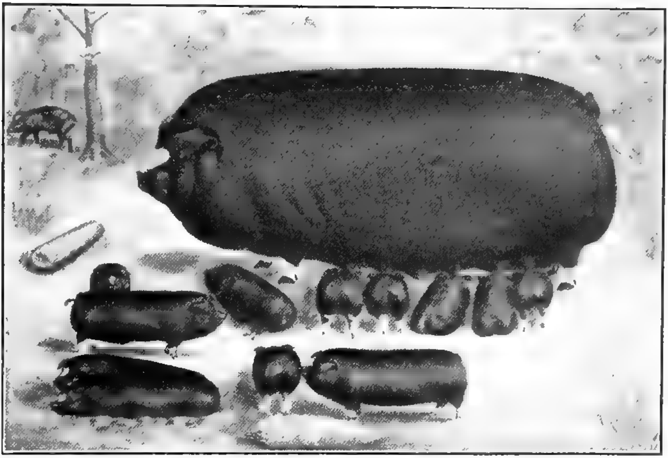


FOUR LEADING BREEDS OF DOGS
Showing how artificial selection has brought about extreme types in form and use.

more quickly and possess more flesh than their relatives of the woods, because by man's selection the more desirable qualities were sought and when obtained were preserved by means of breeding only animals having such characteristics. This artificial selection has become a most valuable aid in fitting every class of domestic animal life for the highest and best service.

8. Heredity.—"If the parentage is chosen to a definite end, the process of *heredity* will develop the form desired by a force as unchanging as that by which a stream turns a mill." This is the keynote in breeding and improving both plants and animals. The law of heredity is the basis of breeding success. Its structural principle is "like begets like." Heredity holds, keeps and guards the values of the best fitted animals.

"I would not miss the opportunity to drive home the idea that frequently the parent can only be sized up by observing the offspring. A parent frequently transmits qualities it does itself not seem to have, at least not to be observed."—Landacre.

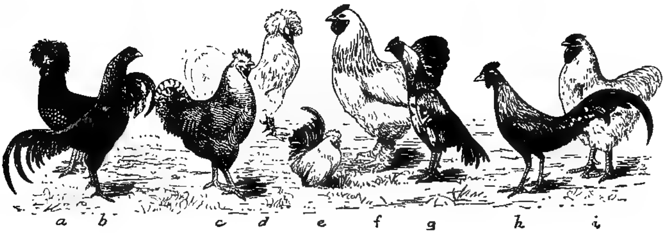


JUST LIKE PEAS IN A POD

Note the striking resemblance of the pigs one to another and to the mother. Here is demonstrated the fundamental law of heredity, or "like begets like."

9. Variation.—Opposed to heredity is the law of variation. This force seeks to produce new things; heredity preserves uniformity. Variation is the law of change; heredity is satisfied with what exists. Variation goes out to explore, to seek new paths and new fields. An animal breeder builds upon present heredity, but he courts variation and urges it to seek new findings. If these are to his liking, he seizes them as his own, attaches them to the old heredity, and builds or improves the structure to higher and better ends.

The breeder's work is to fix the new acquisitions and to make them a part of the building material; and all the while he allows variation free range that it may gather in new discoveries for further improvement and use. When found, through the law of heredity, they are transmitted to the betterment of the class or breed. In improving a herd or flock it is part of the breeder's work to decide which of the new things that variation has found shall be held, which shall be cast aside, and at what point a new acquisition is to be fixed as a part of the old stock. In this way improvement is secured through heredity, variation and selection.



STRIKING VARIATION IN FOWLS

These breeds have been evolved from a single ancestry. *A*, Houdan; *b*, English Game; *c*, Barred Plymouth Rock; *d*, White Polish; *e*, Japanese Bantam; *f*, Light Brahma; *g*, Aseel; *h*, Ceylon jungle fowl; *i*, White Wyandotte.

10. Atavism.—Often it is observed that there is a reappearance of peculiarities or traits after a lapse of one or more generations, either in the lower animals or in man. This phenomenon is known as atavism, or "breeding back." It is simply a reoccurrence to the surface of some old trait that had supposedly become eliminated.

11. Crossing peas.—Gregor Johann Mendel, an Austrian monk, conducted many experiments with peas. In crossing different varieties, and subsequently planting their offspring, he observed the inheritance of contrasting characters in the hybrids or crosses. He made crosses (hybrids he called them) between varieties which differed markedly as regards a pair or several pairs of characters,

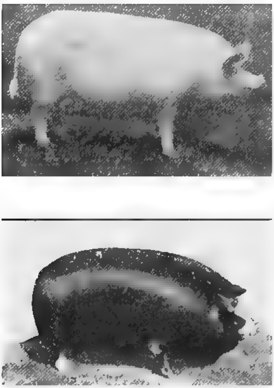
i. e., tall or short, with rounded seeds or wrinkled, with yellow cotyledons or green cotyledons.

Varieties differing in stature were used: One a giant of 6 to 7 feet high, the other a dwarf 9 inches to 18 inches high. "These were crossed, and the resulting seeds grew into plants which were all tall. The character of tallness which appeared in this cross-bred generation to the exclusion of dwarfness was called by Mendel the *dominant* character, the other *recessive*. The tall cross-bred peas were left to self-fertilize, and in their progeny there were talls and dwarfs, in the average proportions of 3:1. When the dwarfs of this generation were allowed to self-fertilize, their offspring were *all* dwarfs, and further generations bred from them were also dwarfs. In other words, one-fourth of the generation were quite pure as regards dwarfness, and these were called pure recessives. But when the talls of the second generation were left to self-fertilize, their offspring were of two kinds: (a) plants which produced talls and dwarfs in the 3:1 proportion, and (b) similar plants which produced talls only, being pure as regards tallness. These "impure dominants" and "pure dominants" occur in the ratio of 2 to 1. Thus the second generation, resulting from the self-fertilization of the cross-bred forms or hybrids, consists of 25 per cent pure dominants, 50 per cent impure dominants, and 25 per cent pure recessives."

12. Dominant and recessive characters.—Important conclusions in a fundamental way have been reached as the result of what is now known as Mendel's law. This law applies to certain kinds of hybridization. A hybrid, you know, is the resulting offspring when two plants or two animals of different varieties or breeds have been mated or bred. In such crossings it is supposed that the generative cells, or gametes, produced by cross-breds are of two kinds, each kind bearing only one of two contrasted or alternative characters which do not blend. These characters are known as *dominant* and *recessive*.

"The idea may be better understood by using mice as an illustration. When what are called waltzing mice are crossed with normal mice, in the hybrid waltzing is *recessive*, the normal is *dominant*. When the members of this generation are in-bred, their progeny consists of normal mice and waltzing mice in the proportion 3:1. The recessive waltzers of this generation are quite pure as regards waltzing, and will produce only waltzers for as many generations as one likes to breed them. But the dominants of the same generation turn out to be two kinds (though they appear to be all the same as far as the eye can tell) one-third of them (*pure dominants*) when inbred, will yield the normal mice, the other two-thirds (*impure dominants*) will split up again, when inbred, into normal mice and waltzing mice in the old proportion of 3 :1."

13. Pure-bred races.—Often there is found certain characteristics that distinguish a family or variety from one or others of that race. These distinctions give rise to breeds, into which all of our domestic animals have been grouped. Thus the Yorkshire hog differs from a hog of the Poland-China in color, conformation, bone and in other traits. These differences of breed are possibly due to climate, food, habit and environment. When a breed has been under the same environment for considerable time and has not been crossed with hogs of a different environment or breed, the race becomes established, and individuals are pure bred. If a record is kept of the ancestry, it is known as its *pedigree*. Pedigrees are recorded by breed associations, the book of such records being called a herd book.



OF THE SAME ANCESTRY

Yorkshire at top, Poland-China at bottom. Their ancestry traces back to the wild boar of the woods.

14. Scrub stock.—Farm animals of no known breeding or of mongrel and degenerated qualities are called *scrub stock*. As a rule these are unsatisfactory because such individuals are not profitable as are those of selected strains. Scrub stock is fast being replaced by individuals of pure breeding or by those "bred-up" through the use of pure-bred sires.

15. Improving the herd.—It has become a proverb that the sire is half the herd. The sire is even more than that. In the first generation he is half; in the second he is three-fourths; in the third, seven-eighths; in the fourth, fifteen-sixteenths, and so on, until, if judicious selection be maintained and only pure-bred sires be used, the character of the herd will be fixed by the blood introduced through the sires alone. Ultimately, such breeding, if continued for several generations, will transform the herd of mixed breeding into one substantially pure bred.

HOW BREEDING UP IMPROVES THE STOCK

The larger individual at the left is the result in the first generation when a pure-bred Berkshire and razorback were crossed. The progeny is inferior to its pure-bred dam but greatly superior to its scrub sire, pictured at the right.

This plan requires the selection of sires belonging to one distinct breed, and there must be no change to any other breed. This kind of breeding always improves the herd, but must not be confounded with improvement of the breed. To improve the breed or race is a difficult task and involves great expense, a long period of time, and the careful application of technical details and much scientific knowledge to the breeding operations.

LESSON THREE

RELATION OF ANIMALS TO MAN

1. When civilization was young.
2. Domestication.
3. Because man was initiative.
4. What domestication requires.
5. Domestication more than taming.
6. Animals in captivity.
7. Animals as a prime motor.
8. Animals as a source of clothing.
9. Animals as a source of food.
10. Animals as civilizing agents.
11. Increase in animal production.
12. Advantages of keeping live stock.
13. Disadvantages of keeping live stock.
14. Man's contract with animals.
15. Live stock industry just begun.

Note to the Teacher.—Domestication is older than history. It is older even than human civilization. From the earliest times animals have appeared by the side of man, both as helpers and companions. Develop the subject further by questions. Aim to show how few species have been conquered but how immensely important these are to the human race. It is very desirable also to teach kindness to these faithful workers. Kindness to animals not only makes their lot more pleasant but helps the doer.

LESSON THREE

RELATION OF ANIMALS TO MAN

1. When civilization was young.—The antecedents of all species now known as domestic animals were once wild and roamed over plains or through forests in search of food, water and shelter. In most instances they lived in droves, flocks, or herds, staying together, more or less, for safety and self-protection. Man was as much their enemy as the savage beasts that constantly preyed on them. With few exceptions, the animals that have been domesticated belong to grass-eating species. While not ferociously hostile, they nevertheless fought when occasion arose and drove other classes less inclined to fight from their midst; and in case of danger or surprise they fled together, or fought the attacking foe until one or the other was vanquished or forced to seek safety in flight.

WILD SHEEP

Known also as Big Horn and Mountain Sheep.

2. Domestication.—Man has brought under his control several species of birds and mammals. In taming and subjecting them to his will, in fitting them to his needs, in requiring them to do certain kinds of work, and in other ways adapting them to his life and well being, a long process was set in operation. Both plants and animals have been domesticated. In the realm of animal life only a few species have been subdued from a state of nature and trained for domestic use. While thousands of species have been captured, only a limited few have really been domesticated. In the entire list of mammals nearly 12,000 kinds have been recorded; and less than a score have proven of use as agricultural animals. Of the birds less than one species in a thousand has responded to a settled life with man.

3. Because man was initiative.—While many wild species have been captured and tamed, only a few have met all the requirements of domestication. Hence the domestic species that we know are the results of fitness for the various environments in which man has placed them. In the early days man himself had a difficult task of establishing his own race and interests. Nature was severe on him. To cope with the stern realities that tested his endurance and that tried his cunning and skill, he sought the aid of wild life to help him. And he succeeded. Brought under control these served as draft animals; they provided clothing, their flesh served as food, and their comradeship made for civilization. Hence, back of domestication is service to the human race.

CAVE MAN AND BEAR

Man's initiative led him to devise tools and implements for defense and assault. By means of these he gained dominion over the beasts of the fields and woods.

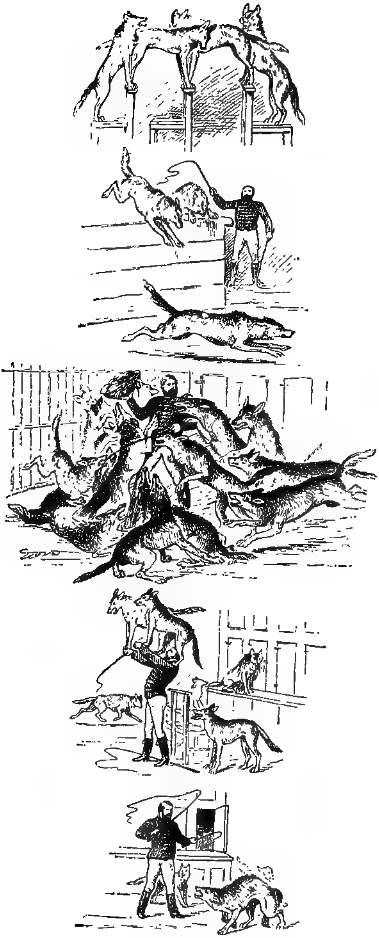
4. What domestication requires.—Unless the animals brought under subjugation are able to survive when put to their new work, little if any advance is possible. Otherwise the process would be a game of continual capture and taming, requiring more effort than the good in the end would justify. To meet the requirements of domestication animals must breed in captivity, thrive under the artificial conditions imposed, and be of service to man.

5. Domestication more than taming.—Domestication means more than merely to capture and tame. The offspring must show fitness for a domestic life. They must have mental capacity for education; plasticity of blood and physical nature to change from the old environment to the new; and power to acquire new habits, develop new characters, assume new shapes, and serve the uses and purposes of their captors. Every domestic animal, if completely domesticated, is an artificial production. It has lost its old ability to care for itself. Under its new environment it depends on man for its parents, food, shelter, protection and care.

6. Animals in captivity.—Thousands of species have been captured and kept in captivity. But few of them give forth offspring; and if offspring result they are as intractable and unresponsive in their new environment as the parental stock. Elephants, for instance, are not difficult to bring under the will of man, but they seldom breed in captivity. The problem with the elephant is one of capturing and taming, not of domesticating. Of all

FLAIR OF THE DOG

The marvelous faculty of being able to locate game by scent has been acquired by certain dogs through long years of breeding, selection and training.



WOLVES IN CAPTIVITY

These animals are trained but not domesticated.

the cat kind of animals, the domestic cat only has been plastic enough to meet the severe demands of man's civilization. Yet enormous numbers of closely allied species have been tamed and have produced young, but have never become domestic. Back of this universal law is the fact that few species are domesticable.

7. Animals as a prime motor.—Working alone and unaided, man would have a sorry existence. His tasks would be too great and severe for his frail body and erect structure. When he trained animals to carry his burdens and do his heavy work he not only conserved his own strength, but increased his productive power. This gave an added incentive to advance; he saved time, enabling him to think and plan, and allowed him to gain in substance for protection and future needs.

One reason why the early people of America failed to develop as did those in the Old World was because there were no domestic animals of any consequence on the American continent. True, they had the dog, but this animal was of little use in subjugating the forces of nature like the horse and ox were for the people of Asia, Africa and Europe.

Not only have animals furnished motive power directly, but they have served to furnish this power in other forms. The application of oil, gas and coal to mechanical devices, wheeled vehicles and man-made motors has come about largely from the ability of domestic animals to do certain difficult tasks that man unaided by them would

TEDDING HAY IN SWITZERLAND

Efficiency of labor is one of the most important factors in the progress and prosperity of North America.

have found impossible of accomplishment, even though his mental insight would have indicated a way. Civilization and human development are most due to the animals that have carried burdens and moved things.

8. Animals as a source of clothing.—Animals have enabled man to conquer nature, not only by adding their force to his relatively weak body, but they have furnished him clothing which has made it possible to extend his habitat. Skins effectively gave him warmth and protection before the days of manufacture, and today leather is in greater use than ever in our history. Although relatively less extensively used than formerly, silk and wool, both animal products, possess qualities found in no other fiber. And cotton, the most extensively used vegetable fiber, is possible only from the assistance that horses, mules and oxen give in its production.

9. Animals as a source of food.—Much the larger part of the vegetation which grows in the earth's surface is unsuited for human consumption. But converted into milk, butter, cheese, meat and animal fats, the supply of human food is greatly increased. Not only is there more of it, but the quality of animal flesh and other products is

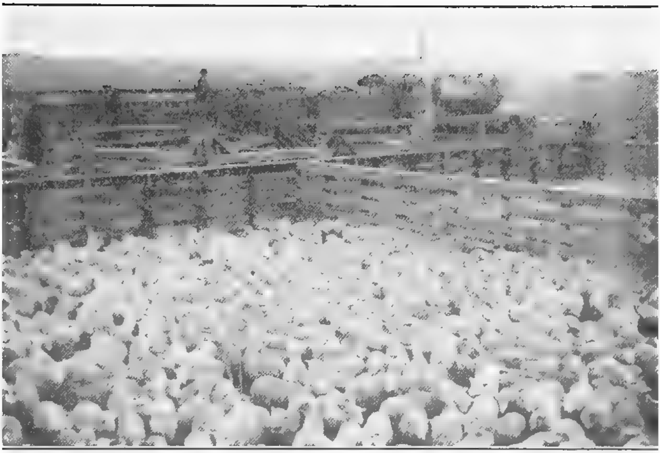
TAKING A CARTLOAD OF SHEEP SKINS TO MARKET

This photograph was taken at Cette, France, and is typical of the custom of gathering animal skins in all parts of the world for man to use for one purpose or another.

superior to an exclusive vegetable diet. Among all the food products of man none are more efficient or refined than meat and dairy and poultry products. The human race has made its greatest progress in regions where animal products are an important part of man's regular dietary.

The domestication of animals has added also to human progress by increasing the stability of the food supply. Like grain elevators in primary markets, domestic animals are storehouses of food to be called on when soil products are temporarily limited, and allowed to accumulate gradually when these products are plentiful. Where meat raising is a part of the activity of the people, famine seldom occurs.

10. Animals as civilizing agents.—Animals serve another purpose besides advancing the material welfare of the human race. They have not been less important to our spiritual welfare. Whether kept merely as pets and



FLESH FROM GRASS

Sheep being loaded in cars for shipment to market centers. They have converted a very large amount of grass, weeds and grain into substances that can now be used for human food.

companions, or for the production of work, clothing and food, they compel habits of care and responsibility and inculcate habits of mercy. These habits, together with the sympathetic influences involved, in all ages have had and still continue to have, an elevating and civilizing influence upon the human race.

"If it be true, as my personal experiences and observations lead me firmly to believe is the case, that man's contact with the domesticated animals is ever to be one of the most effective means whereby his sympathetic, his civilized motives may be broadened and affirmed, there is clearly reason for giving to this side of life a larger share of attention than it has received."—Shaler.

11. Increase in animal production.—In recent years farm animals have not increased in numbers as rapidly as have the inhabitants, but the value of animals has increased much more rapidly. Much of this is due to increase in the individual merit of the animals.

FREE EDUCATION

As much so to the boy as to the dogs. We learn by doing.

In 1850 the average weight of wool was 2.4 pounds per sheep; in 1910 it was 6.9 pounds. Thus, while in 50 years sheep have not doubled in numbers, the production of wool has increased more than five times. This is a striking example of the value of improvement in breeding, because the improvement in wool production is due to the influence of heredity in far greater degree than to the effect of improved feeding.

Beef cattle offer another illustration of the way in which animal products have been increased without increasing the number of animals. Formerly beef cattle were matured in their fourth, fifth and sixth year. They are now placed in the market in their second and third year. The increase in the size of horses and the increased production of butter fat per cow which have occurred in the past century are hardly less important factors in increasing the value of domestic animals and their products.

12. Advantages of keeping live stock.—The most striking advantages affecting the farmer are: (1) Animals make it possible to use land that would be wholly or partly unproductive. (2) They make use of farm crops which would be entirely or partially wasted; straw, corn stalks, the various hays would not have sufficient value to pay for raising if animals were not kept to convert them into useful products. (3) In thus acting as machines in manufacturing raw materials into those which are much more concentrated, thus making their transportation economically possible. (4) In the production of these finer products much of the essential materials of plant growth are left on the farm; this means land improvement. (5) The rearing of live stock makes it possible to arrange a better rotation of crops; and this practice helps to maintain the fertility of the soil. (6) Labor is

ADAPTING POWER TO WORK REQUIREMENTS

European countries have learned to adapt their power to the kind of work to be performed. They do not use a ten-horsepower boiler and engine to perform the work which can be done by a half horsepower.

better utilized also, thus securing greater prosperity to the community and a higher skill of those operating the farms.

13. Disadvantages of keeping live stock.—More capital is required to operate a given area of land where animals are kept than on exclusive grain or other crop farms. This investment is in animals, buildings, feed and labor. The perishable nature entails also a great risk in the investment. Not only the products of a single year, but the growth of a number of years, may be suddenly swept away by disease. Then, when an animal has been properly fattened, he must be sold. If held for any length of time, not only is there a constant outlay for food to maintain the animal, but the condition of the animal may actually deteriorate.

Marketable animals cannot be held for better markets like grain or merchandise. A rise in price of feeding stuffs often seriously affects the profit of animals that are being fitted for the market. It requires continual vigilance on the part of the stockman to meet these several disadvantages as they arise.

14. Man's contract with animals.—Since some animals have responded to domestication, a sort of contract is implied in their consent. In return for the services they render to mankind they are entitled to protection from cold, heat, storms and annoying enemies; to suitable food for their nourishment; to sanitary quarters for their health and comfort; and to humane treatment for their physical and mental happiness. On farms where these attentions are bestowed the best service is rendered the owner. On the other hand, if farm animals are abused, poorly nourished, or improperly housed, they return less wool, less milk, less pork, less beef and less labor than on neighboring farms where these fundamentals are neither neglected nor ignored.

15. Live stock industry just begun.—Much as domestic animals have done for us, their work is only started. For all time they must continue to furnish the human race with food, clothing, labor, and other necessities. Our indebtedness to them will continue rather than diminish. The work of the future will lie in the direction of better care, better feed, and more skillful mating of breeding stock. Thus scrubs and mongrels will become more and more unprofitable. Substituted for such will come efficient animals of quality breeding, each class or breed adapted to its peculiar purpose and special service, that the cheapest meat or milk or wool may be secured.

PRACTICUMS

1. Observation of Animals.—(*a*) Each student is to select five kinds of wild animals with which he is partially acquainted, and, from his observation and experience, enumerate the points at which they touch human welfare. Are they, in each instance, to be classed as helpful, as harmful, or merely as indifferent? Is their influence upon man's interest direct or indirect?

The student will also select five animals that appeal most to his interest. What quality, considering structure, habits, instinct and powers, is of most interest? As you study any one quality do you not find that it takes you at once into all others? Develop these facts into a story or composition paper.

(*b*) Are there any domesticated animals whose species is represented in the wild state? Compare the habits and general structure of some domesticated animal with that of the nearest kin among wild species. How many kinds of domestic animals can you enumerate? Have you ever seen a wild boar or a picture of him? Is it true that all our modern breeds have come from this ancestral stock? Can you explain how such great changes have been effected? What effect have food, care and use on a race or breed?

2. Animal Characteristics.—(*a*) What farm animals have front teeth on both jaws? One jaw only?

(*b*) In what respects (enumerate) and to what degree have you ever noticed *variation* in farm animals?

(*c*) Does *use* or *disuse* produce changes in the organs of an individual? In what way has speed in the race horse and the milk-giving function in cows been developed?

(*d*) Enumerate some facts of your own observation which illustrate *heredity*. Are all blackbirds black? Why? Have you ever seen a white blackbird? Can you explain? Compare any offspring with its parents and note if there are any characters peculiarly marked in one of the parents.

(*e*) Do animals change in shades of color with the seasons? Is color a protection in nature in the wild?

3. Insect Collections.—To collect and preserve ordinary insects the amateur needs only net, killing bottle, phials or pill boxes (for living specimens) and insect pins. For butterflies and moths he will need a cork-lined collecting box and a phial of chloroform with a little brush fitted to the cork.

(*a*) *The best net* has a 12-inch circle of No. 3 wire fitted firmly to a light but strong wooden handle 3½ or 4 feet long. This loop is covered first with a strip of sheeting 5 or 6 inches wide to form a gathering or shirring. To this strip is sewn a cheesecloth bag with a rounded bottom not less than 2 nor more than 3 feet deep. Thus insects may be prevented from escaping by turning the handle.

(*b*) *For the killing bottle* choose a straight tube bottle 1 or 1½ inches across or a big-mouthed 4 to 6-ounce bottle. In the bottom place a piece of cyanide of potassium ¾ inch square, barely cover with water, and immediately add enough plaster of parts to soak up the water. This cements the cyanide to the bottom. Leave the bottle open in a shady place to dry for an hour, then cork it tight with a long cork and label it POISON. No child should be allowed to do this work because of the danger of handling the poison. The teacher or a druggist should do it. In using it keep the cork out only long enough to put insects in. If kept closed tightly it will last for several months. Insects may be left in it overnight without injury.

Instead of cyanide, a few drops of choloform, sulphuric ether or benzine on cotton may be used, but they are not so convenient to handle.

(*c*) *The cork-lined collecting box* is needed for insects too large or too delicate to put in the killing bottle. Such specimens must be carefully caught to prevent injury and touched with a soft paint brush dipped in chloroform, ether or benzine. This kills them instantly. Then they may be pinned through the thorax (the middle section of the body) and placed in the box. Some collectors pinch butterflies while the wings are folded above the back and then place them in pieces of paper folded to form a sort of three-cornered envelope. This is not so good a plan as the other, because there is more danger of breakage.

Pill boxes and phials are useful for holding delicate insects, larvæ and pupæ. Soft-bodied insects, spiders, etc., may be dropped in alcohol.

(*d*) *Insect pins* are long, very thin, small headed and sharp pointed. They are much better for mounting insects than ordinary pins.

LESSON FOUR

PLANTS AND ANIMALS

1. How plants grow.
2. Cells.
3. Formation of plant compounds.
4. Starch.
5. Protein.
6. Fat or oil.
7. Ash or mineral material.
8. Water.
9. Crude fiber.
10. Groups of plant constituents.
11. Plants and animals compared.
12. Function of protein.
13. Heat and energy.
14. What the fat does.
15. What the carbohydrates do.

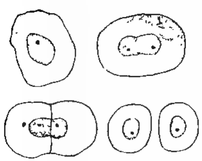
Note to the Teacher.—The relationship of soils, plants and animals is quite well illuminated in this lesson. The substances composing plants and animals are defined, the sources of their formation pointed out, and the work that each performs is indicated, so that a clear idea may be had concerning food and its ultimate end when admitted as digested nutrients into the animal machine. This lesson informs us how this living machine operates and performs its important work.

LESSON FOUR

PLANTS AND ANIMALS

1. How plants grow.—Plants secure food from the soil and air. An animal frame comprises the essential constituents of plants, with sodium and chlorine in addition. Animals cannot subsist directly on the soil and air. Their food consists of plants or of other animals that subsist directly or indirectly in plants. Plant life is the foundation of growth and energy.

The soil, the plant, and the animal represent the three great fields of agricultural activity. They are dependent upon one another, each giving to or receiving from the others the things vital to its very existence. Without a soil there would be, of course, neither plant nor animal life; without plants there could be no animals; and without plants or animals there would be a useless if not a barren soil. The first step is plant growth, whereby the elements essential to all growth are organized in plant cells, compounds and tissues. On this plant tissue the animal feeds. After the animal dies, with its decay and decomposition, come the changes of animal tissue back to soil and air—back to the original materials such as they were before captured by roots and leaves and formed into plants. It is in this manner that the plant grows out of soil and air, the animal out of plants and air, and the soil out of plants and animals. The animal when living contributes active supplies, and when dead both humus and mineral ingredients are returned to the soil; the soil thus reinforced favors the new plants now growing in it; and the new plants, now abundantly nourished, more effectively take care of the animals. From the plant is fed the animal; from the animal is sustained the soil; from the soil is nourished the plant.



HOW CELLS GROW

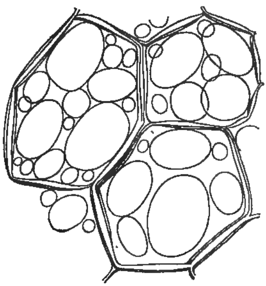
Growth of a single cell, ending in cell division or the production of two individual cells.

2. Cells.—A plant or animal is formed of myriads of *cells*. These increase in number as an individual grows. Simply stated, the cell is an inclosed sac within whose walls are the juices and other substances required for growth and development. The cell walls of plants consist of a wood substance called *cellulose*. In green and growing plants this cellulose is thin and tender, but as the plant matures it becomes hard and woody. The work of building the plant is done within the cells.

3. Formation of plant compounds.—Certain soluble compounds are carried from the soil into plants through the roots and deposited in the cells. These are met by carbon, brought into the plant through the leaves. These substances supply the building materials for the manufacture of plant compounds. The master builder is *protoplasm,* tucked away in the cells. No one knows just what protoplasm is, but it represents life, without which there could be no growth. Every live, active cell contains protoplasm, the life principle. Herein is contained the vital spark that makes all growth possible.

The various agricultural elements used by plants or animals are:

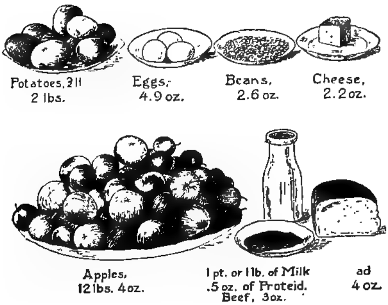
O, Oxygen.	P, Phosphorus.
H, Hydrogen.	K, Potassium.
N, Nitrogen.	Mg, Magnesium.
C, Carbon.	M, Manganese.
Cl, Chlorine.	Fe, Iron.
Na, Sodium.	Si, Silicon.
S, Sulphur.	Ca, Calcium.



STARCH CELLS
This is the way the starch cells from potato tubers look when seen under the microscope.

4. Starch.—When the soluble soil material or plant food has been carried up through the long channel of cells and reaches the leaves, it is brought in contact with the carbon dioxide that has been pulled into the leaf through the little mouths on the undersides of the leaves. Here these various compounds are upset and disintegrated through the action of heat, sunlight, protoplasm and chlorophyll, with the result that a grain of *starch* is made out of water and carbonic acid gas. Some of these starch grains are changed into sugar, which, being readily soluble, is transferred by diffusion from cell to cell and left in those cells that need it most.

5. Protein.—The formation of the *protein* constituents is more complex than that of starch. In a general way it may be said that starch or a starch derivative is united in the cells with nitrates and sulphur which have been brought into the plant from the soil. The living matter, or protoplasm, then breaks up the nitrates in the active cells, uniting them in some way with starch, with the result that a protein compound is formed.

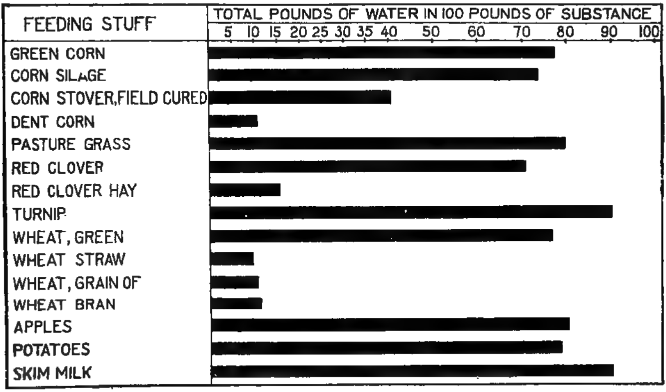


PROTEIN THE SAME IN [illegible]

Here is shown the weight [illegible] required to yield the equivalent [illegible] one pound of milk.

6. Fat or oil.—Oil contains the same chemical elements as starch. Both starch and oil are formed of carbon, hydrogen and oxygen. In the oil compounds there is a larger number of the carbon and hydrogen units in proportion to the oxygen than in the case of starch. All plants contain oil or fat in their woody tissue, [illegible] k of it is deposited in the seed and fruit. Prot[illegible]s in composition from oil or starch in having nitrogen and sulphur in addition to carbon, hydrogen and oxygen.

7. Ash or mineral materials.—When plants or animals are burned a portion is left as *ash*. This consists of the mineral materials taken into the plant from the soil. When food is eaten by man or beast the minerals are used for building bone, teeth and other tissue structures of the body. In most feeding stuffs sodium and chlorine are lacking, but the deficiency is corrected by the artificial supply of common salt. Poor teeth and small and weak bones result when live stock fail to get enough ash or mineral material in their food. A variety of food, including coarse fodders and the legumes, makes it possible to supply the mineral matter in abundance.



GROWING PLANTS CONTAIN MUCH WATER

Several common feeding stuffs are here compared to show the large quantities of water they contain. Note the change when harvested and cured as dry forage.

8. Water.—Often three-fourths or more of the weight of young growing plants is water. Do you wonder now why water in the soil is so important for the production of good crops? The plant not only must have water, but the only way it can make use of it is to carry it into the plant through the roots. Water serves as a carrier of plant food through the roots to every part of the plant. It is to the plant what blood is to the animal. One purpose of the water is to dissolve the plant food of the soil, and when in solution to carry it into the plant.

More than half of the entire weight of the animal is water. It is found in all parts of the body and is as essential for the development of solid tissue as any of the other ingredients. Young and growing animals, like young and growing plants, contain the highest percentage of water. As the animal matures the proportion of water diminishes until it reaches about one-half of the total weight.

9. Crude fiber serves as a framework of the plant. It is to the plant what bones and skeleton are to the animal. It is made of carbon, hydrogen and oxygen. These elements are the same that form starch. Immature and young plants are tender because the crude fiber is tender; as the plant matures, the fiber hardens and toughens—as found in hay and corn stover and trees.

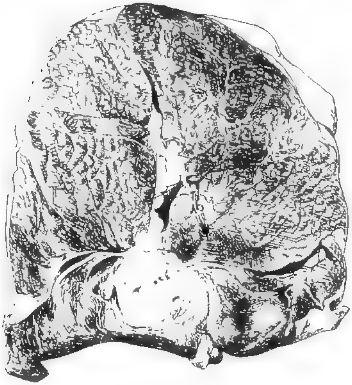
10. Groups of plant constituents.—Plants consist of many compounds. While there are physical differences, the chemical elements are invariably united in definite combinations producing definite compounds. For the sake of convenience these may be grouped as follows:

I. Ash.
II. Water
III. Protein or compounds containing nitrogen.
IV. Nitrogen-free compounds,* or compounds containing no nitrogen, such as starch, crude fiber, sugar, gums, etc.
V. Ether extract, or oil, or fat.

11. Plants and animals compared.—From the standpoint of composition one difference between a plant and an animal is in the fact that the former contains carbohydrates and the latter does not. When the soil elements are taken into the plant they lose their individual identity, and, united in various ways, become organized compounds. They are no longer carbon, hydrogen and oxygen, but starch or sugar or oil; or, if nitrogen and sulphur are added, they become protein compounds. The plant has now fulfilled its destiny and is ready to be used as food for the support of animal life.

*These being derived from the same elements, and having the same fuel value when assimilated by an animal, are usually termed *carbohydrates*. The carbohydrates are formed of carbon, hydrogen and oxygen; the last in proportion to form water, hence the name.

12. Function of protein.—The protein of a food is used primarily to replenish the body wastes of tissues, blood, organs, brain and nerves, etc. Young animals require a larger supply than adult and aged animals because of the requirements of growth and enlargement. Protein may be used also for energy and fat, but usually not economically. A very large consumption of protein may lead to ill health.



BEEF CUT SHOWING PROTEIN
Observe distribution of large and small particles of fat. This improves the quality of the meat.

Protein is the "muscle maker" of the body. The protein of the plant is changed into the protein of the animal. In the animal this constituent comprises the muscular tissues, blood, hair, nerves, internal organs, skin, etc. In addition the protein is used in the repair work of the body. Every beat of the heart, every circuit of the blood, and every move of a muscle, demands that some protein substance be used up. To keep the animal machine in good working order these parts must be kept in repair through protein. If this supply satisfies the waste, the weight of the animal will remain unchanged. When the supply is liberal, or exceeds the demands of the system, material may be stored in the body as flesh or fat, and the animal will gain in weight.

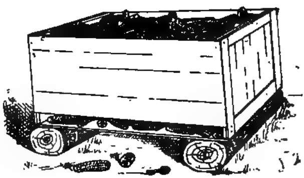
13. Heat and energy.—Food is needed to keep animals warm. As wood burned in a stove gives off heat, so food consumed in the body furnishes heat. This consumption of fuel food is so well regulated in a healthy animal that the temperature remains at the same point at all times. Carbohydrates and fats are mainly the sources of heat supply. These same ingredients are used for the production of fat and muscular energy, and protein may also be used for the same purpose.

14. What the fat does.—When fat is consumed, it is either stored in the body for future use or at once burned in the production of energy and heat. The boy given to much exercise requires a large supply of energy-producing foods. Working animals have a leaner appearance than those kept quietly in a stall. Dairy animals give off much of their flesh and fat stores in milk. Only a small amount of oil or fat should be daily consumed. If fed too abundantly, digestive disturbances often result.

WHEN SHELTER IS DENIED

When farm animals are unsheltered in winter they often suffer from rain, snow and wind.

15. What the carbohydrates do.—The sugars, starches and similar products are used to produce heat, fat and energy. While actually supplying the same purpose as fats, the carbohydrates cannot altogether replace them. Experiments show that at least some oil or fat is necessary to keep animals in the best of health. The carbohydrates are bulky and to most animals they form the greater part of the food, both in quantity and weight. This class of foods is generally the cheapest. The greater part of the food supply the world over consists of feeding stuffs having the carbohydrates in greater abundance than of all others combined.



SELF-FEEDING DEVICE FOR EAR CORN OR ALFALFA

LESSON FIVE

FOOD NUTRIENTS

1. Nutrients defined.
2. Most feeding stuffs are unbalanced.
3. Digestibility defined.
4. How digestibility of a food is determined.
5. First step is to obtain composition.
6. Coefficient of digestibility.
7. Digestible nutrients.
8. Correct rations are based on digestibility.
9. Each constituent is required.
10. Foods must be appetizing.
11. Folly of light feeding.
12. Digestibility little influenced by quantity.
13. Individual character of the animal.
14. Digestibility decreases as plants mature.
15. What most influences digestion.

Note to the Teacher.—The items brought out in this lesson will show how important it is that digestibility of a food be clearly understood. An animal fed a mixed ration digests only about two-thirds of its food. This means that approximately one-third of the food does not contribute in any way to the nourishment of the animal. Indicate some of the factors that influence digestibility. Show the wide ranges of the food nutrients of the more common feeding stuffs.

LESSON FIVE

FOOD NUTRIENTS

1. Nutrients defined.—Any substance absorbed into the system in the process of digestion or that contributes to the support of animal life is a *nutrient*. Hence, the albumen of an egg, the starch of a potato, the salts of an apple, the ash of wheat bran, the fiber of pasture grass, are all nutrients and as such promote the well-being of animals in growth, work, milk, or flesh increase.

2. Most feeding stuffs are unbalanced.—Only a few feeding stuffs furnish alone the required quantities of protein, carbohydrates and fat. The most economical and best results are secured when two or more are combined. By such combinations, if one feed is lacking in protein, the deficiency may be met in the ration through the selection of another substance possessing the protein element

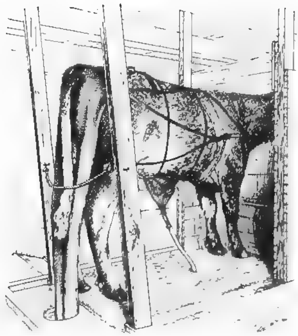
Balancing the Ration Improves It

The two larger pigs at the right have been fed corn and tankage, while the two smaller ones at the left have been fed corn only. This shows why a balanced ration is worth while.

in unusual abundance. In this manner the shortage of one is balanced by the abundance of others.

3. Digestibility defined.—Every feeding stuff contains protein, carbohydrates, fat, ash and water. A distinct portion of each is absorbed, but the remainder is rejected and excreted in the feces. The part so absorbed is spoken of as the amount *digested. Digestibility* refers to the true food value of any nutrient. Every food, regardless of the balance of its proximate principles, contains both digestible and indigestible matter. A feeder must be familiar with the digestible nutrients of feeding stuffs if he is to use them to best advantage.

4. How digestibility of a food is determined.—The general method of ascertaining the digestibility of the various constituents of a feeding stuff is to supply an animal with weighed quantities of food, the composition of which is known by chemical analysis. During the period of experiment the solid excrements are collected, weighed and analyzed by the same chemical methods applied previously to the food. In this manner the amount of each constituent of the food which passes through the animal unabsorbed is determined. It is a simple matter now to subtract this quantity from the amount found to have been present in the food originally. The difference is the amount digested and absorbed.



DETERMINING DIGESTIBILITY

The steer is harnessed in apparatus for ascertaining facts about the digestibility of food.

5. First step is to obtain composition.—Chemists have analyzed all the important feeding stuffs. In the table following a few common feeding stuffs are used for determining the real nutritive value of each constituent.

Composition of Some Common Feeding Stuffs

Feeding Stuffs	In 100 pounds of fresh substance.			
	Protein	Crude fiber	Nitrogen free extract	Fat
Corn stover, field cured	3.8	19.7	31.5	1.1
Red clover hay	12.3	24.8	38.1	3.3
Timothy hay	5.9	29.0	45.0	2.5
Cottonseed hulls	4.2	46.3	33.4	2.2
Corn, dent	10.3	2.2	70.4	5.0
Wheat bran	15.7	9.0	53.9	4.0
Cottonseed meal	45.3	6.3	24.6	10.1
Gluten feed	25.0	6.8	53.5	3.5

Composition of Corn Stover

Fully one-third of the total digestible nutrients of the corn crop remains in the stover after the ears are removed.

6. Coefficient of digestibility.—Composition includes both the digested and unabsorbed materials. But the absorbed matter only is of importance as food. Digestion trials make known the percentage of each nutrient digested. Such figures express the *digestion coefficient* for each constituent. In the table following are given the coefficients of digestibility for the constituents of the feeding stuff previously mentioned.

DIGESTION COEFFICIENTS OF SOME COMMON FEEDING STUFFS

Feeding stuffs	Percentage digestible			
	Protein	Crude fiber	Nitrogen free extract	Fat
Corn stover	45	67	61	62
Red clover hay	55	46	64	53
Timothy hay	48	52	63	60
Cottonseed hulls	6	47	34	79
Corn	76	58	93	86
Wheat bran	77	41	71	63
Cottonseed meal	83	35	78	94
Gluten feed	85	76	89	82

7. Digestible nutrients.—When composition and digestible percentage are known, it is a comparatively simple matter to determine the digestible quantity of each constituent. This is done by multiplying the figures representing the total amount of each constituent by the coefficien of digestibility, the resulting product being the quantity digested.

For example: Corn stover contains 3.8 pounds of protein, 19.7 pounds of crude fiber, 31.5 pounds of nitrogen-free extract and 1.1 pounds of fat. By multiplying these amounts by the figures representing the digestibility for each constituent respectively, the amount of each *digestible* nutrient will be obtained. This is done as follows:

Constituent	Composition		Digestible Coefficient		Digestible Nutrient
Protein,	3.8	×	45	=	1.7
Crude fiber,	19.7	×	67	=	13.2
Nitrogen-free extract,	31.5	×	61	=	19.2
Fat,	1.1	×	62	=	0.7

The total digestible nutrients have been determined for each feeding stuff. Crude fiber and nitrogen-free extract, taken together, are often expressed as carbohydrates Determine the digestible nutrients in corn stover, red clover hay, timothy hay, cottonseed hulls, corn, wheat bran, cottonseed meal, and gluten feed.

Nearly All is Digestible

8. Correct rations are based on digestibility.—The importance of basing all feeding rations on the digestible matter rather than on the total composition is clearly seen. Only a portion of the food taken into the stomach is assimilated. Hence, in every feed a part is lost and wasted. This serves no contribution to the nutriment of the body.

9. Each constituent is required.—No one constituent can wholly take the place of another. Since protein contains nitrogen and sulphur in addition to carbon, hydrogen and oxygen, it is evident that neither the carbohydrates nor the fats which contain carbon, hydrogen and oxygen only can be substituted for protein. Just as the phosphorus or potassium of a fertilizer cannot replace nitrogen, so the carbohydrates or the fats cannot replace the protein of a food. While protein may be substituted for the carbohydrates and fats, it is to a limited extent, and only for a limited time. Even though the well-being of the animal would permit of this substitution the added expense would be against the practice.

10. Foods must be appetizing.—Plants are most appetizing when young and tender. They are then agreeable to the taste and induce a maximum consumption. At this stage of growth little woody tissue has developed, the juices are abundant, the substances are freely acted upon by the secretions, and the largest amount of nutriment is absorbed, Feeds that are unappetizing and disagreeable to smell or taste will be rejected, or if eaten at all will be only to satisfy hunger. The good feeder endeavors to tempt the taste and increase the appetite of his animals, that the largest possible consumption of food may be had to secure the quickest and largest returns.

PROTEIN IS VERY IMPORTANT

The larger two were fed skim milk and wheat middlings with corn; the smaller two were given corn only.

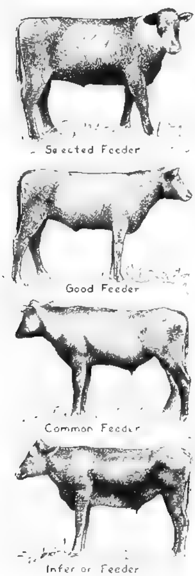
11. Folly of light feeding.—Since growth can result only from food consumed, it follows as an undisputed conclusion that light feeding will retard development. Hence, not only good food must be provided, but much food also. Many a feeder owes his success to his ability of placing before his animals a bountiful ration that is both wholesome and nutritious. Hunger may make his animals partake of almost any kind of food, but nothing he can do will induce these same animals to eat a disagreeable or unappetizing food heartily enough to get a response much beyond their maintenance needs. Growth and production are invariably associated

LITTLE FEED, POOR STOCK

Little profit in this kind of farming.

with well-flavored and appetizing food, even though nothing is added to the nutritive value of the food.

12. Digestibility little influenced by quantity.—Ordinarily, digestion is but slightly influenced by big appetites. Heavy eaters are usually the most profitable animals. Fed to their full capacity they give as good an account of their food as when limited to half feeds. Food is digested and assimilated just as completely in full as in half-filled stomachs. The most rapid growth, or the largest milk flow, is to be had when an animal is permitted to eat to its full capacity, and this is another reason why the ration must be palatable and attractive to taste and smell.



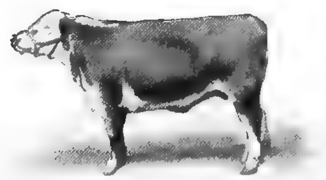
KINDS OF FEEDERS

Note the square blocky type at top and thin angular shape at the bottom.

13. The individual character of the animal.—Armsby has found that a pure-bred animal of superior breeding renders a better account of its food than a scrub. This, however, was not because the pure-bred animal digested a greater percentage of his food, but because he requires less food for maintenance. Of two animals supplied with the same feed, one will often persistently digest a larger proportion than the other. Often very greedy eaters show very poor fattening qualities. In young animals the digestive power is apparently equal to animals of mature age.

14. Digestibility decreases as plants mature.—All classes of plants show a striking diminution in digestibility as they approach maturity, and this is very equally spread over all the constituents. The composition varies also, and for the same reason. Grass is always more nutritious than mature hay. The superior fattening quality of pasture, as compared with that of the hay made of it, is clearly due to the fact that on land continuously grazed the animal is fed entirely on young forage, while hay will largely consist of the mature or nearly matured plants. If hay making is carefully carried out in good weather so the finer parts are not lost by bad treatment, or the soluble matter is not washed out by rain, the digestibility will not be diminished considerably.

15. What most influences digestion.—Feeding farm stock is a gentle art. The old adage, "the hand of the master fattens the flock," is a clear expression of the intimate relation that should exist between the feeder and the animals in his charge. Two men may provide the same feed for two lots of live stock, similar in kind, and far different results will be obtained at the end of a given period. The one studies his individual animals, knows each as if by name, takes an interest in its progress, endeavors at all times to help in case of mishap, and actually encourages, as if to induce greater endeavor. The other feeds simply the stock and lets it go at that. He is a failure as a stockman.



Champion Steer
Well bred, but well fed also by a master hand.

LESSON SIX

SOME SCIENTIFIC TERMS IN FEEDING

1. The animal as a machine.
2. Nutritive ratio.
3. Reducing fat to carbohydrates.
4. Determining the nutritive ratio.
5. Wide or narrow nutritive ratio.
6. Balanced ration.
7. Feeding standards.
8. Maintenance standard.
9. All nutrients necessary.
10. Standards for farm animals.
11. Wolff-Lehmann feeding standards.
12. Based on weight.
13. Feeding standard only a guide.
14. Size of animal.
15. Other standards in recent years.

Note to the Teacher.—The terms used in the discussion of foods and feeding rations are explained in this lesson. Blackboard drill in determining the nutritive ratio of the more common feeds is desirable. Such practice should be continued until the arithmetic of the subject is mastered. Consult the appendix for the digestible nutrients of all common foods.

LESSON SIX

SOME SCIENTIFIC TERMS IN FEEDING

1. **The animal as a machine.**—Considered as a machine, the animal body needs two classes of food: One, to furnish the materials by which the machine may be constructed and kept in repair; and a second, or sustaining reserve, to develop heat to keep the body warm and to supply energy for the production of internal and external work. Water, ash and protein are the essential building materials and the fats and carbohydrates the primary fuel substances. This distinction gives rise to the grouping of feeding stuffs as being either of a building or of a fuel nature. All individual foods contain both classes, but in varying proportions; some are heavy carriers of the first, others of the second, and still others carry moderate amounts of both.

2. **Nutritive ratio.**—A point of some importance in determining the suitability of a feeding stuff as an article of diet is the proportion between the digestible protein

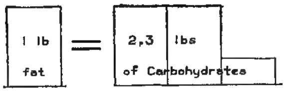
LIVING MACHINES EAGERLY AT WORK
They are converting substances unsuitable for human food into meat of splendid quality.

FEEDING STUFF	NUTRITIVE RATIO	PROTEIN / CARBOHYDRATES & FAT
DRIED BLOOD	1: 0.1	
TANKAGE	1: 1.1	
COTTON SEED MEAL	1: 1.2	
LINSEED MEAL	1: 1.7	
SOY BEANS	1: 1.8	
SKIM MILK	1: 2.	
GLUTEN FEED	1: 3.	
COW PEAS	1: 3.1	
DRIED BREWERS' GRAINS	1: 3.2	
COWS MILK	1: 3.7	
WHEAT BRAN	1: 3.7	
ALFALFA	1: 3.8	
COW PEA HAY	1: 3.8	
PASTURE GRASS	1: 4.5	
WHEAT MIDDLINGS	1: 4.7	
MANGLES	1: 5.1	
RAPE	1: 5.6	
RED CLOVER HAY	1: 5.8	
OATS	1: 6.2	
BUCKWHEAT	1: 6.9	
RYE	1: 7.1	
WHEAT	1: 7.2	
TURNIPS	1: 7.7	
KAFIR CORN	1: 8.1	
BLUE GRASS	1: 8.6	
CORN	1: 9.7	
BEET PULP	1: 12.	
MILLET HAY	1: 12.	
PRAIRIE HAY	1: 12.2	
CORN SILAGE	1: 14.	
CORN & COB MEAL	1: 15.1	
TIMOTHY HAY	1: 16.6	
POTATO	1: 18.3	
CORN STOVER	1: 20.	
KAFIR CORN STOVER	1: 20.	
SORGUM HAY	1: 22.	
OAT STRAW	1: 33.6	
WHEAT STRAW	1: 93.	

NUTRITIVE RATIO OF SOME COMMON FEEDING STUFFS and the digestible non-protein organic constituents. This relation is most conveniently termed the *nutritive ratio* of the food. Simply defined, this term means the ratio which exists between the amount of digestible protein to the combined digestible carbohydrates and fat.

The nutritive ratio as a feed is obtained as follows: The fat is reduced to its carbohydrate equivalent and added to the digestible carbohydrates. The sum of the two, representing the non-protein, is then divided by the figure or figures representing the quantity of protein. The resulting figure is the second factor, which means that for each pound of digestible protein in the feed or ration there are so many pounds of digestible non-protein or carbohydrates.

3. Reducing fat to carbohydrates.—The non-protein constituents of a feed—starch, fiber, fats, etc.—are used to develop heat, energy and fat in the animal body. Their efficiency for this purpose has been ascertained by numerous experiments, which show that a pound of fat will develop as much heat energy as 2.3 pounds of starch. Hence this more concentrated energy must be taken in consideration in combining the carbohydrates and fat as a single unit group if a definite, accurate value is to be obtained with reference to any feeding stuff. In all calculations from now on this higher efficiency of fat will be given its proper weight.



A pound of fat equals 2.3 pounds of carbohydrates when burned in the body.

4. Determining the nutritive ratio.—In a previous table the digestible nutrients in 100 pounds of corn were shown to be as follows: Protein 7.8 pounds, carbohydrates 66.8 pounds and fat 4.3 pounds. The fat first is reduced to its carbohydrate equivalent by multiplying the number of pounds representing it by the authoritatively taken factor 2.3; which being done, shows that 4.3 pounds of fat equal 9.9 pounds of the carbohydrates in producing heat and energy. The fat, now having been reduced to a carbohydrate basis, can be added to 66.8, the amount of carbohydrates in corn, which gives 76.7 pounds of total carbohydrates. This sum, divided by the number representing the quantity of protein, which in the case of corn is 7.8 pounds, gives the final factor of the ratio, or 9.8.

In the form of proportion the stages are as follows:

(1) The amount of protein is to the amount of the carbohydrates as 1 is to the factor to be determined.

(2) Protein : Carbohydrates :: 1 : x.

(3) 7.8 : (66.8 + 9.9) :: 1 : x.

(4) 7.8 76.7 :: 1 9.8.

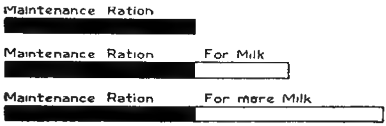
The nutritive ratio of corn is therefore 1 to 9.8, which means that in this feeding stuff for every pound of digestible protein there are 9.8 pounds of digestible carbohydrates and fat equivalent.

5. Wide or narrow nutritive ratio.—A wide difference exists among feeds as to the amount of protein. The oil meals and the legumes are rich in protein, roots and straw very poor, while cereal grain and their products occupy a middle place. These differences give rise to the terms *wide* and *narrow* nutritive ratios, which apply to both single feeds and rations. A feed or a ration has a "narrow" nutritive ratio when the digestible protein it contains is high in comparison to the carbohydrates and fat, and "wide" when the reverse.

6. Balanced ration.—Since all feeding stuffs, with the possible exception of pasture grass, are unfit as single food substances, they naturally fall into a class as being either wide or narrow. If two or more are combined in the proper proportions to furnish all the digestible nutrients, with no excess or shortage of any nutrient, but in just the quantity needed by a certain class of animals fed for a distinct purpose, the combination is then satisfactory, and does provide a *balanced ration*.

7. Feeding standards.—For many years investigators have been conducting feeding tests to learn the amount of digestible protein, carbohydrates and fat best suited to farm animals under average conditions. They have studied the results of various foods and varying amounts in thousands of animals. The results are embodied in what are called *feeding standards*. These tell the proper amounts of the nutrients, or one day's food, for an animal of a certain weight under ordinary conditions.

8. Maintenance standard.—Less nutrients are necessary for animals not doing work, or not giving milk, or not fed for fattening purposes, than for animals actually so engaged. This knowledge has given rise to a standard for maintenance when the animal is at rest in the stall. A dairy cow giving little or no milk does not require nearly as much food as one in full flow of milk. Of course every farmer knows this; but he now has available a guide that suggests the quantity of digestible protein, carbohydrates and fat so as to meet the *maintenance* needs of the dry cow.



AFTER MAINTENANCE, MILK

The first use to which a cow puts her food is for maintenance. That requirement satisfied, any excess may be used for milk or other purpose.

9. All nutrients necessary.—A dry cow does need daily a certain amount of each of the food nutrients. She must keep her body warm, maintain the regular blood supply, repair the broken-down tissues and meet all the requirements of life and health. These things she obtains from her food. If more food is provided than necessary to meet these daily demands, she will increase in weight. If too little food is given, then the reverse will happen, and she will lose in weight, becoming thin in flesh, or poor.

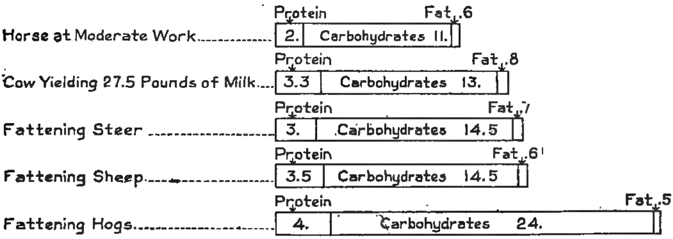
Working from this point, nutrition investigators have carefully prepared standards for cows giving various quantities of milk, for

Prime Beef From Well-Bred Stock and Balanced Rations

These steers topped the market. Their ration consisted of corn and cob meal, gluten meal, linseed meal and clover hay.

steers at different stages of fattening, for horses doing little or much work, and for hogs and sheep during various periods of growth and fattening.

10. Standards for farm animals.—Feeding standards are guides for indicating the amount of each nutrient for different animals and consistent with the purposes for which the animals are fed. A cow giving little milk, according to the standard, is to be given smaller quantities of food than another in heavy milk flow. Likewise rations for beeves differ considerably from those for horses or pigs. Feeding standards, though easily understood, are still very complicated, but they clearly show that the practice of feeding is not only an interesting art, but one that calls for much skill and training also.



DIGESTIBLE NUTRIENTS REQUIRED OF RATIONS

Such food requirements are commonly called feeding standards. Carbohydrates are used in greatest abundance and fat in least.

11. Wolff-Lehmann feeding standards.—The standards in most common use are what are known as the Wolff-Lehmann standards, named after the two German investigators who first suggested the limits to be observed in the daily allowance of the nutrients.

Daily allotment on basis 1,000 pounds live weight.

	Dry matter	Digestible nutrients in pounds		
		Protein	Carbo-hydrates	Fat
Milk cows when giving daily				
11 pounds of milk	25	1.6	10.0	0.3
22 pounds of milk	29	2.5	13.0	0.5
27.5 pounds of milk	32	3.3	13.0	0.8
Fattening cattle				
First period	30	2.5	15.0	0.5
Second period	30	3.0	14.5	0.7
Third period	26	2.7	15.0	0.7
Sheep				
Coarse wool	20	1.2	10.5	0.2
Fine wool	23	1.5	12.0	0.3
Ewes with lambs	25	2.9	15.0	0.5
Fattening sheep				
First period	30	3.0	15.0	0.5
Second period	28	3.5	14.5	0.6
Horses				
Light work	20	1.5	9.5	0.4
Medium work	24	2.0	11.0	0.6
Heavy work	26	2.5	13.3	0.8
Brood sows	22	2.5	15.5	0.4
Fattening hogs				
First period	36	4.5	25.0	0.7
Second period	32	4.0	24.0	0.5
Third period	35	2.7	18.0	0.4

12. Based on weight.—These standards are based on 1,000 pounds live weight. For animals weighing less, as sheep and swine, the quantity prescribed would be proportionately decreased. A sheep, for instance, weighing 100 pounds would be fed one-tenth the quantity called for in the standard. An animal weighing more than 1,000 pounds would require a proportionate increase.

13. Feeding standard only a guide.—Standards are to be taken as guides and varied or modified as circumstances require. In fattening farm stock it is clearly the best sense to supply the largest amount of food that can be profitably used. In feeding dairy cows, so long as pasture, hay, fodder, and silage are home-raised and abundant, the cows may safely be given as much as they can be tempted to eat, provided of course, the concentrated feeds are not denied a proper place in the ration. Such cows

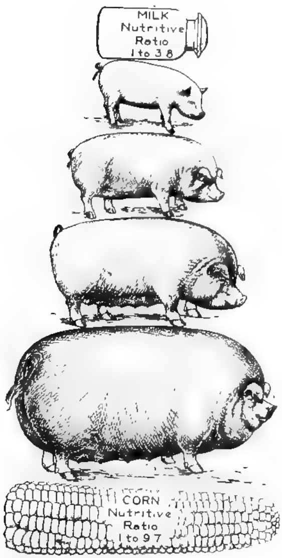
WHEN NATURE BALANCES THE RATION

On no kind of feed does animal life better flourish than on rich, luxuriant pasture grass. It is the first choice of big and little, old and young animals.

as respond with heavy milk yields are entitled to the largest amount of the concentrates, while those that yield little milk will not require much if any grain.

14. Size of animal.—The size of the animal also affects the consumption of food. A part of the demand for food is determined by the surface of the animal rather than by its weight. With these circumstances in mind as examples of various factors that must be considered, the feeding standard may well be used as a starting point in the practical feeding of any class of live stock.

15. Other standards in recent years.—Since the introduction of the Wolff standards other investigators have sought simpler means of measuring the nutrient content of feeding stuffs. The idea of using energy values expressed in terms of starch equivalent in the computation of rations for farm animals originated with Dr. Kellner of Germany. Following him came Dr. Henry Prentiss Armsby of Pennsylvania, who measures the energy content by the therms of net energy they contain. The two methods are identical, but neither method has been before the public long enough to be well known or to be put to practical use. The value of any material as a fuel substance will naturally depend on how much chemical energy that material contains. Both the quantity and the quality must be determined in order to get a fair measure of its energy value. Quite generally the fuel value of feeding stuffs is expressed in *calories*. A calorie is the amount of heat required to raise one pound of water four degrees Fahrenheit. A therm is the quantity of heat required to raise the temperature of 1000 kilograms of water one degree centigrade.



FROM MILK TO CORN

As the animal grows the ration widens.

PRACTICUMS

1. TEST FOR STARCH.—The materials required for making the test below are inexpensive and may be obtained at a drug store. Each school should have on hand a few chemicals and glassware as a part of its regular laboratory equipment. Moisten some starch with diluted iodine. The starch will turn blue. If there is much starch present, the change will be a dark blue; if there is but little, the color will be a light blue.

2. TEST FOR GRAPE SUGAR.—Grape sugar or glucose may be tested as follows: Place a little corn syrup in a bottle or a test tube. Pour on it concentrated potassium hydrate and a few drops of copper sulphate (blue vitriol) and boil. The mixture will turn green, yellow, orange and finally brick red. Test seeds for the presence of glucose.

3. TEST FOR CANE SUGAR.—Add a solution of cobalt hydrate (5 grains of cobalt nitrate to 100 cubic centimeters of water) to the solution to be tested. Add to this a strong solution of sodium hydrate. A violet color indicates the presence of cane sugar. This test applied to grape sugar results in a blue color, which finally changes to green.

4. TEST FOR PROTEIN.—Reduce any common seeds to powder by pounding. Place in a test tube, add a few drops of nitric acid and boil. The protein will turn yellow. Add a few drops of ammonia and the protein will turn orange.

Do the same with white of an egg. Chew several kernels of wheat, until the gluten becomes separated from the starch. The gluten is protein. Apply the same test as above.

5. TEST FOR FAT OR OIL.—Reduce seeds to a powder by pounding. Place the powder on a sheet of paper, lay on a piece of tin and heat—not enough to burn the paper. If oil is present, a spot will be made on the paper.

6. BONE AND MINERAL MATTER.—Place a slender bone in weak muriatic acid and another in a hot fire for a time, and note the effects. The acid will dissolve the lime, or mineral matter, out of the bone, and the fire will burn all grittle, or animal matter, out of the other. The first can be bent or even tied in a knot, while the latter is very brittle.

(*a*) What gives toughness to bones? (*b*) What makes them hard and rigid? (*c*) Why may a child fall many times without breaking a bone, while an aged person is so apt to break one in falling? (*d*) At what time in life are bones most easily bent and made to grow in a wrong shape? (*e*) Would it injure an old person as much as it would a young child to sit long in a wrong position?

7. DETERMINING NUTRITIVE RATIO.—Process: (1) Reduce fat to its carbohydrate equivalent, (2) add the carbohydrates, and (3)

divide this sum by the protein. What is the nutritive ratio of buckwheat, containing 8.1 per cent of digestible protein, 48.2 per cent of digestible carbohydrates and 2.4 per cent of digestible fat?

8. Determine the nutritive ratio of the following:

Feeding stuff	Digestible nutrients in 100 pounds.			
	Protein	Carbo-hydrates	Fat	Nutritive ratio
Wheat	8.8	67.5	1.5	
Oats	8.8	49.2	4.3	
Cottonseed meal	37.6	21.4	9.6	
Wheat bran	11.9	42.0	2.5	
Gluten	29.7	42.5	6.1	
Timothy hay	2.8	42.4	1.3	
Corn stover	1.4	31.2	0.7	
Clover hay	7.1	37.8	1.8	
Alfalfa	10.5	40.5	0.9	

9. Make a list of feeds used on your father's farm. Consult appendix for digestible nutrients and determine nutritive ratio of each.

10. Determine the nutritive ratio of each feeding standard given in paragraph 11 on page 60.

11. Amount of Feed.—Require pupils to make measurements of the home storage places.

1. *Corn in crib.*—Multiply together the height, width and length in feed and multiply this product by 0.45 for old corn, and by 0.4 for new corn. The final product will approximate the number of bushels of corn in the crib.

Problems: (*a*) How many bushels of new corn in a crib 20 feet long, 4 feet wide and 10 feet high?

(*b*) What is the approximate amount of old corn in a crib 30 feet long, 12 feet high and 4 feet wide?

2. *Hay in mow.*—Multiply together the height, length and width in yards and divide by 15 if the hay be well packed. If the mow be shallow and the hay recently placed therein, divide by 18, or by any number from 15 to 18, depending upon the character of the packing. This gives approximately the number of tons.

Problems: (*a*) How many tons in a mow 46 feet long, 18 feet high and 35 feet wide, the hay being just put in?

(*b*) How many tons in a mow 39 feet long, 27 feet wide and 18 feet high, the hay being old and well packed?

3. *Silage in silo.*—Compute the cubic contents of the silo in feet and multiply the product by 40, the approximate weight in pounds of a cubic foot of silage. Divide the total by 2,000 for the approximate amount of silage in tons. The same result may be obtained as follows: Compute the cubic contents of the silo in feet and divide by 50. The quotient is the amount of silage in tons.

Problems: (*a*) How many tons of silage in a round silo 34 feet high and 18 feet in diameter?

(*b*) How many tons in a silo, one-half full, the silo being 21 feet in diameter and 36 feet high?

LESSON SEVEN

HOW FOOD IS DIGESTED

1. Making ready for digestion.
2. What is done in the mouth.
3. From mouth to stomach.
4. Compartments of cow's stomach.
5. The stomach churn.
6. Stomach secretions.
7. Stomach digestion.
8. From stomach to intestines.
9. The two intestines.
10. Food absorption.
11. Villi cells.
12. From intestines to blood.
13. How food is distributed.
14. Respiration.
15. Excretion.

Note to the Teacher.—In this lesson a splendid opportunity is offered for linking some of the facts of physiology with daily life. The processes of nutrition, as here outlined, are brought into their proper relationship with the various organs of the body and with the functions of these organs in their work of growth, life and activity.

LESSON SEVEN

HOW FOOD IS DIGESTED

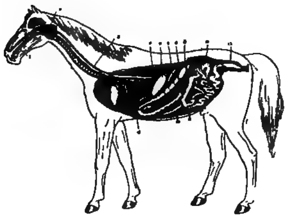
1. Making ready for digestion.—Digestion is more than chewing and swallowing. Before the several plant ingredients can be used as food they must be prepared for absorption. This preparation takes place in the mouth. œsophagus tube, stomach and intestines.

2. What is done in the mouth.—When food is taken into the mouth it is masticated by the teeth. While this is being done there are poured into the mouth large quantities of saliva which soften and soak the foods and start digestion. The active principle of saliva is a soluble ferment called *ptyalin*, which converts the starch into sugar. One authority states that the saliva of a horse will convert raw starch into sugar in 15 minutes.

A large amount of saliva is soaked up by the food. This is often as much as one-tenth of the weight of the animal. Colin states that 84 pounds is secreted by the horse and 112 pounds by the cow in a single day. As a matter of fact, the nature of the food greatly influences the flow, although the control rests with the nervous system.

3. From mouth to stomach.—Food, after being ground and mixed with the saliva, is forwarded to the stomach. Horses, hogs, and humans have a single stomach. Cows, sheep, and goats have a different arrangement, embodying four divisions. With the former the stomach is comparatively simple; it is a single sac not capable of holding a large quantity at one time. In the ruminants, the family to which cattle and sheep belong, the stomach is large, and capable of considerable extension. The capacity of the stomach of the average horse runs from three to four gallons, and of the cow up to 50 gallons or more.

4. The compartments of the cow's stomach are known as the *rumen*, or paunch, the *recticulum*, the *omasum*, and the *abomasum*. The last is the true digestive stomach. The others are largely storage places for the saliva-mixed food. The first of these compartments is very decidedly a storing place where the food is placed until it is thrown back to the mouth for further mastication. This act, or cud chewing, refers to re-chewing the food so as to get it finer and better ground for digestion. The food, on leaving the mouth the second time, is passed through the rumen into the reticulum, then to the omasum and finally into the abomasum, or true stomach, where digestion is continued.



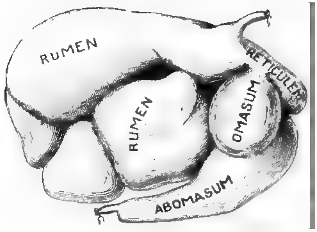
DIGESTIVE SYSTEM OF HORSE

1, mouth; 2, pharynx; 3, œsophagus; 4, diaphragm; 5, spleen; 6, stomach; 7, duodenum; 8, liver; 9, large colon; 10, cæcum; 11, small intestine; 12, floating colon; 13, rectum.

5. The stomach churn.—In the first compartment, or rumen, a churning process is carried on continually. Some think this division of the stomach is never wholly empty. An alkaline fluid is supplied here, as is the case also in the second compartment. Food in the third compartment is subjected to a squeeze which dries it, forcing the extracted juices into the true stomach or fourth compartment.

6. Stomach secretion.—The stomach of every animal is lined by two kinds of membrane—one similar in nature to the lining of the œsophagus tube, and the other that admits of secretion. These do not form a double coat, but one blends into the other. The section giving off the secretion is known as the *villous coat*. It extends to the posterior end, and to the point where the small intestine joins with the stomach.

7. Stomach digestion.—In the stomach, saliva continues the digestion of the starchy matter, and is assisted by the *gastric juice* which pours in from the stomach lining. This secretion has three constituents—*acid, rennin,* and *pepsin.* Pepsin is a ferment whose work is to split up the protein compounds. Rennin, also a ferment, assists in the digestion of milk. There is much of this secretion in calves. Gastric juice converts the protein substances into peptones. The mucus glands of the stomach secrete *mucin,* a substance that lines the walls of the stomach.

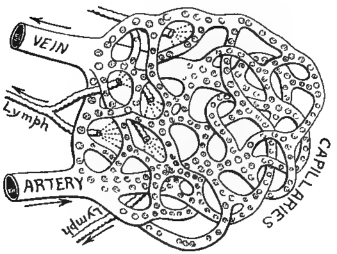


STOMACH OF COW
Showing the four compartments.

8. From stomach to intestines.—The constant churning movement in the stomach causes the food to travel from its entrance to the small intestine. Up to this time there has been no absorption into the body; nor is digestion yet complete. When the partly digested material or *chyme* leaves the stomach it passes into the *duodenum,* one of the three parts of the small intestine, and is there subjected to further action by other digestive juices. Here the *bile,* the *pancreatic* and *intestinal* juices are admitted to complete the work. The bile, dark green or brownish in color, is secreted by the liver and acts in conjunction with the pancreatic juice. The pancreatic juice, alkaline and watery, is secreted by the pancreas, or "sweetbread."

The bile acts as a bowel regulator when the liver is active and healthy. The pancreatic juice has a treble function—it changes starch into sugar, protein into peptones, and the oils into fatty acids. The intestinal juices perform a similar work.

9. The two intestines are not only important for storage purposes, but in them, particularly in the smaller, the real digestive act—the absorption of the nutriment in the food by the blood—takes place. Up to this point, although fluids have been at work, there has been little if any active absorption of the nutrients. The food up to now is, in a sense, outside the body, and there is no entrance or opening for it into the body save through the cells that line the intestinal section of the digestive tract.



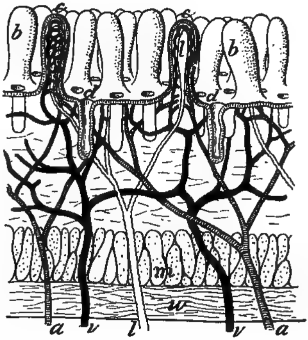
BLOOD PLASMA

This shows blood plasma passing out of the capillaries to feed the cells.

10. Food absorption.—There are no body gates that open and close, and through which the digested materials can be delivered into the body. Food is admitted by absorption. In a way similar to that by which soluble plant food is carried into the plant roots through the cell walls, so is the digested food, after it has been broken up and made soluble, absorbed through the cell walls of the intestines into the blood.

11. Villi cells.—The digested food in the intestines is gathered in by *villi* cells. The mucous membrane lining the small intestines possesses highly differentiated structures that appear as minute fingers. These tiny, hairlike projectiles reach into the intestinal mass for sugar, peptones and fatty acids, and transfer them through the cells into the absorbent vessels or lymphs that in turn empty the assimilated stores of food into larger and still larger vessels. This process continues until the whole of the nutritive fluid is collected in the circulatory system, later to become the very basis of the blood.

12. From intestines to blood.—When food is absorbed it is admitted either to the capillaries or to the lymphatic system. If collected by the capillaries the absorbed food is carried to the portal vein, thence to the liver and finally to the heart, into which it is poured with the blue blood brought in from all parts of the body. At this point the blood contains both nutriment and waste. That part of the absorbed food which entered into the lymphatic system is carried to the thoracic duct, and delivered into one of the main blood vessels.' Lymph is blood without the red blood corpuscles. It wanders to all parts of the body, surrounds all the cells of all the tissues and carries and leaves with the very kind of food they need most.

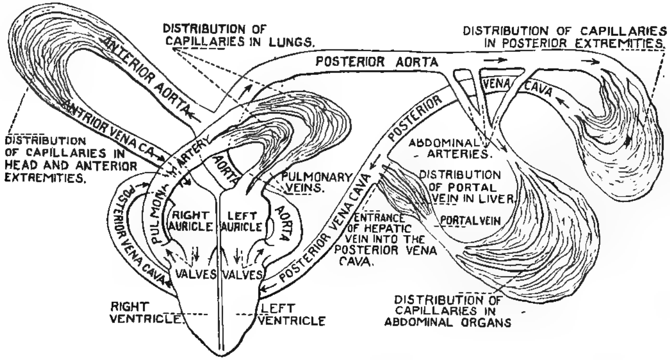


VILLI CELLS

Section of intestine showing villi: The parts are: *a*, arteries; *b*, villi; *c*, villi cut open to show lacteal (*l*), and blood tubes; *d*, glands; *m*, muscle; *v*, veins; and *w*, wall of intestine.

13. How food is distributed.—After food enters the circulatory system it takes the regular course of the blood. In impure blood it is carried to the right auricle of the heart, then to the right ventricle. This in turn contracts and forces the blood into the lungs, where oxygen is taken on and carbonic acid gas and other impurities are given off. From the lungs the blood, now red and pure, passes into the left auricle, and thence into the left ventricle, from which it is forced into the aorta, and distributed to all parts of the body.

14. Respiration.—When the impure blood passes through the lungs, carbonic acid gas and other impurities are held back and in breathing are exhaled and thrown out of the system. At the same time oxygen is taken in with great greediness by the cells of the blood, which distribute it where needed in all parts of the body. When plants are growing, oxygen is released and thrown into the air. At the same time, by means of leaves, the



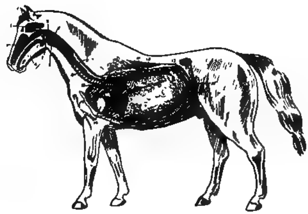
How the Blood Circulates Through the Body

Blood is collected from all parts of the body and delivered into the right auricle, which on contracting, forces the blood into the right ventricle; this in turn contracts and forces the blood into the lungs, where oxygen is taken on and carbonic acid gas and other impurities are thrown off. From the lungs the blood is returned to the left side of the heart and distributed through arteries and capillaries to all parts of the body.

carbonic acid gas is drawn in and used in the construction of the plant compounds. This was got from the air. An animal, in performing its functions and in building tissue, inhales oxygen from, and exhales carbon dioxide into, the air. Animals in this manner use what is waste to the plant, and the plants what is poison to the animal.

15. Excretion.—The products resulting from the oxidation of animal tissues, or of the food consumed, are removed from the body by the lungs, kidneys and skin. The chief products of oxidation in the body are carbonic acid, water, urea, and salts. Carbonic acid is removed through the lungs, and to a smaller extent by the skin; urea and salts by the kidneys and by perspiration; water by the organs of excretion. Fat and sugar when oxidized yield simply water and carbonic acid and are excreted as such products. The undigested part of the food is voided as solid excrement.

The powers of digestion differ with the several species of animals. Thus hogs are not capable of living on hay and similar roughage because their single small stomach does not permit them to digest a sufficient proportion of such material. A hog will not grow fat on grass alone, while a steer may. Cattle and sheep with their four stomachs, have the power of efficiently changing grass into food, clothing and labor. It is this power which makes them useful to man. Horses have the ability of digesting coarse materials in a fairly high degree. When severe work, however, is required horses must be fed on concentrated and easily digested food for the best results.



RESPIRATORY SYSTEM OF HORSE

1. Cranial cavity; 2, guttural pouch; 3, nasal cavity; 4, tongue; 5, pharyngeal cavity; 6, cavity of larynx; 7, epiglottis; 8, trachea; 9, œsophagus; 10, section of left bronchus; 11, ramifications of right bronchus; 12, right lung; 13, left lung; 14, sternum; 15, ribs; 16, heart; 17, posterior aorta; 18, anterior aorta.

LESSON EIGHT

COMPUTATION OF RATIONS

1. Why animals use food.
2. Two kinds of rations.
3. Mixed foods.
4. How a ration is made.
5. First step in making a ration.
6. Second step in the computation.
7. Comparing the trial ration with the standard.
8. Completing the ration.
9. Ration is satisfactory.
10. Feeding for heavy milkers.
11. Rounding out with grain feeds.
12. Using the standard in practical work.
13. What balanced rations accomplish.
14. What foods to choose.
15. Cost of the ration.

Note to the Teacher.—This lesson gives all the details of compounding rations for farm animals. To make students thoroughly familiar with ration making require them to prepare other rations, using feeds available at their homes. Members of the class should be asked to place their work on the blackboard, where careful comparisons may be made. This will develop into very interesting work, particularly if the cost of each food is also included. Calculate the variation in cost for large herds covering half-year or yearly periods.

LESSON EIGHT

COMPUTATION OF RATIONS

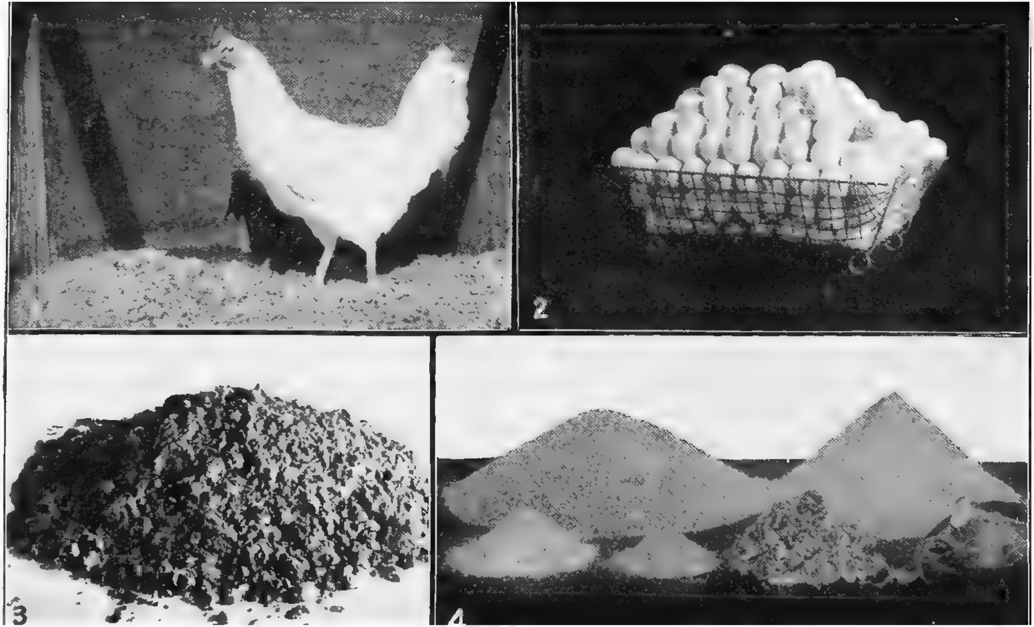
1. Why animals use food.—An animal uses food for five distinct purposes:

1. To replace waste from all parts of the body.
2. To produce heat to keep the body warm.
3. To produce energy so that work may be done.
4. To provide the building materials for larger growth or increase in muscle, fat, flesh and bone.
5. To have materials in reserve for the formation of milk, wool, etc.

These five purposes develop after the food is absorbed, and originate in the digestible nutrients expressed in terms of protein, carbohydrates and fat. To provide nutrients in the quantity and proportions that they should be fed so as to satisfy one or more of the five ends of feeding makes necessary the selection and compounding of rations.

2. Two kinds of rations.—Suppose a ration is wanted for a herd of dairy cows. What class of food shall be placed before the animals? It is possible to furnish a ration consisting of roughage food raised on the farm, like straw, corn stover, the usual farm hays, and ear corn; on the other hand, a ration might be furnished consisting largely of grain food or concentrates, with a small allowance of some cheap roughage.

In villages, and in herds near large cities, cows are fed largely the by-products of certain manufacturing enterprises, or on chop feeds and other grain materials that may be purchased often as cheaply as hay. The result is, these cows are not fed as they ought to be. The cow in the country often is fed too little protein and too



HOW PROPER FEEDING HELPED THIS HEN MAKE A RECORD

At the New York state college of agriculture Lady Cornell, a Single Comb White Leghorn, weighing 3.2 pounds, ate 110 pounds of food in her first year to produce 257 eggs weighing 29.5 pounds and 73 pounds of voidings. In her second year she laid 200 eggs weighing 23.7 pounds. This record is due to rational feeding, coupled with careful management and thoughtful breeding.

much carbohydrates and fat; the village cow too much of protein and too little of the carbohydrates and fat; and the best results are not obtained in either case. The country cow loses in weight; she gets poor; she is forced to take from her own body much protein stored in flesh to use for milk and tissue repair. The village cow may or may not thin down, but the necessity of using the protein in the food for meeting all the functions of the nutrients acts to her disadvantage and she is never able to be at her best.

3. Mixed foods.—Best results are always secured when the two methods are merged; when the country cow is given concentrates in addition to the farm-raised roughages, and the village cow hay and stover in addition to the feed-store mill feeds. It is not enough to secure grain as concentrates for the country cow either; the selection must be made on the basis of the composition; and, since the country cow's ration is already out of proportion because of the excess of carbohydrates and fat, it would not help matters any by a purchase of a grain food also low in protein.

TWO DAIRY RATIONS

Two rations for dairy cows have been compared. From one, 8.9 pounds of butter was produced from one dollar's worth of feed, while from the other but 5.28 pounds of butter was obtained from a dollar's worth of feed. This shows how two rations may cost the same and one may be worth a great deal more for final returns.

In practice many feeders buy corn meal as a dairy concentrate; instead of improving the ration this makes things worse, because corn meal added to grass hay, corn stover and straw only increases the cost without supplying any appreciable increase of protein. The way out of this difficulty is to study the available concentrates and select one or more that contains protein in greatest abundance, and not starch and fat.

4. How a ration is made.—The first step in computing rations is to consider the feeding standard for the class of animals to be fed. If it is assumed that a ration is wanted for a dairy cow yielding 22 pounds of milk daily, the table of standards is to be consulted for that class of dairy cows. The standard calls for 29 pounds of dry matter, 2.5 pounds of digestible protein, 13 pounds of digestible carbohydrates, and 0.5 pounds of digestible fat. Assuming that corn stover, corn silage and clover hay are available, we will use such quantities of each as have been found in practice to be fairly representative of the available supply on average farms and about what an animal will eat up clean without tiring her appetite.

5. First step in making a ration.—As a starting point, we will use 10 pounds of corn stover, 15 pounds of clover hay and 30 pounds of corn silage. The averages of digestible nutrients in these feeds are as follows:

Feeding stuffs	Dry matter	Digestible nutrients in 100 pounds		
		Protein	Carbo-hydrates	Fat
Corn stover	59.5	1.4	31.2	0.7
Corn silage	20.9	0.9	12.6	0.6
Clover hay	84.7	7.1	37.8	1.8

6. The second step in the computation is to calculate the pounds of digestible nutrients in the quantities of each of these feeding stuffs. It is clear, for instance, that 10 pounds of corn stover will contain just one-tenth as much protein, carbohydrates and fat as 100 pounds. If each of these factors is divided by 100 and multiplied by 10, we shall have the amounts of each constituent that 10 pounds of corn stover will furnish the animal.

The 100 pounds of corn stover contains:

59.5 pounds of dry matter
1.4 pounds of protein
31.2 pounds of carbohydrates
0.7 pounds of fat

If 100 pounds of corn stover contains these quantities of digestible nutrients, then 1 pound contains just one one-hundredth as much, or the following quantities:

.595 pounds of dry matter
.014 pounds of protein
.324 pounds of carbohydrates
.007 pounds of fat

Ten pounds will contain ten times the quantity of 1 pound, or the following:

5.95 pounds of dry matter
.14 pounds of protein
3.24 pounds of carbohydrates
.07 pounds of fat

The digestible nutrients in 30 pounds of corn silage are ascertained in the same manner:

	In 100 lbs.	In 1 lb.	In 30 lbs.
Dry matter	20.9 ÷ 100 =	.209 × 30 =	6.27
Protein	0.9 ÷ 100 =	.009 × 30 =	.27
Carbohydrates	12.6 ÷ 100 =	.126 × 30 =	3.78
Fat	0.6 ÷ 100 =	.006 × 30 =	.18

Making the same computation for each constituent in clover hay, we have the following:

	In 100 lbs.	In 1 lb.	In 30 lbs.
Dry matter	84.7 ÷ 100 =	.847 × 15 =	12.70
Protein	7.1 ÷ 100 =	.071 × 15 =	1.06
Carbohydrates	37.8 ÷ 100 =	.378 × 15 =	5.67
Fat	1.8 ÷ 100 =	.18 × 15 =	.27

7. Comparing trial ration with the standard.—If we arrange these figures in a table and add the nutrients together, we shall have a statement of the quantity of each constituent supplied, and will be in a position to compare their totals with the standard, to know what nutrients are insufficiently provided. This is done as follows:

TRIAL RATION FALLS BELOW STANDARD

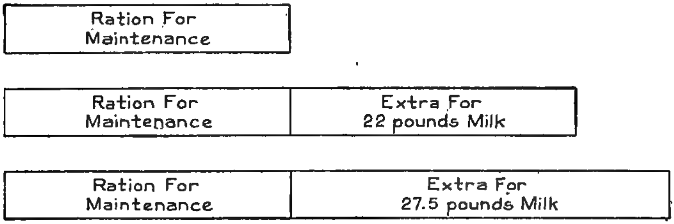
Feeding stuffs	Dry matter	Digestible nutrients		
		Protein	Carbo-hydrates	Fat
10 lbs. corn stover	5.95	.14	3.24	.07
30 lbs. corn silage	6.27	.27	3.78	.18
15 lbs. clover hay	12.70	1.06	5.67	.27
Totals	25.92	1.47	12.69	.52
Feeding standard	29.00	2.50	13.00	.50

8. Completing the ration.—Comparing the nutrients in the feeds used with the standard, it will be seen there is a striking deficiency of protein. It will now be necessary to introduce into the ration one or more other feeds in order to correct the faults so evident in the trial ration. Since the greatest deficiency is in the protein, we must seek a supply from among such feeding stuffs as are particularly rich in protein. The oil and the gluten meals are of this kind. Suppose we now try two and three-quarter pounds of cottonseed meal. The digestible nutrients are ascertained in the same manner as before, and a second trial made.

FEEDING RATION FOR DAIRY COW APPROXIMATES STANDARD

Feeding stuffs	Dry matter	Protein	Carbo-hydrates	Fat
In preceding	25.92	1.47	12.69	.52
2¾ lbs. cottonseed meal	2.55	1.03	.59	.26
Totals	28.47	2.50	13.28	.78
Feeding standard	29.00	2.50	13.00	.50

9. Ration is satisfactory.—In this ration no serious faults are noticed. We have the correct amount of protein, but an excess in carbohydrates of .28 pounds. The dry matter is slightly under the standard. This does not matter so long as the quantity does not so greatly overrun the standard as to give greater bulk than the average cow has room to accommodate. A deficiency in dry matter can be evident and still not affect the efficiency of the ration. The excess of the fuel foods is so small as to be of no importance. Were a pound less of clover hay and a quarter of a pound more of cottonseed meal used in the ration, the ration would correspond to the standard with considerable exactness.



RATIONS CHANGE WITH RATE OF MILK YIELD

Food requirements for maintenance are the same, but more food is necessary in proportion as the yield of milk is increased. Heavy milking cows, therefore, require the biggest rations.

10. Feeding for heavy milkers.—Suppose, now, a ration is wanted for the same cows at another period when they are giving more milk than in the case just cited, say 27.5 pounds daily. How shall we proceed to adjust this ration to the new requirements, using as nearly as possible the same feeding stuffs as before? The first step is to consult the standard. This we find calls for 32 pounds of dry matter; 3.3 pounds of protein; 13 pounds of carbohydrates; 0.8 pounds of fat.

Obviously, each cow has a certain limit as to storage and digestion capacity for bulky feeds. In the preceding ration about all of the corn stover, silage and clover hay that the average cow can handle was used. Her limit, therefore, was reached as far as the roughage foods are concerned.

11. Rounding out with grain feeds.—Since the ration already contains just about all that a cow of this size can eat, we will prepare a place in the ration by withdrawing three pounds of the clover hay. We will increase the cottonseed meal to four pounds and add 2½ pounds of gluten feed. This done, we have the following:

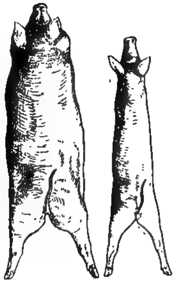
Feeding stuffs	Dry matter	Digestible nutrients		
		Protein	Carbo-hydrates	Fat
10 lbs. corn stover	5.95	.14	3.24	.07
30 lbs. corn silage	6.27	.27	3.78	.18
12 lbs. clover hay	10.12	.85	4.54	.21
4 lbs. cottonseed meal	3.76	1.50	.84	.36
2½ lbs. gluten feed	2.25	.53	1.30	.06
Totals	28.35	2.29	13.70	.88
Standard	32.00	3.30	13.00	.80

This ration agrees closely with the standard and is assumed to satisfy all the requirements for a cow yielding 27.5 pounds of milk daily and weighing 1,000 pounds.

12. Using the standard in practical work.—Many people take feeding standards and balanced rations far too seriously. They fail to understand that it is in the spirit and not in their literal use that these feeding aids are to be adopted. The balanced ration, at best, can be made to approach only approximately the food requirements for any animal or set of animals.

The composition of a feeding stuff is always open to considerable variation, and what adds still to the uncertainty is the fact that foods are not digested with equal facility or completeness by different animals, even in the same herd and given the identical feeding stuffs. Moreover, it is impracticable to provide a ration for every individual in a herd. To do this would require as many different rations as there are animals to be fed, and definite weighings of every feeding stuff contained in the ration. But all this is unnecessary, and no exponent of the balanced ration asks that it be done.

13. What balanced rations accomplish.—The aim of the balanced ration is to avoid serious faults in the use of feeding stuffs. Used on broad lines, the balanced ration enables the stock feeder to utilize to the best advantage his plant products or feed crops. In case he needs an additional supply, a bit of figuring will fully advise him as to what class of available purchased feeds he ought to buy in order to secure the greatest efficiency from the food.



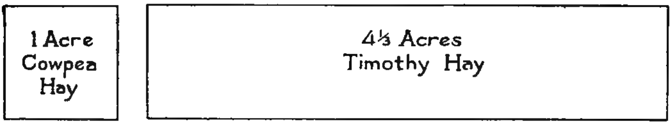
FEED DID IT

The hogs were litter mates. The smaller of the two lived its little life on corn alone. The big fellow had corn and alfalfa.

14. What foods to choose.—On every farm some feeding stuffs are grown that possess little commercial value. Corn stover, the straws, legume hays, and silage are all splendid bulk foods, are easily raised on the farm and should be used freely in ration making. They will supply also the greater part of the carbohydrates and fat. The farm is the best factory for the production of these fuel nutrients. In the legumes and cereal grains much of the protein may be obtained. If a protein shortage exists, it is good business to meet it, even though expensive concentrates must be purchased.

15. Cost of the ration.—The wise farmer will figure the cost of foodstuffs very carefully to find out what are most profitable to feed. It is often economy to sell some food having a wide nutritive ratio, such as timothy, corn, oats and wheat, replacing with other foods having a narrow nutritive ratio, such as the oil meals, and the factory by-products. Very often this exchange is made; and not only is the ration improved, thus bringing about better results from the animals under feed, but a money profit is secured in addition to that obtained because of the greater efficiency of the ration.

More milk can be produced from a given herd of cattle if the grain is fed in proportion to the milk given than if distributed equally among all the cows of the herd. Let it be assumed that in addition to what clover hay and



INCREASING THE FARM PROTEIN SUPPLY

The two fields will produce the same amount of protein. This is one reason why legume farming pays.

silage a cow will eat, she should receive 1 pound of grain for each 5 pounds of milk. Under these conditions, a cow that is producing 20 pounds of milk would require 4 pounds of grain; one giving 30 pounds, 6 pounds; while a cow producing 50 pounds of milk would require 10 pounds of grain. The best results are obtained by the skillful feeder who studies the needs of his cows.

LESSON NINE

GETTING THE MOST FROM FEEDS

1. Appetite
2. Pasture grass
3. Soiling crops
4. Silage
5. Roots
6. Variety in food
7. Steaming and cooking food
8. Coarse or roughage feeds
9. Concentrates
10. Protein most important
11. Cutting hay
12. Shall grain be ground
13. Double value in feeds
14. Loss of fertility contained in feed
15. Profit from feed

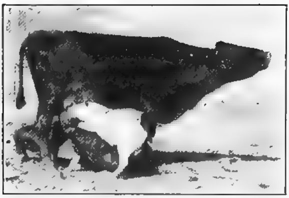
Note to the Teacher.—The opportunity is offered in this lesson to summarize the entire subject of feeding, and to combine the practical phases with the fundamental scientific facts. A ration might be compounded that would be balanced in the proper sense, and yet be so bulky that it could not be entirely consumed; or it might be so unappetizing as to be largely rejected. Bring the student to see the importance of rational feeding, of growing the feeds at home, and of using them to the very best advantage.

LESSON NINE

GETTING THE MOST FROM FEEDS

1. Appetite.—A stock raiser may provide a balanced ration, but if the animal has no appetite for it, or if for other reasons cannot take enough of it, failure will result. From an economic point of view appetite should be considered in the management of all live stock. Aim to provide foods that animals relish; and to set the food before them in such a way that they will eat greedily and heartily. The heavy eaters are the most profitable feeders. Appetite is promoted by exercise, fresh air, salt, condiments or cattle spices, succulent foods, silage and variety.

2. Pasture grass.—The food that stands at the head of feeding stuffs is fresh pasture of mixed grasses and legumes. On such a ration every class of farm animals thrives in vigor and energy. They grow in weight, give off their maximum in milk or labor and enjoy the best of health. On most farms where live stock is reared some provision is made for pasturage for at least part of each year. In some sections, because of nearness to large cities, the land is often considered of too great value to devote to pasture and grazing. In such regions trucking crops are grown.



NO COMPLAINT ABOUT FOOD OR APPETITE

3. Soiling crops.—Near large cities or where land is too expensive to devote to pastures, soiling crops are frequently resorted to for feeding dairy herds. Fed when green, the tender stalks are greedily eaten, the appetite is kept keen and sharp by the succulent and juicy forage and the largest quantity of milk is yielded. Where soiling is practiced no fences are required. This saves land and capital in fences. As fast as manure is made it is hauled to the fields and a fresh crop is started. Often two or more crops are grown on the same land each year. The aim is to have a crop growing all the time. The leading soiling crops are corn, alfalfa, clover, rye, oats

FILLING THE SILOS FOR WINTER FEED

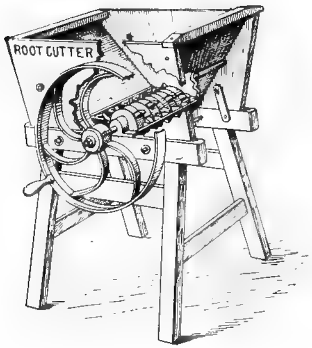
Corn should be reasonably well matured before placed in the silo. With this should go thorough tramping. The silage will then be sweet, substantial and nutritious.

and peas, cowpeas, wheat and vetch, barley and vetch or Canadian peas, and local grasses.

4. Silage.—When green corn is cut in short pieces and stored in the silo, it makes excellent food for all classes of farm animals. While storing corn in the silo adds nothing to its food value, this method of preservation retains the succulence and juice and provides a more appetizing corn dish. More milk or meat will be produced from an acre of corn put in the silo than from an equal area of similar corn fed when matured and cured and used as dry fodder and ear corn.

Corn is the leading silage crop, although alfalfa, soy beans, clover, rye, and other crops may be used for the same purpose. These crops, however, do not keep as well in the silo as corn does. When crops other than corn are to be siloed, it is better to mix them with corn. Soy beans and corn, or alfalfa and corn, are excellent combinations. Prepared in this manner, the mixture is better balanced and gives maximum results in the stable and feed lots.

5. Roots.—In summer, if pasture is available, animals fare very well without silage, soiling or roots. In winter a succulent food is advisable. Root crops have long been popular with sheep, cattle and horsemen and with breeders of valuable farm stock. Roots are not valued solely for their nutriment. They aid digestion and assimilation of dry foods and contribute to healthfulness.

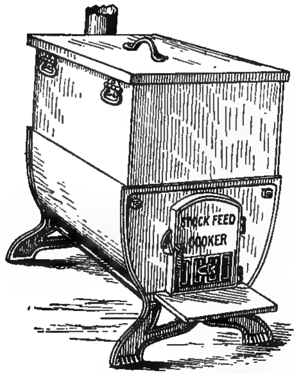


ROOT CUTTER

The leading root crops are carrots, turnips and beets. If silage is available, roots may be dispensed with. The cost of labor in growing has been against their extended use in this country. One reason why roots are so satisfactory an article of food is because they are so completely digestible.

6. Variety in food.—Animals are less likely to tire of their food if it contains several kinds of feeding stuffs. Farm stock are like people—they relish variety in their food supply. This does not mean frequent changes in the ration. If a ration is correct, animals do better if fed continuously upon it. Provide variety at the time of selecting the feed, but after the proper combination has been secured make no changes except for very good reasons. Under what circumstances is it sometimes advisable to change the ration?

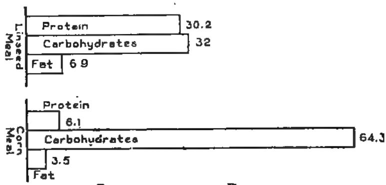
7. Steaming and cooking food.—A great many devices have been placed on the market for the preparation of feeding stuffs for live stock. The labor and expense connected with the steaming and cooking of food are usually unwarranted and uneconomical.



Device for Cooking Feed for Live Stock

8. Coarse or roughage feeds.—These include the grasses, cereals, legumes, roots and anything of a bulky nature, whether fed green or dry, as hay. In all feeding practice, the ration should be based on one or more of these products. They are home grown and are thus produced at less cost than other feeds if purchased. The roughage feeds contain more of the carbohydrates than of protein.

9. Concentrates.—The grain by-products and other concentrates are relatively rich in protein, but not always so. Cottonseed meal, linseed meal and gluten are very high in protein. The concentrates are easily digestible, and where high production is demanded, liberal quantities should be used in daily rations. In purchasing concentrates,

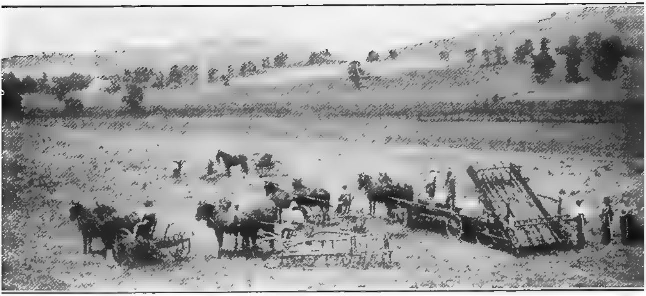


Selecting for Protein

Note the much larger amount of protein in linseed meal than in corn meal.

make it a rule to ascertain the amount of total digestible nutrients and of digestible protein in a ton. Then select the feeding stuff that supplies the protein at the cheapest rate to the pound. In this way economical buying of feeds is possible.

10. Protein most important.—In buying concentrates choose those feeds that are high in protein and relatively low in carbohydrates. For instance, cottonseed meal contains nearly six times as much protein as corn meal. The dairyman who has a large supply of corn stover,



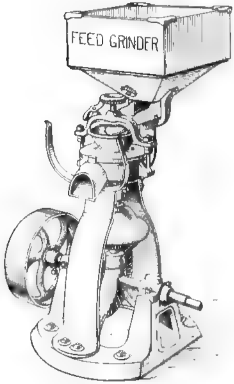
USEFUL TOOLS FOR MAKING HAY

Our forefathers cut the hay crop by hand. Haying operations are now done largely by horse-drawn tools. Farm tools and implements save labor and lessen the cost in producing crops.

silage and grass hay would make a poor purchase if he selected corn meal instead of cottonseed meal or gluten for dairy cows, even though the corn might cost but half as much per ton as cottonseed meal or gluten. Getting protein at the cheapest cost a pound is the most important thing in buying concentrated feeds.

11. Cutting hay.—Early cut hay is richer in protein and contains less crude fiber than late cut. As plants ripen, the more nutritious compounds move into the seed, and leave the food part of hay less valuable. The best time for cutting is between the time of blossoming and seed forming. The nutritious compounds at this time are distributed throughout the plants, and there is correspondingly less woody tissue. If cut when the plants are in blossom the yield will be less than at a period a little later.

12. Shall grain be ground?—Grain feeds are most digestible if ground. Corn, oats, wheat and other grains often are so hard that if passed into the stomach without mastication the digestive juices fail in their duty. But it does not follow that it is good business management to grind feeds. Experiments show that when corn, for instance, is ground the returns are increased from 8 to 15 per cent; yet the labor of hauling to and from the mill or of grinding the grain at home may mean a loss in the end. The custom of following cattle and horses with pigs to pick up the undigested grain or other food is both wise and profitable, and satisfactorily meets this condition.

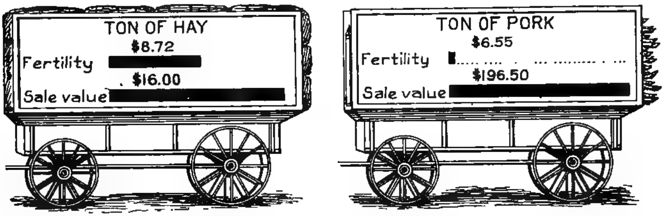


FEED GRINDER

13. Double value in feeds.—All feeding stuffs have two values—feed and fertility. The man who buys concentrated feeds rich in protein gains by the enterprise, but the men lose who produce and sell them. By disposing of these valuable food products farmers really sell the plant food of their lands. When animal products are sold the drain on the land is not large, but if grain crops are sold much plant food is withdrawn from the soil.

The farmer who sells a ton of clover hay withdraws from his soil $8.72 worth of fertility. This is half as much as he receives. If, on the other hand, he sells a ton of pork, he sends from his farm but $6.35 worth of fertility, but receives 30 times as much as the value of the fertility contained in it. If he sells milk, he receives 40 times as much as the fertility contained in it; and if he sells butter, his returns are 1,000 times as much as is the value of the fertility sold in the butter.

14. Loss of fertility contained in feed.—Due to careless methods of handling manure, there is a tremendous loss of fertility in the aggregate each year. Much of the nitrogen is lost as fast as the manure is made, through fer-



Selling Hogs Versus Selling Hay

Equal amounts of hay and pork are sold. Note the difference in market value and quantity of plant food sent from the farm in each.

mentation and leaching. Much of the potash is lost in drainage waters from the stable and the barnyards. This loss can be greatly lessened by the use of litter in the stables, by covered barnyards, and through the addition from day to day of a preservative like acid phosphate to the excrement.

There is loss through leaching, not only in barnyards, but wherever manure is exposed to the influence of the weather. In loose, open piles fully one-half of the fertilizing value may disappear in a half-year period. If manure is not hauled direct to the field and scattered, it may be fairly well preserved in large piles, which should be kept moist; or in covered barnyards, where it should be thoroughly compacted, with enough litter provided to absorb the liquid and keep the animals clean. Fresh manures that undergo fermentation rapidly, such as horse and sheep manures, should be mixed with litter immediately, else the nitrogen will be lost. Acid phosphate sprinkled on fresh manure has long been a popular preservative.

15. Profit from feed.—The full value of a feeding stuff for feed and fertilizer is secured only when the feed has been properly prepared in the first place, then fed in the proper combination with other feeds to farm animals of good breeding and selected for the purpose to which they are best adapted, and finally so handled as manure that the fertilizing materials are not lost through fermentation, decomposition and leaching. Such practice is good farming and is fundamental for success in feed lot or open field.

How Not to Store Manure

This bad practice causes an annual loss of millions of dollars. Why will we do it?

To get the best results there must be a proper relation (1) between the total dry matter and the total digestible nutrients and (2) between the digestible protein and the digestible carbohydrates. For example, from 100 pounds of hay a horse may digest 40 pounds of nutrients. Twenty-four pounds may be burned up in the work of digesting the hay, thus leaving but 16 pounds available for labor. From 100 pounds of oats, a horse may digest 72 pounds, 12 pounds of which are consumed in the work of digestion, leaving 60 pounds for labor. Thus oats may be nearly four times as valuable as hay for a horse that must exercise great power or speed. An ordinary milk cow will consume from 24 to 30 pounds of dry matter, two-thirds of which should be digestible, while one-eighth of the digestible material should be protein.

PRACTICUMS

1. Do horses have teeth in front in both jaws? Do cattle? Do sheep?

2. COST OF NUTRIENTS.—(Consult appendix for digestible nutrients in feeding stuffs.)

(*a*) When corn is worth $25 a ton, what is the value of a pound of digestible protein? Of a pound of total digestible nutrients?

(*b*) When cottonseed meal can be bought for $32 a ton, and protein only is required for balancing a dairy ration, what is the cost of a pound of digestible protein?

(*c*) If protein only is needed, in which feeding stuff—cottonseed meal at $32, linseed meal at $32, corn meal at $25, or wheat bran at $28 a ton—can it be most cheaply purchased? Show by figures.

3. RATION FOR DAIRY COWS.—Compound a ration for dairy cows, averaging 1,000 pounds in weight, and yielding 22 pounds daily, using 10 pounds of corn stover, 10 pounds of clover hay, and 40 pounds of corn silage for the foundation and such amounts of cottonseed meal, wheat bran and gluten as will be necessary to balance the ration.

4. RATIONS WITH REFERENCE TO COST.—(*a*) Use the following feeding stuffs for compounding a ration for a cow weighing 1,000 pounds and yielding 22 pounds milk daily. Timothy hay worth $20 a ton, corn stover $5, corn $25, oats $30 and bran $28. What is the daily cost of the ration?

(*b*) Use the following feeding stuffs for compounding a ration for the same cow: Alfalfa hay, worth $15 a ton; clover hay, $12; corn silage, $2; cottonseed meal, $32, and gluten, $25. What is the cost of the ration?

(*c*) What is the difference in cents of the daily cost between these two rations?

(*d*) Suppose both rations are available for a dairy herd of 40 cows to be fed six months. What would be the total cost of each ration and the saving in cost if the cheapest is used? Is not the cheapest ration also the best?

5. HOME USED RATION.—What quantities each of five feeding stuffs used at your home may be used in combination so as to furnish an approximately balanced ration for a dairy cow weighing 1,000 pounds and yielding 22 pounds of milk? (For digestible nutrients, see appendix.)

6. Using for the purpose timothy hay, corn, oats and bran, how many pounds each will be required for feeding a horse weighing 1,000 pounds and doing light work?

7. A farmer fed each of his cows about 10 pounds of timothy hay, 35 pounds of corn silage and 5 pounds of corn and cob meal daily. Suggest some changes that might be made to make this ration better.

8. TWO DAIRY RATIONS COMPARED.—At the Ohio station two

rations were compared for feeding dairy cows. Ration A contained 58 pounds of corn and soy bean silage, 6.8 pounds of mixed timothy hay, 2 pounds of linseed meal and 2 pounds of bran. Ration B consisted of 4.7 pounds of corn stover, 6.4 pounds of mixed timothy hay, 2.5 pounds of linseed meal, 5 pounds of corn meal and 6 pounds of bran. (*a*) Compare these two rations as to digestible nutrients. (*b*) Determine nutritive ratio of each ration.

The value of the feeds was as follows: Corn silage, $2 a ton; corn stover, $5; hay, $12; linseed meal, $34; wheat bran, $30; and corn meal, $30. (*c*) What was the daily cost of Ration A? of Ration B? What is the difference in cost of the rations? (*d*) Suppose 40 cows are fed 210 days; what is the difference in cost of feeding that number of cows during that time if the cheaper ration is used? (*The results of this trial showed that Ration A produced 96.7 pounds of milk for each 100 pounds of food, based on dry matter contained in it, and Ration B, 81.3 pounds. Thus Ration A was better, but was it also cheaper?*)

9. Two Horse Rations Compared.—Weight of horses, 1,000 pounds; kind of work, severe. Feed in Ration A, 10 pounds of timothy hay, 14 pounds of oats. Feed in Ration B, 10 pounds timothy hay, 2 pounds linseed meal and 9 pounds of corn meal.

(*a*) Compare the two rations for digestible nutrients. Value of feeds, hay $16 a ton, oats 56 cents a bushel, corn 65 cents a bushel, and linseed meal $30 a ton.

(*b*) What is the cost of each ration?

(*c*) What is the difference in daily cost?

(*d*) If six horses are fed for nine months, what would be the saving if the cheaper ration were fed?

(*e*) Is the cheaper ration less efficient? Why?

10. Cost of Nutrients.—Complete the following table and calculate the digestible protein and total digestible nutrients that can be procured for $1. In making the calculation use the prices of your local or home market. What are the three most expensive feeds? The cheapest?

Comparing Feed Prices

Feeds	Price	Pounds for $1	Nutrients procurable for $1	
			Protein	Total digestible nutrients
Corn				
Oats				
Wheat bran				
Linseed meal				
Gluten meal				
Cottonseed meal				
Timothy hay				
Clover hay				

LESSON TEN

DRAFT AND SPEED

1. Work
2. Beast labor
3. Why horses excel
4. Two types of horses
5. Draft breeds
6. Carriage or coach breeds
7. Lighter breeds
8. Action
9. Quality
10. Temperament and disposition
11. Beauty
12. Defects
13. Blemishes
14. Schooling
15. Educating the colt

Note to the Teacher.—In the horse are combined both work and speed to greater useful advantage than in any other animal. The early wild horses were swift and strong, and these two qualities have been still further developed since man has taken these beasts into his keeping. It is not out of place to honor and caress this noble animal, which, sturdier, stronger and fleeter than ourselves, is, nevertheless, one of the most serviceable and devoted of all domestic animals.

LESSON TEN

DRAFT AND SPEED

1. Work.—In the early days the work of the world was done largely by human beings. Burdens were carried, the arts of agriculture performed, and the necessary tasks of life were all based on hand labor or on the toil of men and women. After a time animals were domesticated, captive beasts being forced to perform the sterner and more severe kinds of labor and work.

2. Beast labor.—In our own days the ox and the horse were drawn to do this work, but the horse proved to be best adaptable and most efficient. This superiority is due not entirely to greater strength, but to more rapid and graceful movement. In many parts of the world oxen or other cattle are generally employed. Oxen have done much in subduing the wilderness and the prairies of this land. Horses and machinery are now the chief motive forces in the United States. Although steam, gasoline and electrical power are much used, horses are more in demand today and command higher prices than ever before. The call of cattle for meat has practically exhausted their supply for labor.

DEVELOPED FOR WORK
Note the heavy muscles and substantial frame.

3. Why horses excel.—Horses are more popular for working purposes than other domestic animals, because they are readily educated to their task. They draw vehicles, tools and implements at quick speed; they may be ridden or driven at a fast or slow pace, and in all other respects they meet the necessities of an active,

CATTLE USED FOR PLOWING IN GERMANY

While horse labor is generally employed in this country, in Europe ox labor is common and efficient. Ox teams were once common on many American farms.

dependable beast for labor, travel or other work. Their racial characteristics have admitted of easy development, so much so that they have become among the most useful and most indispensable of the domestic animals.

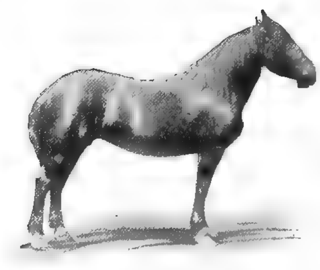
4. Two types of horses.—Horses now existing may be divided into two great groups: the heavy, cold-blooded

COACH HORSES OF STYLISH ACTION

horses of western Europe, and the lighter, hot-blooded horses of eastern origin. This difference relates to character and temperament, the eastern horses being ardent, quick, susceptible, courageous, sometimes restive; while those of the west are calm, steady, slow and gentle. The draft breeds belong to the latter, the roadsters, carriage and speed to the former.

"A low, heavily built horse, with comparatively large feet and limbs, developed and spread over a considerable portion of Europe, especially in the northern, low-lying sections; and from this old black horse of Europe, or the black horse of Flanders, as it is variously called, all of our modern draft horses have been produced by selection, careful breeding, and mixture of other strains of blood."

5. Draft breeds. — The principal draft races are Percheron, French Draft, Belgian Draft, Clydesdale, Suffolk and English Shire. Horses of this type are heavy in body and muscle, have broad shoulders and backs, thick necks, broad loins, strong, compact hips and thighs, and clean, powerful legs. They are large and massive, possess big, heavy bones and are powerful in appearance and form.



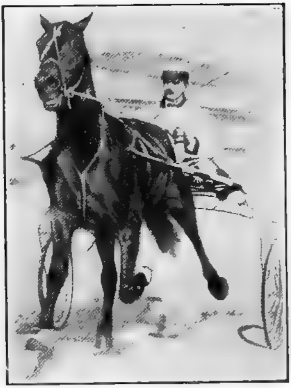
French Draft
Typical of the draft type.

6. Carriage or coach breeds.—The Hackney, French Coach, German Coach and Cleveland Bay are the leading heavy carriage breeds. These horses are less massive than the draft breeds. They may be as tall or long, but are less muscular and less heavily clothed in flesh. They carry less substance and weight. They have been bred and selected to move more rapidly on the road than the draft breeds, but are not able to draw as heavy loads.

To be of the most approved fashion they must show elegance in movement, grace in bearing and in action, move with care and regularity. High knee action is a point that is held in high favor.

COACH IN HARNESS

7. Lighter breeds.—This class includes the speed horses and roadsters, such as the Thoroughbred, trotters, pacers and saddle horses. They are primarily used on race tracks, and on roads for fast and light travel. These horses are light in body, bone and muscle, and are capable of moving at a rapid gait. In appearance they may be as tall as the horses of the other breeds, but they weigh much less. Their bodies are narrow, their necks thin and supple, their muscles long and elastic. In appearance they are just the opposite of the draft breeds, both in bulk and strength. Their muscular development and skeleton framework enable them to reach and stretch out in rapid action.



DAN PATCH

A fine representative of the lighter breed type.

8. Action.—A prime requisite of a good horse, regardless of breed or class, is action. When drawing a load or moving at swift travel a horse is expected to move along with ease and grace, otherwise its value is lessened and its efficiency discounted. Action is most important in the carriage and speed horses. Even the walk expresses distinction. In the carriage type a snappy, stylish movement is observed with high knee action. The feet should touch and leave the ground with trueness and snap. The gait of the roadster should be regular with less flexing of the knee and hocks than required of the carriage breeds. Draft horses of good action show regularity and trueness of movement and a more powerful, although a plainer gait.

GOOD ACTION

Note the stylish movement in the high knee action.

9. Quality.—Without refinement and fitness there can be no beauty. Quality is the indication of refinement in each individual as expressed in its breeding. Animals of quality are of pleasing proportions. Their refinement is expressed in bone, muscle, hair, body, legs and feet. The hair should be fine and silky, the bones neat, not coarse, the muscles clean, not fat or flabby, the body of good form, the legs straight, the feet of good texture. In horses of quality clean-cut features are noticeable, the veins of the skin are distinct and the lines of the face are clearly defined.

10. Temperament and disposition.—A mean disposition is an undesirable character of any horse. Well-bred horses, while showing a nervous temperament, need not be excitable or vicious; on the other hand, rather a quiet, docile manner is liked. The pleasing and well-bred horse is intelligent when worked. Viciousness, excitability and untrustworthiness are the result either of bad training or inheritance.

11. Beauty.—What makes a horse beautiful? Is it the the color of the hair, the shape of the body or the length of the head, neck or legs? Too frequently our thoughts of beauty and of the beautiful spring from superficial conceptions. The word beautiful applied to the landscape means proper blending of its objects and their proper fitness one to the other and in relation to the

QUIET AND DOCILE, INTELLIGENT AND WILLING

These draft mares are of improved breeding and have been thoughtfully fed and intelligently trained in their service for labor and work.

whole. In the horse, *beauty* is significant of the "perfect adaptation of the organ to its function, or of the subject to the service for which he is destined. Beauty is, therefore, synonymous with fitness." A beautiful horse is, therefore, a good horse—one capable of doing its work well and possessed of parts or regions that function in the easiest, most graceful and most efficient manner.

There are two kinds of beauty: the *absolute* beauties that are necessary in all horses and the *relative* beauties that apply to horses bred to a special work or service. Among those of the first class that all horses should possess, are big chests, width between the eyes; clear, steady breathing; powerful attachments of the muscles; large articulations of the joints; sound, perfect feet, and sturdy constitutions. Of the second class, the relative beauties are distinguished in respect to the type of the individual for the work he is best fitted to do. Thus the draft horse must have a broad, muscular croup for heavy work, whereas the trotting horse is much less developed in this region. The neck of the draft horse is shorter, the shoulders straighter, the arms more heavily muscled and the weight more ponderous than horses for the road or speed track.

12. Defects.—All horses are not born equally good or useful. Some at birth possess certain *defects* which in meaning refer to just the opposite of beauty or fitness. A defect, therefore, is a disadvantage and the animal possessing such a defect is less valuable because less can be expected when put to general or special work. Sometimes a defect is the result of accident or is acquired as the result of use. A defect observable at birth is known as congenital. Common defects are flat feet, slender legs, flat chests, irregular movements of the legs, and thin, narrow hocks. Defects often acquired are knee-sprung forelegs, swayed backs, sweenied shoulders, curby hocks, and ill-shaped legs and feet.

KNEE SPRING
A common defect of forelegs.

13. Blemishes.—Frequently some disfiguring mark that mars the beauty of a horse is observed. This may be seated in the skin or in the tissues underneath the skin. Wherever located or whatever the cause, the injury or deformity is a *blemish* and detracts from the value of the animal. While such disfigurement may not in any way prevent the animal from doing everything expected of it in the performance of its work, the marred condition is a recognized flaw that brands imperfection. Common blemishes are wire fence cuts, hock enlargements, blistered surfaces, and scars from improperly healed wounds.

14. Schooling.—Boys and girls are sent to school to learn useful things and to develop their mental capabilities. Horses, like boys and girls, must be educated and trained in order that they may attain the power for them to give their best service in any one or more directions. A colt should be educated to do its work, but this education should be along the lines of usefulness for which it is best fitted by breeding and inheritance. A draft colt should not be trained for work on the race track, nor a colt of speed breeding for the plow. Yet each should be educated to its class, because it is only through such training and schooling that a high degree of proficiency is attained.

15. Educating the colt.—The old idea of "breaking" a horse is giving way to educating the colt. Training from the early days of colthood is a far better way of securing control and subordination than through neglect until the age of putting to work. The little foal should be petted and haltered early in its life, and in this way will not become willful and headstrong. Taken in hand early, a colt's education will be continuous, each step in training being taken at the proper time. When the time comes for driving and working, the final touches will be easy of accomplishment. It is of vital importance that during no state of the educational work should the colt or young horse be frightened or alarmed. Most of the difficulties encountered in way of the vices and faults of adult life have their beginnings in fear and distrust arising during the training time.

LESSON ELEVEN

HOW DO HORSES MOVE?

1. Plants and animals
2. Crowbar
3. Bones
4. Lever
5. How a horse moves
6. How a horse stands
7. The center of gravity
8. Gaits
9. The walk
10. The trot
11. The pace
12. The gallop
13. Quality
14. Saddle gaits
15. Muscles

Note to the Teacher.—The points brought out in this lesson are (1) that the laws of physics apply to the horse or other animals just as they do to inanimate machines; (2) the influence of the center of gravity upon the production of force and speed; and (3) the relation that this fact has upon the well-known difference in the speed of such gaits as the walk, trot, pace and gallop. It is believed that considerable time can be spent profitably in watching the movement of horses. This lesson can be made more useful and interesting if it is possible to have a horse present during the recitation period.

LESSON ELEVEN

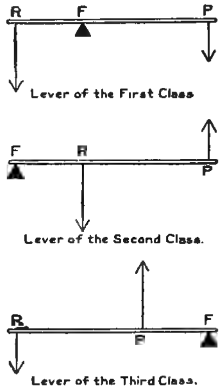
HOW DO HORSES MOVE?

1. Plants and animals.—One important distinction between higher plants and animals is that while plants are rooted to the ground, animals move freely about through a power that exists within them. No such power exists in plants. Mankind has taken advantage of this power for its own advancement. It exists in the horse in a high degree. Without animals man could never have advanced beyond the stage of barbarism. America was not developed as was Europe because the Indian did not have the horse and the ox to assist him.

2. Crowbar.—If one wishes to move a large bowlder, he places one end of a crowbar under the edge of it and then places a small stone under the crowbar. He next presses down on the upper end of the bar. What happens is that he increases his power at the expense of speed. If the upper end of the crowbar is ten times as long as the lower arm, ten times as much power will be exerted. At the same time, the hands of the person moving the bar go ten times as far as the stone which he moves. This is an absolute law. Increased power cannot be obtained without loss of speed and increased speed cannot be obtained without a corresponding loss of power. A horse of great speed cannot be a horse of great power. Powerful draft horses cannot be fast horses. A horse for general utility can have both power and speed only in fair degree.

CROWBAR INCREASES POWER

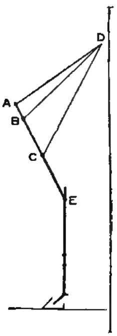
3. Bones.—Certain bones, such as those of the head, the vertebræ, and the ribs, are useful in protecting the organs of the body. For the most part, however, bones are a series of crowbars. When the horse moves, these bars or levers are operated by the muscles. In no other way can a horse move. If any of the movable bones are examined, it will be found that they are not smooth bars, but that they have many irregularities of surface. The projections and depressions in the bones are for the attachment of muscles. When a muscle is attached to a small projection, this projection becomes the small arm of a lever.



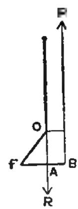
KINDS OF LEVERS

4. Lever.—When any object does what a crowbar does, it is called a *lever*. The point where the small stone touched the crowbar is called the *fulcrum*. There are three kinds of levers, all of which the horse uses. They are shown in the diagrams. In levers of the first class the fulcrum (F) is between the power (P) and the resistance (R). In the second class, the resistance is between the fulcrum and the power, while in the third class the power is between the fulcrum and the resistance. It will be seen that a lever of the third class must always be a lever of speed, because the power arm is always shorter than the resistance arm. A lever of the second class must always be a lever of power, because the resistance arm is shorter than the power arm. A lever of the first class, however, may be either a lever of speed or a lever of power, depending upon whether the resistance arm or the power arm is the longer. In horses, levers of the first class are always levers of speed.

5. How a horse moves.—In the horse, levers of the first and third class are levers used for producing motion. A simple illustration may be found in the movement of the arm about the point of the shoulder. Muscles of the shoulder, A D, attached to a projection on the arm bone, are enabled by contracting to rotate the arm and leg forward. The fulcrum is at B. It is a lever of the first class. Muscles, D C, lift the foot from the ground, preparatory to being moved forward by the muscles, A D. The fulcrum is at B. The power arm is represented approximately by the line B C, while the resistance arm is approximately the line B E. It is, therefore, a lever of the third class. The more nearly the arm A E is at right angles to the shoulder B D, the more powerful the horse will be. The greater the angle of shoulder with the arm the greater speed will the horse be capable. Horses having large joints are powerful horses, because the power arms of the levers are longer in proportion to the resistance arms.



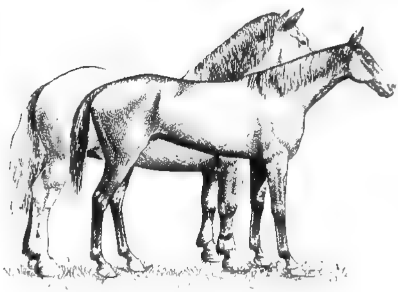
How a Horse Moves



How a Horse Stands

6. How a horse stands.—It is natural that a horse should wish to stand with the least possible effort. This is accomplished by using a lever of the second class, which is always a lever of power. When a horse stands properly the weight of the body descends directly down the cannon through the fetlock to the ground. The fulcrum, F, is in the foot, while the power which prevents the fetlock from touching the ground and thus sustains the weight of the body is exerted through the muscles and tendons, the latter passing back of the fetlock. The power arm is F B, while the resistance arm is F A. The straighter and shorter the pastern, O F, the easier the animal maintains a standing position and the greater the power. The longer and more slanting the pastern, the greater the speed. Heavy draft horses have short, steep pasterns, while light, running and trotting horses have long slanting ones.

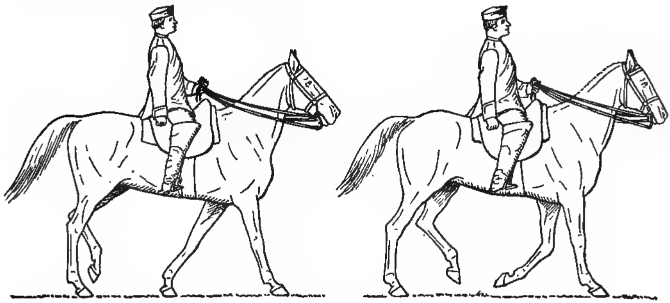
7. The center of gravity.—An object of uniform density does not topple over of its own weight, unless its center falls outside its base. The farther one must push an object to cause its center to fall outside the base the more difficult it is to move it. If a horse is near the ground, and has its feet wide apart, its center of gravity does not readily fall outside its base. In a horse that is tall and has its feet near together, this occurs easily. A draft horse is able to pull a great load, not alone because he has large muscles, but because he is near the ground and has his feet wide apart. On the other hand, a horse does not run fast simply because he has long legs, but because his body is farther from the ground and he is relatively shorter, bringing his feet closer together. The reason a boy cannot run when leaning backwards is because his center of gravity is in the wrong place.



CENTER OF GRAVITY IN HORSE

It is evident that the center of gravity is not located at similar points in these two horses.

8. Gaits.—The horse has four well-defined gaits—the walk, trot, pace and gallop. A horse or other animal can move only by changing his center of gravity. This he does when he starts to walk, by a slight movement of the head, throwing the weight of the body on one foreleg before he lifts the other one. The rapidity with which he moves depends upon the relative amount of time that the center of gravity is outside the base during each step. This is the reason that the gallop is faster than the pace, the pace a faster gait than the trot, and the walk the slowest gait of all.

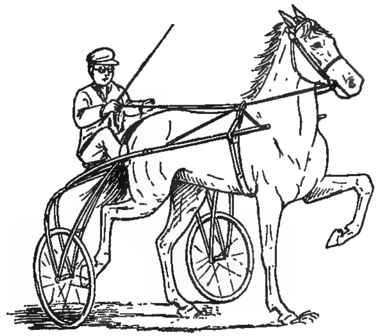


How a Horse Walks

The feet are on the ground longer in the walk than in any other gait. Much of the time three feet are in contact with it. As the walk is made faster the periods of contact with the ground are shortened in length.

9. The walk is a slow gait, because during each step at least two feet are always upon the ground, while part of the time three members furnish support to the body. Assuming a horse starts to walk with his left forefoot, the walk is accomplished as follows. Left fore member, right hind member, right fore member, left hind member and then back to the left fore member. The feet reach the ground at equal intervals. As one listens to a horse walking upon a pavement, there are four equally spaced beats to each step. Notice, also, that the hind foot is raised before the forefoot on the corresponding side, but the latter is lifted in time to allow the hindfoot to be placed in its track or even in some cases in advance of it.

10. The trot.—The trot is a faster gait than the walk because, under ordinary conditions, there are only two feet upon the ground at any one time, sometimes only one and at other times none at all. In the typical trot one forefoot and the opposite hind foot reach the ground at the same time. There are, therefore, only two beats to each step. Ordinarily the hind foot will be placed either on the track of the front foot or ahead of it. In order for this to happen the front foot must be raised before the hind one comes to rest. Hence there must be an interval of time when all four feet are off the ground. The longer this interval of suspension, the faster is the gait.

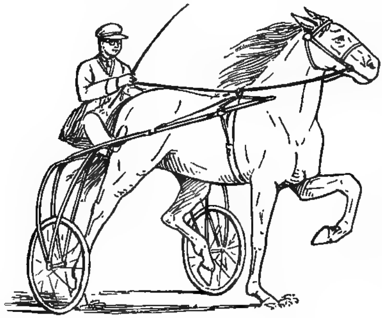


When a Horse Trots

A forefoot and the opposite hind foot are on the ground at the same time.

11. The pace.—Since when a horse trots the diagonal feet move forward together and are on the ground at the same time, it follows that the center of gravity is moving in a line between the two points of support. When a horse paces, however, the two members on one side go forward together. Hence the point of support alternates from one side to the other of the line on which the horse is moving. The equilibrium is, therefore, less stable. This is another way of saying that the pace is a faster gait than the trot.

12. The gallop.—When a horse gallops, the last foot to leave the ground is a front one, and the first one to reach the ground is a hind foot. Assuming the horse leaves the ground from the left front foot, the first foot to reach the ground will be the right hind one. This is followed by the left hind one closely associated or simultaneously with the right front foot. The left front foot then returns to the ground while the others are preparing to leave it.



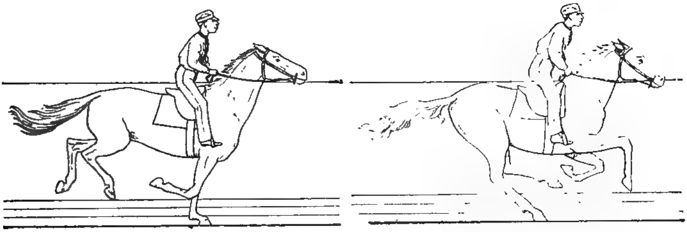
WHEN A HORSE PACES

Fore and hind feet of the same side are on the ground in unison. Compare with the trot.

The horse is suspended in the air a much larger proportion of each step than in the pace or the trot, which accounts for its being a more rapid gait. A horse has its feet doubled up under it while thus suspended, and not stretched out, as often depicted. It is only when the horse is on the ground that its feet are extended.

13. Quality.—Any gait is properly executed when it is performed regularly and without due loss of motion. A straight line is the shortest distance between two points. Other things equal, the nearer that the foot can be carried from one contact with the ground to another contact in a straight line, the less will be the loss of motion. Therefore when one views the horse in motion, from front or rear, the members should swerve neither to the right nor to the left. The feet must, of course, be raised sufficiently to overcome obstacles, but if the feet are raised excessively, it results in loss of speed. In showy, carriage horses this is not considered objectionable, because speed is not desired so much as appearance of motion.

14. Saddle gaits.—It is customary to recognize two types of saddle horses—one known as the walk, trot and canter horses; and gaited saddle horses, which can execute five gaits. In addition to the walk, trot and canter, gaited saddle horses must go the rack and either the running walk, fox trot or slow pace. The running walk is



WHEN A HORSE GALLOPS

It will be observed that the horse leaves the ground from a forefoot and on completing the leap reaches the ground with the opposite hind foot.

the most distinctive of the last three. It lies between the trot and the walk. It is a slow gait. The rack, sometimes called single foot, is a modified pace. Its execution lies between the pace and the walk. It is a fast gait. Instead of having two beats, as in the case of the pace, it has four, as in the case of the walk. Instead, however, of these four beats being equally divided, they are unequally associated. Thus, if one hears a single-footer passing along the pavement, it will sound something like this—peck-a-peck, half-a-peck; peck-a-peck, half-a-peck—repeated rapidly.

15. Muscles.—Deep, broad horses with bodies close to the ground are powerful horses. Tall, slender ones are capable of greater speed. These differences are not wholly due to shape and weight. It also depends upon the muscles, which are the source of all motion. Large muscles give power. Long muscles give speed. In running and driving horses the muscle lies more nearly in the same direction as the bones, while in draft horses the muscles act more nearly at right angles to the levers. In judging a horse, therefore, one considers not only the form of the animal, but the character of his muscles.

WEIGHT AS A SOURCE OF POWER

This horse is able to pull this great load of alfalfa hay because he is carrying part of the weight. The extra weight which he carries not only enables him to pull more, but he does not have so much to pull.

LESSON TWELVE

WHAT SHAPE SHOULD A HORSE BE?

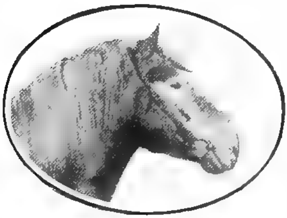
1. Head.
2. Neck.
3. Eyes.
4. Ears.
5. Front legs.
6. Shoulders.
7. Arms.
8. Body.
9. Croup.
10. Hind legs.
11. Cannons.
12. Joints.
13. Hocks.
14. Feet.
15. Attitudes.

Note to the Teacher.—This lesson may be made useful in training the powers of observation and judgment, two powers very differently developed in different persons. The purpose is to give those fundamental conceptions of form which apply to all horses for force or speed. Shire horses differ from Percheron horses, and Hackney horses differ from French Coach horses by virtue of certain characteristics which are not touched upon in this lesson, but must be considered when judging whether a horse is a correct representation of a certain breed.

LESSON TWELVE

WHAT SHAPE SHOULD A HORSE BE?

1. Head.—Measure the length in a straight line from the top of the head to the point where the lips come together. In an ideal head, this measurement will be two-fifths the height of the horse at his withers. In draft horses, the head tends to be relatively longer, while in running horses it may be relatively shorter. The width of the forehead should be more than one-third the length of the head. The head is twice as long as the distance from the forehead to the point of the lower jaw. There should be good width between the jawbones, because between them pass the windpipe (trachea) and the gullet (œsophagus). If these are restricted, the lung power and the digestion may be reduced. Too short a distance from eye to ear compared with distance from eye to lips is an especially bad feature. It indicates a sullen, morose disposition, probably associated with a lack of intelligence. A wide forehead, large nostrils, well-situated eyes, ears widely separated and larger space between jawbones go together and constitute a good head.

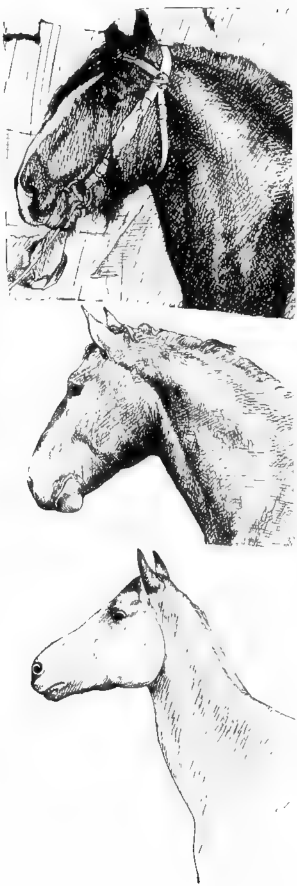


GOOD HEAD

2. Neck.—Measure the distance from the base of the ear to the middle front of the neck where it joins the shoulder. Under ideal conditions this length is equal to that of the head. The head and neck serve the same purpose in the movements of the horse as the balancing pole does to the movements of the tight-rope walker. They help to balance the horse and keep him from falling. The faster the horse the more agile must be the head and neck. A light head and a long slender neck respond to this requirement. A heavily muscled neck is required for great power.

Under average conditions both the head and neck form an angle of 45 degrees with the ground; thus the head and neck form a right angle with each other. For trotting and running, the neck is held up and the head extended horizontally; hence the over-draw check. For heavy draft the head is lowered and held more vertically. For the slow gallop the neck is arched and the head is held more vertically than for running. These different positions of head and neck are for the purpose of changing the center of gravity.

3. Eyes.—From the standpoint of soundness there are four weak regions in the horse. They are the eyes (blindness), the hocks (spavin and curb), the region below the front knees (splints, side bones and navicular disease) and the flanks (heaves). The best position for examining the eyes is with the head in the stable doorway facing outward. The eyes, eyelids, ears, nostrils,



TYPICAL NECKS

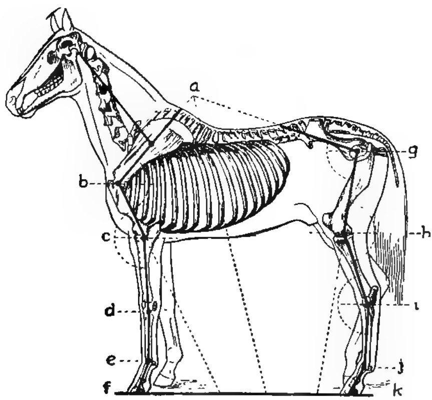
Arched at top; straight at middle; ewe neck at bottom. A ewe neck is objectionable.

lips, and mouth constitute the facial expression of the horse by which is judged the intelligence, disposition, and temperament. Among the beauties of the eye are a separation proportionate to forehead and face, a proper degree of prominence, perfect equality and freedom from blemishes, either of the eye itself or the eyelids. A certain vivacity and changeableness of expression is desirable.

4. Ears.—The size, quality, position and movement are characteristics of the ear that must be studied. The size of the ear should be in proportion to the size of the head, neither too small nor too large. Generally speaking, horses with small ears are more energetic and courageous. The texture of the ear should be fine and free from coarse hairs.

To improve the appearance of the ear the internal hairs are sometimes clipped. This is not a good practice, since these hairs are intended to prevent the entrance of insects and other objects.

The ears should be well placed. A too narrow distance between the ears is particularly objectionable. When the head and neck are held as stated above, a side view of the ears should be vertical. The ears should be vertical, also, when viewed from the front. Lop-eared horses are unsightly. A sluggish movement of the ear may mean that



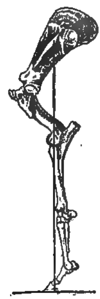
SKELETON OF HORSE

Observe the bones of the forequarters and of the hindquarters. See paragraph 10, page 121.

the horse is deaf, or merely that he is lazy. A constant movement of the ear may mean that the horse is skittish, or it may be that the horse is blind.

5. The front legs.—The fore members of a horse may be somewhat puzzling to one who has never seen the skeleton of one. Think of your own arm and then locate the corresponding region in the horse. Place the end of your middle finger upon the desk. Your nail corresponds to the horse's hoof; the pastern, *e f*, to your finger; the cannon, *d e*, to the middle bone of your hand; the forearm, *c d*, to your forearm; and the arm, *b c*, to your arm. The shoulder blade is shown at *a b*. The horse does not have a collarbone. His shoulders are attached to the body by means of muscles, thus giving greater elasticity to his movements.

6. Shoulders.—The shoulders of a trotting horse should be long and sloping. They should be long because long bones give long muscles. They should be sloping, because sloping shoulders give a greater elasticity to the movements and because they enable the horse to take longer steps. They may be steeper in draft horses, because, owing to the better position of the collar, the horse is enabled to exert a greater force. The shoulders should be heavily muscled, especially in the draft horse.



BONES OF THE FRONT LEG.

7. Arms.—In a draft horse, the arm should be relatively horizontal, while in the trotting horse it should be more vertical. Since the arm itself is hidden in a mass of muscle, the position of the arm is best determined by examining the position of the elbow. The elbow should be relatively high as compared with the bottom of the chest for draft horses, and just the reverse in running and trotting horses.

The movement of the arm is directly forward and backward. Horses cannot rotate their arms as can boys and girls. This is because the horse does not have a collar bone. For the same reason, the horse cannot carry food to its mouth as can a squirrel. But the horse is fleet, because the backward and forward movement of the arm prevents lost motion.

8. Body.—The body varies greatly with the service to which the horse is to be put. In the draft horse the body is much larger and rounder than in the trotting horse. The loin must be wide, short and thick, since all the force exerted by the hind members must pass through the loin. In a powerful draft horse the distance from the chest to the ground should not be greater than half the height of the horse. In trotting and running horses this distance may be 2 to 4 inches greater than that from the chest to the withers. This is a very important factor in the relative power and speed of the horse. All horses should have well-sprung ribs, which are wide apart and extend well back so as to make the flank narrow and low. The

THREE WELL-BODIED DRAFT HORSES

Note the width and depth of the bodies. They show great force and power. The legs are no longer than the body is deep.

main point of beauty in the back is that it be straight, neither convex (arched) nor concave (sway-backed).

9. Croup.—The croup is the region above a line from the haunch to the point of the buttock. In draft horses this region should be wide, relatively steep and, including the buttocks, heavily muscled. Watch a draft horse pull, and it will be noticed that he places his croup in a relatively vertical position. This is an aid to power. A horizontal croup, on the other hand, is better for speed. The legs are longer in a horse of the same height. The step is longer while the body is projected in a more horizontal direction. While relatively steep shoulders and steep croup are conducive to power, many draft horses are so defective in speed that horses with more sloping shoulders and horizontal croup are often preferred.

10. Hind legs.—Can you imagine yourself standing upon the end of your middle toe? That is what a horse does. Referring to paragraph 5, the pastern *j k* corresponds to the toe; the fetlock, *j*, to the ball of the foot; the hock, *j*, to the heel; the leg, *h i*, to your shin bone; the stifle, *h*, to the knee; while the thigh, *g h*, is hidden beneath a mass of muscles. The thigh is attached to the croup at *g* by a ball and socket joint. The hind legs are the greatest agent in pulling. This kind of a joint enables the animal to exert more power than would be possible if attached only by muscles, as in the case of the shoulders.

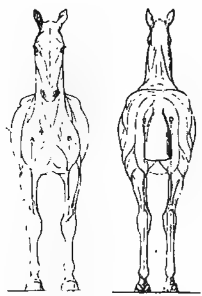
Draft horse with a croup that is too steep even for a draft horse.

11. Cannons.—The front cannons are 9 to 10 inches long, while the hind cannons are about two inches longer. Horses whose knees and hocks are close to the ground are fitted for draft, while running horses have their knees and hocks relatively high from the ground. The principal requirement of the cannons is that they should be perfectly vertical. This is especially true of the front cannons. To be kneesprung, or over on the knees, is a particularly bad fault.

Draft horse with a good croup (rump).

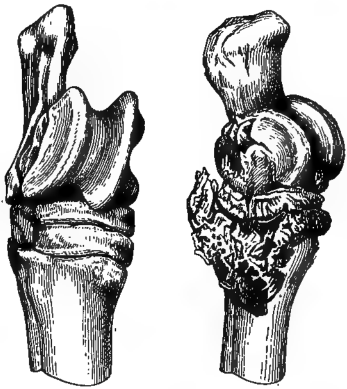
There is a saying that horses should have a flat bone, meaning that the cannons should have a long diameter from front to back. This flatness is not due to the shape of the cannon bone but is due to the position of the tendon. The farther the tendons are detached from the bone the flatter the cannon appears and the greater the ease with which the bone can maintain a standing position.

12. Joints.—All joints, such as knees, fetlocks, elbows and hocks, are like the hinges on the barn door. They should be proportionate to the size of the object to be moved. The knees and the hocks are made up of a collection of bones, some above the others, in such a manner as to take up the concussion when the animal is moving. The larger the area of these joints the less the concussion to the square inch. In general, rather prominent, lean, well-defined joints are desirable. They should be free from puffiness, blemishes or other evidence of disease.



FRONT AND REAR
Showing how a horse should stand.

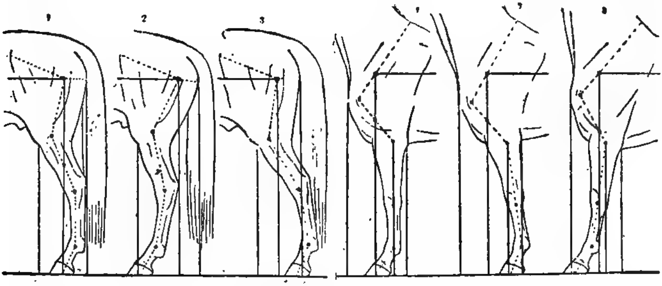
13. Hocks.—In many ways the most important joint in the horse is the hock. Because it is apt to be the weakest point in the horse, the ultimate speed and power is often dependent upon the shape and soundness of this region. One must learn to recognize the shape of a sound hock in order to recognize spavin or curb. The angle that the leg makes with the cannon is greater in running and driving horses than in draft horses. This means that the depth of the hock from front to rear is greater in draft horses than in those for speed. In like manner the thigh of the draft horse is more horizontal than in driving horses. Such a condition gives greater power, but shortens the step.



GOOD AND DISEASED HOCKS
Normal, healthy hock at left; diseased hock, the result of bone spavin, at right.

14. Feet.—It is the front feet that require the most attention. It is seldom that there is anything seriously wrong with the hind feet of a horse, except through accident. The front feet should be round and of equal size. The horn should be dense in texture and dark in color. The sole should be concave, the bars strong, and the frog large and elastic. The heel should be one-half the length of the toe and approximately vertical. In comparison with the front feet, the hind feet should be more oval, the bottom more concave, the heels higher and more separated. The walls of the foot should be more vertical.

15. Attitudes.—When a boy sits upon a one-legged milk stool, he balances with the least effort when the bottom of the leg is directly under the top. This is equally true whether the leg happens to be straight or crooked. The properly formed horse stands with the least effort when each foot is directly under the point of attachment with the body. Whether this requirement is met may be determined in the following manner: The point of the shoulder, the middle of knee and the point of the toe should be in a vertical line when viewed from the front. The distance between the front feet should then be equal to the width of either foot. In heavy horses this distance is apt to be greater and in light horses less. Viewed from



POSITION OF HIND LEGS AND OF FORELEGS

Front and hind legs: 1, as it should be; 2, feet too far under; 3, feet too far out. Both 2 and 3 positions are objectionable.

the side, the center of the elbow, the middle of the knee and the pastern should be in a vertical line, which when extended passes in the rear of the foot. A plumb line dropped from the point of the buttock should just touch the hock and extend parallel to the hind cannon. The distance part of the hind feet should be about equal to the width of the hock. Such a horse is said to have a correct attitude.

PRACTICUMS

1. Age of a Horse Determined by the Teeth.—At eight to 10 months of age the milk teeth of the foal are complete. The shedding of the milk teeth and the beginning of the permanent set occur between 2½ and 3 years of age, the permanent set being complete between 4½ and 5 years. Between five and 10 years it is possible to determine the age with considerable accuracy from a study of the front teeth of the lower and upper jaws. These teeth undergo changes due to form and wearing. The determination by years may be made as follows:

a. At three years.—Two or three months under three years, the permanent pair of center nippers replaces the milk or baby colt teeth. At three years they are ready for use. These teeth are larger than the milk teeth and have deep cups in their middles.

b. At four years.—Two or three months under four years, the next or intermediate pair of permanent nippers replaces the intermediate pair of milk teeth. At four years these are ready for use. Some wear is shown on the center pair and the cups are partly worn down.

c. At Five Years.—The mouth is full and dentition complete.

d. At Six Years.—The cups in the center pair in the lower jaw have disappeared, or very nearly so. Some wear is shown in the corner nippers.

e. At Seven Years.—The cups in the two teeth next to the center pair in the lower jaw have disappeared. Those of the corner teeth are quite shallow also.

f. At Eight Years.—The cups of the six teeth or nippers of the lower jaw have disappeared. The cups still show in the upper jaw.

g. At Nine Years.—The cups of the center teeth in the upper jaw have disappeared.

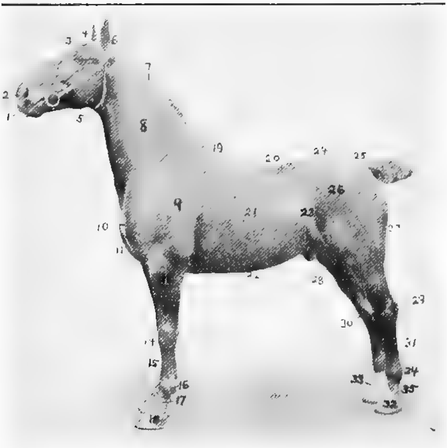
h. At Ten Years.—The cups of the two teeth next to the center pair of the upper jaw have disappeared.

i. At Eleven Years.—The cups of the corner and remaining teeth of the upper jaw have disappeared. No cups now show in any of the teeth.

Note.—Often, due to denser bone, the cups occasionally wear until the twelfth year or longer. Other changes in the teeth are taken in consideration by experts, but these are too complicated to describe here, and are understood only after long experience and practice.

2. MEMBERS.—Place pieces of numbered paper on the various regions, such as shoulder, arm, elbow, forearm, knee, cannon, fetlock, pastern and hoof. Require each student to write the name of each region and name the corresponding region in his own body.

3. RELATIVE WEIGHT.—Place the front feet on a pair of scales and obtain the weight. Then place the hind feet where the front ones were, and vice versa Be careful to have feet as nearly as possible in the same place; then weigh. If carefully done, the com-



POINTS OF THE HORSE

1 Lip
2 Nostril
3 Forehead
4 Poll
5 Cheek
6 Ear
7 Mane
8 Neck
9 Shoulder
10 Point of shoulder
11 Breast
12 Forearm
13 Arm
14 Knee
15 Cannon
16 Fetlock
17 Pastern
18 Foot
19 Withers
20 Back
21 Side
22 Underline
23 Flank
24 Croup
25 Tail
26 Haunch
27 Thigh
28 Stifle
29 Hock
30 Point of hock
31 Cannon
32 Foot
33 Coronet
34 Fetlock
35 Pastern

bined weights should equal the total weight of the horse. It is difficult to get this result exactly because of the more or less constant movement of the head and the internal organs. It will be sufficiently accurate, however, to show that a horse supports approximately five-ninths of its weight through its front members and four-ninths through the hind ones. This is one reason why more trouble occurs in the front than in the hind feet.

4. GAITS.—Take one or more horses and cause them to walk, trot and gallop. Try to follow the movement of the feet as explained in paragraphs 9, 10 and 12 of Lesson XI. Also note the difference in the regularity and elasticity with which different horses execute the same gait. Observe them from front, side and rear.

5. ATTITUDES.—Secure one or more plumb bobs or pieces of lead attached to a stout cord 5 feet long. Place the cord at the point of the shoulder, and note whether it divides the knee into two halves and falls at the point of the toe. Determine whether the distance between the two front feet is equal to the width of either foot. Drop the plumb line from the center of the elbow, and note whether fore arm and cannon are vertical, as indicated by cord bisecting knee and fetlock and falling just behind the heel. Measure the distance between the point of the shoulder and the front of the elbow. Locate a point half way between. The plumb bob dropped from this point should be in line with the center of the foot. Drop to plumb bob from the point of the fetlock and note whether hock and fetlock are adjacent to cord, making cannon vertical. Measure distance between hind feet and determine how nearly the measurement corresponds to the width of the hock. If the hind feet are too far under the horse, too much of the weight is placed upon the hind members. This is especially bad for the hocks. If the front feet are under too much, weight is thrown upon them, causing them to wear out sooner. If a horse stands with his front feet too far forward, it may indicate he is lame in one or both front feet.

6. FORM.—There are several regions of the body which in an ideal prize-winning animal should be equal to the length of the horse's head. Have students take these measurements on one or more horses, as follows:

Length of head ——.
Length of neck ——.
Length of shoulder ——.
From back angle of shoulder to hip ——.
From point of hock to ground ——.

There are three measurements in the horse that should be the same in horses of good conformation, and each two and one-half times the length of the head. Have measurements taken as follows:

Height at withers ——.
Height at croup ——.
From point of shoulder to buttock ——.

In draft horses the tendency is for the length to be greater than the height, while in running horses the height may be greater than the length.

7. SELECTING HORSES.—Secure not less than three nor more than five horses of any one type or breed. Have each student place the horses in the order of merit for the purpose for which they are intended. Give reasons based upon the discussion in the text. Any special defects or unsoundness should be noted.

LESSON THIRTEEN

BREEDS OF HORSES

1. Ancestry
2. Early qualities retained
3. Oriental horses
4. American trotters
5. American saddle horses
6. The Hackney
7. The French Coach horses
8. German Coach horses
9. Cleveland Bays
10. The Percheron
11. Clydesdales
12. Belgian Draft
13. English Shire
14. The Suffolk Punch
15. Ponies

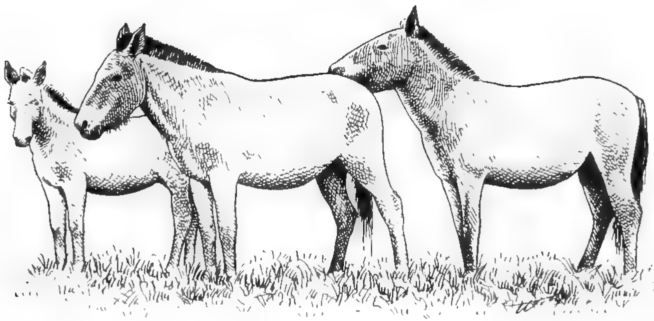
Note to the Teacher.—Try to see the purpose in breed development. The pony is small because of cold, tempestuous climates and limited food; the draft breeds descended from the big horse stock of northern Europe, where food was rich and luxuriant and the great out-of-doors mild and invigorating; and the lighter breeds from the regions where stamina and endurance were most highly appreciated. Thus ancestry has been used as foundation, and selection, training and purpose as the building material for the superstructure of every breed.

LESSON THIRTEEN

BREEDS OF HORSES

1. Ancestry.—Recently unearthed skeletons reveal the fact that at one time horses lived in North America as well as Europe and Asia. When America was discovered no horses were in existence here. It is from the vast highlands of northern Asia, where the tempests rage and man can scarcely live, that the ancestral modern horse has come. At first they were sought for food; then subsequently they were captured alive and herded in inclosures like cattle, where they were trained for either riding or draft. Mare's milk is now, but was more so in the past, prized as food. It is greatly esteemed as cheese or whey among the Tartars.

Wild horses have always been terrorized by wild beasts. They early learned to perceive at great distance their natural enemies. On approach of such their quick ears pricked, a short neigh sounded,



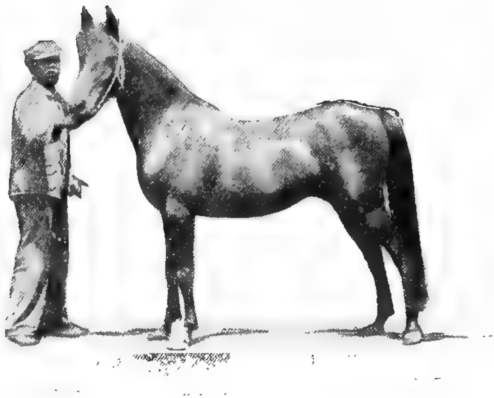
WILD HORSES STILL EXIST

Here are pictured three wild horses of Central Asia. It is believed that in this region the only genuine wild horses are now to be found. In a wild state these animals are timid and difficult to approach, but when confined they gradually assume the confidence of domesticated horses.

and the horde dashed away with the speed of the wind. Man was as much feared by them as other strange life, because their flesh made delightful dishes for their half-wild people. And here we come upon the great natural motive, the first cause of the drawing together of man and animals—hunger and its satisfying. When the horse was ridden for the first time speed was impressed on man so firmly that horse and speed soon became synonymous.

2. Early qualities retained.—Of the principal and best qualities of those wild and ancestral horses two still remain—speed and strength. These qualities, which served them once for flight, are now employed in the service of humanity. A third quality of almost equal importance is endurance. The first two, under the guiding hand of man in training and breeding, has steadily increased. It is possible that, in the freedom from danger and the less severe environment under which they are now allowed to live, that horses do not possess the endurance they once possessed. Yet some of the races are still remarkable in this respect. They possess remarkable enduring powers and quickly recuperate after even the most fatiguing work.

3. Oriental horses.—Every important modern breed



ARABIAN HORSE

has been influenced, directly or indirectly, by the blood of the original races, especially the Oriental. A few of these, known as Arabian blood, were fundamentally used in crossing with the native mares of western Europe. From these beginnings, with subsequent crosses, various breeds were evolved. But the Arabian blood was not without great influence. As early as the days of the Crusades, Arabian horses had been brought to England and there used in the improvement of the horse stock. The English Thoroughbred is the result of such crosses. Although several original races were used to produce the Thoroughbred, the Oriental predominates.

The best known ancestors of the English Thoroughbred are Byerly Turk, Darley Arabian and Godolphin Barb, all taken from the east to the west. The modern Thoroughbred owes its greatness to English breeders and not to Arab breeders. These horses are primarily famous as racers or running horses. Their chief qualities are rapid gait and staying power. In form and every action a noble origin is revealed. The Thoroughbred has a small, refined head; a delicate, long neck; keen and intelligent eyes; skin and hair so fine that the veins show through them; broad chest; long and robust back and straight croup; and long, lean, delicate legs with hard tendons and solid hoofs. Although Arabian blood did much to improve the Thoroughbred, it has been the blood of the pure English breeding that has been sought and used in the production of other modern breeds.

AMERICAN TROTTING HORSES

The horse at the left is Uhlan, the world's fastest trotting horse.

4. American trotters.—The most remarkable of all horses, the Amercan trotter, has been improved and developed for a special purpose—speed. This breed is a descendant of the English Thoroughbred. They have long, sloping shoulders, strong backs, horizontal croups, clean and fine-boned legs and good feet. In color they show great variety. The pacers belong to this breed, their distinction resting on a style of gait and not in characteristics. Some individuals of this breed both trot and pace. The most notable families among the trotters and pacers are the following: Hambletonian, Mambrino, Pilot, Clay and Morgan.

One hundred years ago there was no authentic record of any horse going faster than one mile in less time than two and three-quarters minutes; today we have records for one mile in both trotting and pacing in less than two minutes. Some very distinguished individuals of this breed are the following: Maud S, 2.08¾; Nancy Hanks, 2.04; Cresceus, 2.02¼; The Harvester 2.01; Low Dillon, 1.58½; and Uhlan, 1.54, among the trotters. Hal Pointer, 2.05¼; Star Pointer, 1.59¼; Minor Heir, 1.59; and Dan Patch, 1.55¼, among the pacers.

5. American saddle horses.—Horses of this breed are intended primarily for riding, either for business, exercise or sport. Their development has occurred largely in Kentucky, Virginia and Tennessee. Thoroughbred blood, mingled with that of good riding stock, has been responsible for this race. These horses have elegance and style, as shown in their step and in the carriage of head and neck. While no uniformity of color is observed, bay, brown and chestnut are most common. All good saddle horses are

Saddle Type

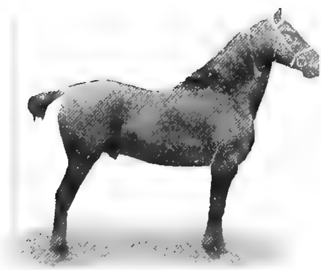
able to walk, trot and canter with ease and distinction. In addition to these gaits some riding horses have been educated to take the gaits known as the rack, and either the running walk, fox trot or slow pace.

ENGLISH HACKNEY

6. The Hackney. — The Hackney originated in England from good driving mares bred to Thoroughbred stallions. The name comes from hack, originally meaning any horse which is suitable for hauling light carriages at a rather rapid pace. Modern Hackneys have not been developed to go fast, but to serve as heavy harness horses of great style. The walking gait, with high knee action, is the technical conception of what these horses should be. Hackneys are not as angular as Thoroughbreds. They are also smoother; the neck is more arched, the chest fuller, the back shorter, the thighs better muscled than in the case of the Thoroughbred or trotter. The striking characteristic of these horses is the leg movements. They greatly flex their legs, the knees and hocks being raised to an extreme height. There is no fixed color of the breed, but bay, brown and chestnut are the most common. These horses are used chiefly as park animals and for driving in boulevards, where style and not speed is required.

FRENCH COACH

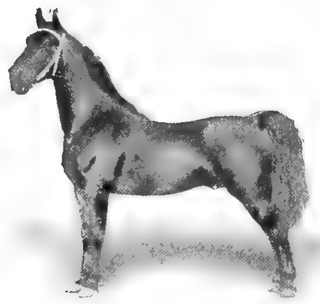
7. The French Coach horses.—As the name indicates, these horses are a French breed. They have resulted from crosses of the English Thoroughbred with the native blood that came down from the rule of the Normans. The French Coach is primarily a carriage horse, and as such enjoys great popularity in the land of his birth. He possesses all the necessary external qualities—height, massiveness and nobility of shape. The French government has for a long time encouraged the people to breed these horses and has assisted breeders in many ways. Chestnut, bay and brown are the leading colors.



GERMAN COACH

8. German Coach horses.—Germany is a land of many horses. In the southern part of that country the heavier draft horses predominate, and in the northern part light horses for saddle and harness mostly are found. Many of these latter have been imported to our country. They are solid, weighty animals of noble form for carriage use. The head is well formed, the neck and shoulders handsome, the withers high, and the legs thickly muscled. They are very docile and fine in action. They are usually bay or brown in color.

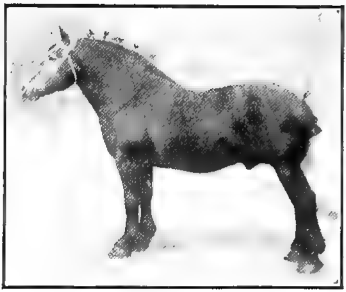
9. Cleveland Bays.—The good qualities of this English breed, becoming more widely known, led to the introduction of many of these horses to America. They belong to a very old race, derived, probably, from an ancient mixture of the native horse with Oriental blood. Animals of this race are well built, lively, vigorous, with strong, lean legs. They at one time were much in demand for carriage and also for work horses.



CLEVELAND BAY

10. The Percheron.—There are several races of heavy horses in France, representatives of which have been imported to this country. The most popular of the heavy draft breeds of France is the group that takes the name from the Perche region between Normandy and the river Maine. The Percheron has a broad head, short and thick neck, with a heavy double mane, the withers low, the chest broad, cleft and pendant, the legs short and strong. These horses are especially suited to draw, at a rather quick pace, moderately heavy loads, such as carts, trucks and farm tools and implements. Their docility, ease of acclimating and quick movement have made them the most popular draft breed in the United States. There is a constant demand for these horses.

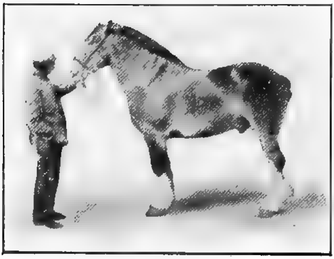
The French breeders have co-operated with great care in endeavor to develop this breed to still greater size. These horses are massive, heavily muscled and stand 16 hands or more high. They weigh from 1,600 to 2,100 pounds. Up to recent years gray was the characteristic color, but black is now more in fashion. Bays and roans are not uncommon, and occasionally a bay or chestnut is seen. The



PERCHERON

legs are free from the long hairs or "feather," so conspicuous on some of the draft breeds.

11. Clydesdales.—This notable breed originated in the Valley of the Clyde in Scotland. The foundation stock was the "old black horse" of northern Europe. Years of selection and careful breeding under the local environments gave rise to this distinct breed of horses, weighing from 1,600 to 1,800 pounds. The prevailing colors are brown, bay or black, with a star or blaze, or other mark on the forehead, and they frequently have white feet. The breed produces excellent work horses. The hind quarters are well covered with muscles and the legs and feet are good. Some say they have the best feet of any of the draft breeds. Considerable hair grows out from the back of the tendons of all four feet. They have a long stride and rapid walk.

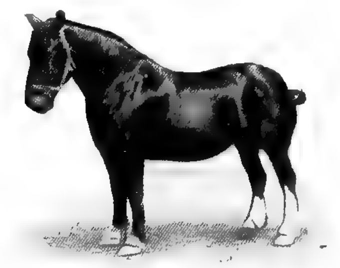


CLYDESDALE

12. Belgian Draft.—Belgium is the country of the heaviest draft horses. Here they reach a giant size, weighing from 1,700 to 2,500 pounds. These horses are renowned for developed muscles, fine shape and vast strength. The croup is powerfully developed, the legs relatively short, but the

BELGIAN

horses trot with ease. The breed is steadily gaining in popularity in the United States, and many fine specimens have been imported. The breed is characterized by great size, broad chest, short but wide back, deep body and heavy weight. The legs are free from long hair. Much variety is seen in color, although bay, brown, chestnut and roan are most in evidence.



ENGLISH SHIRE

13. English Shire.—On the plains and in the fertile valleys of England there have been from time immemorial solid, heavy draft horses. The Shire is an ancient animal whose own blood has been mixed with that of other heavy races. His true cradle is the center of England. The race is distinguished by its ponderous conformation, its fine shape, especially by the thick hair at the back of the leg, descending into long locks about the fetlock. They possess extraordinary strength, great height and excellent qualities for draft purposes. They are usually gray, black or bay in color.

14. The Suffolk horse, commonly known as the Suffolk Punch, has come down from ancient times in the English county of that name. He is equally heavy and stout and enjoys great popularity because of his gentleness and the ease with which he lends himself to toilsome work, especially farming. The Suffolk horse is well rounded, the legs are clean and the action brisk. The prevailing color is some shade of chestnut or sorrel. These horses vary from 1,500 to 2,000 pounds in weight.

15. Ponies.—A great variety of ponies has been produced in the mountainous parts of Great Britain. The Shetland ponies, coming from the islands of that name, are the most characteristic because they are the smallest. These little animals, sometimes less than three feet in height, are not only used in circuses, and as children's playmates, but also in mines, where they draw the train cars. Not infrequently, when once taken down in the mine they never again see the light of day. Some have lived 15 years, stabled and fed underground. There are several other tribes of ponies named for the localities where they originate, such as Welsh, Exmoor, Dartmoor and the New Forest.

SHETLAND PONY

The broncho ponies of the western plains are of Spanish origin, and therefore are of Oriental blood. The polo pony is externally a Thoroughbred and descends from one, but by birth he is a half breed. His sire is usually a Thoroughbred, and his mother a common mare.

LESSON FOURTEEN

FEEDING FARM HORSES

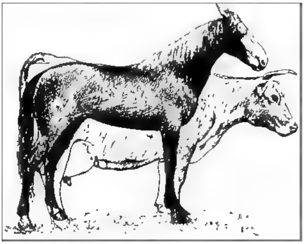
1. A fundamental principle in horse feeding.
2. Sound and wholesome food.
3. Character of food.
4. Requirements for work.
5. Quantity may vary.
6. Giving water.
7. Order of hay, grain and water.
8. Regularity in feeding and watering.
9. Roughage feeds for horses.
10. Balanced ration.
11. Mettle of oats.
12. When corn is fed.
13. Other concentrates.
14. Selecting the ration.
15. Feeding mules.

Note to the Teacher.—The entire anatomy and physiology of its digestive apparatus show that the food of the horse should be nutritious in quality, supplied frequently, and in comparatively small quantities. The amount and character of the food must vary with the size and constitution of the horse, the climate and season, the amount and kind of work required, and the section it lives in.

LESSON FOURTEEN

FEEDING FARM HORSES

1. A fundamental principle in horse feeding.—A relatively smaller quantity of roughage and a correspondingly larger amount of concentrates is advisable for horses than for bovines. The kind of work to which horses are put calls for the least possible load on the digestive organs, which, even in the heavy draft breeds, are small, and particularly the stomach. Hence the food of the horse should be nutritious in quality, be supplied frequently and in comparatively small quantities.



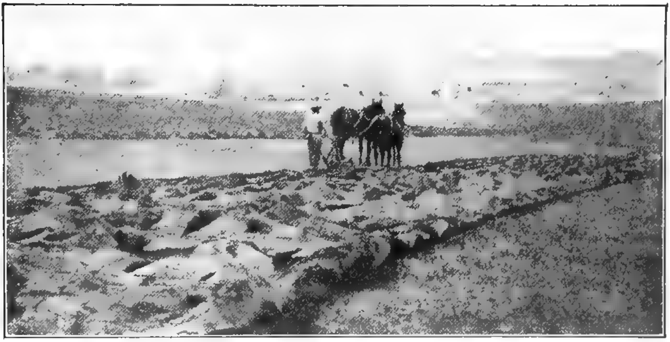
STOMACH CAPACITY

The principal reason why coarse foods may be used for cows but not for horses.

2. Sound and wholesome food.—The food—and it may include a wide range of feeding materials—must be clean, wholesome and sound; but beyond this no specific rules can be laid down, except that, generally speaking, reasonable attention should be given to the digestible nutrients, in that they should bear the proper proportion one to another. The amount and character of the food must vary with the size of the horse, the purpose for which it is used, the climate and the season, and the section in which it is used.

3. Character of food.—The horse feeds on a wider range of food substances than is popularly supposed. In Arabia, where stamina and sinew are famous, the principal food is barley and scant herbage; in Ireland it is dried fish mainly; in England hay, oats and beans comprise the food supply largely; on the continent of Europe, rye, barley and inferior wheat make up the grain portion of the rations; while in this country many feeding stuffs, covering a wide range of roughage and grain, find their way into the feed mangers and satisfactorily keep the horse stock in health and vigor.

It is not so much the kind of food, but the purity and character, that count. Moldy hay and grain cause many ills in the horse, and imperfect methods of preparation and curing have cast an odor of unpopularity on many meritorious feeds that, if properly handled, would be eagerly sought because of their ease of production or relatively less cost when compared with the standard horse feeds of each particular section.



FARM HORSES AT WORK IN THE FIELD

Their feed consisted of corn, bran and oil meal for grain, and timothy and clover hay mixed for roughage.

4. Requirements for work.—Naturally the work demanded of a horse will influence the choice and amount of food. The race horse or the roadster, fed on coarse roughage and little grain, will be greatly handicapped if in competition with another supplied with nutritious and appetizing concentrates and but little of coarse fodder. In winter the draft horse can subsist readily on hay or fodder and little or no grain, providing the work is light and the hours of labor few. But this same horse, when put to hard labor in spring and summer, at plow, cultivator or harvester, will demand less hay and more grain.

5. Quantity may vary.—Farm work usually is not of a strenuous nature, even in the busy season. On some days and during some periods the work is light, and not infrequently there are many days of rest. At such times less food should be given, but the feeding should be done in such fashion as to keep the horse in good work form and in thrifty condition.

WATER AT THE ROADSIDE

A thoughtful and humane provision for the horse's comfort that ought to be in greater use than it is.

6. Giving water.—In a state of nature horses feed upon juicy herbage and drink at pleasure only pure water when that is available. No animal is more delicate and fastidious about its drink than the horse. Often these animals will suffer agonies of thirst rather than quench it with impure, stale or tepid water. Water should be given frequently and in small quantities.

Some horses require more water than others, the quantity varying with the nature and amount of the ration, the propensity to sweat, and the season of the year. In a test at the New Hampshire station the amount of water drunk by five horses was recorded, showing a variation of from 25,895 pounds to 32,997 pounds in the course of a year. Stale or foul water from a neglected cistern is unfit for a horse and will be refused, except in case of extreme thirst or when no other kind is provided.

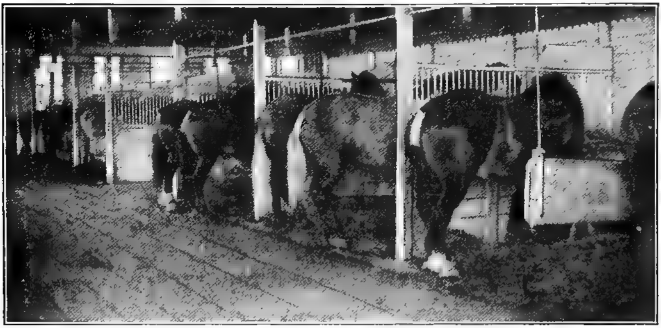
The custom of not giving horses a drink during the forenoon or the afternoon when working in the field is frequently condemned but generally followed. In our larger cities horses are often never given water between morning and evening. This is cruel, of course. Good horsemen are more thoughtful of these dumb beasts. Not only should the horse be permitted to drink his fill at noon, but during hot weather, in the dusty fields, a cool drink should be provided also.

7. Order of hay, grain and water.—Drinking water should be given at least three times a day to horses at rest, and more frequently when at work. Small quantities of water may be given horses at work, even though they are hot and tired. When horses are at heavy work, their noon feed should consist largely of grain. After being watered, grain is fed and some hay given. For the evening meal the grain should come first, and after a brief interval the hay. Usually hay and grain are given at the same time. A drink of water after feeding is both humane and desirable.

8. Regularity in feeding and watering.—Whatever the system of feeding and watering, it should be strictly adhered to during the season. Habit is part of the ration. Water given one day before meals and the following day after meals is as unsatisfying to the horse as it would be to man. If accustomed to grain before hay at noon, there will be dissatisfaction if this procedure is reversed the following day. Drink and food should be given at about the same time each day.

Not only does the animal know when to expect its grain and hay, but the animal system adjusts itself accordingly, and discomfort results if this order is not adhered to. This does not mean that a set scheme should be followed throughout the year, but rather followed during certain periods of the year when special work is performed. During the winter season when farm horses are not called to do strenuous or regular work, a different plan may be followed than that employed in the summer season, when every minute counts. But, winter or summer, a reasonable regularity should be required.

9. Roughage feeds for horses.—Timothy hay, oats and corn are standard articles in horse rations, but many other grasses and legumes are equally available and equally satisfactory. The red and alsike varieties of clover, alfalfa and timothy are all good and may be fed in varying amounts. On some farms red clover hay is often the sole food of work horses during winter. It is



FATTENING HORSES FOR MARKET

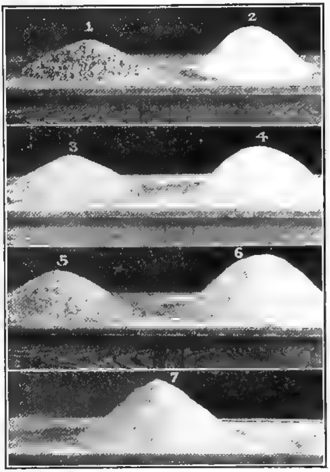
These grade Percherons are ready for shipment, having been put in proper condition for market.

a balanced food in itself, but somewhat too bulky to be used exclusively when these same horses are put to heavy farm work.

In the southern states, Bermuda, timothy, cowpea hay, corn stover, the cereal hays, with or without vetch, and other legumes and grasses, admit of considerable choice and variety. Although crimson clover is frequently fed to horses, it is not a desirable roughage because of the fuzzy condition of the clover head. Frequently this fuzz curls up into balls, lodges in the intestinal organs, and causes digestive disorders and sometimes death. In the western states many of the cereal hays, brome grass, alfalfa, prairie hay, corn stover, timothy and the clovers are available. These allow a wide range of roughage materials for horses. In every section millet grows well and is frequently fed. If cut and cured just as the first blossoms appear, a hay scarcely inferior to timothy is made. Overripe millet should not be fed to horses.

10. Balanced ration.—It does not matter very much what kind of roughage is fed horses, providing the roughage is well cured and free from dirt, and is wholesome. An important thing is to provide concentrates that will carry the nutrient or nutrients lacking in the roughage, but which are abundantly supplied in the concentrates. Thus, if legume hays are fed, the concentrates need not be high in protein, and if the roughage is of a carbonaceous nature, like timothy or corn stover, some concentrate like bran or oil meal should be introduced into the ration.

11. Mettle of oats.—It was formerly thought that oats were indispensable for horses. There seems to be some constituent of this grain that gives mettle and energy. For horses of the roadster type and those where quick action is demanded, oats should be, and no doubt will continue to be, a principal part of the ration, but for farm work the value of oats perhaps has been overestimated. Many tests have been conducted in which various feeding stuffs have been compared, and the oats theory has been overthrown. It is not so much the kind of concentrate, but rather that the grain portion shall contain the digestible nutrients in the best balance, and that they be of an easily digestible nature.



BULK IN GRAIN RATION

Each pile contains the same amount of digestible nutrients. 1. Corn. 2. Corn meal. 3. Oats. 4. Ground oats. 5. Corn and oats, half and half. 6. Corn meal and ground oats, half and half. 7. Corn meal, ground oats and wheat bran, equal parts.

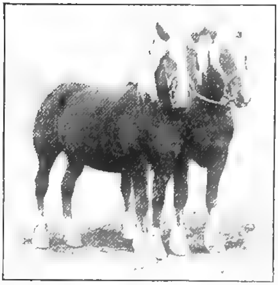
12. When corn is fed.—Indian corn shares with oats popularity as a horse food. Although a very concentrated food it is deficient in muscle-forming elements. If fed in combination with timothy or corn stover, too little protein will be provided. Concentrates of a nitrogenous nature, therefore, should be admitted to the ration. Oats then may be used, or bran, or the oil meals; indeed, practically any commercial concentrated feed. Bran and oil meal are laxative, and are particularly good when succulence otherwise is not to be had. These may be given in small quantities daily, or fed in larger quantities two or three times a week. Both are extremely valuable articles for horses, and may be fed either dry or in mashes. When fed as mash once a week, night is the best time, preferably before a day of rest.

13. Other concentrates.—Barley is a principal grain food for horses in many parts of the world. In some of the great breeding stables barley and oats are ground together in proportions varying with the season and fed to stallions and mares. Cottonseed meal is similar in its chemical composition to linseed meal, but is more highly concentrated and contains more protein. It should be fed with caution, one or two pounds a day, and never to exceed three or four pounds. This concentrate is coming more and more into favor, but some horses seem never to learn to like it. It is more often used in rations for mules than for horses.

The carrot is the root crop par excellence for the horse. It serves to cool the system and assists in the digestion of other food. Only a few roots should be fed at a time and two or three times weekly. Salt is wholesome and beneficial for horses, and attention should be given to this matter. An occasional feeding of salt is not desirable. Salt should be in rock form and placed where the horses can get it at all times.

14. Selecting the ration.—In making up a ration for a horse the first point is to find out how much the horse will eat, the next is to regulate the ration according to the demand to be made upon the animal, whether the work is heavy or light, regular or irregular; then consider the feeding stuffs that are available; and finally the season and the weather.

The harder the work and the colder the weather, the greater the proportion of carbohydrates required in the food. Be particular, however, to get enough protein, even though it necessitates the purchase of a concentrate, that the horse may get enough to meet the needs of the body machine and to secure the completest digestion of the other substances.



FINE AS A FIDDLE

This farm team was fed alfalfa, timothy, corn and oats—each a home-grown feed.

15. Feeding mules.—There is a prevailing notion that mules eat less than horses. Riley, after a long experience with thousands of army mules, maintains that "a mule requires just as much as horses of similar dimensions." In fact, at hard work, Riley says, "the mule will eat more than the horse will or can." In general, an animal that eats little is a poor animal, regardless of its class or kind. The mule will manage to get along on poor feed given at irregular intervals, but this neglect will be manifested in its condition and efficiency. What has been said about feeding work horses applies to mules.

LESSON FIFTEEN

THE ASS AND THE MULE

1. The wild ass.
2. Description.
3. The domestic ass.
4. Spanish jacks.
5. Poitou jacks.
6. Native jacks.
7. Other breeds.
8. The burro.
9. The mule.
10. Best types.
11. Uses.
12. Market classes.
13. Disease immunity.
14. Raising.
15. Choosing dams.

Note to the Teacher.—The horse *(equus caballas)*, the ass *(equus asinus)*, the zebra *(equus zebra)* and the quagga *(equus quagga)* are closely related. Their skeletons when compared are not essentially different, showing that these four classes of animals are closely related and had the same ancestors. The mule is not only a most faithful beast, but can be used for certain kinds of work for which other work animals are not nearly so well fitted.

LESSON FIFTEEN

THE ASS AND THE MULE

1. The wild ass.—The ass and the horse in a wild state were not widely different. It is only when the domestic relations are reached that a divergence of characters exists, and these are more external than otherwise. In their wild state they live in herds and wander to and fro, gathering their food regardless of quality or scanty herbage. Under domestication they submit to the worst forms of drudgery, but in a wild state are distinguished by an inborn love of freedom. Job excellently describes him:

> "Who hath sent out the wild ass free? Or who hath loosed the bands of the wild ass? Whose house I have made the wilderness, and the barren land his dwellings. He scorneth the multitude of the city, neither regardeth he the crying of the driver. The range of the mountains is his pasture, and he searcheth after every green thing."

2. Description.—Compared with the domestic ass, the wild ass is taller, more active, is more solidly built, and is capable of enduring great fatigue. He drinks salt or fresh water, and eats bitter herbs, weeds and tough grasses, even when other pasturage is available. In color, they are grayish. In winter the coat gets very heavy and takes on a fleecelike appearance which changes in summer to soft, silky hair. Their sharp eyes and quick, keen ears enable them to detect the approach of an intruder or enemy at great distances away.

HEAD OF JACK

3. The domestic ass.—Under domestication the ass has become the donkey drudge of mankind. Although obstinate and provoking, he does work that other animals would soon perish in doing, or in performing certain labors that no other beast of burden could with safety be intrusted. His footing is so firm and sure and his back so strong and untiring that he and his kind have largely displaced all other living carriers in mountainous countries for the transportation of merchandise.


DONKEY

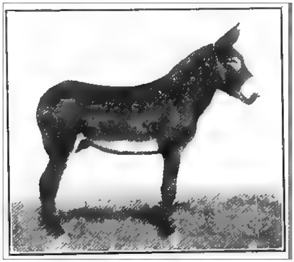
He is also an excellent riding animal. In many parts of Europe, Asia and Africa he is held in high favor as a driving animal for private carriages and as riding steeds for men and women.

4. Spanish jacks. –The Andalusians come from Spain, where the breed originated. The color is gray, frequently white. They stand 14 to 15 hands high and have fine legs with large bone. The Catalonian· stands about 15 hands and has a good, clean bone. They are black in color, with white points, and very popular because of their fine style and action. These qualities give the breed a high standing.


CATALONIAN JACK

5. Poitou jacks.—This French breed has by merit alone taken a high place among breeders. The head is a little large, the mouth is small, the tail short, the chest broad and all the joints large. The hair generally is fine and silky. Draft mares bred to this jack produce excellent mules of striking size and quality.

6. Native jacks.—Many experienced breeders prefer the native jacks to any of the imported breeds. This is because of the large size, greater weight and larger bone that have been developed after several generations of feeding on blue grass and other foods grown on limestone soils. While all colors are found, breeders prefer black with white points. Colts from native jacks are stronger, with better body and more length than those from imported jacks.



NATIVE JACK

7. Other breeds.—The Maltese breed comes from the island of Malta. The jacks are small, seldom standing over 14 hands. They have good color and fine bone, and while much liked for riding and driving, they are too small for farm breeding. The Italian jacks are smaller than the Maltese, 13 to 14 hands high. They are black or gray in color. The Majorca jack is the largest of the imported breeds. Mature individuals stand over 16 hands. They are heavy and rather coarse. The head and ears are large.

8. The burro.—The pony of the jack tribe is the burro, a descendant of the jacks brought to this country by the earliest Spanish settlers. Its hair is shaggy, usually of mouse color, although this may vary from white to black. The neck is very thick, and, in proportion to the rest of the body, is enormous. These beasts are very popular in mountainous regions. They carry large loads on their backs, and move slowly and patiently, but with great sureness of foot over the narrow, dangerous, rocky passes. Many of these animals are used in mines, where they perform steady service for a great many years.

BURRO AT WORK

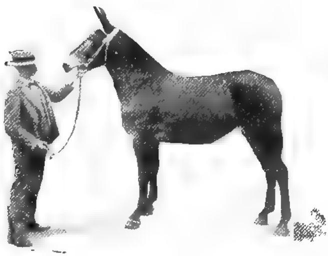
These little beasts, while not in general use on farms, are willing workers and never complain at any task to which they may be put.

9. The mule.—The mule is a hybrid, not a breed. It is a mongrel product, having a jack for sire and a mare for dam. If the breeding is reversed, the product is known as a *hinny*, but this is always inferior to the first-named cross. The mule is tall and strong, corresponding to the horse in height and in the shape of the neck, shoulders and body, while the form of his head, his long ears, his thin, wiry legs and narrow hoofs are the inheritance of his father, the ass. The mule has better style and finish and better bone than the hinny and greater size. Hinnies, while homelier in appearance, are nevertheless faithful workers and are able to endure work and to labor under the most trying hardship.

10. Best types.—The mules in greatest favor are those that most nearly approach the horse type and follow closely in all points of symmetry of form. Compared with the horse, the body is more cylindrical and smaller. The mule markets demand a fine body on the mule, with bigness, but not paunchiness. They must have fine, hard legs and show action and power in every movement. Smooth, dense bones are desirable, as are also prominent tendons and well-developed muscles. Small feet are not wanted.

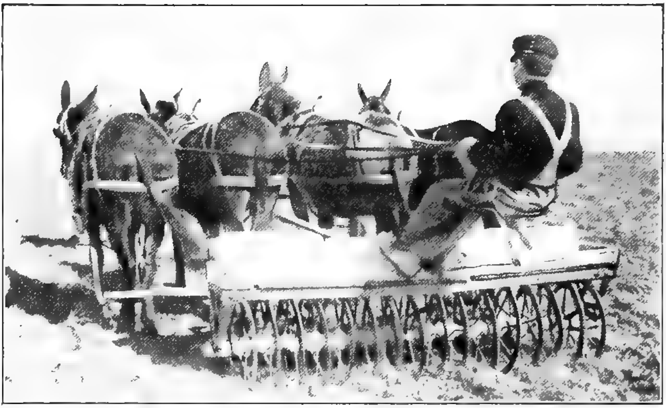
Span of Prize Mules

11. Uses.—First and foremost the mule is a work animal. In this respect he stands unsurpassed. He matures slowly but lives to great age. Trying heat in hot fields in summer affects the mule much less than the horse. These creatures stand rough weather better than horses. They are noted for their great vigor and little tendency to disease. For severe road work, and for labor in cotton and sugar fields and in the mines, they are without a rival. They are considered indispensable for many kinds of army work.



Farm-Raised Mule

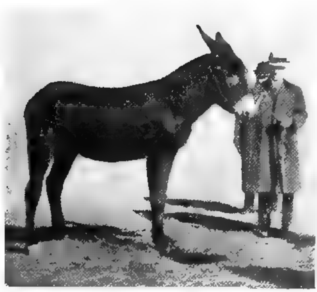
12. Market classes.—The market grades of mules are as follows: (1) Sugar mules, (2) cotton mules, (3) lumber mules, (4) general-purpose mules, and (5) mine mules. Of these, sugar, cotton and lumber mules command the highest prices. They must stand 15 to 17 hands, be heavy boned, very rugged and have capacity for very hard work. Finish in body, good style in action, and considerable refinement about head, neck and legs



FOUR BIG FARM MULES AT WORK
These mules have done severe farm work for years. They are as active as ever.

give an added value. The general-purpose mule is used on the roads for heavy hauling, for railroad construction, farm work, and dray purposes in towns and cities. This class is a regular competitor of the draft horse and by many is preferred. The mine mules are small, often no more than 10 or 11 hands. They are chunky, hardy, and have heavy bone. They must have the capacity for long, steady pulls and to bear heavy loads.

13. Disease immunity.—While mules are subject to disease and bone troubles, they are unquestionably hardier and healthier than the horse under adverse conditions. Many of the common ailments of the horse never affect the mule at all; and when affected with certain ailments, mules more quickly recover and appear to be less disabled during the course of the disease.



JACK COLT
Fifteen months old.

14. Raising.— Mule colts are less troublesome in raising than horse colts and therefore the expense is less. It takes less time to prepare mule colts than horse colts for the market. They are also in demand at any period. When quality and condition are considered, mule colts uniformly command higher prices than ordinary draft colts of the same age and quality. There is less risk in bringing a mule colt to a salable age than a horse colt. The steps in raising are similar to those for raising other colts. Nutritious, appetizing food is essential for size and growth.

15. Choosing dams.—The best dams are those of good conformation and otherwise sound and in good health. The ideal type is a draft mare possessed of good length and well-rounded barrel. Her head must be

MULE COLT AND DAM

clean and fine, her neck of approved proportions, her chest broad, her hips wide. With these must go good bearing, finished style and improved breeding. The size of the dam influences the size of the mule colt. Large, hardy and healthy mares of the draft breeds will make good and satisfactory mule mothers. While color is a secondary point, bay, black, brown or chestnut mares are preferred.

PRACTICUMS

1. Judging Draft Horses.—Provide two or more typical draft horses. Use the score card below, which contains all important points of the draft horse and their relative values in judging work.

Score Card for Draft Horses

Scale of Points	Perfect Score	Student's Score	Corrected Score
A. **General Appearance:**			
Height—estimated; actual			
Weight—estimated; actual	6		
Form—low, blocky, massive	8		
Quality—fine hair and skin	7		
Action—smooth step; quick movement; regular walk and trot	2		
Attitude—stands straight and square	1		
Disposition—docile, friendly	2		
Temperament—agreeable, no look of stupidity	2		
B. **Head and Neck:**			
Head—lean, wide forehead	2		
Muzzle—fine, nostrils large, lips thin, teeth sound	1		
Eyes—intelligent, bright, big	2		
Ears—short and clean and directed forward	1		
Neck—well muscled, short, thick, rather horizontal	2		
C. **Forequarters:**			
Shoulders—good length, rather upright	4		
Knees—clean, wide and deep	2		
Cannons—straight up, lean and wide, fine tendons	2		
Fetlocks—wide, thick and free from puffs	2		
Pasterns—angle 45 degrees, medium length	2		
Feet—round, even, sole concave; frog large and elastic	8		
D. **Body:**			
Chest—wide and deep, showing long capacity and strength	2		
Withers—clean, broad	2		
Breast—broad and muscular	2		
Ribs—long and round	2		
Back—straight, short, muscular	6		
Loin—wide, short, thick, well joined to hips	3		
Underline—low flank	1		
E. **Hindquarters:**			
Hips—wide, level, smooth	5		
Thighs—muscular, thick	5		
Hocks—clean cut, deep, wide and broad	5		
Cannons—larger than front legs, otherwise like them	2		
Fetlocks—as front ones	1		
Pasterns—straighter than front	1		
Feet—solid, more oval than front, heels higher	7		
Tail—carried up, long and full	1		
Total	100		

2. Judging Driving and Trotting Horses.—Provide two or more light horses and use the score card until all the points are fixed in mind and their relative values memorized.

Score Card for Driving Horses

	Scale of Points	Perfect Score	Student's Score	Corrected Score
A.	**General Appearance:**			
	Weight—estimated; actual			
	Height—estimated; actual	4		
	Form—long, deep chested, lithe and long muscles	4		
	Quality—neat, clean, fine hair, mellow skin, clean bone	5		
	Action—smooth, regular, walk, trot, rapid	13		
	Attitude—stands straight and square	1		
	Disposition—active, but kindly	2		
	Temperament—bright look, intelligent interest	3		
B.	**Head and Neck:**			
	Head—wide forehead, lean	2		
	Muzzle—large nostril, thin lips, sound teeth	1		
	Eyes—bright, big and prominent	2		
	Ears—medium size, alert	1		
	Neck—somewhat long, refined	2		
C.	**Forequarters:**			
	Shoulders—long, smooth and slanting	4		
	Knees—wide in front, deep through and broad	2		
	Cannons—short, straight, fine tendons	2		
	Fetlocks—wide, thick, no puffs	2		
	Pasterns—strong, 45 degrees shank	2		
	Feet, medium size, sloping; frog large and elastic	8		
D.	**Body:**			
	Chest—deep, making large girth	2		
	Withers—muscular, well-set back	1		
	Breast—high and projecting	2		
	Ribs—long and round	2		
	Back—strong and muscular	5		
	Loin—wide, short, thick, neatly fitted to hips	2		
	Underline—long and well down in flank	1		
E.	**Hindquarters:**			
	Hips—smooth, rather wide and level	2		
	Thighs—long, muscular, well muscled quarters	6		
	Hocks—wide, deep, broad, clean cut	5		
	Cannons—straight, fine tendons, longer than front	2		
	Fetlocks—as for front legs	1		
	Pasterns—as for front but straighter up	1		
	Feet—solid, more oval than front, heels higher	7		
	Tail—covered well up, full	1		
	Total	100		

LESSON SIXTEEN

THE OX AND THE COW

1. Their contribution.
2. Two types of cattle.
3. Milk-yielding function.
4. Indications of milky tendencies.
5. Beef cattle different.
6. The beef type.
7. Best beef cuts.
8. As producers of human food.
9. Two individuals compared.
10. What influences milk formation.
11. How often to milk.
12. What age of cow is best?
13. Quality of milk.
14. Quantity of milk.
15. Cow comfort.

Note to the Teacher.—As a work animal the cow and her kind are no longer of great importance in the United States. The demand for beef and dairy products has forced each individual to do a specific kind of work and to do that work well. All things considered, this race has been the most useful of all domesticated animals in man's welfare. The battle from now on will be the survival of the fittest in the production of meat or dairy products.

LESSON SIXTEEN

THE OX AND THE COW

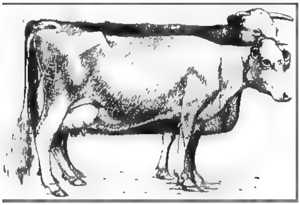
1. Their contribution.—The cow and her kind contribute more to man's welfare than any other domestic animal. "She gives us milk, our most important food, to drink; she provides us with butter and cheese, both wholesome and rich in food nutriments; her flesh enters largely into our dietaries; the leather made of her hide covers our feet and provides us with necessities and luxuries in other directions; and finally her bones, blood and offal fertilize our gardens and fields."

In addition to food and protection their labor has made the earth to yield forth generous harvests. The first crooked stick used as a plow was fastened to the horn of a bull and not to a leather thong attached to the shoulder of a horse. Horses when first domesticated were used to ride, not to work. The cow labored in the fields to raise vegetable products, yielded up her milk at night time to give drink and when needed submitted her carcass as flesh for food.

2. Two types of cattle.—Cattle are raised either for the milk or the flesh stored up in their bodies as meat. This

AN ODD TEAM IN GERMANY

gives rise to two classes—milk cows and beef cattle. The milkers may be used after a time for beef, but if long used as milk producers little is expected of them as producers of beef. The most generous milkers during their careers give out their food forces so abundantly, that as old age approaches, there is little left, either of nerve force or flesh. The cows kept for the shambles render their service by storing abundant fat on their sides and much lean meat on their backs and loins. This flesh is solid and elastic, mellow and yet firm. The tender flesh for meat is found on those parts of the steer where there was the least movement during its life, as, for instance, the loins and the sides. The parts of least value are about the head, neck and legs.

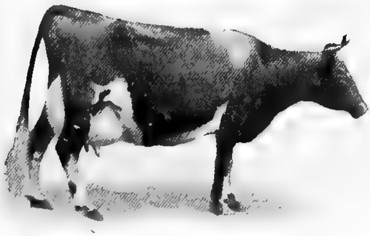


DAIRY VERSUS BEEF

Two kinds of cattle in outline, contrast the two as to type and character.

3. Milk-yielding function.—Before men were interested in cattle breeding as a primary work there was no large production of milk by any single individual. It was only expected that a cow yielded milk enough for the nourishment of her new-born calf until it might be able to support itself. The large production of dairy cows today is an artificial development. During the lapse of centuries, cows were saved for the dairy because of their tendency to give much milk, or to give milk of a rich quality. The milk-yielding capacity of breeds was not achieved in one generation or in five; it is the outcome of many centuries. Once this quality becomes the habit of the breed or the family or the individual, it cannot be discarded.

4. Indications of milky tendencies.—To the practical eye there are several indications of the milky tendencies in dairy cows. These are known to be the wedgelike shape of the body when observed from the front, side or rear; the wide spacing of the eyes; the fine, narrow forequarters and broad, spacious hindquarters; the springing ribs, long and wide apart; the refined feminine countenances; the hair, silklike and smoothly laid on the skin, which itself is fine, mellow and soft to the touch. In addition to these characteristics the stomach should be prominent, the udder large and not flabby or fleshy, with medium large teats, evenly set; and extending forward along the abdomen should be strong, tortuous milk veins, which, carried internally, are admitted by means of large milk wells. The dairy cow is angular, lithe, thin; she gives off the nutriment of her food as milk and does not lay it on her skeleton as fat or flesh. She is a dairy philanthropist; she gives away the product she manufactures.



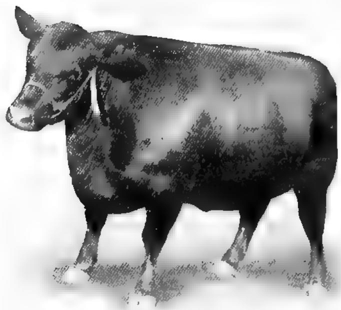
DAIRY TYPE
Contrast with beef type on page 163.

5. Beef cattle different.—On the other hand beef animals are meat misers. They hold fast to the assimilated products of their food. On the several parts of their sturdy frames they store fat and protein as if they were providing for rainy days or for times when the food years might be lean. Unlike their dairy cousins, they supply only small quantities of milk, or milk with little butter fat in it. The production of milk is only an incident: they

REAR OF STEER

are willing usually to secrete milk enough to support an offspring for a short time, but that duty performed they selfishly proceed along their chosen road of growing bigger and fatter.

This tendency of making beef was long ago observed by cattle breeders and early made use of by them in the service of the human race. Beef was a tasty dish; it served as useful food and was demanded in increasingly large quantities. If races of cattle were more willing to manufacture beef than milk, then their disposition would be allowed a free and easy course. And today the business of making beef is one of the largest of human activities.



BEEF TYPE
Contrast with dairy type on page 162.

6. The beef type.—The steer that will fatten readily is low-set, deep, broad and compact rather than angular, long-legged, gaunt, narrow and loosely put together. The broad, compact form indicates good constitution. Low-set animals are good feeders. When viewing individuals from the side, those of ideal beef conformation show a surprising evenness along the back and abdomen: the top and under lines are nearly parallel. Prominent hips, tail, head and shoulders are avoided, as smoothness of outline insures more and better beef. A good quality of beef is required at the dinner table; this character is externally indicated by a smooth, refined head, fine bones, thin skin and a covering of silklike hair. The skin should be loose and mellow. Steer efficiency is indicated by a wide, deep chest, long and well-sprung ribs, compactness of form and fineness of bone.

7. Best beef cuts.—Quite naturally, the best cuts of beef would be expected in those regions where little muscular action occurs. Hence the neck, legs, stomach and head are not store places of meat. Not only do we find little meat in these regions, but that which is obtained is least in demand and of an inferior quality. The choice cuts are derived from the sides, the loins and the upper region of the thighs. In these parts not only is found the best beef, but here the greater part of the salable portion of the slaughtered ox is stored.

Men who make it a business of fattening and of breeding superior strains of beef cattle are at all times endeavoring to develop this tendency of some races to deposit their increase in those regions from where the most valuable cuts of beef are obtained.

FRONT, REAR AND SIDE OF BEEF ANIMAL

8. As producers of human food.—While both beef and dairy products are human necessities, the dairy cow is a much more economical provider of human food than the ox. A dairy cow yielding at the rate of 20 pounds of milk daily, in one week manufactures milk nutrients in the following totals: Protein, 5.1 pounds; sugar, 6.4; fat, 4.9; mineral matter, 1.1; or a total of 17.5 pounds. On the other hand, a steer gaining slightly over two pounds a day, or 15 pounds a week, supplies in meat only five-ninths as much. The steer's weekly contribution is as follows: Protein, 1.1 pounds; fat, 9.5; mineral matter, 0.2; or a total of 10.8 pounds. Considering the amount of food required to yield 20 pounds of milk daily and two pounds of beef increase daily, the dairy cow not only supplies more human food each day, but does it a great deal more economically. This is one reason why dairying as a business is steadily increasing and beef production is in some sections on a decline.

9. Two individuals compared.—At one experiment station the entire body of a fat steer that weighed 1,250 pounds was analyzed. It contained 700 pounds of water, 172 of protein, 333 pounds of fat and 43 pounds of mineral matter. The total amount of dry substance in the steer was 548 pounds. These facts are particularly interesting when compared with the dry matter in the milk of a dairy cow that yielded 18,405 pounds of milk during the course of a year. In the cow's milk the following nutrients were determined: 552 pounds of protein; 618 pounds of fat; 920 pounds of sugar; and 128 pounds of mineral matter, or a total of 2,218 pounds. This comparison shows that a cow of this production yields more than four times as much of the food nutrients as a fat steer weighing 1,250 pounds. As a producer of human food the cow, next to the hen, is the most efficient of all domestic animals.

10. What influences milk formation.—The milk formation is hereditary to a certain extent. Certain breeds and certain strains of these breeds possess the ability to yield much milk and to transmit this characteristic to their offspring. Other breeds yield very little milk, and no manner of care or feeding will largely increase the amount or change the character of its quality. To the former belongs the dairy races, and to the latter the beef races. Cows possessed of beef tendencies are of small merit in the dairy herd. In many dairy herds there are cows that are useless as milk producers. Their production returns in money are less than the cost of keeping them. By means of milk scales and the Babcock tester incompetent ones may be determined and discarded.

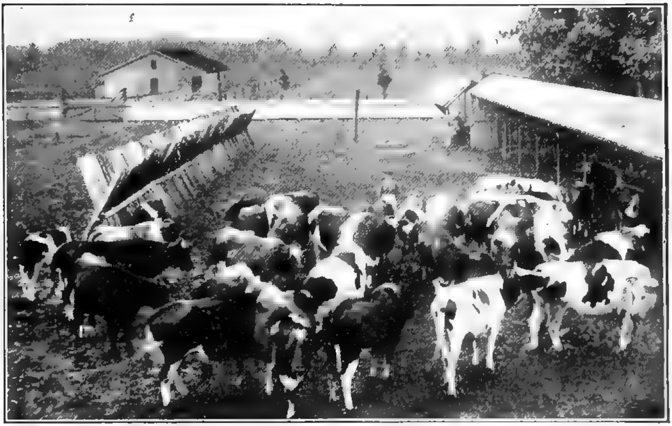
11. How often to milk.—The custom of milking twice a day has become fixed, and no marked advantage is secured when the number of milkings is increased. Experience and repeated tests show that three milkings a day increase the amount of milk secured less than 7 per cent. Considering the extra labor involved, the extra milk obtained by three milkings will not repay the cost and trouble.

Famous Dairy Queen

This is Sayda Queen of Vetmore. At 12 years of age she gave 11,400 pounds of milk and 809 pounds of butter.

12. What age of cow is best?—The formation of milk is closely associated with the birth of the offspring. Milk increases for several months after calving, and may abruptly or gradually decrease, as the case may be. As a rule, fat increases slightly as the lactation period advances. The young heifer generally will give increasing amounts of milk with each succeeding calf until the sixth or seventh year, and remain near that point a few years longer; then the milk flow will gradually diminish.

13. Quality of milk.—So far as the question can be decided, the influences that bear most on the *quality* of milk are breed, heredity and inherent functional capacity. It used to be thought that the kind of food, the care of the cow and her surroundings influenced the quality of milk. When put to actual test, that was proved to be incorrect. The quality of milk is an individual character due to inheritance, and is not influenced by food or treatment. A cow that yields a rich milk does so because it is her nature and inheritance so to do. Another cow that yields a thin milk will always yield a thin milk regardless of food or care.



A COMFORTABLE CORNER IN THE BARNYARD

The owner of these cows believes that exercise in the open is equally important with good food. The rack in the center serves as a manger for hay. The shed at the side is a comfortable shelter in bad weather.

14. Quantity of milk.—On the other hand, the *quantity* of milk may be, and commonly is, influenced by the amount and nature of the food, the treatment bestowed on the cows and the attention given to all details of dairy management. If the mammary gland is small the milk yield will be small. Quantity of milk, therefore, is dependent upon the size and condition of the udder, nature and kind of food, and treatment of the cows.

15. Cow comfort.—Unappetizing and ill-smelling foods depress milk secretion, although they may normally provide the nutrients abundantly. The same foods set before cows in more appetizing and tempting ways often cause an increased flow, although no more provender is consumed. The appetite bears a direct connection with the udder. Cows that are annoyed by flies and other insects, or that are chased about by dogs or other tormentors, will yield milk less in quantity, and, perhaps, poorer in quality, than if they are placed under more comfortable and agreeable conditions. Dairymen are more and more realizing the importance of these facts in practice, and are now giving much attention to the simple details of cow comfort.

LESSON SEVENTEEN

DAIRY CATTLE

1. Milk.
2. Two classes of dairy cows.
3. Channel Island cattle.
4. Demand of butter a controlling factor.
5. Jersey characteristics.
6. Guernsey characteristics.
7. Dairy cattle of the North Sea.
8. Holstein-Friesian characteristics.
9. Cattle of Bonnie Scotland.
10. Ayrshire characteristics.
11. Brown Swiss cattle.
12. Two Irish breeds.
13. Dutch Belted cattle.
14. Red Polled cattle.
15. French-Canadian cattle.

Note to the Teacher.—This lesson teaches how certain breeds have been evolved to meet the needs and circumstances of the people in the land of their development. The physical character of the soil has had much to do with the choice of occupation, and this is reflected in the kind of live stock produced by the people. A milk or butter breed is not a mere chance result; it is the outcome of a people and a soil.

LESSON SEVENTEEN

DAIRY CATTLE

1. Milk.—This product of the bovine race is composed of a white, opaque substance, in which small globules of fat are floating. It is devoid of odor, except for a short time after its extraction. It is of slightly sweet taste. When it has been allowed to stand for some time, a thick, fatty, yellowish-white stratum forms upon its surface. This is the cream. Skim milk has a bluish-white tint. The milk of some cattle races is of a golden tint and of other races of a paler, lighter tone. On standing for some hours, exposed to the air, milk exhibits an increasing acid reaction, from the formation of lactic acid from the milk sugar.

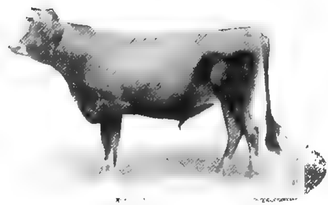
2. Two classes of dairy cows.—Dairy cattle fall within two special classes—one, where the milk yield is of moderate quantity but the fat proportionally high; and a second where the quantity of milk is large but the fat much lower. To the first class belong the Jerseys and Guernseys, and to the second the Holsteins and Ayrshires. Jerseys and Guernseys are known as the "butter breeds," the Holsteins and Ayrshires as the "milk and cheese breeds." The quantity of milk and its quality of any representative cow is an individual as well as

A DAIRY QUEEN

a breed character. Often milk cows that are otherwise equal in conformation and in appearance will show great difference in their production of milk.

While these distinctions are breed characteristics in the main, not all of the second class yield more milk than many individuals of the first class and not all of the first class yield milk possessing higher percentage of fat than individuals of the second class.

3. Channel Island cattle.—Our magnificent breeds of Jersey and Guernsey cattle are the direct descendants of cattle imported from the Channel Islands or of those bred in this country. Very likely the original stock was brought to the islands from France. A near neighbor of these people are the cattle lovers of Brittany and Normandy, who also have good cattle, their stock being in one instance a white, fawn color, and in another, a blacker hue. But, regardless of descent, the superior qualities of these races are due to the people who developed them, to the rigid rules under which they have been bred and reared, to the fertile soil that yields good foods, and to the balmy climate that admits living the year round out of doors.



JERSEY BULL

4. Demand of butter a controlling factor.—The Channel Islands are near to London and other large cities. They are of small size. As the population increased it was necessary for the young people to seek other fields of labor. Having settled in nearby cities, and remembering the golden butter their parents made, they naturally sent home for this delicious table article. Others learning of the sources of this superior product naturally joined in the call for larger supplies. In the course of time Jersey and Guernsey butter became well known. The calls for it tried the fullest possibilities of the Island cows and people, and set in motion every means of increasing the supply and of securing superior cattle to meet the ever increasing demands. Here is the controlling factor that led the people to carefully breed and select their cattle stock and to guard against any change or new blood that might in any way injure the improved butter qualities or jeopardize the butter trade already built up.

GUERNSEY BULL

5. Jersey characteristics.—These cows are rather small, weighing around 850 to 900 pounds. Some weigh much less, not more than 600 to 700 pounds, and others as much as 1,000 or 1,200 pounds. In color, a fawnlike appearance predominates. This varies in shade from a deeper yellow to a brown, reddish or silvery fawn. White markings are common, but no really white individuals are ever seen. White and black are identification marks of the tongue and switch. Jerseys are a horned race, the horns of no particular form or style. A yellow skin secretion in the ear and about the udder and thighs is a mark in much favor by breeders. It is claimed to be an indication of the quality of the milk. Typical Jerseys belong to the approved dairy type. As producers of high quality milk they are famous the world over.

SOME NOTABLE JERSEY RECORDS OF MILK AND BUTTER.

Name of cow	Milk pounds	Butter fat pounds
Eminent Bess	18,783	1,045
Sophie 19th of Hood Farm	17,558	999
Jacoba Irene	17,253	953
Lass 38th of Hood Farm	15,284	890
Olga 4th's Pride	16,275	852
Adelaide of Beechlands	15,572	849
Rosaire's Olga 4th's Pride	14,105	837
Warder's Lady	14,821	820

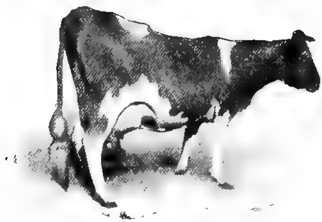
6. Guernsey characteristics.—The Guernsey is slightly larger than the Jersey and perhaps a little more robust. Both give very rich milk, but the milk of the Guernsey is of a more yellow shade. The Guernsey breed is not as widely distributed in this country as the Jersey, but is still well known and popular. Good individuals are in such constant demand that the average selling price is always high. In color, the fawn shade predominates and is of a brown or reddish or yellow character. White markings are common. These cattle, like the Jerseys, have horns. The skin secretion is richly yellow and abundant. Guernsey breeders lay much stress on this, giving it weight in their scale of points. As butter producers these cattle have no superiors. The fat globules are large, very yellow, from which is secured a butter of the highest excellence.

JERSEY COW

Some Notable Guernsey Records of Milk and Butter.

Name of cow	Milk pounds	Butter fat pounds
May Rilma	19,673	1,073
Spotswood Daisy Pearl	18,608	957
Dairy Maid of Pinehurst	17,285	911
Dolly Dimple	18,459	907
Imp. Beauty of Park Farm	14,687	899
Yeksa Sunbeam	14,921	857
Murne Cowan	16,729	845
Dolly Bloom	17,297	836

7. Dairy cattle of the North Sea.—In the days of long ago the sturdy settlers of the North Sea held fast to the two races of black and white cattle that they had brought from the old lands they had left. The land was very rich in some places, and nutritious vegetation was found to thrive luxuriantly. Much of this land is below the level of the sea and has been reclaimed to agricultural use by dikes which keep the waters of the sea in check. Being ardent lovers of cattle, it was natural that these pioneers should bring to high perfection a race of producers that would convert the abundant and nutritious provender of that land into dairy products of the highest excellence.



Guernsey Cow

Unlike the farmers of the Channel Islands, there were no nearby cities to quickly consume their dairy output if made into butter. And butter soon grows rancid, even if kept in cold storage. In the days of Holstein cattle development, cold storage was unknown. What were these people, then, to do? Make cheese. This they did; and cheese could be stored for many months until a market was secured or until they themselves had used up their stores for food. Since the casein as well as the fat is of great importance in cheese making, it is not surprising that a breed was finally evolved whose chief characteristic was a large output of milk. Even if the fat content were low it did not matter. These circumstances of soil, environment, and people have been prominent in the development of the black and white cattle of Holland. In the course of time not cheese only, but butter also, has been made a feature of the production of these cattle.

8. Holstein-Friesian characteristics.—Holstein-Friesian cattle have long bodies with the loins and shoulders well filled out. They are of large build, black and white in color, and popular because of their large milk supply. The udder of the cow is remarkable for size. The demand for market milk to supply city needs has made these cattle the most sought breed at the present time. Mature cows weigh from 1,200 to 1,800 pounds and mature bulls from 1,800 to 2,000 pounds. Many individuals of either sex are even larger than these general weights, often 500 or 600 pounds more.

HOLSTEIN BULL

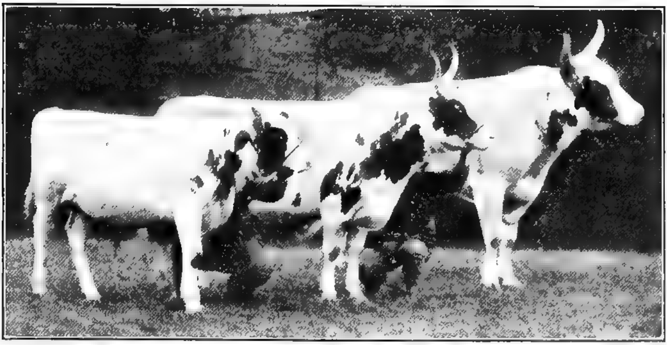
These cows take first rank as milk producers, and as butter producers they are famous. While the fat content of the milk is low, a large production is possible because of the large yield of milk. Their milk runs from 3 to 4 per cent in fat, while that of the Jerseys and Guernseys ranges from 5 to 6 per cent, and even more. The fat globules are small and of a whiter shade than the Guernseys. Cattle of this breed are often rated as beef producers, but they fall short when tested side by side with the distinct beef breeds. The young calves make excellent veal, and for this purpose are in great demand.

HOLSTEIN COW

SOME NOTABLE HOLSTEIN RECORDS OF MILK AND BUTTER.

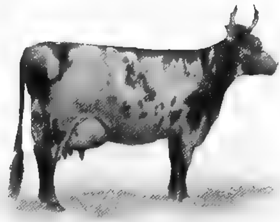
Name of cow	Milk pounds	Butter fat pounds
Banostine Belle De Kol	27,404	1,058
Pontiac Clothilde De Kol, 2d	25,318	1,017
High Lawn Hartog De Kol	25,592	998
Colantha 4th's Johanna	27,432	998
Daisy Grace De Kol	27,718	962
Creamelle Vale	29,591	924
Aralia De Kol	28,090	913
Caroline Paul Parthenea	21,966	888

9. Cattle of Bonnie Scotland.—In Scotland, in the county of Ayr, in the land of Burns and Tam o'Shanter, a breed of cattle has been developed that has long been popular, and long esteemed because of superior merit. The Ayrshire cow is not as common as the Jersey or the Holstein in this country, but in the land of her evolution she is highly esteemed, a quality fast spreading here, and particularly true of those who best know her qualities. Ideal in many respects she is hardy and robust. In size she ranks between the Jersey and the Holstein. Her color



AYRSHIRE CATTLE: BULL, COW AND CALF

of red or white, or a mixture of the two, gives her attractiveness and distinction. Her high merit as a producer of milk and cheese has brought her fame in every land.



AYRSHIRE COW

10. Ayrshire characteristics.—These cattle are quite uniform in many particulars. There is greater evenness in size, color and form than of any other dairy breed. The cows average 1,000 pounds in weight, the bulls 1,500 pounds. The udders are very uniform, their development averaging a higher perfection of outline than those of any other breed. It is not often that an imperfect, fore udder is observed, but this is a common occurrence in all other breeds. In dairy form Ayrshires rank high. Their thin necks, shapely horns, lithe shoulders and wedgelike bodies and ample udders give these cows a distinction of uniformity that no other breed possesses to a like degree. Their capacious abdomens quite well accommodate the coarse roughages of their rations and their vigorous digestive systems quite

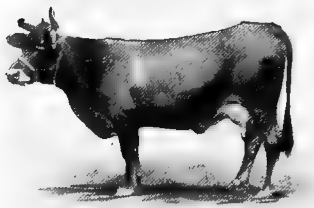
SOME NOTABLE AYRSHIRE RECORDS OF MILK AND BUTTER

Name of cow	Milk pounds	Butter fat pounds
Auchenbrain Brown Kale 4th	23,022	918
Lily of Willowmoor	22,106	889
Netherall Brownie 9th	18,110	821
Gerranton Dora 2d	21,023	805
Jean Armour	20,174	775
Rena Ross	15,072	644
The Abbess of Torr	14,582	641
Auchenbrain White Beauty 2d	14,721	637

well enable them to convert this provender into much milk.

While the milk is less rich than the Channel Island breeds, it is richer in general than the Holsteins; and while these cows yield less milk in quantity than Holsteins, they do surpass in quantity the Jerseys and Guernseys. While of average production in both butter and milk yield, their robust health and meritorious other qualities give them rank as one of the leading four dairy breeds.

11. Brown Swiss cattle.—These are a secondary dairy breed, but they have attracted some attention in the United States. The Brown Swiss cattle originated in Switzerland. They are mouse-colored, rugged animals. Some are good milkers, but many are indifferent when compared with the heavy-milking Holsteins or abundant butter-making Jerseys or Guernseys. Cows of this breed weigh from 1,250 to 1,400 pounds, and bulls from 1,500 to 1,800 pounds. In butter fat the milk ranges from 3.2 to 3.8 per cent. Records of 500 to 600 pounds of butter have been made in a year. Fairly good cows often show a decided beef tendency, but those having the keeping of this race in charge insist that the Brown Swiss should be known as a dairy breed.



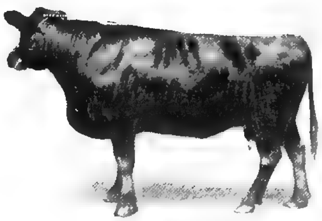
BROWN SWISS COW

12. Two Irish breeds.—From Ireland we get two breeds, better known in this country on account of their small size than because of numbers. These are the Kerry and Dexter. The two breeds have a common ancestry. The Kerry is black in color, the Dexter black and red. Their small size enables these cattle to forage where other breeds would starve. Some are good dairy cattle, the milk testing about 4 per cent fat. There is a record of a 500-pound Dexter yielding over 8,000 pounds of milk in one year. These cattle will never have a place in money-making herds, but as family cows they may in time find a place.

13. Dutch Belted cattle.—These cattle belong to the Holstein class, but are inferior to the parent stock. The white belt around the body gives distinction, but adds nothing to their ability as milk producers. Some excellent records of milk have been reported, but as a dairy competitor this breed is outclassed. The fancy of the breeder will be the sole dependence of these cattle for perpetuation and popularity.

DUTCH BELTED COW

14. Red Polled cattle.—As the name indicates, these cattle have no horns and are red in color. They originated in England, and although bred in this country in considerable numbers, they are outranked as dairy animals by the primary dairy breeds. They give a good grade of milk and are prized also as beef producers.



RED POLLED COW

15. French - Canadian cattle.—These cattle come to us from Canada. Their ancestry is represented in stock similar to that used in the development of the Channel Islands breeds. In color the cattle are black or browish fawn. They are of small size, mature cows weighing 600 to 900 pounds and mature bulls from 700 to 900 pounds. The milk tests about 4 per cent fat. Only a few herds have been established in the United States.

It is pertinent to point out that while each of the breeds have certain characteristics which are uniformly transmitted, which set it apart from each of the other breeds, yet, so far as the leading breeds are concerned, each produces an equal amount of butter fat. The several breeds vary in the amount of milk given, in the per cent and color of the butter fat, in their adaptation to different climates, and to their ability to consume different kinds of feeding stuffs. Each breeder should select his breed with reference to his conditions and, also, with reference to his own preferences. The man who likes his animals best is the one who succeeds best in rearing them. Other things equal, it is best to rear that improved breed which is most economic in the neighborhood.

FRENCH-CANADIAN COW

LESSON EIGHTEEN

BEEF CATTLE

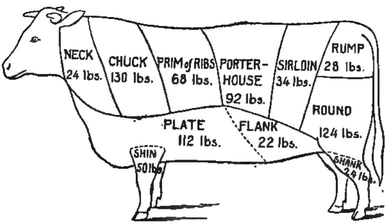
1. Beef.
2. Baby beef.
3. General beef production.
4. Beef cattle.
5. The popular Shorthorn.
6. Beef and dairy Shorthorns.
7. Shorthorn characteristics.
8. Herefords.
9. Hereford characteristics.
10. The Scottish doddies.
11. Angus characteristics.
12. The Polled Scots.
13. Galloway characteristics.
14. West Highland cattle.
15. Sussex and Polled Durham.

Note to the Teacher.—The cow that turns her food into milk and butter fat, naturally is unable to convert it at the same time into flesh. If, on the other hand, food is stored up on the body frame as meat, the milk yield will be small. Here is the turning point that leads either to dairying or beef production. The beef breeds consist of races that have been carried along the beef road; what they eat is stored on their backs and not given away as milk.

LESSON EIGHTEEN

BEEF CATTLE

1. Beef.—The flesh of the ox may be called the staple article of animal food. Certain beef cuts are the most esteemed of all meat dishes. In the region of the loins, the flesh is tender and juicy, and commands the highest prices of any parts of the carcass. Sirloin is said to owe its name to Charles II. of England, who, on dining upon a loin of beef, and being particularly well pleased with it, asked the name of the joint. On being told, he said: "For its merit, then, I will knight it, and henceforth it shall be called Sir Loin."



RETAIL BEEF CUTS AND WEIGHT

Retail dealers' method of cutting a beef carcass.

2. Baby beef.—When calves of good breeding and quality are brought to a marketable condition to weigh 1,000 to 1,400 pounds by the time they are 10 to 18 months of age, they are sold as baby beeves. So marketed, they fetch good prices, but their raising and fattening are expensive. To attain success in baby beef making, an exceptionally high grade of breeding stock is required. The calves from the day of their birth must be fed much milk and nutritious concentrates, and each individual must have close attention until sold. The raising of baby beeves is a difficult and complicated specialty. No one should engage in it who is not a skillful judge of cattle. Good quality, a strong constitution and right conformation are basic essentials behind profit in this business.

3. General beef production.—Two classes of producers are engaged in beef production. One class makes it its business to grow the beef stock or "feeders," the other to feed and fatten this stock for market. At one time the wide areas of the western plains were more or less

BABY BEEF

These are now ready for market. Note the high quality and finish.

covered with vast hordes of cattle which were tended and cared for by ranchers and cowboys. Many of these animals were purchased by farmers in the corn-belt sections, who fed them corn and grass, thus fitting them for market. This feeding stock was full grown in frame but thin in condition. The passing of the ranges has reduced the output of this kind of cattle. From now on beef will be produced largely on farms where other activities also are pursued. Cheap lands no longer being available, the production of "feeder" stock on ranges naturally will decline and the cost of producing beef as a consequence will advance.

4. Beef cattle.—The stock from which beef is secured the world over is now limited to the few choice breeds of Great Britain and the United States. Continental Europe has many strains of cattle. Some of these strains make excellent beef, but compared with the products of England, Scotland and the United States, the beef stock is inferior. The English have long been a beef-eating

WHERE GRADE STEERS ARE FATTENED IN LARGE NUMBERS

Note in the background the large silo which, with clover furnishes the bulk of the roughage portion of the ration. Corn and the oil meals are largely used for the grain portion. These are western raised steers being fattened in the eastern part of corn belt.

people, and from the earliest until recent times have sought to improve their cattle breeds, that not only more meat, but meat of a high quality, might be secured.

5. The popular Shorthorn.—It is not to the discredit of other beef breeds that the Shorthorn in the popular mind holds first place in the beef world. These cattle are of such high merit, and have been with us so long, that their fame has become world wide and notable.

They are easily at home under most conditions, are of good size, fatten readily and produce meat that is tender, juicy and nutritious.

Among the early English improvers of this breed were the Colling Brothers of Ketton, who began their work of improvement nearly a century and a half ago; Thomas Bates, a faithful disciple of the Collings, who founded the famous Princess, Duchess and Oxford families; Richard Booth, who together with his sons, did so much to lengthen the hindquarter, to fill up the fore flank, and to secure greater depth of flesh, thus increasing the value of the carcass; and Amos Cruikshank, the father of Scotch Shorthorns, who has given us a family of Shorthorns compact and blocky in build, easily fattened, and of superior meat when placed on the block.

SHORTHORN BULL

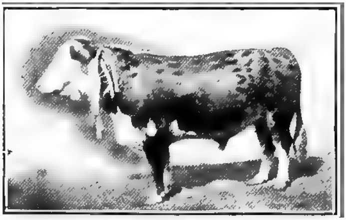
6. Beef and dairy Shorthorns.—Of the beef breeds the Shorthorn alone claims merit as a dairy breed. Two types are evident—one that adheres to the typical beef type, and a second that shows decided dairy tendencies. Both distinctions have been accentuated by breeders, depending on whether they wanted beef or milk and beef. The extreme beef families among Shorthorns are as typical of their class as other beef breeds. Some splendid milk and butter records have been made by cows of strains. One Shorthorn cow at the Wisconsin station produced over 10,000 pounds of milk, from which was made 506 pounds of butter in 326 days. Many records are reported of dairy Shorthorns yielding 6,000 pounds to 8,000 pounds of milk and 300 to 400 pounds butter in a year.

7. Shorthorn characteristics.—The Shorthorn is the largest beef breed. Average mature cows weigh 1,400 or 1,500 pounds and mature bulls 1,800 to 2,100 pounds.

In many instances these weights are greatly exceeded. As the name indicates, the horn is short and small, and is usually curved forward. The tips bend inward or upward. These cattle mature early, equaling any breed in this respect. As grazers they are just fair. They make good use of their food and lay on a thick coat of fine flesh on the outside of the frame. Their flesh is of excellent quality. In grading up common cattle, Shorthorns have been widely used, with excellent results. In color red and white predominate. They may be pure white, pure red, red and white, or roan. This breed is noted for the high quality of its flesh. The skin is mellow and elastic, the hair and bone fine and of good texture.

SHORTHORN COW

8. Herefords.—These white-faced cattle are descendants of one of the aboriginal breeds of Great Britain, and as a distinct breed has a long lineage. The presence of the white face is an indication of purity of blood. The most notable of the early improvers was Benjamin Tompkins, who died in 1790. Like Batewell, who did so much for sheep, Tompkins improved his animals through the most careful selection of his breeding stock. The first authentic importation of Herefords into this country was made by Henry Clay in 1817. Since that time these animals have been distributed over all parts of this country. They are especially liked on the plains and in the pasture dis-



HEREFORD BULL

tricts of the southwest. Herefords are good "rustlers" and have long been popular for their grazing qualities. They make their best beef at an early age.

9. Hereford characteristics.—In size and weight Herefords are slightly under the Shorthorns In color they are red and white, the body being red with white on the face and on the underline from the throat along the lower part of the body. The tail tip is white. Because of their early maturing qualities, they are excellent for the production of baby beef, and thousands are annually used as such. As meat producers they rank high; as milk producers they are inferior to the other breeds. They are sturdy, rugged beasts, of distinctly superior quality; the hair is fine, the skin mellow, the flesh soft and elastic and the bone of good texture.

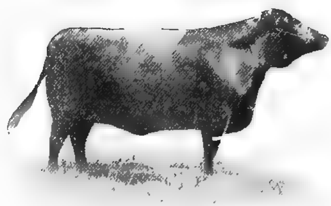
HEREFORD COW

10. The Scottish doddies.—The Aberdeen-Angus has only lately been brought from Scotland, but he has already become a rival of the other beef breeds. His greatest popularity is found in the middle and western states, although many have gone to the south and southwest. These cattle are prized for their early maturing qualities. In the economic use of food the Angus is second to no other breed. In recent years they have carried away their share of prizes at fat stock shows and in block contests.

ABERDEEN-ANGUS BULL

The quality of meat is usually recognized as superior to that of Shorthorns and Herefords, commanding the highest place in this respect.

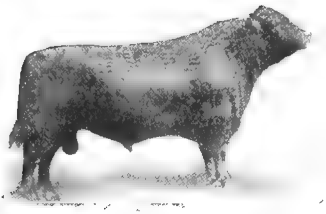
11. Angus characteristics.—All specimens of this breed are black in color and hornless, blocky in shape, and compact, with short legs. They are poor milkers, but since they are bred only for beef, their supporters say this does not matter. In size, average individuals follow closely the Herefords, but are slightly smaller than Shorthorns. They are fair grazers, though probably not as good as the Herefords. They ship well, are unsurpassed in crossing or grading, and are destined to occupy a commanding position in beef production of the future. Many new herds of this breed are annually established in the corn-belt districts.



ABERDEEN-ANGUS COW

12. The Polled Scots.—The most common name of this Scottish breed is the Galloway. They were brought to our country only a few years ago. In his native land he was always a good rustler and hustler for food. Some say he is the best breed for the open plains. When slaughtered, his meat is in the first rank in competition with other breeds and always commands the highest price in English and American markets. These cattle are hornless, possess unusual hardiness, enabling them to endure a severe climate. They do not mature quite as early as the Shorthorn or Angus, but they take on flesh smoothly. The hide is of peculiar value, and may be used for robes and fur coats.

13. Galloway characteristics.—In color they are pure black, with a brownish tinge. The head is short and wide with a broad forehead. The body, like the Angus, is broad, rounded and symmetrical, the skin mellow and thick, the hair soft and wavy, with a mossy undercoat. In size they are smaller than the Angus, Hereford or Shorthorn. Representative cows weigh 1,200 to 1,350 pounds and bulls from 1,800 to 2,000 pounds. Yearlings of this breed are frequently brought to weigh 1,000 to 1,100 pounds and two-year-olds 1,200 to 1,400 pounds. As milkers, the Galloways are inferior, but they yield enough to nourish their calves. When crossed on other breeds, their black color and hornless condition are transmitted almost without exception.



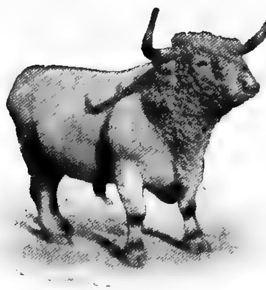
GALLOWAY BULL

14. West Highland cattle.—This breed originated in Scotland. The horns are large and upturned. The color is generally black, red and black, dun or brindle. The hide is thick and covered with long, soft hair, even longer than the Galloways. In hardiness these cattle are superior over all others; as milkers they are poor. Their claim to distinction is in their meat, which is of the highest quality, surpassing that of any other breed, and in their hardiness, which also surpasses all other breeds. They endure not only cold, but wet and damp weather, and can secure a satisfactory living on either grass or brush. In size they are the smallest of the strictly beef breeds, ma-

GALLOWAY COW

ture cows weighing 850 to 950 pounds and mature bulls 1,050 to 1,200 pounds.

15. Sussex and Polled Durham.—The Sussex is an English breed of solid red color. In size they range from 1,700 to 2,000 pounds for bulls, and from 1,200 to 1,500 for cows. They are inferior in milking qualities. They mature early and are highly esteemed as good grazers. They are not popular in the United States, although many excellent herds are in existence in this country.



West Highland Bull

The Polled Durham is now a distinct breed, growing out of the Shorthorn race and owing their distinction to lack of horns. Much attention has been given to their milking qualities, these animals excelling even the milking strains of their parental stock. The breed is steadily growing in popularity and numbers. They are very similar to Shorthorns in all physical respects.

PRACTICUMS

1. Judging Dairy Cows.—Provide one or more typical dairy cows. Use the score card below, considering the details outlined in it. Practically every dairy point has been mentioned, with a description fitting the ideal of a good dairy animal.

Score Card for Dairy Cows.

Scale of Points	Perfect Score	Student's Score	Corrected Score
A. **General Appearance:**			
Size—small, medium or large..............................			
Form—wedge shape, from front; side, top and rear angular and open..............................	8		
Quality—hair, fine, silky; skin mellow, loose; secretion yellow	8		
Temperament—feminine and full nervous force.............	1		
Constitution—general healthy appearance..................	2		
B. **Head and Neck:**			
Muzzle—clean cut, with large mouth and nostrils...........	1		
Eyes—bright, big, kindly looking..........................	2		
Face—broad forward; lean face............................	1		
Ears—fine texture; broad, yellow secretion................	1		
Neck—long, thin; thwart clean; light dewlap..............	2		
C. **Forequarters:**			
Shoulders—lithe, oblique; withers lean....................	3		
Legs—straight, short	2		
D. **Body:**			
Chest—deep, large girth; big, well-sprung ribs..............	8		
Abdomen—deep, large capacity; light flank.................	5		
Back—lean, open, straight................................	5		
Loin—broad, level.......................................	5		
E. **Hindquarters:**			
Hips—far apart, not fleshy................................	3		
Tail—slim, long, with fine switch..........................	1		
Thighs—thin, long, wide apart............................	4		
Legs—straight, short.....................................	2		
F. **Mammary Development:**			
Udder—capacious, extending well forward, high up behind, full, but not fleshy, mellow; quarters even...............	26		
Teats—evenly placed, good size...........................	4		
Milk veins—large, tortuous, elastic, and entering large milk wells...	6		
Total...	100		

2. Diagram of Cow.—Place pieces of numbered paper on the various regions of the cow as indicated in the illustration. Require each student to write the name of each region and name the cor-

responding region in his own body. Each student should be required also to make a sketch of a cow and name each part or region on the drawing or sketch at the proper point. Continue this practice until each student of the class has learned the regions and is able to name the location without referring to his sketch. Definitions of all terms should be learned and memorized.

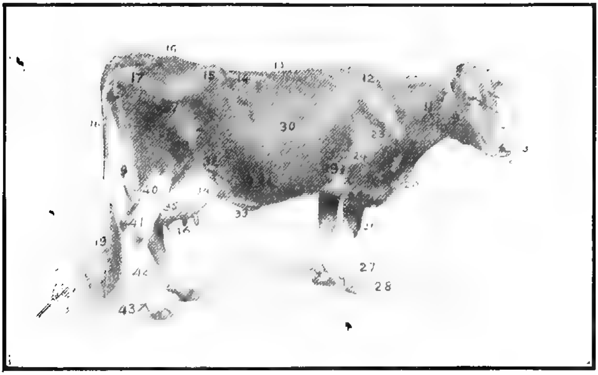


DIAGRAM OF COW

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

3. DAIRY VERSUS BEEF TYPES.—Require each student to make drawings of typical dairy and beef cattle, showing differences of form and conformation. Important facts to be considered are: Wedge shape of body, length and shape of neck, milk veins, size and nature of udder, back and underlines, fleshiness of loins and thighs. Bring out in the drawings the distinctive characteristics that distinguish the dairy from the beef type.

LESSON NINETEEN

CONCERNING CATTLE

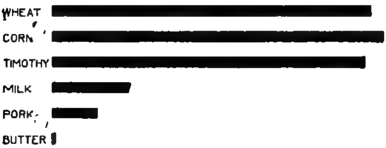
1. Cattle farming.
2. Quality.
3. Dairy temperament.
4. Swine after cattle.
5. Age and yields of milk and meat.
6. Dishorning.
7. Co-operative breeding.
8. Milk records.
9. Cow shelters.
10. Milk-testing associations.
11. Advanced register.
12. Maintaining the milk flow.
13. Keeping cattle on the gain.
14. Live and dressed weight.
15. Shrinkage.

Note to the Teacher.—In paragraph 1, the relation of cattle raising to soil fertility is clearly indicated. The teacher can point out with great profit the depleting effect of grain farming and the restoring effect of cattle farming. American agriculture is full of these examples. It will be advisable to show the practical bearing that each paragraph of this lesson has on handling and caring for cattle.

LESSON NINETEEN

CONCERNING CATTLE

1. Cattle farming.—Whoever raises cattle improves his farm. Grain or cotton or hay depletes the land. With cattle a leading feature, the farm becomes a farm factory, where crops home grown and farm raised are converted into milk or beef. Both are finished products that are worth as much or more than the commercial value of the crops consumed. In addition their fertilizing elements are largely returned to the soil from which they were obtained originally. Crops ought to be "marketed on the hoof" as milk or butter or beef or pork or mutton. Such a system secures larger efficiency, insures better profits, improves the land, makes happier the family life.



WHEN A TON IS SOLD

In the sketch are indicated the relative amounts of plant food removed when a ton of product is sold. Live stock products are much less exhaustive on the land than grain crops.

2. Quality.—In raising live stock the aim is to secure the highest efficiency in the line of breeding undertaken. Quality is an expression of fitness. It denotes ancestry, lineage, breeding. Animals possessing quality manifest the same in fine, silky hair; soft, mellow skin; neat, fine, bone; prominent veins in the skin; fine features; and in the choice products which they produce.

3. Dairy temperament.—A cow used for the dairy should possess, in addition to proper form and good quality, an intangible something commonly known as *dairy* *temperament.* This is not a physical character but rather an outcropping of the nervous nature. It is indicated in manners and bearing, but is not capable of being measured as are other tangible qualities. Our best dairy cows manifest this typical dairy temperament in their general appearance, deportment, and disposition. A quiet, docile nature, with motherly attributes, and a willingness to give her milk to the milker instead of to her calf, typifies the spirit of dairy temperament.

SWINE FOLLOWING STEERS IN THE FEED LOT

Cattle take their grain from the feed box and the pigs gather up what falls to the ground. Usually no additional food is given the pigs other than what they gather from the waste and the droppings.

4. Swine after cattle.—When cattle are fed concentrates or unground grain, such as corn, oats, barley or wheat, pigs and shotes should be placed in the feed lots or barnyards to pick up the undigested grains in the droppings. Often pigs secure the larger part of their support in this way. A steer, on fattening rations, particularly when snapped corn is generously fed, will supply in its voidings food enough to support two or three good-sized shotes. If fed husked corn, the waste from two steers will suffice for three hogs; if fed shelled corn, a pig to the steer; and crushed or ground corn, one shote to two or three steers.

5. Age and yields of milk and meat.—The most economical gains in meat cattle are secured during the earlier periods of growth. Calves lay on a pound of increase for every pound and a half of food. When maturity has been reached from 10 to 12 pounds are necessary for making a pound of gain. To produce a pound of butter requires about two and one-half times as much food as to produce a pound of gain in steers. The cost of milk is greatest in the first milking period in heifers. The cost decreases steadily until old age. The average dairy cow is at her best from the sixth to the tenth year. After the twelfth to thirteenth year the decrease in milk is very great.

Using the Dishorning Clippers

6. Dishorning.—Removing the horns of cattle is humane because it prevents torture and permanent pain that certain individuals in every beef or dairy herd inflict on their mates. Horns may be removed in two ways. In the use of the dishorner, an implement for cutting off the horns of growing calves and mature cattle; and of caustic potash, a chemical that can be obtained at any drug store. The latter method is the simplest and anyone can perform the operation. Get a stick of this chemical, wrap a bit of paper about one end so as to protect the fingers, moisten the horn buttons on the week-old calf, and rub the stick of potash on the moistened part. This will prevent the growth of the horns.

7. Co-operative breeding.—A community working in harmony can accomplish more than individuals alone. In co-operative breeding a few choice sires are purchased by an organization of interested members and each secures his proportionate use of these high-grade animals. Such an organization may take on many forms, but its essential principle is that quality be obtained in a few select purchases rather than mediocrity in many. As good sires are bought exchanges are made, so that a choice animal can be kept in the same locality during the entire period of his usefulness. Certain sections have become noted the world over because breeders have been working together raising a class of stock of high quality.

8. Milk records.—A report of the amount of milk yielded by each and every cow of a herd is known as a *dairy record.* Before milk is emptied from

FORM FOR DAILY MILK RECORD.

NAME OF COW	PRINCESSA		REGENA 4th.		Q. BEAUTY		Q. IDEAL		QUEEN		ALTA		SEBOLT		E. JILIX		EVESTA 6th.	
MONTH	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
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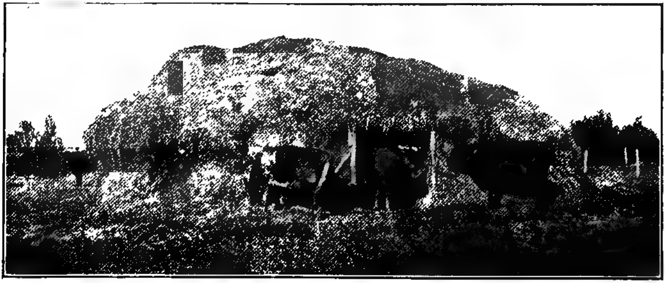
TOTAL																		

MAKING THE COWS TELL

the pail in which it is milked it is weighed and then written on a milk sheet. Both the morning and evening milkings are recorded for each day of the month and for each month of the milking period. A milk sheet large enough for all the cows should be provided, one for each month. By means of this sheet, when the totals are added up, a complete record for each cow is available by month and year and her worth may be readily calculated.



Good Cow Shelter at Small Cost

Posts are set in the ground and covered with rails or boards, on top of which straw is stacked at threshing time.

9. Cow shelters.—Dairy cows require comfortable quarters. Steers are able to shift to better advantage, since the thick coating of fat just under the hides serves as a warm blanket for protection. Dairy cows are not thus shielded; they turn their food into milk and butter fat, and were they able to reason, would expect their keepers to furnish quarters that would protect against rain and snow and bad weather. Even for steers and other stock, shelters are desirable. These may be built of any material and may be of costly or simple construction to suit the taste and purse of the owner. In either case the important consideration is to protect from rain, snow and wind and to provide a dry bed,

10. Milk-testing associations.—In some places local groups of dairymen organize as a body and enter their herds for testing both the butter fat and quantity of milk. Both morning and night milkings are weighed and set down on record sheets. Once a month samples are taken to test for butter fat. Such associations are most successful when enough herds are under test that a trained milk tester may go from herd to herd obtaining samples of all the individual cows and determining the full measure of production. The usual cost for making such tests is from $1 to $2 per cow a year. Cow testing associations point out the good and poor cows of a community. By eliminating the poor cows and preserving the heifer calves of the best cows for milkers, a herd can soon be improved.

11. Advanced register.—All of the important dairy cattle clubs now maintain an *advanced registry*, in which are recorded tested cows that meet certain requirements as to production of butter fat and total milk yield. Prescribed regulations are enforced as to when a cow may be entered and under what conditions the tests are to be made. The dairy breed associations coöperate with the experiment stations. Disinterested testers are sent from month to month to conduct the tests. The testers watch the

MAKING YEARLY TESTS

At the top is shown Eminent's Bess before beginning her test; at the bottom how she looked a year later on completing the test. She is a world's champion Jersey cow, having produced 18,783 pounds of milk and 1,133 pounds of butter in one year.

milking, take the samples, weigh the milk and determine the percentage of butter fat. This is done for a two-day period each month. Daily milk records are recorded, in addition to the monthly test to ascertain the full yields for the lactation period. Entry into the advanced registry is a mark of merit.

12. Maintaining the milk flow.—Once a cow drops in her milk yield, it is a difficult matter to restore her production to a high point during that period of lactation. Hence good dairymen endeavor to secure, through feeding, care and management, a steady and even flow; and

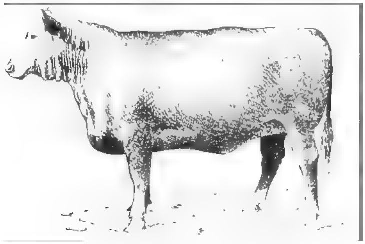
Folly of Light Feeding

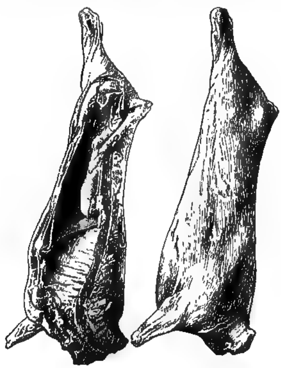
When cattle are underfed they lose in weight, and this requires extra feeding to replace previous weights. Profit in feeding means keeping the stock steadily on the gain.

when the decrease comes, to have it slight and gradual. Anything that checks normal production for any considerable time generally proves disastrous during the lactation period. Concentrated foods, succulent forage and appetizing provender make hearty appetites and tend to stimulate not only an even but the maximum yield of milk.

13. Keeping cattle on the gain.—It is equally important that cattle raised for beef be provided with abundant rations in order that they may steadily increase in weight and growth. If the ration is insufficient at any time, meeting only the needs of the body or forcing the animal temporarily to fall back on its reserve forces, a check in growth will occur which can be overcome only through extra feeding. This kind of feeding, although common, is unprofitable in the end. During a period of insufficient feeding an animal must be supported and no returns are secured from the use of that food. It is advisable under most circumstances to feed liberally so as to get a steady increase in growth from birth until maturity.

14. Live and dressed weight.—When steers or other cattle are sold on the hoof, the purchase is made on the basis of *live weight*. If first slaughtered and then sold, it is as dressed carcasses, or by *dressed weight*. The percentage of dressed weight to live weight varies with the breed, type and condition. Old cows of the strictly dairy breeds may dress as low as 40 per cent of their live weight, while prime steers of the best beef breeds often dress 68 to 70 per cent.





PRIME HEIFER AND HER CARCASS

15. Shrinkage.—In shipping cattle from farms to market there is always some loss in weight. This loss is known as *shrinkage* and varies with distance, time on the road, feed and care while en route. The average shrinkage in weight from shipping steers on the railroad, as computed from 50,000 animals, is 43 pounds to an animal. Grass-fed steers when shipped shrink more than those fed corn and dry roughage. Much shrinkage will result if steers get "off feed" or scour. A day or two before shipping feed largely of hay and give little water. "As to feed on the road, nothing equals good sweet hay, which excels corn or other grains because it is easily digested and does not fever the animal." As for water for drink, give just enough to quench thirst.

LESSON TWENTY

FEEDING DAIRY CATTLE

1. Grass.
2. Pastures ideal for cows.
3. Feeding grain on pasture.
4. When pastures are short.
5. Producing milk economically.
6. Grain feeding.
7. Getting cheap food.
8. Foods that all may grow.
9. Liberal feeding.
10. Protein most important.
11. Grain feeds of first rank.
12. Grain and quality of butter.
13. Salt and water.
14. Testing with tuberculin.
15. Order of supplying the food.

Note to the Teacher.—The purpose of feeding dairy cows is to secure the largest yield of milk. The rations, therefore, will consist of such feeding stuffs as will not only supply the milk-producing constituents most satisfactorily, but at the same time tend to stimulate milk secretion. Practical work in compounding rations should be continued until the student becomes proficient in this work.

LESSON TWENTY

FEEDING DAIRY CATTLE

1. Grass.—In early spring cows are usually put on pasture as early as there is food enough for support. New fresh grass is generally very laxative, and if it alone is relied on, a very bad effect often occurs. This can be avoided by feeding only partially on grass, completing the ration through the use of both hay and concentrates. In a short time cows become accustomed to grass, and may then be left to subsist entirely on it

CONDITION OF COWS SHOWS THE PASTURE IS GOOD

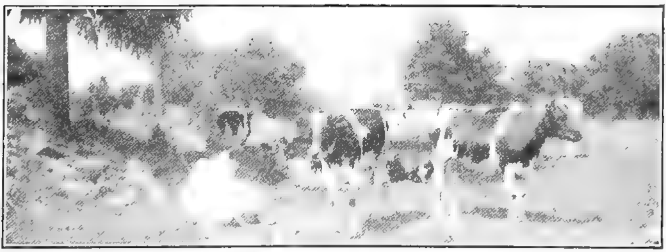
Remember the old proverb, No grass, no cattle; no cattle, no manure; no manure, no crops.

2. Pastures ideal for cows.—Pasture grass is one of our best foods. It is succulent, fresh and appetizing, and very nutritious. The splendid results obtained in having cows on pasture is not solely because the food is unusually well utilized over winter rations, but because it is so rich in nutriment. It ranks with the cereals, and everyone knows how effective such feeds are in milk production. When cows in milk are on pasture their treatment is very simple, and quite in contrast to the diligent necessities of the stable during winter. Labor is largely dispensed with, except that required for milking. Cows are nowhere so well treated as when on pasture. They gather their own feed, and even on scanty pasture add flesh and vigor for heavy winter production.

3. Feeding grain on pasture.—Cows give more milk if fed grain on pasture, but the cost of producing the milk will thereby be increased and the practice may not be economical. Certainly the cows that give but little milk do not require concentrates when on good pasture. The very heavy milkers may be given grain, the kind depending on what is available. Corn is satisfactory if but two or three pounds are given; but, in case more is fed, gluten, cottonseed meal or bran should be used in a mixture with corn.

4. When pastures are short.—During the hot days of late summer the pastures often become parched, dry and scanty. At this time great care is needed in managing the dairy herd. Unless some supplementary food is fed, the cows will drop off in their milk flow, and once down it is a difficult task to get them back.

'The short pasture problem may be overcome by providing soiling crops, such as green corn, millet, oats and peas, alfalfa, and



Pasture is short, but soiling crops and grain at the barn keep the cows in flesh and maintain the milk flow.

corn silage. If a patch of corn be planted on warm land as early in the spring as the weather will permit and planted thickly, by July a great abundance of green foliage will be available for green feed. This may be fed in the field in racks, or on the grass, or in the stable mangers. A very large amount of succulent food can be provided in this way at no great expense. The barnyard millets make excellent green forage. They are usually ready by late July or early August. If alfalfa is grown, a good soiling crop is at hand when needed.

5. Producing milk economically.—The production of milk economically depends upon high-producing cows and cheap home-grown feeds. On most dairy farms the food raised is of a roughage character, but just as much of this roughage material as the cows will eat up clean at all times should be put before them. If the legume hays are grown, the demand for concentrates containing protein will be much lessened, and consequently the expense bills for grain will be much smaller than otherwise would be the case. But even with an abundance of legumes and silage some grain will be called for, and particularly by heavy-yielding cows. Cows yielding from 30 to 50 pounds of milk will not usually be able to manufacture these quantities from farm roughages, even though legumes and silage are included. The bulk is too considerable and the stomach capacity of the cow is unequal to the demand.

6. Grain feeding.—Practical dairymen introduce grain concentrates freely into rations, basing the quantity on the amount of milk produced. To cows yielding 20 or more pounds of milk a day one pound of grain is added to the daily ration for each three pounds of milk or for each pound of butter fat produced a week. If much legume roughage is fed, these amounts may be lessened to one pound of grain for every four or five pounds of milk or butter fat. Cows giving milk low in butter fat will need less grain in proportion to the milk yield, and those high in butter fat will need more. It is a delicate problem, each cow requiring individual attention.

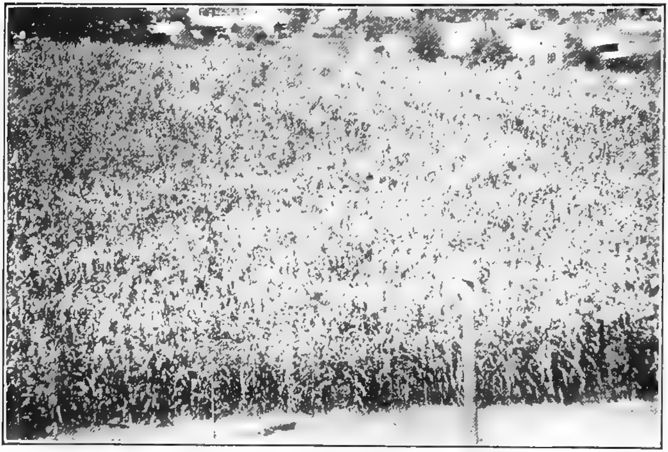
7. Getting cheap food.—The kind of food for cows in milk will be much governed by the production in any given locality. Every farmer can grow his own carbohydrates and fat; and more and more the legumes will be introduced into the cropping system on dairy farms. In this way it will be possible to grow most of the protein at home. Concentrates or grain feeds are bought either to increase the protein or the digestibility of the ration.

FAMOUS COW AND WHAT SHE DID

Auchenbrain Brown Kate 4th during one lactation period gave 23,022 pounds of milk containing 918 pounds of butter fat. During this period she consumed $184 worth of food. The milk was sold for five cents a quart and returned $575 in money.

8. Foods that all may grow.—A few foods may be looked upon as standard for dairy cows. These include plants of the clover family, alfalfa, corn silage, soy beans, cowpeas, corn, peas and oats. On every dairy farm, if possible, there should be a permanent pasture, and this should be intelligently handled, that it may improve steadily. If the pasture is of limited size, soiling crops should be introduced. These may include rye, peas and oats, alfalfa, clover, cowpeas, soy beans, green corn, millet and other crops of local adaptation.

9. Liberal feeding.—A liberal supply of these feeds is indispensable for milk or butter. On many farms there is too frequently a shortage of hay, silage or dry provender. When such are grown insufficiently, either the cows are denied full rations, or else feed must be purchased. Ordinarily, the high prices absorb the greater part of the profits of the dairy business. On farms where the normal supply of roughage is not equal to the requirements of the stock, it would be better to dispose of the least productive cows, bestowing on those remaining more care and feed.

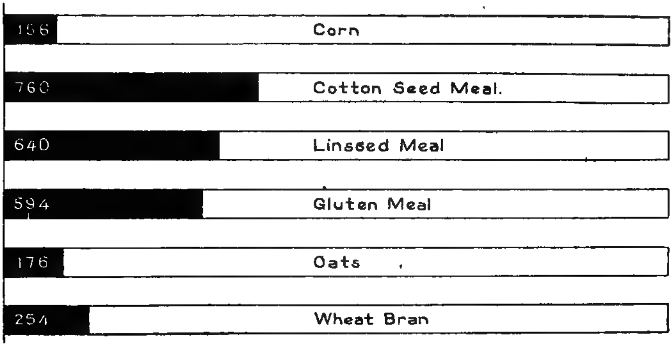


CROP OF CORN AND SORGHUM SILAGE

The yield on heavy road clay was 15 tons an acre. Formerly this land was in rundown condition, but deep tillage, cover crops, thorough cultivation and chemical manures made it possible to secure the crop as pictured.

Next to the legumes no food provides so large a proportion of desirable nutrients as corn preserved in the silo. The nutrients in silage are very appetizing for winter feeding. Moreover, the succulence of silage is beneficial; it aids digestion, and, of course, favors milk production. It is undoubtedly true that wherever dairy cows are kept, the silo is indispensable, both for economical feeding and for the production of milk at a reasonable profit.

10. Protein most important.—The list of concentrates for dairy cows is practically unlimited. The cost, however, must be considered. It is not enough that a concentrate be labeled a food for dairy cows; it must possess a relatively large amount of protein and a small amount of fiber. The less of fat and carbohydrates in proportion to the protein, the better, provided the supply of home-grown roughage feeds is sufficient to meet the demand. In the past too little attention has been paid to the chemical composition of concentrates. The cus-



PROTEIN IN A TON

Relative amounts of protein in common feeding stuffs. Compare corn and oats with linseed and cottonseed meal.

tom has too long prevailed of buying these by name, whereas the only thing that counts is merit. The only sensible rule to follow is to study the composition of each feeding stuff, and ascertain which kind or brand will give the largest quantity of digestible protein and the least quantity of crude fiber. This information will be of incalculable value in buying feeds and will be a means of saving money.

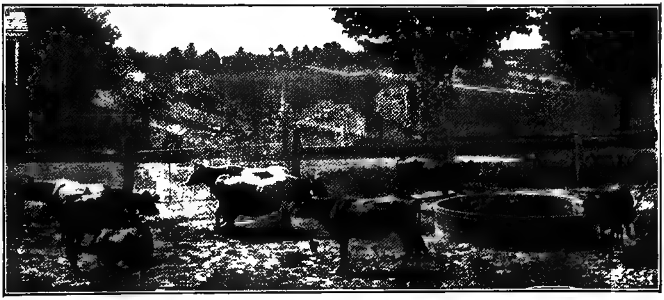
11. Grain feeds of first rank.—Among the most useful and best liked concentrates are cottonseed meal, linseed meal, gluten meal, gluten feed, bran, brewers' grain and malt sprouts. The several by-products of starch and cereal food factories are extensively advertised, but they usually sell for more than they are worth. Cereal grains are often fed dairy cows, corn more so than other cereals. On farms where alfalfa and clover form the bulk ration, corn may be fed if its market value is on a level with the best meals and other grains. If corn silage is fed in connection with timothy, mixed grasses and corn stover, corn would not be a desirable food. There will be wanted in this instance, and in others like it, concentrates such as oil meal, wheat bran, gluten, distillers' grains or other concentrates having protein as the predominating factor.

12. Grain and quality of butter.—The character of the food frequently influences the quality of the butter. The white, hard, tasteless character of winter butter is the result of food. Fresh pasture, bright legume hays, corn silage and soiling crops give color to milk and to butter. Gluten and corn produce a soft butter. Wheat bran makes a harder butter than either. If much of gluten is introduced into a ration, the butter will be soft, but its hardness may be improved by the use of cottonseed meal, a feed that makes a very hard butter. By mixing the two, a better grade will be obtained than if either is used alone. When cows are on pasture, a pound or two of cottonseed meal helps to counteract the objectionable softness of butter during the pasture season.

13. Salt and water.—Cows should have salt, either added to the rations or furnished in lump form. If added to the feed, from a half ounce to an ounce and a half should be furnished daily to each cow. One ounce of sulphur added to each pound of salt gives good results. Cows do not need to have water kept before them continuously, summer or winter. They need a liberal supply at all seasons, however; and ice water is not good, since they often will drink really less than they need. If comfortably stabled in winter, natural water, even if cold, will be satisfactory.

14. Testing with tuberculin.—There are two methods of controlling tuberculosis in cattle. One is the Ostertag or German method, which consists in removing from the herd only such animals as show physical signs of disease; and the other is the so-called American method of removing and slaughtering all animals which react to the tuberculin test. The latter method is considered practical in herds which do not contain more than 15 per cent of reactors.

15. Order of supplying the food.—Certain foods, like cabbage, silage and turnips, will be less likely to taint



PURE WATER AT ALL TIMES

The dairy herd requires fresh water at all seasons of the year. This herd is never in want.

milk if fed after milking. Grain may be given just before or some time previous to milking. In the case of hay, there will be less trouble from dust if fed after milking. The following order is followed on many up-to-date dairy farms: Milking, first; then the grain feeding; then silage or roots; stable cleaning while the cows are watering; following this work come hay feeding and grooming. In winter, if the weather is pleasant, the cows may be turned out for exercise and morning air.

LESSON TWENTY-ONE

FEEDING BEEF CATTLE

1. Wild cattle are seldom fat.
2. Younger stock now being fattened.
3. Two classes of beef animals.
4. Skim milk calves.
5. Whole milk calves.
6. Making veal.
7. Feed during the first winter.
8. Finishing beeves under 18 months.
9. Baby beeves finished on grass.
10. From calf to steer.
11. Finishing two-year-olds on grass.
12. Summer feeding on grass.
13. Fall feeding on grass.
14. Older steers are still marketed.
15. Many kinds of food.

Note to the Teacher.—Growth and flesh are sought in feeding beef cattle; also the conversion of rough feed and green grass into human food. Were it not for meat-producing animals a large part of farm products would not be utilized at all. The steer occupies a very important place in agriculture. How best to feed him in order that he may yield much juicy meat is a problem worthy of deep thought, close study and careful testing.

LESSON TWENTY-ONE

FEEDING BEEF CATTLE

1. Wild cattle are seldom fat.—Animals in a wild state are not easily fattened. It has taken many centuries of careful selection and breeding to bring the cattle of the plains, lowlands or mountains up to a point at which they will lay on gains rapidly and at a reasonable cost. It has been the work of the breeder to select out of the whole those individuals that were most disposed to fatten easily and naturally, and use them as foundation stock for an ever-improving race of meat animals.

Breeds have been developed that represent in a high degree this tendency or disposition to give rapid growth and to fatten readily. A large proportion of the cattle stock is still inferior for any purpose. Success in the feed lot depends on the class and the inheritance of the animals selected. In fattening cattle, the first task is to select the right kind of animals—those that have been bred to fatten, that possess hidden quality and that are of the conformation which practical experience has shown to be associated with rapid increase and tender, juicy meat.

2. Younger stock now being fattened.—In the old days cattle were carried along for four or five years and then fattened. The new way is to grow beef. Young animals are now brought to maturity and finish at as early an age as possible. If steers can be brought by liberal treatment to marketable weight at 12

FEEDER OF OLDEN DAYS

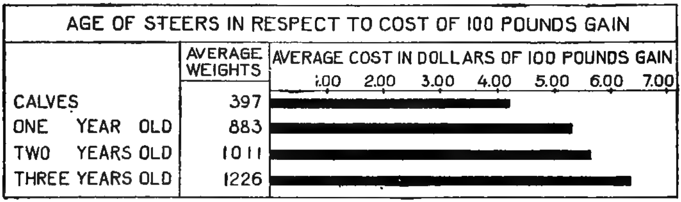
There is no profit in this kind of stock in these days of high labor and costly feeds.

to 18 months old the amount of food consumed will be smaller than if two, three or more years are spent in attaining the same weight. Thus the food that would have been consumed for animal heat and energy during the longer period can be saved.

New Idea Is to Grow Beef

3. Two classes of beef animals.—Lean feeding animals that have depended on scant pastures require a different ration when put in the feed lot than those in moderate condition. In the thin stock the fibers of the flesh need development in order that fat may be stored in between and among them. Such animals require a feeding period of three or four weeks, in which a greater quantity of protein will be given than later on. After this preliminary feeding the proportion of carbohydrates and fats may be increased. When more than a couple of pounds of digestible fat are consumed, appetite and digestion are disturbed.

4. Skim milk calves.—Corn should be added to the skim milk diet of calves while the change from whole to skim milk is under way. At first a very small amount may be given. This quantity will be increased when



Cheapest Grains Are Made with Young Animals

As animals advance in age the cost of food for maintenance and increase advances also. Compare the four classes of cattle as sketched above.

whole milk is no longer given, and still further increased as the calf grows older and larger. These calves should be on pasture, be fed skim milk twice each day, have clean water available for drink, and have placed before them a mixture of other grains like whole corn, wheat bran and oats.

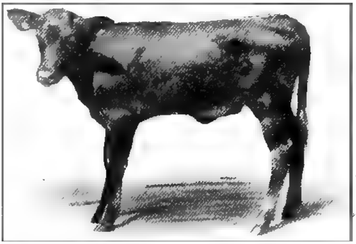
5. Whole milk calves.—Calves on whole milk will show fine flesh at weaning time. If allowed to run with their dams on good pasture, little additional food than the milk will be required. It is desirable to encourage whole milk calves to eat grain as soon as they will take it. Equal parts by measure is a good mixture, say corn 56 pounds, oats 32 pounds and bran 14 pounds. Corn and oats are best fed whole. Whole milk calves, when separated from their mothers, should have the run of a good pasture, and the grain mixture should be fed in increased quantities right up to weaning time. After being weaned the calves will hold their flesh and keep on gaining steadily.

READY FOR THEIR BREAKFAST

This simple contrivance is much esteemed where many calves are fed and raised. Each gets its own ration without fuss, confusion or fighting.

6. Making veal.—Much veal is made from feeding skim milk and milk-substitute grains, yet the highest quality of veal is obtained by exclusive whole milk feeding. The calf is either left with its dam or early taught to drink milk from a pail. If the latter method is followed, the calf may be given all the milk it will consume. If for any reason additional food is given, let it be of an easily digestible nature and reasonably high in protein. In other words, the nearer it resembles milk the better.

7. Feed during the first winter.—The best food for calves depends somewhat upon the age at which they are to be marketed. If they are to be finished during late spring or early summer on grass, they should have a very liberal supply with steadily increasing amounts of grain.



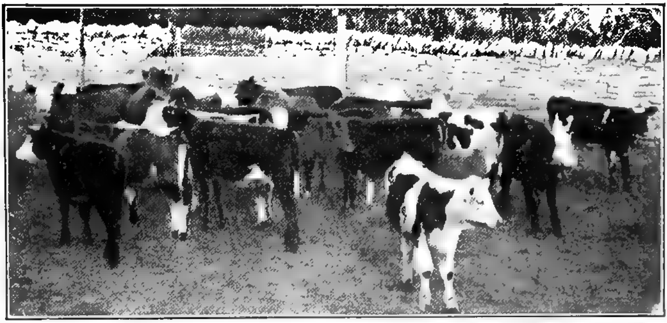
VEAL CALF

Best results are secured during the first winter if alfalfa, clover, cowpea or soy bean hay is made the basis of the ration. Let the calves have about all they will eat. If corn silage is available, from 10 to 15 pounds may be fed daily. As for grain, nothing is better than corn, and particularly so if a legume hay is fed. From two to four pounds may be fed each day. In case grass hays, corn stover and corn silage are used for roughage, a protein concentrate will be necessary in addition to corn. For this purpose linseed meal, cottonseed meal, or soy bean meal may be used. A pound or two of either, mixed with corn, will meet the requirements. Oats are good, but the price usually is against them.

8. Finishing beeves under 18 months.—When calves are to be finished as baby beeves, their ration will include more and more of the grain concentrates as winter passes. Corn should be fed liberally, from one-half to three-quarters of the grain consisting of it. If legumes are largely fed, the grain may consist largely of corn, with enough oil meal or bran added to give a safe supply of protein. In the absence of alfalfa, clover or other legume hay, one of the oil meals should be used to the extent of 20 per cent of the grain. The ration should be gradually increased to meet steady growth and weight.

By spring these calves, now yearlings, should weigh from 800 to 1,000 pounds and be in such good flesh that they may be marketed in a very short time after being put on a finishing ration. If finished in a few weeks the roughage may be decreased and concentrates proportionally increased, but consisting of the same or similar feeding stuffs as previously fed.

9. Baby beeves finished on grass.—If pasture is abundant grain may be fed less heavily during winter and the calves finished a few weeks later on grass. Less grain will be required during the winter, but on grass an ample

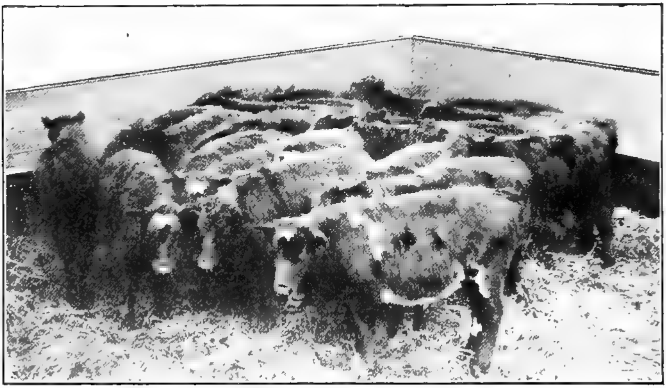


CALVES READY TO FATTEN FOR BABY BEEF

These have been kept steadily on the gain from the very day of their birth.

supply is desirable. The grain ration should contain 15 to 20 per cent of linseed meal, cottonseed meal or other protein concentrate if the calves are pastured on timothy, prairie, Bermuda or blue grass. If the pasture consists of mixed grasses, clover and alfalfa, not more than 10 per cent of the concentrates needs to be of a protein nature. Calves fed in this manner should weigh from 1,000 to 1,200 pounds and be ready for market before tormenting insects and hot weather come to annoy them.

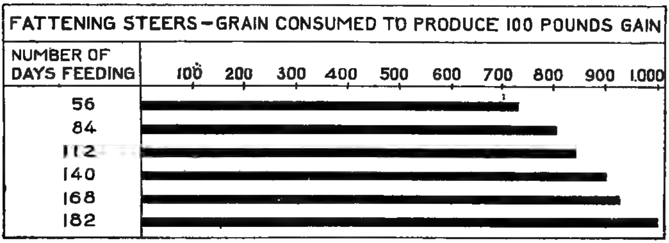
10. From calf to steer.—For growing baby beef, continuous grain feeding from birth to finish is necessary. While adapted to certain farms, the practice of carrying cattle along until in the range of two years of age is still the more popular. This custom more nearly meets the conditions of the average farm on which beef cattle are raised. The steer is, by nature, a good instrument for converting large quantities of coarse or bulk food into meat. Compared with the pig, the baby beef steer renders a less satisfactory account of the grain it consumes. For this reason doubtless this pig competitor will limit the extent to which baby beef will be produced.



YOUNG FEEDERS SELECTED FOR FEED LOT

When calves are fed that they may be ready for market at around two years of age their first winter's food should be such as will secure favorable growth and keep them steadily on the gain. The manner of feeding will depend on the roughage. In the spring these calves will go on grass, and if the pasture is good, grain will ordinarily not be fed. If hot, dry weather cuts short the pasture, light grain feeding will be advisable. The skillful farmer will watch these matters as they arise and meet them in accordance with his best judgment, which will be influenced very largely by the amount, kind, and market value of the grain on hand, and the cost incidental to obtaining a supply of commercial feeds. During the second winter the steers will be fed on hay, stover, and silage if available, and grain. The steers should be allowed to eat all the roughage food they want. If alfalfa, clover or other legume hay is fed, more corn in the grain mixture may be used. In the absence of a legume hay then protein concentrates will be necessary. From two to five pounds may be fed daily at first. The nature of the hay, the character of the cattle, and the market price of feed, must all be considered in deciding the kind and amount of each.

11. Finishing two-year-olds on grass.—In feeding out steers that have passed through two winters and are in good flesh, pastures are a great help. During the second winter grain will be fed rather liberally. By May or June such animals ought to be of marketable finish if turned on good pasture and fed heavily on grain. Corn is sufficient on alfalfa; but on mixed grasses, at least 10 per cent of the grain should consist of linseed meal, cottonseed meal or gluten meal. Steers fed in this way should gain two pounds a day.



WHEN THE FEEDING PERIOD IS EXTENDED

When fattening steers were fed 56 days, slightly over 700 pounds of food were consumed for each 100 pounds of gain. When the feeding period was lengthened to 128 days, over 1,000 pounds of grain were necessary to give 100 pounds of increase.

12. Summer feeding on grass.—On many farms early spring pasturing is delayed until grass attains a fine growth, and until the sod is dry enough after spring rains to prevent injury from tramping. The steers are continued in the feed lot and fed silage, hay and grain in amounts liberal enough to give a fair rate of increase at a reasonable cost. The steers are then turned out on pasture, the grain is increased and a market finish obtained as early in the summer as possible.

Care should be exercised in changing from dry feed to grass; otherwise shrinkage will certainly result. Steers should be turned on the pasture for a short time at first, the grazing period being gradually lengthened day by day. This accustoms them to grass.

13. Fall feeding on grass.—On many farms the older beeves are pastured through summer, with little or considerable grain, and finished on new corn. Corn is hauled direct from the cornfield to the pasture and is fed on the

SHOCKED CORN FOR ROUGHAGE FOOD

In addition to ear corn and stover, cottonseed meal was fed in order to balance the ration for cheapest gains.

stalk. If little grain had been given previously, only a small feed at first is hauled to them. As rapidly as may be done safely the corn may be increased, when in a month or six weeks the steers will be on full feed. From now on they may refuse much of the roughage. Where this forage is of value, snapped corn should be substituted for half of the ration.

If the pasture is short at the beginning of winter, shocked corn may be used for roughage. When the pasture is no longer available, protein feeds must be used, and some shelled or ground corn used in connection with them. Pigs should follow the steers, else much valuable grain will be wasted. Not only will pigs make steady growth, but will practically grow up to marketable finish, thus giving a double chance of profit from the grain.

14. Older steers are still marketed.—In some sections cheap lands are still common and more pasture is available than could be used economically under the tillage system utilized. Under such circumstances older steers are preferred. They are bought of neighboring farmers at all ages and at small cost and turned on pasture, where they are forced to shift for themselves. So placed they grow slowly, may or may not keep steadily on a gain, but in time attain size and foundation for fattening.

PRIME STEERS THREE YEARS OLD

On many farms it is more profitable to carry the steers to considerable age in order to consume the home-raised roughage crops. This is a bunch of prime steers.

The initial cost is inconsiderable and the outlay for feed is practically nothing. During favorable seasons pastures may be good. Then rapid increase will follow as a certainty. Steers raised in this manner mature slowly, but they do not cost much. Even if they are three years old or more, the total cost is at such a low figure that some profit is bound to result. The finishing period may be short or long. It will depend somewhat on the condition of the animals and the state of the market. Given the run of a good pasture, and supplied corn and other concentrates for a short period, a reasonable finish and often highly satisfactory money results are to be expected. Often steers of this nature are carefully and painstakingly fattened, and when sold bring the highest prices that the market pays.

15. Many kinds of food.—Various hay crops, corn stover, fodder corn, and silage are all valuable at certain periods of the steer's growth. They will be used in scant or liberal quantities in accordance with the supply and the general style of farming. Pastures, either of a temporary or a permanent nature, will go hand in hand with the forage crops grown on the farm. Corn is first in the list of grain products.

Among the supplementary concentrates for steers are cottonseed meal, linseed meal, soy bean meal, wheat bran, the glutens, and various by-products of starch and cereal factories. It is unnecessary to record the long list of grain products that enter into the production of beef. Whether grains shall be ground, crushed or fed whole, or whether they shall be fed on pasture or in the feed lot, in outside racks or in closed stalls, will depend upon circumstances, the management of the farm and the nature of the man. What is most important of all is to grow as much corn as can be profitably grown; to grow as much roughage as the method of farming will admit, and to have as much of this of a legume nature as possible; to use home-grown corn to feed in connection with this roughage; and, finally, to supplement roughage and corn with other concentrates purchased outright or secured in exchange for corn and fed in such ways as will give balanced rations to meet the ever-changing needs, of the steers under feed.

Feeding Beef Cattle in the Open

It used to be thought that steers were most profitably fattened when stall fed. It has been found that they do even better if cared for in the open. Many cattle feeders now provide open sheds for feeding during winter and inclement weather.

PRACTICUMS

1. Judging Beef Animals.—Provide one or more beef animals or steers. Use the score card below. Every important feature is scheduled, with a description fitting the ideal beef animal.

Score Card for Beef Animals

	Scale of Points	Perfect Score	Student's Score	Corrected Scroe
A.	**General Appearance:**			
	Size and Weight—according to age	6		
	Form—top and underline parallel; broad, deep, low set, compact and fleshy	10		
	Quality—fine hair, skin pliable and mellow; evenly fleshed	10		
	Constitution—healthy, wide chest, bone strong, thrifty	6		
	Condition—well fleshed, firm flesh, no patches	6		
B.	**Head and Neck:**			
	Muzzle—nostrils large, mouth large	1		
	Eyes—large, bright and full	2		
	Face—broad and short	1		
	Ears—fine texture, medium	1		
	Neck—short and thick, throat clean	2		
C.	**Forequarters:**			
	Shoulders—compact, covered with flesh	3		
	Brisket, well developed, full heart	2		
	Legs—straight, short, bones smooth	2		
D.	**Body:**			
	Chest—wide, deep; large girth	3		
	Back—broad, straight, evenly fleshed	9		
	Loin—thick, broad	10		
	Ribs—long, arched, thickly fleshed	8		
	Flanks—full, even with underline	2		
E.	**Hindquarters:**			
	Hips—smoothly covered, well set in	2		
	Rump—long, level, wide; tail head smooth, not patchy	4		
	Thighs—full, thick, plump, twist	8		
	Legs—short, straight, fine, heavy bone	2		
	Total	100		

2. Removing Horns on Calf.—Calves from one to two weeks old preferred. Locate the budding horn and clip away the hair with scissors. Rub the horn with the end of a stick of caustic potash until the skin or scurf begins to loosen and get red. If properly done the broken skin will quickly heal and no horn will ever appear. The caustic may be obtained at any drug store. In using wrap with paper to protect the fingers, and moisten the end in water before placing on the horn button. Avoid rubbing the skin round about the budding horn.

3. Milk Records for Home Practice.—Prepare a milk record for each cow of the herd. Rule off 31 spaces for every day of the month, beginning with 1, or the first day of the month, and numbering down to 31, the last day. Leave space at the top of the sheet for the name of each cow and rule the paper crosswise, with two blanks for each cow, for the purpose of recording the weight of milk for both morning and evening. Small scales are necessary for weighing the milk and the milk pail. By knowing the weight of the pail and subtracting this weight from the gross weight of milk in pail, the weight of the milk is obtained. The weight of each milking is now placed in the space prepared for it for that day and both morning and evening milking recorded. See illustration, page 197.

LESSON TWENTY-TWO

WOOL AND MUTTON

1. Ancestry.
2. Qualities in common.
3. Wool.
4. Two principal classes of wool.
5. How wool grows.
6. Yolk.
7. Washing and shearing.
8. Handling wool.
9. Mutton.
10. Quality of mutton.
11. Mutton carcass.
12. Desirable kind of sheep.
13. Cuts of mutton.
14. Hothouse lambs.
15. Market classes of sheep.

Note to the Teacher.—From the earliest ages the sheep has been a source of profit to mankind, and its keeping and rearing an important industry. As civilization progressed stage by stage, and the manufacture of garments of wool displaced those of skin, careful breeding began to improve the fleece, and varieties among sheep became fixed in type. Later on, as people became more settled in their occupations, cities were built and demands for mutton increased, until at the present day it is greater than the supply.

LESSON TWENTY-TWO

WOOL AND MUTTON

1. Ancestry.—Wild sheep are by nature timid, and flee at the slightest noise, which they hear at a very great distance. Their strength and agility enable them to spring among the most inaccessible rocks which they seek for safety. In the evolution from wild to domestic life

RAISED BOTH FOR WOOL AND MUTTON

This group of Oxford sheep is part of a flock owned by a farm boy, who starting with a few individuals, steadily enlarged his flock, until now he has so many that his entire time is devoted to raising sheep.

many changes have taken place, but none more striking than in personal safety. The domestic sheep has become so entirely dependent on man that he could not exist without his care and protection.

2. Qualities in common.—Sheep are so easily acclimated, that we find them in the hottest and coldest climates. They attain their greatest prosperity in the drier regions, and if forced to subsist on wet lands certain ailments often affect them that seriously interfere with their thrift, health and vigor. As for food, they prefer the weeds of the fence corners to the luxuriant herbage of rich fields, and the short, tender shoots of a closely cropped pasture of the hills to the maturer grasses of the lower and fertile levels.

Sheep are very partial to salt, either as a part of their rations or as a natural character of the land. Among the domestic animals they are the most docile as well as most stupid, and are utterly unable to protect themselves, even if the attacking foes are physically their inferiors.

3. Wool.—The fleecy covering of the sheep is revealed by the microscope as composed of cells which overlap each other like the scales of a fish, and within is a hollow, full of marrow, forming the canal of the coarser kinds of wool. In the very fine wools this hollow is absent. This change has come as a result of domestication and breeding. Among the important characteristics, and by which wool is judged, are the following: (1) The weight, or what each fiber can bear without breaking; (2) the density or the number of fibers to the square inch; (3) the length when uncurled and stretched out; (4) the elasticity, or the quality of again curling up after having been stretched; and (5) its color and brilliancy.

4. Two principal classes of wool.—Although of many classes, for manufacturing purposes wool is divided into two principal groups—combing wool that includes the fine and short grades, and the carding wool that includes the long and coarse grades. In years past Merino wool has been the chief wool on the American market. The medium and coarse grades, supplied largely by the mutton type of sheep, have been offered in very much smaller quantities. By far the large proportion of woolen goods is manufactured from the finer and shorter wools, but for some purposes longer wools are superior, and for one purpose or another every grade and length can be used.

5. How wool grows.—The wool of sheep grows continuously throughout the year. If the feed is uniform and nutritious, a uniform quality of wool will be produced according to the breed of sheep. Anything which affects the health of the animal also affects the quality of the wool. During a period of sickness or scant rations, the wool may temporarily stop growing. When the animal recovers, or when better rations are fed, the wool begins growth again. However, as a result of this interruption, a weak spot is produced in the wool, which greatly decreases its strength and value for manufacturing purposes. Like a chain which is no stronger than its weakest link, so the strength of a wool fiber is determined by its weak spot.

Examining Wool for Length and Density

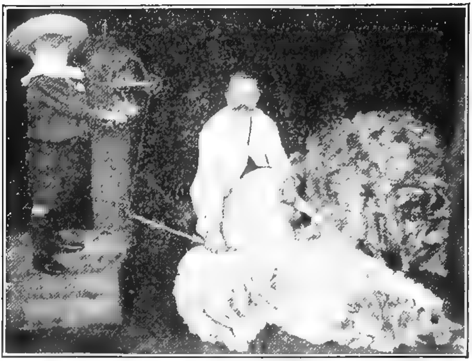
6. Yolk.—By yolk in the wool is meant the natural grease or oil secreted by the skin. Under normal conditions the yolk gives the fleece a kind of creamy appearance. In healthy sheep the yolk constitutes about one-third of the weight of the fleece. At the factory, the fleeces are scoured and the yolk washed out before the wool is used in manufacture. The secretion of yolk is favored by nitrogenous and fatty foods. The yolk is of great importance, as it keeps the fleece soft and compact, clean and bright on the inside, and is a protection to sheep in turning water. Sheep in poor health or underfed show a lack of yolk, while overfeeding may induce an excess.

7. Washing and shearing.—The washing of sheep in creeks is entirely ineffective, and manufacturers now pay as good prices for unwashed as for the so-called washed wool. Shearing is performed once a year, as a rule, although in the southwest it is done in both spring and autumn. Both hand and power machines are used. On small farms where only a few sheep are kept the hand shears are commonly used, but in large flocks the clipping machine is economical, and on account of shortage of labor, indispensable.

SHEARING SHEEP BY HAND

8. Handling wool.—As soon as the fleece is removed, it should be spread on a folding box or table, the inside being downward. The sides of the fleece are overlapped, then the ends in a similar manner in the other direction. The fleece is folded up and tied in a neat roll, the smooth side of the roll only showing outward. No filth or tags should be rolled up with the wool. Such refuse always reacts against the seller. When the wool has been rolled up, it is next put in sacks awaiting shipment. As the fleeces are dropped in the sacks they are tramped down until each sack is full. The filled sacks are then stored in a dry place until sold.

9. Mutton.—The flesh of the sheep has long been valued as food for man. A saddle of any of the leading mutton breeds, cooked at the proper time, is considered by many to be one of the best of all meat dishes. Yet it is a surprising fact that mutton has never been a popular article of diet in this country. In recent times, however, the demand has increased. Now the New York market

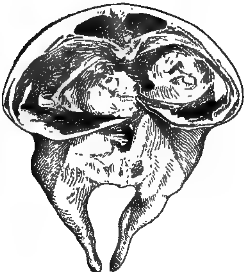


MACHINE SHEARING OF SHEEP

A modern tool of great value where many sheep are raised. The shearing work is cheaply and quickly done.

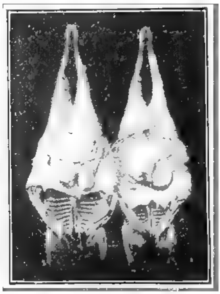
alone requires more than a million sheep a year. This change in taste and fancy will be helpful to both producer and consumer. It will hold the consumption of beef and pork within bounds and enlarge the market for mutton. Whoever eats mutton selects an unobjectionable flesh, and wherever the sheep's feet tread for any length of time the land improves and wealth abounds. This domestic friend is the beast of the golden hoof.

10. Quality of mutton.—In young, well-fed animals the flesh is of pleasing color and is of finer grain than beef. The older the sheep grows the darker and coarser the grain becomes. When the older animals are fattened the tendency is to deposit the fat about the shoulders, loins and at the root of the tail. Old mutton is more inclined to be tough and stringy than old beef. Lamb meat is in more popular demand than mutton.

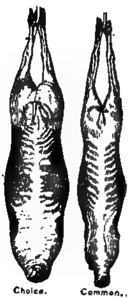


SADDLE OF MUTTON

11. Mutton carcass.—Butchers prefer a short-legged, plump carcass of mutton that is full of meat and not too fat. The neck should be short but thick, the body round and the flank of small proportion. The shoulders and legs should be thick, and full of meat right down to the knee or hock. Thick loins, moderately fat, are demanded. The loin when cut in "chops" are in greatest esteem if a "full eye" of lean meat is conspicuous. Mutton may be placed in cold storage for a considerable time, and so kept it improves in quality, and on being eaten is more tender and tasty. The fact that the flesh of the sheep is more free from disease than pork or beef should bring this flesh article into greater popularity.



WELL-FINISHED MUTTON CARCASSES



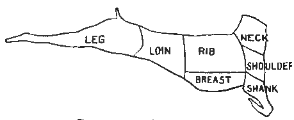
WETHER CARCASS

12. Desirable kind of sheep.—Early maturity is of first importance. This suits the consumer and pays the grower a better profit. A strain that deposits the fat uniformly over the body and not in patches, is most approved by the butcher. Most of the improved mutton breeds have been selected to meet these needs; and the effort of breeders and growers is to surpass their present work in these respects. The most useful size is also sought. An over-sized lamb, although evenly fleshed and fat, may not command near as good a price at market as a smaller lamb of even slightly inferior quality.

FLOCK OF EWES AND LAMBS AT PASTURE

The sheep have been kept thrifty by wise feeding and careful attention. The ewes and lambs are together, and are excellent representatives of the Hampshire breed.

13. Cuts of mutton.—The two loins joined are called a "saddle of mutton." The quarters are usually sold as a "leg of mutton, or lamb," for roasting. If saddle is used, it goes as a roast. As a rule, the loins are cut into "chops" and broiled. Not infrequently shoulders and legs are cut as chops, but only where the demand for lamb or mutton chops is greater than the supply. The flanks, breasts and other less valuable parts are bought as stewing meats, or for the purpose of making soup, or for boiling, which may be eaten hot or cold. Often goat meat is substituted for mutton. The kids

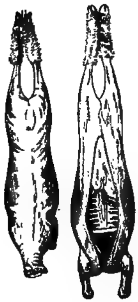


CUTS OF MUTTON

Common method of cutting the mutton carcass.

make a good meat, but detection is easily possible by the color, usually a darker shade. This deception is practiced because goat meat is not in demand.

14. Hothouse lambs.—These are lambs born in late fall or early winter, and forced in rapid growth for two or three months, when they are marketed. Their mutton is tender and juicy and always in great demand. It fetches the highest price of any meat. It is a great delicacy of private families, and during the season is usually to be found on the menu cards of leading hotels. Success in raising hothouse lambs is dependent upon early breeding strains of ewes; forced feeding on appetizing and nutritious food, much of which must be grain; and pleasant environments. During the nursing period a rich, succulent ration for the ewes, as will conduce to the largest flow of milk, is essential. The lambs are induced to eat grain at an early age and provided with rich food until slaughtered.



WINTER LAMBS

WETHERS READY FOR MARKET

Their ration consisted of clover hay, oil meal, ground oats and corn.

15. Market classes of sheep.—When sold at market age, quality and condition play an important part in the prices obtained. Mutton sheep are classified as lambs, yearlings, wethers and ewes. In each of these classes there are a number of grades such as prime, common and inferior. Breeding sheep are marketed as ewes and bucks, and "feeder" sheep as bucks, stags, lambs, yearlings, wethers and ewes.

Sheep are somewhat unique among domestic animals. They make use of food not relished by other animals, the goat excepted. They can subsist under conditions of food, water and climate that are unsuited to other domestic animals. Great areas of the world are by them made of economic importance. They produce at one time both food and clothing. No other fiber can quite take the place of wool.

LESSON TWENTY-THREE

RACES OF SHEEP

1. The Merino.
2. Rambouillet.
3. The Dorset breed.
4. Southdown.
5. Shropshire.
6. Hampshire.
7. Oxford Down.
8. Suffolk.
9. Cheviot.
10. Leicester.
11. Lincoln.
12. Cotswold.
13. Romney Marsh.
14. Black-Faced Highland.
15. Persian lamb fur.

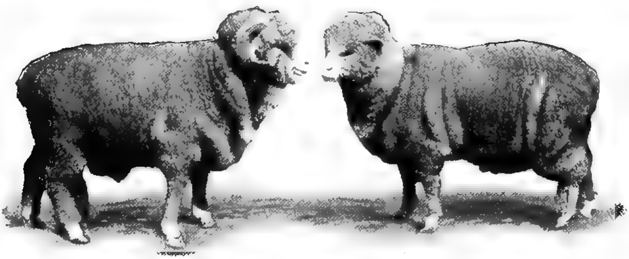
Note to the Teacher.—The obvious purpose of this lesson is to describe the leading breeds of sheep and to point out the leading qualities of each. It is desirable that the distinctive characteristics of each breed be learned and remembered by the student. The fine wool breeds were at one time in most demand, but in recent years the mutton types have grown in popularity. Ask the members of the class to bring samples of wool to the school for purposes of comparison.

LESSON TWENTY-THREE

RACES OF SHEEP

1. The Merino.—These sheep are of such ancient origin that their domestic ancestry has become entirely lost. In Spain, the land of their early development and improvement, they were prized for wool rather than for butchering. Ancient breeders paid little attention to the conformation of their bodies for meat; the production of fine wool was the only thing they cared about. When these sheep were first introduced into the United States early in the nineteenth century, it was for the purpose of improving our wool-growing industry and not our mutton supply. American breeders, however, did not undervalue a good carcass, and in time greatly changed the type, improved the carcass and made the wool longer and finer. The American Merino is the result.

The Delaine is one variety of this highly esteemed breed. These sheep are larger, possess a better mutton form, carry a longer fleece

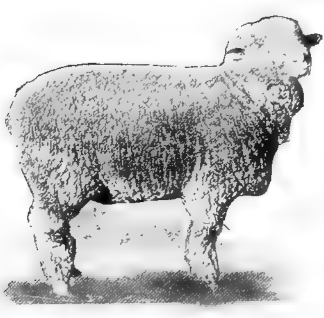


MERINO RAM AND EWE

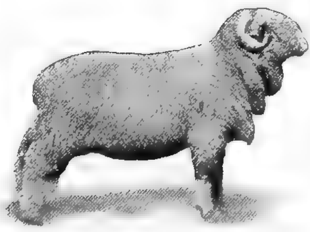
and have less folds and wrinkles than the parental Merino. Closely related to these, but still of the original family, are the Black Top Spanish Merino, the Improved Black Top and the Dickinson. All Delaine Merinos have horns and more or less folds or wrinkles about the neck and breast. The Black Tops have blacker fleeces, no wrinkles, and have horns. The Dickinson type is without horns or wrinkles and larger in size, with a longer wool.

For a great many years the Merino in its several varieties has been our most popular sheep. They have been used extensively in crossing on the western range sheep where the fleece has become light and open. When mature the ewes weigh 100 to 160 pounds, the rams 140 to 190 pounds. The fleece in ewes will weigh nine to 15 pounds, and in rams from 12 to 20 pounds or more. These sheep are hardy, one of the hardiest breeds, and adapt themselves to various conditions of climate, care and food equally as well, if not better, than any other breed. They can be herded in flocks of great size, which is not possible of the mutton breeds. They mature slowly, are ideal of grazing, but their feeding qualities are inferior to the mutton breeds. When crossed with the mutton breeds their mutton is more tender and juicy.

2. Rambouillet.—Years before Spanish Merinos were brought to this country others had been taken to France and in time were changed and improved into the Rambouillet. The French breeders were the first to produce a Merino combing wool, from which have developed some of the most interesting and profitable branches of wool manufacturing. Sheep of this particular breeding have greatly improved in mutton form, quality of flesh and weight. These imorovements have come from within



RAMBOUILLET EWE



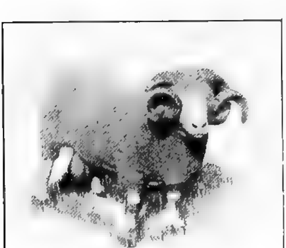
RAMBOUILLET RAM

the breed, liberal feeding and rigid selection being responsible.

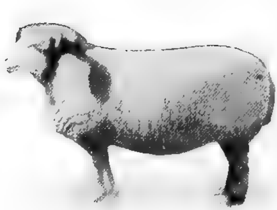
These French breeders were able to develop a fleece of fully double the weight of the original Spanish stock. The sheep are taller, of heavier limb and more rangy than the American Merino. The ewes weigh up to nearly 200 pounds, the rams a quarter more. They are less wrinkled, the carcass is better and the wool is longer than the American Merinos. They more nearly correspond to the Delaines than any other sheep. These sheep are hardy, the meat is excellent and they hold a firm place as grazers and for crossing on western range stock.

3. The Dorset breed.—An English breed of growing popularity is the Horned Dorset. Its heavy horns and its coarse and horny head suggest still much to do in way of improvement. The fine, short wool and the extraordinary fecundity of the ewes, which may give birth twice a year, and at a time when the breeder most desires them, give this breed a position and a place of great advantage. These sheep are much sought after in the production of "hothouse" lambs. The ewes are exceptionally good milkers. They are hardy, excellent rustlers, mature early and give a carcass of high favor. The rams weigh 200 to 220 pounds, the ewes 160 to 175 pounds. The fleeces range from six to eight pounds in weight.

4. Southdown.—This sheep is the generally accepted type of the mutton and short wool sheep of England. The



HORNED DORSET RAM



HORNED DORSET EWE

breed takes its name from the downs that line the southern coast of England. The Southdown has a smooth, even body, a round, clear barrel, short legs, fine head, and broad loins. The face and feet are brown or gray. They are hornless and rather small. The fleece is of moderate weight and quality. They are at their best on hilly land with a dry soil and not too moist herbage. They have been much used in crossing for mutton.

PEN OF SOUTHDOWN LAMBS

5. Shropshire.—The Shropshire is the most popular mutton breed in the United States. It is larger and heavier than the Southdown and grows a heavier and better wool. It is readily adapted to good or thin pastures, and the mutton is excellent. The wool covers the whole face and scarcely leaves visible the eyes and the black tip of the nose; it also extends down the legs almost to the hoofs. The ewes are prolific, many twin lambs appearing. The ewes will weigh from 150 to 175 pounds, the rams up to 225 pounds. These sheep are especially at home under general farm conditions.

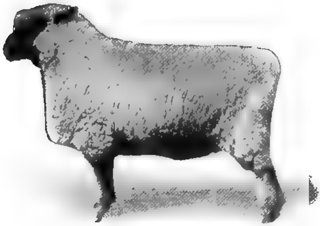
SHROPSHIRES

6. Hampshire.—These sheep are without horns and have black faces and legs. It is an English breed and favors in some respects the Southdown, its chief progenitor. It is larger than the Southdown, is more prolific, yields a heavier fleece and rustles better on grazing lands. The body is rather long and not as well proportioned as the Southdown or Shropshire. Its head has a rather coarse and heavy appearance. Lambs of this breed grow rapidly to maturity. For this reason these sheep are ex-

FLOCK OF HAMPSHIRE SHEEP

cellent for crossing where large and quick-maturing lambs are desired.

7. Oxford Down.—These are a double cross, the blood of the Hampshire and Cotswold having been used in establishing the breed. They are large, meaty and much heavier than any of the other Down breeds. They rank well as farm sheep, resembling the Hampshires in general form. They are not as well adapted to broken pastures as the Shropshire or Southdown, but do splendidly on lands that grow good pastures. In good flesh the ewes weigh up to 225 pounds and the rams from 250 to 275 pounds. The wool is a bit coarse but weighs well—from 10 to 12 pounds unwashed.



OXFORD EWE

8. Suffolk.—These sheep are lighter in form and color than any of the preceding. The head and feet are dark brown, and while not so compact in form as the Hampshire, the Suffolk somewhat resembles it. There is a general absence of wool on the head and between the

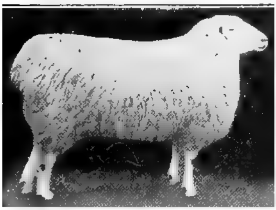
PRIZE FLOCK OF SUFFOLK SHEEP

ears. The wool is of medium quality, and the breed is without horns. Compared with other breeds, it is considered inferior and is not extensively bred in the United States.

9. Cheviot.—Owing to the shape of its head, neck and ears the Cheviot forms a group apart from any breed heretofore discussed. The head is bald and carried very low, so as to seem sunk below the level of its back, but the ears stick up boldly above its thin, pale face. These sheep come from the Cheviot hills of England and are more useful for their supply of wool than of mutton. Nevertheless the mutton is of superior quality. The Cheviot is of medium size, the ewes weighing up to 150 pounds and the rams up to 200 pounds. Being a mountain breed, it is to be expected that they are especially at home in our hilly sections, even though the pastures are scant and short.

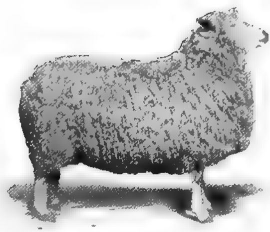
Cheviot Ram and Ewe

10. Leicester.—These sheep have white faces, big, square bodies and are without horns. They grow long wool, that hangs in spirals, with fleeces ranging from 10 to 12 pounds. Mature rams weigh 230 to 260 pounds and mature ewes 200 to 225 pounds. They are suited to rich lands where an abundance of succulent food is available. Under such conditions they are easy keepers and mature early. These sheep originated in England, the great Batewell being one of the earliest improvers.



LEICESTER RAM

11. Lincoln.—English breeders used the improved and early refined Leicester with the coarser and stronger Lincolnshire sheep breeds. From this improvement has come the modern Lincoln, the most popular of the long-wooled breeds of sheep. They are the heaviest of all breeds, mature ewes weighing 230 to 260 pounds and mature rams from 270 to 300 pounds. Unwashed fleeces range from 12 to 15 pounds. The breed is without horns, the face is white, and a tuft of wool grows on the forehead. They graze well on rich pastures, but their meat, although dressing out well on the block, is inferior in tenderness and flavor.



LINCOLN EWE

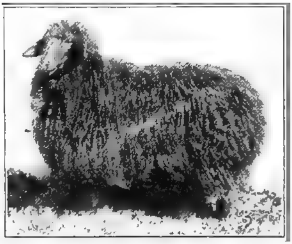
12. Cotswold.—This breed, originating in the mountainous regions of that name, resembles in many ways the Leicester and Lincoln. Their legs are longer and the body less bulky, a conformation that gives them a most active appearance. Like the Lincoln, it carries its distinguishing tuft on its forehead. And like both the Leicester and Lincoln, it fares well only when allowed rich pasture or winter provender in abundance. These sheep in size and weight are between the Leicesters and Lincolns. The rams weigh up to 280 pounds and the ewes up to 235 pounds.

COTSWOLD RAM AND EWE

13. Romney Marsh.—These, also called Kent sheep, are a product of the plains of Kent in the southeast part of England. The head and legs are white. They like a good living, fatten well when provided with it, and yield a fair grade of mutton. The fleece in weight averages about eight pounds. The breed is little known in the United States. It is claimed that these sheep are not subject to footrot to the extent of other breeds.

14. Black-Faced Highland.—These came to us from Scotland, from the mountain sections where grazing and rough weather have combined in making a very hardy breed. They have horns, black or black and white faces, and no wool beyond the forehead. They yield an excellent mutton, but mature slowly. In size, they are rather small. Their principal field of usefulness in the United States will be limited to the wilder, mountainous portions. But even there dogs and other enemies will greatly injure their chances to prove their worth.

15. Persian lamb fur.—From time immemorial breeders in Central Asia have raised a peculiar broad-tailed sheep which produce the Persian lamb fur of commerce. The original stock is known as Karakul, but near kin is the Arebi, which has been used in crossing to improve the luster and curl of the wool. Arebi lambs are black when born and have a tight, curled fur of wonderful luster. As the lambs grow the wool turns brown on the outside, but underneath remains black. A few Arebi have been imported to this country for crossing on Cheviots and Lincolns, the aim being to secure a product to take the place of the Persian lamb fur of Asia.



AREBI EWE

LESSON TWENTY-FOUR

FEEDING SHEEP

1. Wool and mutton.
2. Relative economy of sheep, steers and pigs.
3. Choosing the feed.
4. Roots always fine for sheep.
5. Sheep and water.
6. When turning to pasture.
7. Proportion of grain to roughage.
8. How often to feed sheep.
9. Rape an excellent sheep feed.
10. Roughage feeds.
11. Temporary fences by means of hurdles.
12. Putting sheep on full grain rations.
13. Green crops for roughage.
14. Feeding lambs for market.
15. Fattening grown sheep.

Note to the Teacher.—Sheep are dainty feeders, and a thorough familiarity with their habits is required to secure the fullest success from them. They are easily disturbed and will leave their food if anything excites them. Not only good food, but a peculiar kindness or friendliness is necessary in caring for and looking after them.

LESSON TWENTY-FOUR

FEEDING SHEEP

1. Wool and mutton.—Sheep use food for both flesh and wool. Hence these animals must meet a double requirement. Wool contains much nitrogen, and a slightly more liberal supply of protein is demanded than for either swine or beeves. Sheep, too, are very active creatures; the body surface also is proportionately greater than of beeves, and hence they require more food, proportionately.

The larger breeds of sheep require about one pound of digestible protein to eight pounds of starch equivalent, the smaller breeds slightly more. The wool growth becomes less active as the food supply is reduced, but if more food is given than the animal has use for, the rate of wool growth will not be increased.

2. Relative economy of sheep, steers and pigs.—Compared with swine, the sheep does not render quite as good an account of its food as does the pig; in fact, it requires nearly twice as much digestible organic matter to produce 100 pounds of gain. While this is true, it is not to be forgotten that much of the sheep's provender is in the form of hay or other roughage, and of a nature that the pig could not use. Pigs demand easily digested food, which must be largely in the form of grain. From the point of profit, therefore, sheep are not at a disadvantage at all.

BAA, BAA!

Compared with steers, sheep have slightly the better of it. Nearly 50 years ago Lawes and Gilbert determined that, covering a whole fattening period, a steer, to produce 100 pounds of increase, required 3,500 pounds of swedes, 600 pounds of clover hay and 250 pounds of oil meal. To produce the same increase these investigators found that sheep required 4,000 pounds of swedes, 300 pounds of clover hay and 250 pounds of oil meal. The advantage as between steers and sheep was slightly with the latter.

3. Choosing the feed.—While there is wide choice as to the variety of food, those foods which furnish abundant flesh should be chosen for the growing classes, and those

POOR WAY TO FEED SHEEP

On many farms corn is fed to sheep on the ear and stalk. This is a disappearing custom. Food is wasted, because sheep will not eat what has once been run over.

rich in starch and oil selected for fattening. If the protein supply is not sufficient, the body will not be properly supported, the wool growth will be checked, and the readiest, digestion of the carbohydrates and fats will not be secured. This last point must always be kept in mind in feeding any class of live stock. Much may be gained by varying or mixing the food so as to stimulate the appetite. A healthy sheep will increase in weight in proportion to the food consumed only as long as digestion and assimilation are of a high order. If a sheep can be made to increase its diet by the addition of roots or appetizing concentrates, a manifest advantage is gained.

4. Roots always fine for sheep.—Roots are a staple sheep food and of the greatest value in winter feeding. If fed in excess, the large amount of water they contain and their bulkiness tend, especially in winter, to reduce the temperature of the animal and otherwise gradually to act unfavorably on the health. Watery foods are not good for sheep. Sheep need succulence, but roots and green crops should be considered as supplements and not as the basic portions of the ration.

The most common roots for sheep are sugar beets, mangels, rutabagas and turnips. Each kind is favorable in effect upon the quality of the wool. The quantity of roots will depend on the kind of sheep. As a safe guide, it may be stated that one bushel of roots will be sufficient as a daily allowance for 10 sheep weighing 150 pounds each, if along with the roots one and one-half pounds of hay and one-half pound of meal or bran are given daily to each animal.

5. Sheep and water.—Sheep in the Nebo national forest in Utah go 4½ months during the grazing season without water, except for such moisture as they get from dew and juices of forage plants. In the Farghee forest in Idaho, sheep get water only twice during the four months' summer grazing season. While sheep are able to subsist under these conditions, they often suffer, and even perish, from lack of water. Heavy dews and succulent grass enable them to secure water for a time; but, like other animals, they thrive best when they are not entirely denied water as drink. It is an old fallacy that sheep never need water.

6. When turning to pasture.—Change from dry forage to fresh pasture gradually. An afternoon is best, when no moisture is on the grass. After eating of this pasture for a short time return the flock to the yard. Repeat in

Range Sheep by the Hundreds

this manner for a few days, and little if any digestive disturbances will arise. After four or five days the sheep will become accustomed to green feed.

7. Proportion of grain to roughage.—Practical feeders have found no definite rule to follow in this matter. If grain is abundant and hay scarce, more grain is fed

SHEEP BARN SHOWING FEED RACK

Portion boarded off in corner is for lambs to get their grain where the older sheep cannot bother them.

than when the opposite condition obtains. For economical gains the roughage material will be fed in as large quantities as the animals may be induced to eat. Some grain, however, is necessary. The amount will vary from one and a half pounds to two pounds of roughage to one pound of grain. Under average feeding conditions about 300 pounds of grain and 500 pounds of roughage will be required to yield 100 pounds of increase. If on blue grass or rape pasture, about 175 pounds of corn should secure 100 pounds of gain.

8. How often to feed sheep.—Sheep on fattening rations are usually fed twice each day. Slightly better returns have been observed when three feeds are provided. The gain is not large, but it is frequently sufficient to meet more than the cost in labor and trouble.

9. Rape an excellent sheep feed.—This splendid forage crop combines well with corn. When corn in the field is to be fed off, it is desirable that rape be seeded in

FARM FLOCK ON RAPE PASTURE

the field at the last cultivation. Ordinarily, the sheep will blend the two feeds, consuming both corn and rape. If rape is seeded separately and sheep turned on it to graze, the addition of one to two bushels of corn a head during the fattening period of 100 days is to be commended.

10. Roughage feeds.—Pasture is entitled to the first place in the list of good roughage feeds. It may consist of alfalfa, clover, mixed grasses, or blue grass. After these come the roots and rape. Each has its place. Cured as hay, alfalfa and clover naturally fall in the first rank, and are always to be preferred in lamb feeding, fattening ewes or wethers, or during the lambing season. In their absence the mixed hays may be used, but heavier grain feeding will be necessary, and particularly at lambing time.

11. Temporary fences by means of hurdles.—In grazing forage crops, such as peas and rape, temporary fences

LAMBS ON PASTURE AT WEANING TIME

The lambs have been kept thrifty by wise feeding and careful attention. Having been properly raised, there was no setback at weaning time.

in the form of hurdles may be used. These hurdles are moved forward every few days, providing in this way a strip of fresh pasture. Otherwise, if given the run of a field, much forage will be destroyed and soiled by tramping. Move the hurdles before the eaten-over portion has been cleaned up.

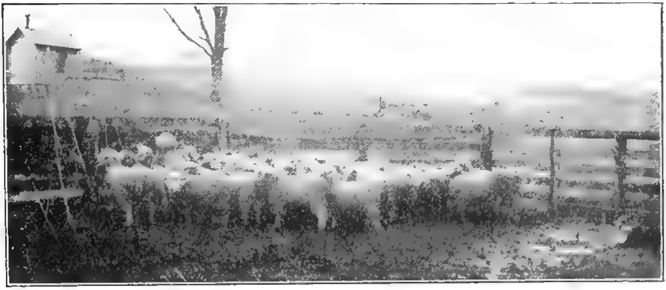
12. Putting sheep on full grain rations.—If grain has been fed while sheep are at pasture, it is an easy matter to change from pasture to yard and put on fattening rations. Beginning with a fourth of a pound of grain daily, the amount may gradually be increased by a fourth of a pound the second week, and so on. At the end of the fourth week the animals should be cleaning up a pound or more of grain each day. By the end of two months a daily allowance of one and one-half or two pounds may be fed. It is seldom advisable to feed more than two

SHEEP IN YARDS BEING FATTENED

pounds of grain a head daily. The good shepherd watches his sheep and observes the first indication of bad appetite. When noticed, he corrects the trouble at once.

13. Green crops for roughage.—Sheep are most at home in pasture fields. They not only feed on the tender grass blades, but they strip weeds and other foul plants of their leaves and branches. They are in truth the plant scavengers of the farm. But kept on the same land in the same field year after year without change, the pastures become foul, disease lurks in the soil and dangerous parasites accumulate. For these reasons sheep should be changed frequently from field to field, from year to year; and except in the case of well-established permanent pastures, crop rotation should be followed so the fields may be clean of disease or parasites and may be ever fresh with new-growing grass crops.

Over a good part of the country. timothy and clover, with red top and alsike or white clover occasionally mixed, comprise much of the pasture land. The prairie grasses of the West and Bermuda grass and Japan clover of the South take care of the local needs in these parts of the country. Blue grass is the standby of the old



FLOCK OF LAMBS IN THE FATTENING PEN

At first they had the run of pasture, but are now being finished on clover and mixed grain, consisting of cracked corn, oil meal and ground oats.

grazing sections; in addition to it other crops may find place and may be profitably grown. Rye seeded in August makes a fairly good pasture for lambs and old sheep in the fall. It will furnish excellent grazing in the spring before the clovers, alfalfa and blue grass are available.

14. Feeding lambs for market.—For most markets the feeding process begins late in fall or early winter. In addition to late fall pasture, such as rye, rape, new growth of blue grass, young clover or alfalfa, lambs will have been using in many instances leguminous hays or other dry fodder, so that by the time they are actually confined in feeding pens and placed upon a fattening ration their digestive systems will have become accustomed to dry feed.

Alfalfa is beyond question the best forage, but in its absence clover, cowpeas or other leguminous forage is a good substitute and practically indispensable. If such forage is not at hand, then sugar cane, kafir corn, millet or mixed hay cut at the proper period and carefully cured, will give good gains, although more grain will be necessary. The grain ration will consist largely of corn. Cracked corn is usually preferred to whole corn. Small amounts of oil meal, ground oats, or both, may be introduced into the ration with good effect; if a leguminous hay is not used, one of them should certainly be added. Lambs should weigh about 60 pounds when placed in the feed lot. After a feeding period of 60 to 90 days they should weigh from 90 to 95 pounds.

15. Fattening grown sheep.—The feeding of wethers or grown ewes for market does not differ much from the method employed in fattening lambs. On some farms lambs are held over a season to utilize plentiful pasture and to secure one or two wool clips. Such sheep also weigh more at market time, although they bring a smaller price per pound. These older sheep on good pasture in summer, in the feed lot in winter, will usually make excellent use of grain and hay. They may be marketed during late winter or early spring.

Concentrated feeds should be used in connection with bright, clean leguminous hays and so mixed with the hay as to give a well-balanced ration. Corn, bran, ground oats, oil meal and cottonseed meal, are all excellent. During early winter, corn silage and alfalfa or clover hay may be fed exclusively. In other cases fodder corn and mixed hay may be used for roughage, with wheat bran and corn for grain, about one-half pound of a mixture of corn and bran being given daily to each animal. As they plump up, the grain may be increased gradually, until it reaches as much as two or even three pounds a day.

Where alfalfa or clover is used, a pound of corn daily will be satisfactory. If alfalfa or clover is freely used and corn is relatively low in price and hay high, then cut down the allotment of hay and feed one or two pounds of corn daily. Where some grass, hay or corn stover, shredded or unshredded, is the only source of roughage, bran and one of the oil meals should be used in addition to the corn. If fed throughout the winter in this manner, a heavy wool clip may be secured the following spring before the animals are marketed.

PRACTICUMS

1. Judging Sheep.—Provide one or more sheep of the wool and mutton class. Students should familiarize themselves with the details of this score card and fix in their minds the relative weights of the different regions. If it is possible to have available several sheep for scoring so as to place the several individuals in rank from best individual down to poorest individual the value of the exercise will be increased and more interest will be added to it.

Score Card for Wool and Mutton Sheep.

	Scale of Points	Perfect Score	Student's Score	Corrected Score
A.	**General Appearance:**			
	Weight—according to weight, at six months, 35 pounds.....	3		
	Form—blocky, low down, compact........................	8		
	Quality—fine bone and wool............................	10		
B.	**Head and Neck:**			
	Muzzle—large nostril, thin lips, medium face..............	1		
	Eyes—big and bright..................................	2		
	Ears—fine and well carried............................	1		
	Neck—short and thick..................................	2		
C.	**Forequarters:**			
	Breast—broad and full.................................	3		
	Shoulders—smooth, filled on top.........................	5		
	Chest—wide and deep..................................	6		
	Legs—wide apart and straight...........................	2		
D.	**Body:**			
	Back—level, wide, loin wide and thick.....................	6		
	Ribs—well sprung, well covered..........................	4		
	Underline—low and thick...............................	1		
E.	**Hindquarters:**			
	Hips—smoothly fleshed, wide and level....................	7		
	Thighs—thick and wide................................	6		
	Legs—straight, good bone.............................	..2		
F.	**Wool:**			
	Quality—fine, soft, even..............................	10		
	Density—thick all over body...........................	9		
	Length—long, uniform.................................	9		
	Yolk—evenly distributed, not excessive....................	3		
	Total..	100		

2. JUDGING SHEEP OF MUTTON TYPE.—While every breed of sheep is raised for both wool and mutton, certain breeds are bred and fed with mutton the leading consideration, just as certain other breeds are grown with wool as the leading consideration. The score card following applies for the mutton type. Compare this score card with the one on the previous page and point out the principal differences.

SCORE CARD FOR MUTTON SHEEP.

	Score of Points	Perfect Score	Student's Score	Corrected Score
A.	**General Appearance:**			
	Weight—according to age; at six months, 50 pounds	5		
	Form—blocky, low down, compact	8		
	Quality—fine wool and bone	8		
	Condition—even covering of flesh	10		
B.	**Head and Neck:**			
	Muzzle—large nostril, thin lips, short face	1		
	Eyes—big and bright	2		
	Ears—fine and well carried	1		
	Neck—short and thick	2		
C.	**Forequarters:**			
	Breast—broad and full	3		
	Shoulders—smooth, filled out on top	5		
	Chest—wide and deep	8		
	Legs—wide apart and straight	2		
D.	**Body:**			
	Back—level, wide, broad in loin, and thick	15		
	Ribs—long, curved, well covered	5		
	Underline—low and thick	1		
E.	**Hindquarters:**			
	Hips—smoothly fleshed, wide and level	6		
	Thighs—thick and wide	10		
	Legs—straight, good bone	2		
F.	**Wool:**			
	Quality—soft, fine, uniform	3		
	Density—heavy, dense, somewhat oily	2		
	Condition—good length, even fibers, clean	1		
	Total	100		

3. DIAGRAM OF SHEEP.—Place pieces of numbered paper on the various regions of the sheep as indicated in the illustrations. Require each student to write the name of each region and name the corresponding region in his own body. Each student should be required also to make a sketch of a sheep and name each part or region on the drawing or sketch at the proper point. Continue this practice until each student of the class has learned the regions and

is able to name the location without referring to his sketch. Definitions of all terms should be learned and memorized.

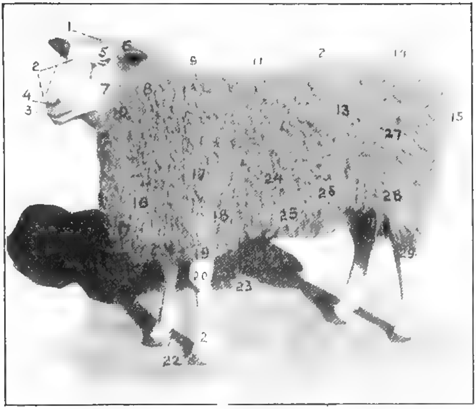


DIAGRAM OF SHEEP

1 Head
2 Face
3 Muzzle
4 Nostril
5 Eye
6 Ear
7 Cheek
8 Neck
9 Withers
10 Throat
11 Back
12 Loins
13 Angle of Ilium
14 Rump
15 Tail or dock
16 Chest
17 Shoulder
18 Elbow
19 Forearm
20 Knee
21 Ankle
22 Claw
23 Girth measure
24 Side or barrel
25 Belly
26 Flank
27 Hip joint
28 Stifle joint
29 Hock joint

LESSON TWENTY-FIVE

THE PIG AND HIS PRODUCTS

1. Pork.
2. Lard.
3. Soft pork.
4. Two types of hogs.
5. Bacon type.
6. Lard type.
7. Weaning pigs.
8. After weaning.
9. Fall pigs.
10. House for dam.
11. At time of birth.
12. Selecting breeding stock.
13. Dipping tanks.
14. Hogs are single-purpose animals.
15. Marking hogs.

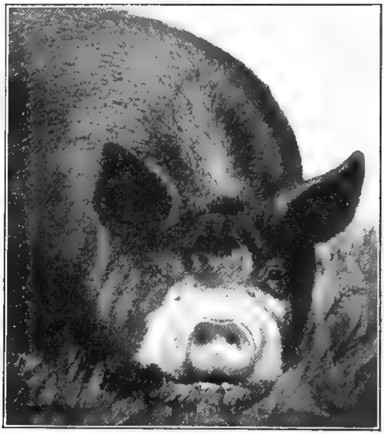
Note to the Teacher.—Swine flesh, from its ready reception of salt, is the most easily preserved of all the farm animals. It enters largely into farm dietaries because of this fact. The ease with which hogs can be raised and slaughtered will always cause them to be a source of household economy and comfort. Emphasize the economy of hogs in the production of meat.

LESSON TWENTY-FIVE

THE PIG AND HIS PRODUCTS

1. **Pork.**—The flesh of the pig is known as pork, and is used either fresh or cured. The sides when cured and treated are sold as bacon. Some breeds of hogs deposit so much fat in the region of the sides that a good grade of bacon is not possible to obtain. The best breakfast bacon is secured from those breeds bred up as bacon hogs and so fed as to get a good mixture of lean meat and fat. Pork contains a large proportion of fat and is therefore difficult to digest compared with beef. The fat is quite soft in character. It has been estimated that salted pork requires five hours for digestion, roast pork four hours and boiled ham three hours. Bacon is the most digestible form of all.

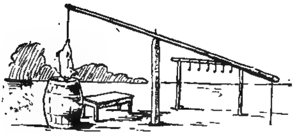
2. **Lard.**—To obtain lard, the tissues containing the fat are cut into small pieces, heated in an open vessel over the fire and constantly stirred. The heating causes the fat cells to burst. After this is accomplished the liquid fat is poured off and is ready for use. Lard is a mixture of fats, containing palmitin, olein and stearin.



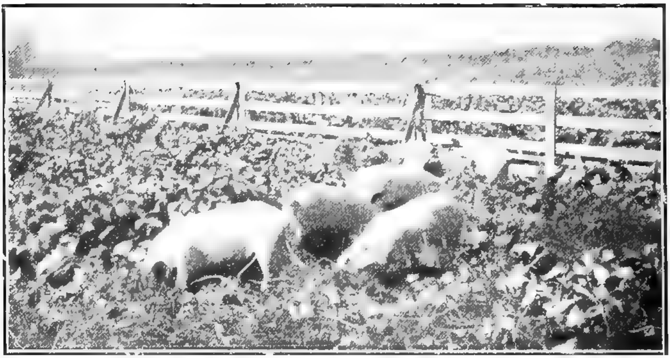
HIS MAJESTY, THE PIG

Much of the fat of the hog is formed under the skin and round the kidneys. The large layer of fat deposited around the kidneys is called *leaf lard,* and is considered the best in quality. Pure lard is white and nearly tasteless and odorless. It is principally used in cooking, and for making oleo, soap and ointments.

3. Soft pork.—Of the three principal fats in lard, olein is the most prominent. It is also the softest, going to a liquid at ordinary temperatures. It occurs in varying amounts, much less in lean pork than in fat pork, Pigs fed exclusively on corn give a lard containing over 90 per cent of olein, while pigs fattened on a more balanced ration, or one consisting of oats, peas, and barley, in addition to corn, yield a lard with less than 70 per cent of olein. The kind of ration, therefore, has most to do with producing a soft or firm class of pork or bacon.



Device for Easy Scalding and Hanging



One Way to Avoid Soft Pork

These pigs have the run of a soy bean field, in addition to a daily feed of corn. They are balancing their own ration, harvesting a crop and providing a high grade product for human food.

Soft pork makes a poor grade of bacon. From these facts it is evident that to secure high grade bacon the hogs must be fed a mixed ration in which the protein or lean meat elements shall occupy a leading place.

4. Two types of hogs.—As the outcome of market requirements and local methods of feeding, two types of hogs have resulted. By far the most prominent is the fat or lard type, which includes most of the breeds, and particularly the larger and best known breeds in the United States. These hogs not only yield a large amount of fat, but the meat portion of the carcass supplies the greater part of the fresh and cured pork consumed at home or exported. Corn is the principal grain used in fattening. The second class is the bacon type, represented by a few breeds of slightly different conformation and which supply the demand for a leaner class of meat. Hogs that yield this character of meat are called "bacon hogs." A mixed diet, with considerable protein

FINE EXAMPLE OF TYPICAL BACON HOG

Note the long body, light shoulder and ham, and moderate length of side. These features are characteristic of the ideal bacon hog.

in the ration, is most suitable as a food for hogs developed and fattened for bacon.

5. Bacon type.—People who eat bacon demand a choice article. They want plenty of lean mixed with the fat. Hence a hog that will yield the largest amount of bacon of high quality must not be expected to yield at the same time a maximum quantity of lard or fat. The ideal bacon hog is long in body, only moderately deep and thick, and light in shoulder and ham. The back, if wide, will carry too much fat for a good grade of bacon. A full, strong loin well packed with flesh, is required. A flat, straight side is the result of the bacon rib that springs out boldly from the backbone, and after making a sharp turn, drops down evenly and straight. Length of side is always held in high favor. The flesh of the good bacon hog is always firm and the bones heavy.

6. Lard type.—On the other hand, the lard hog is compact and blocky, rather than long and open. Depth and thickness in the region of shoulders, hams, back and loin are among the first points considered in this type. Packers demand as much meat and lard as the frame will carry. A high percentage of dressed product in pro-

GOOD REPRESENTATIVES OF THE LARD TYPE

The lard hog consumes less dry food to produce a given increase than either the sheep or steer. They are, therefore, the best meat makers.

portion to live weight commands a premium in the market places. Hogs of this type may be fattened to the limit, and a ration that produces fat with a moderate amount of lean is acceptable. For this reason corn has become the most popular hog food, and the fat hog industry a profitable business in the corn states. The limit in fattening is more a matter of profit than of nature of product. The lard type of hogs may be fed to weigh 250 pounds and up, but the bacon trade demands a hog weighing 190 pounds and under.

READY TO BE WEANED

These pigs were early induced to eat slop and pasture. The weaning period will, therefore, not interfere with their steady growth and development.

7. Weaning pigs.—The weaning season is more or less critical with young swine. Loss in growth always follows a setback at this time. When young pigs have learned to take slop freely, made of shorts or middlings and skim milk, they are ready for weaning without a serious check to their growth. Pigs may be weaned at the age of eight weeks. If they cannot be given skim milk, it is better that such pigs remain on the dam until, say, 10 or 11 weeks old. In no case should they be weaned until they can take food freely. Much care should be exercised to furnish those kinds of foods that promote good growth. Slop food is best. Corn meal, linseed meal and middlings or shorts make an ideal combination.

8. After weaning.—As soon as young pigs are weaned, they must be kept entirely away from the dam until she ceases to secrete milk, but not necessarily for a longer period. Give them access to a good pasture in the day, and a grain slop in addition, morning and night, until the time of fattening. The amount of slop or meal will depend, to some extent, upon the character of the pasture, but it should be nitrogenous in character. When fed in connection with skim milk, a less quantity can be given, and the meal can be more of a carbonaceous nature, like corn.

Pasture may consist of alfalfa, clover, green cereals, cowpeas, or mixed grasses. In addition to pastures, green crops may be grown with advantage for store pigs, such as field peas, sweet corn, squashes, mangels, rye, cowpeas and soy beans. These are to be fed to supplement pastures and also the meal part of the ration. Store pigs will make a substantial growth when gleaning among wheat stubbles, providing they be given access to the stubble soon after the wheat has been cut. If clover has been sown in the spring, no grain will be required.

9. Fall pigs.—When store pigs are to be reared in winter, the aim should be to have them farrowed early in the season, in order to be considerably advanced in growth when winter sets in. The pens must be warm, well lighted and dry, and the pigs must be allowed exercise. The food may be essentially the same as that given in summer, except that roots, milk, clover or alfalfa may be given in lieu of the green food of summer. The pigs usually bring a better price when sold before the season for grass pasturing. For various reasons there is more hazard in rearing autumn than spring litters, but with due preparation and due care such litters may be profitably reared.

10. House for dam.—Young sows should be mated 10 months to a year old, according to growth. An individual hog house for shelter should be provided. This house may be of any form and style. but one A-shaped in construction is becoming very popular. These are built on runners and can be drawn to any part of the lot or field. Change of location insures cleanliness and does away with filth and mud at the entrance.

MRS. PORKER AT HOME

Houses of this sort are easily built and may be moved from place to place in the fields or hog lots. They make sanitation a simple matter.

If the period of birth occurs in winter, the house cannot be made too warm. A lantern hung inside at the top of the house is excellent protection at farrowing and when the pigs are very small. Always have a yard for the sow outside the pen; or what is better, give her the run of a pasture field. Such attention not only gives her contentment, but exercise, thereby preventing the accumulation of flesh, which is a detriment to the coming brood. Exercise also develops bone and muscle and imparts to the offspring vigorous constitutions.

11. At time of birth.—Feed at this period light, tasty food, such as middlings, bran, alfalfa, or clover hay and a bit of corn. Give just enough bedding to lie upon. It is a good plan to chop it up. At least add fresh straw some time before farrowing, in order that it may be broken up. Otherwise, after the little fellows arrive, they may be crushed if covered up in the litter. Feed moderately for two or three days, when the milk will come in full flow. Then gradually increase the ration, giving a variety of feed, and let the dam have about all she will eat. Whole corn at this time will be relished, but let the milk-making foods be given in greatest abundance.

12. Selecting breeding stock.—The more important considerations in selecting breeding stock include lineage, general individual qualities, characteristics as to form, and constitutional vigor. In respect to type, the aim should be to get individuals with short heads, dished in the forehead and having good width between the eyes; fine muzzles, with a short snout; strong, bright eyes; drooping or upright ears, not thick or coarse; soft, mellow skin, with fine silky hair, somewhat abundant, but without bristles; short, well-knit, and straight legs, standing well on small, strong feet; full, long body, square and broad, with a straight back and underline. Hogs of such conformation are certain to be of good breeding and to possess early-maturing qualities.

PIGS SELECTED FOR BREEDING
Note uniformity and fine quality.

13. Dipping tanks.—Swine of all ages should be kept free from lice and other vermin. Otherwise the best growth is not possible, nor can the best thrift be expected. The dipping tank offers an easy method of treatment. This may be made of concrete, or purchased ready made of galvanized iron. A homemade device for use except during winter is a shallow vat about 10 inches deep and 10 to 12 feet square. It may be built of concrete or timber. It should be placed conveniently to the well or other watering place. The vat is partially filled with water and a quart of one of the coal tar dips added. The hogs will do their own dipping. The dip

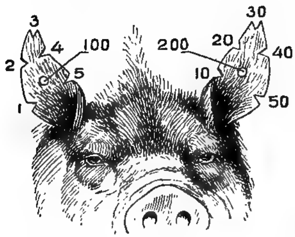
DOING THEIR OWN DIPPING

Home-made wallows like this may be constructed of boards or cement. If small quantities of disinfectants are added from time to time there will be no trouble from lice or skin diseases.

is renewed once or twice a month and the water supplied as needed. No harm will result if the hogs drink some of the liquid. Occasionally, the mud, as it settles at the bottom of the vat, should be removed.

14. Hogs are single-purpose animals.—Cattle furnish meat, milk, hides for clothing and sometimes labor. Sheep furnish meat, wool, hides and sometimes milk. Hogs, however, furnish only meat, lard and bristles. Hogs are, therefore, a single-purpose animal. The reason they can compete with other domestic animals is due to their prolificacy, to their ability to convert efficiently food, often waste products, into human food, and to the ease with which these products can be preserved. Before the days of cold storage pork was the only meat that would stand long shipments.

15. Marking hogs.—The best means of identifying pure-bred hogs is by means of permanent ear tags inserted in the ears. These may be purchased of dealers, with a number on each tag. In the absence of tags, markings may be made in the ears, the position being the governing factor. The small numbers are represented by the right ear, the larger numbers by the left. The corner of each ear is marked, and two other incisions are made on both the lower and upper edges. A hole punched in the center may be used in case a number of hogs are to be identified or recorded.



METHOD OF MARKING HOGS

LESSON TWENTY-SIX

FROM WILD HOG TO USEFUL BREEDS

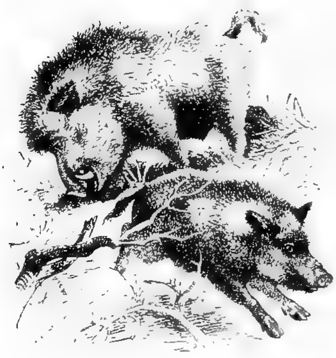
1. In native haunts.
2. Pigs early used as food.
3. Berkshire.
4. Poland-China.
5. Duroc-Jersey.
6. Chester White.
7. Ohio Improved Chester.
8. Large Yorkshire.
9. Small Yorkshire.
10. Mulefoot.
11. Hampshire.
12. Tamworth.
13. Cheshire.
14. Essex.
15. Other minor breeds.

Note to the Teacher.—From the coarse, rough and savage wild hogs of the woods have been evolved the gentle, meat-making swine breeds of the cultivated fields. It took centuries to accomplish this task and thousands of earnest minds have been devoted to the work. Students should know the leading breeds and what their important and distinguishing characteristics are. The obvious purpose of this lesson is to bring these facts out. Such study ought to create a strong interest in hog raising and in growing only well-bred stock.

LESSON TWENTY-SIX

FROM WILD HOG TO USEFUL BREEDS

1. In native haunts.—All of our important breeds have come from the wild hog that once roamed over Europe, Asia and Africa. Active and powerful, the original progenitor was also coarse, rough, fleet, and a vicious fighter. His head was large and bony, his jaw strong and well provided with tusks that inflicted severe wounds, his neck long and muscular, and the back and loins broad and strong. In his wild habitat he selects places that are moist, rather well concealed by forest growth, where he may feed upon plants, fruits and roots, though when hunger affects him he greedily appeases his appetite on worms, snakes and flesh of any kind. The twilight, early dawn and night time seem by choice his favorite periods for seeking food, sport, adventure and exercise.

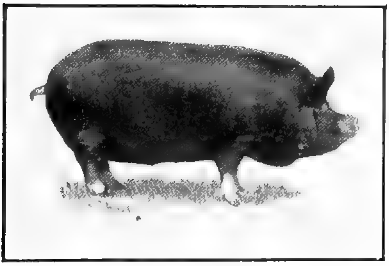


WILD BOARS
Ancestors of all modern breeds of swine.

Sense of smell has been developed to such a marked degree in the wild hog that he is able to detect the presence of food, though it be covered in the ground. In his early life he prefers the society of his kind, but when age comes on he strolls about much to himself, never seeking danger, but when it comes not avoiding it. Thirty to 40 years is not an infrequent age for some of these wild animals to attain.

2. Pigs early used as food.—As meat, hog flesh has long been esteemed. It is not strange that the wild boar was sought in all ages to meet a table want. The hog entered largely into the diet of the Romans, and all sorts of practices were employed to impart delicate flavor to the flesh.

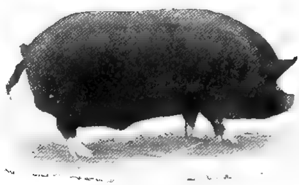
"Pliny informs us that old dried figs, drenched with honey and wine, were employed as a means of enlarging the liver, so choice a dish was it considered by Roman palates. It has been said that the Romans often served hogs whole, one side being roasted and the other side being boiled. Further still was this carried by stuffing the dressed animal with larks and nightingales and delicacies of all sorts, and serving with wine and rich gravies." We can imagine how delicious this dish must have been by comparing it with the Brunswick stews and barbecues so well known in many rural sections, and which possess rich and delicate flavors never equaled by other domestic animals.



BERKSHIRE SOW

The wild hog possessed a courage and fierceness that have made him a favorite sport with all classes and conditions of society. When Rome was at the hight of her greatness, he entered into their sports and fights, and in recent times both the English and German people have made much of these qualities in their hunting expeditions.

3. Berkshire.—These hogs are of English origin, sharing popularity with the Duroc-Jersey, next to the Poland-China, in the United States. They are black hogs with white



BERKSHIRE BOAR

points on the feet, face and tip of tail. Formerly the breed was reddish with black points, but breeding and selection have brought a change. The face is short and dished, ears small and erect, and slightly inclined forward, the neck short, the back arched and broad. In England this is a bacon breed, but here in the land of corn clover and alfalfa, the lard and pork characteristics have been intensified and developed.

Hogs of this breed readily attain a weight of 500 or 600 pounds at maturity, and if fattened, at age of eight or nine months, reach 225 pounds and up. They possess excellent grazing qualities, reach maturity at an early age, and fit in with varying conditions. They are popular in all sections, and the carcass they give is universally approved.

4. Poland-China.—This hog originated in the Miami Valley of Ohio and has come to be the most popular American hog. His fame and place are due to his great qualities as a pork and lard hog. His greatest domain is in the corn and clover sections. In color the Poland-China is spotted, black and white; in size and form he is similar to the Berkshire, except that the frame averages a bit larger and stronger; the ear falls over the eye, while in the Berkshire it is short pointed and straight. These hogs are characterized by early maturity, compact, blocky forms, and ease of making meat and lard. They may be finished for the market under ordinary farm conditions in eight or nine

Poland-China Sow

Poland-China Boar

months, and at maturity the breeding stock attains a weight of 500 to 600 pounds and over. The boars are larger and heavier than the brood sows.

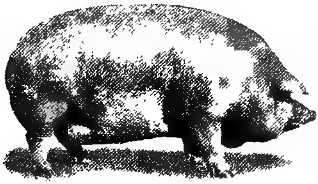
5. Duroc-Jersey.—In form these hogs resemble the Poland-China, but are red in color. The standard is cherry red, without spots. Their origin is not clearly defined, but their development as a breed has been solely in this country. They are very prolific, grow rapidly, and make pork and lard cheaply. In recent years they have advanced to the front rank in the corn states as a pork and lard hog. They are quiet and good feeders, take well to grazing and corn and produce a carcass of rich flavor, with a fair proportion of lean meat.

At public sales very high prices are paid for popular family strains. These hogs are found everywhere, but the place of greatest popularity is in those sections where corn, clover and alfalfa are most at home. Here they reach under fattening conditions 250 to 275 pounds at an age of eight or nine months and of 500 to 700 pounds at maturity.

6. Chester White.—Chester County, Pennsylvania, is

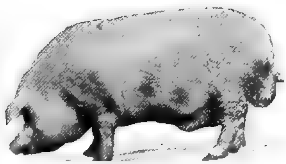
A TRIO OF DUROC-JERSEY HOGS

the place of origin of this good breed. The hair is white and thin, the frames large, the meat excellent. At maturity they average 600 to 700 pounds. Under normal fattening conditions they are comparable with the Berkshire or Poland-China. This breed possesses good grazing qualities, the hogs are docile and they fatten readily. They have never been popular in the South on account of their tendency to sunscald. The very lengthy body is well liked by many, but the long snout and slight tendencies to coarseness have been considered objectionable.



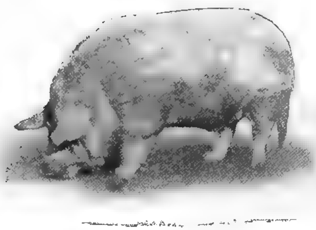
Chester White Sow

7. Ohio Improved Chester.—In Ohio certain breeders sought to improve what by some were considered defects of the Chester White by refining the rougher points and still holding fast to the large size, solid frame and fine length. The Improved Chester is the result. These hogs retain all of the fundamental characteristics of the old Chester, but the bone is smaller, the snout shorter, the face more dished. The result of this breeding is a splendid big hog of the true lard type that feeds well, carries a big, broad back, and gives a choice ham.



Chester White Boar

8. Large Yorkshire.—This breed is typical of the bacon class. The hogs are noted for great length, being longer in form than any other breed. They are of similar weights to the Chester Whites but are not as broad of back. Their sides are deep and smooth, ideal in this respect for bacon. They have good strong legs are excellent rustlers, very hardy and prolific. They do not mature as early as the Poland-China or the Duroc-Jersey. They graze well and develop the carcass to cut out much bacon of the richest and best quality. Their bacon qualities and great prolificacy have given this breed chief place among all breeds throughout the world.



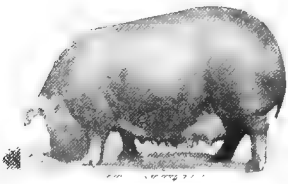
OHIO IMPROVED CHESTER BOAR

9. Small Yorkshire.—As the name indicates, this breed is of the same original breeding, but, due to different crossing and different ideals, a smaller size has resulted. At the same time these hogs are finer in quality than the large Yorkshire, present greater symmetry and more compactness. They mature early and give a small carcass, fat and round. At maturity they seldom go above 225 pounds in weight. At the present time this breed is not popular and few herds remain in this country.

LARGE YORKSHIRE SOW AND BOAR

SMALL YORKSHIRE SOW AND LITTER

10. Mulefoot.—This is a very old breed, but only in recent years has it come into prominence. It gets the name from the foot—the hoof being solid and somewhat like a mule in shape. The hogs are black in color, of very large size and very prolific. They attain very heavy weights at maturity, averaging with the heaviest of the pork and lard breeds. The meat is in high favor, because of the excellent quality. In shape and form the Mulefoot resembles the Duroc-Jersey. The carcass cuts out fine hams and very choice bacon. The breed is still lacking in refined development, but its merits are of such high order that notable improvements are fast occurring. Then hogs are in the first rank as grazers, fatten easily and mature early. The big litters of fine, sturdy youngsters have done much also to give the breed popularity.



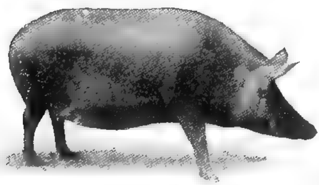
MULEFOOT SOW

11. Hampshire.— This

breed is characterized by a white band of hair 4 to 12 inches in width encircling the body and including the front legs. The rest of the body is black. The head is

HAMPSHIRES

small, broad back of rather striking uniformity and fairly heavy bones. The legs are rather long. The breed is still in process of development, the tendency being to change what once was a hog of bacon tendency into one more nearly of the lard type. The hogs are esteemed as grazers, and feed out well, but are a bit lacking in early maturing qualities. Mature boars weigh up to 500 pounds and mature sows up to 350 pounds.



TAMWORTH SOW

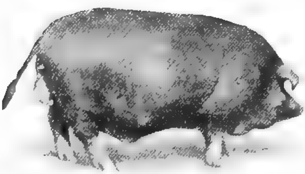
12. Tamworth. — This breed is of extreme bacon type and of English origin. In color the hogs are red, in light and dark shades. They are raised especially for bacon and do not fatten rapidly. They do attain good size, boars ranging up to 600 pounds at maturity and sows up to 450 pounds. The head is very long and straight, the ear large and coarse, the body narrow, the legs long. The carcass shows a large amount of lean meat in proportion to the fat. They are very prolific, and graze well. Due to the small numbers raised, these hogs are rated as a minor breed.

TAMWORTH BOAR

13. Cheshire.—This white breed originated in New York. While not raised on many farms, the hogs possess much merit. They mature early, make good use of forage crops, and pasture and fatten easily. They are medium in size and farrow larger litters than are averaged by the major breeds. The ears are small and erect, and point slightly forward in old animals.

CHESHIRE SOW

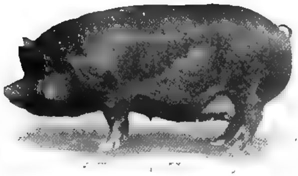
14. Essex.—This is another of the smaller breeds, black in color and of English origin. Considerable variation of type is observed, also of size. While mature hogs average around 250 pounds, not infrequently others range up to 400 pounds. The head is small and fine, the nose short and the face beautifully dished. The legs are fine, firm and short. The larger breeds have gradually replaced the popularity these hogs once



ESSEX BOAR

enjoyed, although they were never bred to any great extent in the United States.

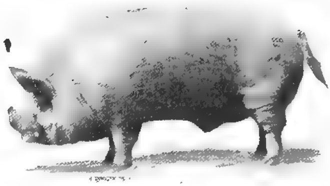
15. Other minor breeds.—The American Suffolk is little known. It is a white breed, yellowish in shade. It stands wide and deep in body, on short, fine legs. The body is of just moderate length. Its principal merit is in its early maturing qualities under limited confinement, with little or no range for forage. It is, therefore, most popular under a very intensive system and where few hogs are raised.



ESSEX SOW

The Victoria is white in color and a hog small in size. It is often seen at fairs and shows, but is not raised to any extent for either bacon or pork. It has more characteristics of the lard than of the bacon type. It does not occupy any important place of usefulness.

The razorback breed, if it may be called such, is long snouted, long legged, long bodied. These hogs are unimproved as to breeding, but are hardy, prolific and exceedingly good foragers. They are found mostly in the open country of the southern states, where they feed on mast, grass and roots. The improved breeds are fast displacing them.



VICTORIA BOAR

LESSON TWENTY-SEVEN

FEEDING HOGS

1. Meat producers compared.
2. Most meat from hogs.
3. Fastest gains during early growth.
4. What weight limit is best?
5. Early feeding.
6. Creeps for little pigs.
7. Mineral matter and charcoal.
8. Making a slop.
9. Pasture for pigs.
10. Grazing runs for hogs.
11. Forage for cheap grain.
12. Fattening hogs.
13. Last stage of fattening.
14. Making good bacon.
15. Hogs as corn harvesters.

Note to the Teacher.—It is desirable to emphasize the importance of the ideas brought out in the first four paragraphs of this lesson. Bear in mind that in hog raising the largest production of pork at the least cost a pound is a factor of fundamental consideration. In fattening hogs often the cost of a pound of gain is much greater than the value of that gain when the animal is sold. Young hogs of a moderate weight are more profitable to raise for market than aged hogs of enormous weight.

LESSON TWENTY-SEVEN

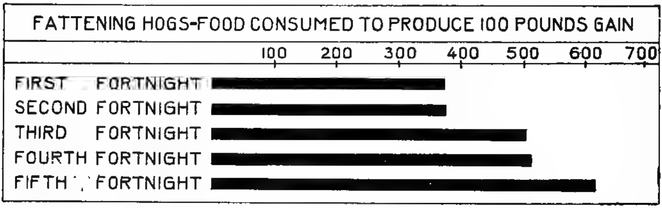
FEEDING HOGS

1. Meat producers compared.—When compared with other meat producers the hog consumes less food for what he gives than any other meat-making animal. He works faster. It is due in part to his digestive apparatus, to the kind of food he relishes, and to the fact that he uses less food than the other animals for work and body heat. On the basis of 1,000 pounds live weight the hog uses about 275 pounds of dry food to 160 for the sheep and 125 for steers a week. Of this he will digest 230 pounds, while the sheep will digest but 120 pounds and the steer but 88 pounds.

Modern Meat Makers

2. Most meat from hogs.—To produce 100 pounds of increase the steer will consume 1,100 pounds of dry food, the sheep 910 and the hog 420. The increase in live weight for food consumed, on the basis of one point for steers, will be 1.5 for sheep and 5.8 for hogs. From this it is clear that in proportion to its weight the sheep eats more food than the steer and yields a greater increase in consequence; but the pig, by eating more heartily, consumes more food and yields more meat or increase than either.

3. Fastest gains during early growth.—It used to be that hogs were kept as stockers on grass until they had reached a year or two in age, and then were fed until they weighed from 300 to 500 pounds. When slaughtered or sold they, of course, showed great returns, but the cost of



FOOD CONSUMED BY HOGS DURING FATTENING PERIOD

During a 10-week fattening period, with hogs, the food consumption increases more than 50 per cent to produce 100 pounds of increase. There is a limit to which hogs may be profitably fed.

bringing them up to such weights was not considered. When put to the test it was soon realized that while such hogs in the feed lot would take on large increase, the cost of the increase was far above the returns in money. In other words, large hogs will steadily take on increase, but they do so only with great consumption of food.

4. What weight limit is best?—A pig of proper age and weighing under 100 pounds will require less than 300 pounds of feed to yield 100 pounds of increase, while a mature hog weighing 300 pounds will demand over 500 pounds of feed to yield 100 pounds of increase. There is, therefore, a decided economy in feeding hogs only up to a certain point. This point ranges from 175 to 250 pounds, depending on circumstances—the market price of hogs, and the sale value of feed. In these days few hogs are fed until they attain a weight of 400 or 500 pounds. If they are so fed every pound of gain costs twice as much as it fetches in the market.

5. Early feeding.—The first food of the pig is milk; and milk is a narrow ration. Soon after birth additional food is demanded that will admit the gradual introduction of

MAKING HOGS OF THEMSELVES

the carbohydrate ingredients. Middlings, shelled corn, or corn meal may each be profitably used If skim milk is available, it will supply abundant protein, but corn meal, middlings or shorts should be added also. This combination is easily furnished as "slop," which may be continued even until the beginning of the fattening period.

6. Creeps for little pigs.—Young pigs during their suckling days will do best if fed additional slop in a separate pen and away from the mother and the larger pigs. Runs in which are grown green grasses, the clovers and other forage crops are indispensable if pork is to be made at profitable returns. Provided for in this manner, pigs will widen their ration in accordance with their needs.

The ration, which at first was very narrow, will now widen until spread to one part of protein to five or six parts of carbohydrates and fat. When the finish of the fattening period is reached the ration will be near one of

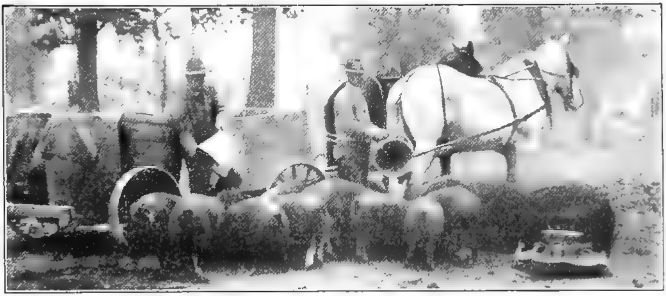
ENJOYING THE CHARCOAL BOX

One reason why thrift is frequently wanting is due to an insufficient supply of protein and mineral elements in the hog ration. A charcoal box in which may be placed charcoal, soft coal, ground bone, salt and oil meal meets the situation.

protein to eight or nine of the heat and fat-producing ingredients. The great fattening food is corn; its nutritive ratio is one to nine plus. Thus the food changes in character from milk to corn or other similar foods, and the ration is gradually widened to meet the increasing requirements for fat production.

7. Mineral matter and charcoal.—If the ration consists largely of corn and the young hogs are on pasture they will fare better than young pigs in the dry feed lot. Pigs grow rapidly if fed well. If the food supply is deficient in mineral elements the lack is told in smaller bones and slower gains. Ground bone or bonemeal can be introduced advantageously into the ration, either when the hogs are in the feed lot or on pasture. Soft coal, charcoal and salt, either in mixture or given separately, should be kept before the animals at all times.

8. Making a slop.—When pigs are young, food in the form of slop is most easily and safely fed. At first it should be quite thin. The nearer it approaches the consistency of buttermilk the better for the pigs. As the



SLOPPING THE HOGS

Different lots are fed in accordance with their requirements. The attendants pass from pen to pen, mixing the slop as needed and in accordance with size and number of animals in each pen.

pigs grow it is a mistake to continue to feed a very thin slop. An over-supply of water in slop is harmful; fat production is retarded. If food is given in slop continuously the water is to be lessened as the animals increase in size. When a weight of 100 pounds or so has been reached, the pigs now being five or six months old, the slop should be so made as to have a consistency somewhat like mush. If the pigs demand more water than this food supplies, let it be available as drink.

9. Pasture for pigs.—The great opportunity for making a profit out of pigs, especially when prices are low and grain products high, is to depend on the use of clover, cowpeas, soy beans, alfalfa and rape pastures. As the subject of pig feeding is studied, more conclusive becomes the evidence that pasture crops go hand in hand with pork production. It should be the swine raiser's aim as much to grow these forage crops as it is to grow the hog itself. Particularly is this true of the legume

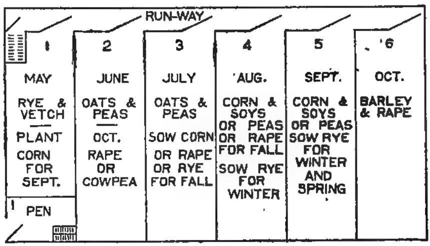
LEGUME PASTURES IDEAL FOR PIGS

For growing pigs, alfalfa, clover and other legumes are excellent forage crops. If these are not available, tender mixed grasses will serve. Corn or slop or both is advisable in addition to the green forage.

crops. Alfalfa naturally comes first because of its highly digestible nutrients, its vigorous growth and consequent heavy yields, its long cycle of life and its land-improving benefits. In time alfalfa will be commonly grown in all sections.

Hogs may be turned into an alfalfa or a clover field early in the spring and kept there through the season until frost, provided the acreage is large in proportion to the number of animals. The tramping will not hurt the crop, and the grazing of the swine will not impair the feeding quality of the alfalfa when made into hay. When a large field is pastured a portion may be cut, to be followed a week or so later by another portion, and so until the field has been cut over. In this way there will be a new growth of alfalfa at all times, giving the pigs just the sort of pasture they desire. Alfalfa is rich in protein; hence the addition of corn to the ration while the animals are running on the pasture is advisable, especially if early maturity is sought. Young pigs on alfalfa, supplied with a light feeding of corn daily, within seven or eight months will weigh 250 pounds.

10. Grazing runs for hogs.—Where large fields are not available small runs may be resorted to. These solve the problem very satisfactorily on many farms. The small run lots may be of any size from a half acre to five acres. The number of hogs to be kept will decide as to size and number of runs. An average size is about an acre. One or two of these lots may be permanent pasture of either clover or blue grass, a temporary pasture of timothy and clover, or a permanent pasture of alfalfa. The other lots may be used in rotation. Several of them may be seeded to rye in the fall, and as they are pastured off in turn during the winter and spring, they may be seeded with other forage plants. The one first grazed down may be plowed and seeded early to peas and oats, the next one to corn or sorghum or a mixture of the two, a third to cowpeas, and the others to soy beans, rape, peanuts, or sweet potatoes.



GRAZING RUNS FOR HOGS

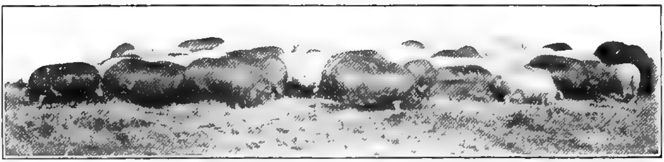
The hogs are shifted each month to a fresh pasture in which one of the best crops of the season is available as food.

11. Forage for cheap grain.—Any growing crop is helpful in producing cheap pork. In sections where a temporary pasture like timothy and clover is available spring pigs may be given the range of the fields. Thus they will gather a considerable portion of their food. But they should not be denied additional food in the way of slops or of dry grain. Corn or corn and oil meal, or corn and tankage, may be used in combination to insure steady growth. Spring pigs thus raised, by July will be of fair growth. From this time they should be pushed somewhat in order that they may be fat by late fall or early winter.

The feeding of green corn on pasture is common and has much in its favor. Practically all of the plant but the coarse stalk is consumed. The kinds of forage cover a wide range. The fact is, anything green that is appetizing is good for hogs.

12. Fattening hogs.—The aim should be to get flesh growth rather than an overburden of fat. At the beginning of the fattening period hogs will eat 40 to 50 pounds of dry matter per 100 pounds of live weight. This diminishes to 25 or 30 pounds as the fattening period advances. Hogs will get fat when on corn. Their best development is obtained when other feeds containing more protein are provided in addition. Tankage, peas, or beans are excellent. Use one part of either to eight or ten parts of corn at the beginning of the finishing period.

The most intensive fattening is secured on easily digestible material. Corn is the universal food and enters most largely into the grain combination. All other grain feeds are to be used as supplements and as balancing foods with corn. During the beginning period of fattening when clover, alfalfa, or other pasture is available,



TOPPING OFF ON CORN

corn is the only grain necessary. Fattening hogs can be kept on such pastures almost up to the finish.

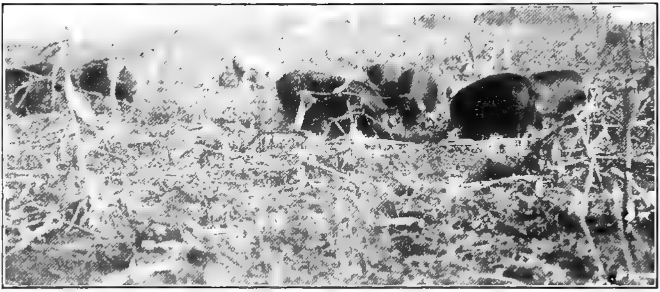
13. Last stage of fattening.—Hogs very heavy with fat should not be required to roam about for food. Hence, during the final stage of fattening, the smaller the pasture or feed lot the less the loss because of this needless expenditure of energy. A great many of the most successful feeders take the fattening hogs from pasture to the feed lot. In most cases corn is the exclusive feed. Water should be at hand at all times, or available at frequent intervals. Rations containing one part of tankage or meat meal or soy bean meal to eight or ten parts of corn, unless corn is low in value, will produce a more rapid and cheaper growth than corn will alone.

14. Making good bacon.—Feeding stuffs greatly influence the quality of bacon. Oily grains have the strongest effect. To get good bacon, these oily grains

CHOICE BACON

These pigs average 180 pounds. They were fed a ration consisting of corn, wheat middlings and tankage. They will make choice bacon because they are not too fat, and their food contained considerable protein.

should be reduced to a half or a third of the whole ration. Corn is the principal food for both lard and bacon hogs, and may compose as much as 75 or 80 per cent of the ration in bacon production. Middlings and tankage may be used for the balance. In Canada, where bacon is in much favor, barley is a common food for hogs. It is fed both ground and soaked. Other foods used in combination are skim milk, peas, oats and middlings. If oats are used they should be crushed. The most profit from bacon is secured when clover, alfalfa, cowpeas or rape are provided as forage.



Hogging Off the Corn

Hogs are here harvesting the corn crop. They not only eat all of the ears, but consume the greater part of the stalks. When the fat hogs are removed, brood sows and pigs should be turned into the field to clean up.

15. Hogs as corn harvesters.—Not only may hogs produce more with less grain in hogging off, but they often mature in less time than when pen fed. It is not unusual to save at least a quarter of the fattening period where this method is followed. Young hogs weighing 80 to 125 pounds are best in the green cornfield. At this size they have good frames, are mature enough, and carry enough flesh to fatten in a few weeks and be ready for market. Brood sows also will make good use of green corn. When thin from suckling pigs, or are unthrifty from any cause, they will quickly flesh up and improve and be ready for market in from 30 to 50 days.

While corn may be hogged off at any period, it is best to let it mature somewhat. Then you get all there is in the crop. If the ordinary summer pasture is short give some additional feed, like shorts and middlings, in slop, to tide along until the corn is fairly well developed. When it passes the milk stage, and is somewhat dented, the hogs may be turned into the field. The entire field is usually given over to the hogs, when labor is high, the soil not wet, and the herd and the field not large in size. Use old hogs, stock hogs and brood sows for cleaning up after the fattening bunch has been taken away. Not much will be left, but still there will be some; if this were not so, the fattening hogs would have been fed rather unwisely for the last week or two.

PRACTICUMS

1. JUDGING SWINE.—Provide two or more hogs of the pork and lard type. Students should familiarize themselves with the details of this score card and fix in their minds the relative weights of the different regions. If it is possible to have available several hogs for scoring so as to place the several individuals in rank from best individual down to poorest individual the value of the exercise will be increased and increased interest will be added to it.

SCORE CARD FOR LARD HOGS

Scale of Points	Perfect Score	Student's Score	Corrected Score
A. **General Appearance:**			
Weight—according to age	6		
Form—deep, low, compact, square on legs	10		
Quality—skin and hair fine; bone fine; flesh smooth, mellow	10		
Condition—deep and even covering of flesh; flesh firm	10		
B. **Head and Neck:**			
Snout—medium, not coarse	1		
Eyes—big and bright	1		
Ears—soft, medium size	1		
Jowl—short and broad	1		
Neck—thick, medium length	1		
C. **Forequarters:**			
Shoulder—broad, deep, full, on top compact	7		
Breast—wide	2		
Legs—straight, short; bone clean; upright pasterns	2		
D. **Body:**			
Chest—deep and broad with large girth	2		
Sides—deep, long, full; well-sprung ribs	6		
Back—broad, straight, thick, evenly fleshed	10		
Loin—wide, thick	10		
Underline—even and straight	2		
E. **Hindquarters:**			
Hips—smooth and wide apart	2		
Rump—straight, wide, long, evenly fleshed	2		
Ham—fleshed heavily; full and plump; deep; wide	10		
Thighs—fleshed close up to hocks	2		
Legs—straight, short; bone clean; upright pasterns	2		
Total	100		

2. Score Card for Bacon Hogs.—As with lard hogs, have available two or more individuals of the bacon type for judging. If bacon hogs are not raised in the community, the exercise may be given over to judging lard hogs, using the previous score card. It is advisable to compare the two score cards, indicating the principal differences between the two classes. Every student should be able to distinguish the bacon type from the lard type, and to know a good bacon hog when he sees it.

Score Card for Bacon Hogs

	Scale of Points	Perfect Score	Student's Score	Corrected Score
A.	**General Appearance:**			
	Weight—according to age; for market 180 to 220 pounds...	6		
	Form—long body, smooth, level, deep sides................	10		
	Quality—skin and hair fine; bone fine; flesh smooth, mellow	10		
	Condition—deep and even covering of flesh; flesh firm......	10		
B.	**Head and Neck:**			
	Snout—medium, not coarse..............................	1		
	Eyes—big and bright..................................	1		
	Ears—soft, medium size...............................	1		
	Jowl—light, trim.....................................	1		
	Neck—light, of medium length and muscular..............	1		
C.	**Forequarters**			
	Shoulders, smooth, even with back......................	6		
	Breast—full, moderately wide..........................	2		
	Legs—straight, longer than lard hogs; bone clean; upright pasterns...	2		
D.	**Body:**			
	Chest—deep with full girth............................	5		
	Sides—long, smooth, level; long, well-sprung ribs...........	10		
	Back—uniform and even in width; smooth.................	8		
	Loin—even with back..................................	6		
	Underline—even and straight...........................	6		
E.	**Hindquarters:**			
	Hips—smooth, wide, blend with rest of body...............	2		
	Rump—even and long; uniform with back.................	2		
	Ham—firm, not flabby; tapering to hock..................	6		
	Thigh—fleshed low down...............................	2		
	Legs—straight; longer than lard hogs; strong pasterns........	2		
	Total..	100		

LESSON TWENTY-EIGHT.

GOATS.

1. In ancient times.
2. Uses.
3. Goats' milk.
4. Milk goats.
5. Milking qualities.
6. Cashmere goats.
7. Angora goats.
8. Feeding.
9. Housing.
10. Fencing.
11. Milking.
12. Breeding.
13. Flock management.
14. Protection for sheep.
15. Around the house.

Note to the Teacher.—In the popular mind the goat is a creature of ridicule found only in dirty city alleys and subsisting on old paper or on such refuse as may be picked up along neglected roadsides. The wonderful usefulness of these hardy creatures and their steadily increasing numbers, because of merit of fleece and milk, are giving them a place and reputation among our most useful animals. In Europe the goat enjoys its greatest popularity, and there in numbers it totals up into the millions. Point out the many ways that the goat may be used in this country.

LESSON TWENTY-EIGHT.

GOATS.

1. In ancient times.—The goat, closely related to the sheep and the deer, likes warmth and dryness and is most at home in hot climates. Originally it chose mountainous regions for its home. From time immemorial the goat has been a domestic animal. Its cradle seems to have been in central Asia, from which it has spread to Europe, Africa, America and to other parts of the world. A fair estimate places the number of goats in Europe at 20 millions and in the United States at over two millions.

AS FINE AS SILK

2. Uses.—In some communities goat meat is relished. When kept in sanitary quarters and fed clean and fresh forage the meat is considered good, especially of the young. Sometimes it passes as mutton. Mature goat meat is strong, and of nasty flavor. A great field is open for breeding flavor and quality in good flesh. The milk of goats has for a long time been greatly prized and is approved for infants and invalids. The skin of goats is used in our day for the manufacture of kid for gloves, morocco and other fine leathers, and also for parchment. The hair is very useful in the manufacture of brushes. Mohair comes from Angora goats and is in constant demand at good prices. Mohair skins are frequently tanned and dyed and used as rugs and coverings.

3. Goats' milk.—In Europe goats are largely kept for their milk. Goats' milk is very nourishing on account of the great quantity of fat and albumen which it con-

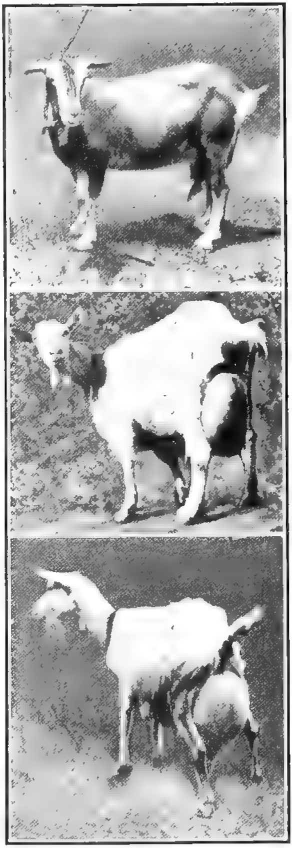
IMPORTED GOATS OF THE MILK CLASS

Here are excellent representatives of goats raised primarily for milk. They belong to the Saanen breed, a very popular race of the milk class from Switzerland.

tains, and also because it is easy to digest, and comes from an animal relatively free from disease. Goats are less troubled by the ravages of disease than cattle, and their milk seems to present no danger to those that use it. If the milk has a bitter taste it is because of the food. The goat eats with satisfaction what other animals reject; it will eat wild berries, bushes, bark of trees, weeds or anything it can get. It is truly the scavenger of the farm.

4. Milk goats.—A few flocks of milk goats have been established in this country. The demand for these is great both here and abroad, causing the prices of healthy specimens of dairy qualities to be rather high. Importations from milk goat regions in Europe are made by American importers and breeders. The future of this line is full of promise for a new industry of bounded limits. The Swiss goat of Saanen is the chief species of central Europe. It comes from the valleys of the Saanen and the Simmen and is characterized by its color, which is wholly white, by the absence of horns and especially by its great production of milk.

The Toggenburg, also a Swiss breed, and the Maltese, from the island of Malta, are noteworthy breeds of the milk goat. The Toggenburg is of a medium brownish color, but the Maltese is white. The hair of these breeds is usually short and rough, the beard long and heavy. The race has delicate heads, slender necks, long bodies, straight backs, thin legs and large, tender, hairless udders in the ewes. The bucks readily reach three feet in height.

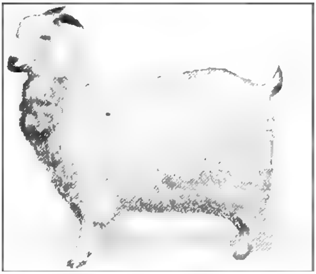


MILK GOATS
Saanen goats at top and bottom; Toggenburg goat in the middle.

5. Milking qualities.—With

good food, production in some instances reaches six to eight quarts a day, but three to five quarts is more the rule. Goats are milked about six months and then are dried off. The production will run from 500 to 1,000 quarts of milk during a lactation period. One ewe in Europe is reported to have produced 3,000 quarts during a single year.

6. Cashmere goats.—At one time the making of cashmere shawls was a great industry in Cashmere. That old industry, however, has lost some of its glory and importance. These animals originally flourished in Cashmere and Tibet. The wool enables the goats to bear the severe cold of the mountainous climate of these regions, although only a pound to a pound and a half is sheared at a clip. These animals have a double coat—a covering of outer hair, long, fine, straight and stiff; and beneath this is the fine, soft and fleecy wool that has made the breed so famous. The goats are of medium size; they have rather large heads and pendent ears, and long spiral horns that curve obliquely backward.



ANGORA GOAT

7. Angora goats.—These goats are natives of Asia Minor, and since their introduction have steadily grown in popularity. The bucks have long, flat, finely curved horns, but those of the ewes are smaller and simpler. In addition to their service in yielding a clip of valuable mohair, their flesh is more and more coming to be used for human food. It is often sold as mutton, and if the animals are properly fed and slaughtered while young, the mutton is very good. Another use to which Angoras are put is for clearing land. They eat the bark of trees, various kinds of underbrush and weeds and soon kill out bushes. Many Angora enthusiasts claim they are worth a great deal for this purpose.

"Mohair comes from the Angora goat. That of the finest quality is sheared from kids a year old. It gradually deteriorates until the sixth year, when it is of practically no value. The wool is abundant, thick, long, soft, shining, silky and slightly curled. The color is white. An average clip is three pounds. Mohair is extensively used in the manufacture of plush and certain kinds of dress goods. Sometimes the skins are tanned, either in natural color or dyed and used for rugs and robes."

ANGORA GOATS AT PASTURE

They are cleaning the hillside of weeds and brush.

8. Feeding.—Goats like to browse around in fence corners, thickets and on broken areas. Wherever they browse on brush they so completely destroy the rubbish that grass invariably springs up. This is because the undergrowth is destroyed and grass is given an opportunity to thrive. They take to grass also, but not so readily as to brushwood. When on pasture, the coarser grasses are preferred. In winter they will pick over corn stover, eat straw and grain. Sheaf oats, alfalfa, cowpea and clover hay are all excellent coarse food for them, and they eat these readily and with great relish. Milk goats require heavier feeding than those kept solely for mohair or as scavengers. They should be fed liberally and treated as other milk producers. The legume hays for roughage; kitchen refuse such as potatoes, carrots and turnips; bran and linseed meal, make an ideal ration. Oats, barley, corn, and similar feeds may also be used to secure change and variety.

9. Housing.—Give goats clean quarters. If they belong to the milk varieties, let them be treated and housed simi-

"Mr. Billy" Leading the Flock to Pasture

lar to dairy cows. This means a warm barn or shed, dry stalls, and an abundance of fresh air. Goats are particularly sensitive to moisture. They should have shelter in rainy weather. They should be provided with a rack in which their coarse fodder is placed, and given fresh bedding like other farm animals for cleanliness and comfort. Salt in rock form may be kept before them at all times. Their drinking water should be fresh and pure.

10. Fencing.—In summer it is expected that these animals will have grazing facilities as do other kinds of live stock. In winter a paddock or small lot for exercise is desirable. In either case substantial fences are needed. Goats are great climbers as well as great creepers. They go over and under things if the opportunity is offered. By nature they are climbers; unless trained to do so, they will not jump. The fences should be high and of such construction as to prevent climbing.

11. Milking.—Milk goats are milked two or three times daily. Regularity is as important with these animals as with cows. Gentleness and kindness at all times have their value. It is a good rule to wipe the teats and udder before drawing any milk. The udder is then stripped a few times from above, downward. The milking should not be done in the stall on account of odors that tend to contaminate its flavor. Each milking should be weighed and a record of its weight kept for future reference and as an aid in determining the value of each individual.

12. Breeding. — As a rule goats are very prolific. From two to four kids are dropped at a time, depending on the breed or race. Angora goats breed once a year, but other goats breed very soon after kidding. Maturity is reached in from 15 to 18 months. If bred before this time, the offspring are neither

ONE WAY OF MILKING

In Europe goats are commonly milked from the rear. By placing the goat on a box, as shown above, the operation is less tiresome.

strong, nor do they show sturdy development. Angoras are at their best at from two to six years, and are not worth much after that time. Milk goats may be kept longer, especially if they produce offspring of exceptional merit. The average life of these animals is about 12 years. Owing to the delicate nature of the kids, the breeding period should be timed so that the young may be dropped after the warm days have come.

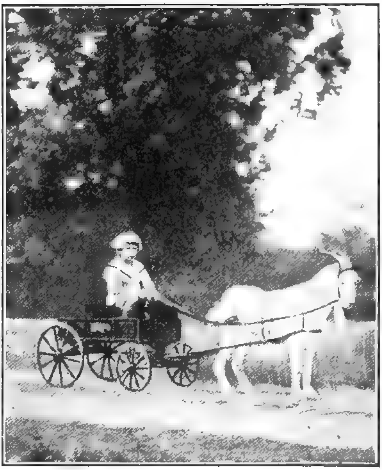
13. Flock management.—Start with a few individuals at first and learn by experience. Don't make the mistake of getting inferior quality. A few good specimens will prove a great deal more profitable than double the

Angora Flock Raised for Wool and Meat

number of poor or mongrel stock. When kids are four to five months old, they may be weaned. Watch the feet. When the toes grow out and turn up, they should be trimmed—otherwise they become a nuisance to the animal, or they may get sore and cause much pain. On rocky land trimming is not always necessary. Footrot often results if goats are kept on land that is wet much of the time. In case of infection change to new pasture after treating with sulphate of copper or other antiseptic wash. While goats are subject to a variety of diseases, they are not so much so as sheep.

14. Protection for sheep.—There is some truth in the statement that a goat running with sheep will keep off the dogs. But this means the protecting buck must be trained to fight the dogs. Being fighters naturally, their pugnacious disposition is easily developed; and if so developed when dogs visit the flock, the buck will at once lead in the attack, and thus in many cases save the sheep. A few goats will stay with a flock of sheep, but when in considerable number they prefer to graze off to themselves, and the protection thus desired is not secured. Where protection is wanted one or two fighting bucks are greatly to be preferred to a dozen.

15. Around the house.—As pets for children the goat has long been popular. They are troublesome only when teased and annoyed. They show much intelligence and are easily trained. Children have no difficulty in controlling them when harnessed to carts, and driven. Common goats have been used mostly for these purposes, but the Angora is equally satisfactory. Angoras are freer from the "goat odor" than common goats and their beauty makes them very desirable as pets.



BILLY AT WORK

LESSON TWENTY-NINE.

BEES.

1. Honey.
2. Young bees.
3. Nurses.
4. From grub to bee.
5. Queens.
6. Two kinds of eggs.
7. Why bees swarm.
8. Division of labor.
9. Honeycomb.
10. Hives.
11. Feeding bees.
12. Three kinds of honey.
13. Wintering bees.
14. Kinds of bees.
15. Bee diseases.

Note to the Teacher.—No story is more interesting than how bees live and gather honey. The lesson teaches the essential facts about these useful busybodies. As a matter of general culture every student ought to have a thorough understanding of the honeybee—how it lives, how it works, and what it does. No where in the animal kingdom is mutual help and community co-operation more strikingly demonstrated than in the case of the honeybee.

LESSON TWENTY-NINE.

BEES.

1. Honey.—When plants are in flower they secrete a substance (nectar), which, when worked over by bees, is known as *honey*. The working or neuter bees are able to suck the nectar out of the flowers by means of lapping mouth parts. They then swallow this fluid, passing it into the dilation of the œsophagus called the crop or honey bag. On arrival at the hive the honey is disgorged into the cells of the comb. The nectar is probably altered by admixture with the secretion of the crop. At first this substance is very much of a fluid consistency, but it is readily thickened by the workers who vibrate their wings so violently over the cells into which the deposit was placed that the surplus water is evaporated. The product thus gathered and stored in the comb is used by the bees as food.

EXAMINING THE HIVE

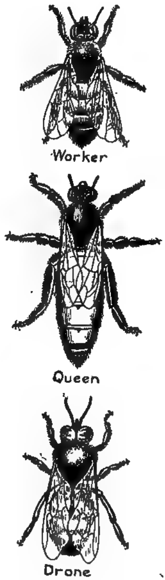
Beekeepers must look after their bees as carefully as the stock breeder looks after his herds, if he would have them thrifty and profitable producers.

2. Young bees.—Not all of the cells of the comb are filled with honey. In some, eggs are deposited by the queen bee. The queen bee is the mother of the colony. She moves about at laying time, leaving one egg in a cell. Three days later, from the eggs are hatched the young bees; these are small, soft and white—and helpless, without feet or wings.

3. Nurses.—Unless carefully looked after, these helpless creatures would surely die. Fortunately for them, they have nurses, whose special duty is to feed and care for them. The nurse bees stay in the hive, attend to these struggling offspring, and until their charges are more mature never go forth in search of nectar as do the other workers. These nurses are, as a rule, the younger members of the brood. When the new arrivals are old enough to take their places they join the other workers in gathering food for the community. One of the duties of the nurse bees is to prepare the bee bread for the little ones. They make this in their stomachs and disgorge and feed to the grubs or larvæ. The food is highly nutritious, but after two or three days of such feeding ordinary honey and nectar are substituted for it.

4. From grub to bee.—When the grubs or infant bees are well started forth a small amount of food, all in a lump, is placed in the cell and the cell sealed up with wax. The grub or larva consumes the allotment in the course of two or three days and then changes into its pupal state. It now goes to sleep for 13 days, after which time it throws off its cover and emerges as a mature bee. To break open the waxed-up cell is its next task; this done, the new bee comes out, joins its kin and goes to work with the rest of the inhabitants of the hive.

5. Queens.—The nurse bees are ever mindful of the welfare of the colony. Anarchy would reign in the community were a queen bee not on hand to preserve quiet and peace, and to lay the eggs. Hence, the nurses always provide for this contingency. When the eggs are hatching they select a cell for enlargement. The other cells round about the chosen one are torn down, that this one may be given royal size. When the egg is hatched much bee jelly is set before the grub. This nutritious food is given throughout the larvæ days, and only to the grub selected to become a queen bee. Honey is good enough for the other infant bees; not so, however, with this one on whom so great care was bestowed to provide a birthplace of greater splendor. When this particular individual comes out of its pupa form it is not an ordinary worker or a drone bee, but a queen of royal size and character.



THREE KINDS OF BEES IN EVERY HIVE

6. Two kinds of eggs. — Queen bees hatch from eggs of the same character as the eggs from which come worker bees. The queen bee owes her superiority to the nurses for their attention in providing a larger cell and more nutritious food. Had it not been for a big cell and much bee jelly the queen would have issued from the pupa a regular worker or a drone. If the queen reaches maturity without mishap and enjoys the obeisance of her followers, she in due course of time lays eggs. It is in her power to lay either fertilized or unfertilized eggs. The male or drone bees are hatched from eggs that are fertilized. From the latter class are obtained the queens, their existence being dependent upon the manner in which nourishment is provided.

7. Why bees swarm.—Ordinarily there is but one queen to the colony. If perchance additional queens arrive, there is trouble at once. The first thing observed is fighting between the new queens. They keep it up until only one of the new queens is left. The old queen, or mother of the hive, as if in disgust, issues forth and seeks a new abiding place. Many of her loyal attendants follow her, and finding a suitable branch or crotch they mass together in a dense body or swarm. After collecting their wits they seek out a hollow tree or branch and start a new community. In apiaries the bee tender is on the lookout for these outbreaks, and when they occur the swarm is put in a new hive, where everything is in nice order for vigorous work in filling comb cells with honey. Here the bees make ready the cells, gather honey, bring on new broods, and found a new establishment.

SWARM OF BEES

8. Division of labor. — Every hive or bee community contains three kinds of bees—a queen, drones, and workers. The duty of laying eggs devolves on the queen. The drones are male bees; they serve the community by fertilizing the queen, who fertilizes the eggs. To the workers is committed the task of providing the material and well-being of the hive or community. They secure the honey, build the combs, feed the young and gather the food for all. "And all the work done by the workers is strictly work for the whole community; in no case does the worker bee work for itself alone; it works for itself only in so far as it is a member of the community."

9. Honeycomb.—Making wax is one of the duties of the worker bees. They manufacture it from their food. It is really a secretion from certain glands in the abdomen. The bees arrange wax in slabs and pack hexagonal cells all over it. The result is the honeycomb. They now have a place to store the honey they gather and tiny incubators for the eggs when the queen lays them. When the honey cells are filled they are sealed with wax. The brood cells are sealed with both nectar and wax.

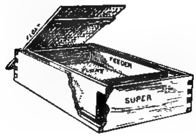
The work of bees may be greatly facilitated by providing comb foundations in the hives. These are strong sheets of wax with the imprint of the base of bee cells upon both sides. Except for wild bees, these artificial foundations are now provided for all domestic hives. Successful bee keeping is due more largely to the skillful use of artificial combs than to any other single factor in the management of the hive.

Apiary Showing Hives and Their Arrangement

The beekeeper who owns this apiary devotes his entire time and attention to his bees.

10. Hives.—Various kinds of hives have been provided by manufacturers, so that to-day the selection of a type is more the result of taste or choice than of merit. Practically all modern hives are good. The common requirements are that the hive shall have a movable roof and a movable comb frame. Between the combs there should be space enough to let two bees pass. Most hives are built in two compartments—an upper and a lower story. The queen bee is kept in the lower one, and here she lays her eggs, and here also the other responsibilities of the community are looked after. Modern bee culture has added the upper division as storage for honey. A sheet of metal usually separates the two compartments; holes in this are made just the right size for the workers to pass back and forth, but the queen and drones being somewhat larger are prevented from entering.

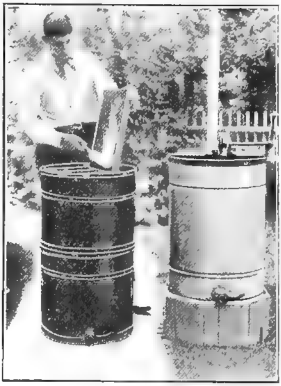
11. Feeding bees.—In good seasons bees not only lay up enough honey for their winter food, but provide a considerable surplus that goes to the bee tender for his profit in caring for and looking after the hive. If for any reason the season is bad, as it sometimes happens, the bees will require a nourishing ration, or otherwise many will perish during the winter months. Good bee men make a practice of feeding their bees when misfortune overtakes them with a thick warm syrup made from pure cane sugar, or honey, early in the autumn. In this way they are enabled to get ready for the hard days of winter.



BOX FOR FEEDING BEES

Sometimes bees are fed in spring also in order to induce early breeding. Early colonies are desirable, because such are almost certain to collect surplus stores, whereas the late ones are unable to supply enough even for themselves. In the latter case the keeper has no honey for his trouble and labor. During the winter season it is of especial importance that the hives be wind and water tight. Bees can stand much dry cold, but not damp and drafty quarters.

12. Three kinds of honey.—The trade uses three kinds of honey—chunk, section comb, and extracted honey. Chunk honey is made in large frames of different sizes, holding from three to seven pounds. When ripened by the bees it is cut out of the frames in chunks and packed in jars. Section-comb honey is made in boxes holding about one pound. In these it remains until consumed. Such honey is neat and attractive, but tedious to produce. It is not the kind for the beginner to attempt. Extracted honey is made in large frames, just like chunk honey. When ready to remove it is drawn from the combs with a machine called the honey extractor. The empty combs are then returned to the hives for refilling by the bees.



EXTRACTING HONEY

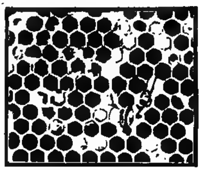
13. Wintering bees. — Two methods of wintering are practiced—outdoor and indoor. In exceedingly cold climates, where there is continuous freezing weather between December and March without any warm days, the indoor method is usually preferred. Where the temperature varies the outdoor custom is popular. This region starts within 50 or 100 miles south of the Great Lakes. It permits the bees to fly during warm days, as they occasionally do even in midwinter. In its use double-wall hives or single-wall hives with winter cases are used. In the southern states single-wall hives without outside jackets are warm enough for the climate. In indoor wintering in the cold climates, double-wall hives or winter cases are not necessary; but in the spring, when the hives are placed on their summer stands, it is usually necessary to provide extra protection. Cellar wintering requires less costly hives, but demands more skill than outdoor wintering.

In large apiaries special cellars or buildings are provided for winter quarters. It is essential that for outdoor wintering the hives weigh at least 50 pounds; that is, that they contain 30 pounds or more of honey. In indoor wintering much less honey is required, since the bees do not need so much food to keep them warm.

14. Kinds of bees.—The Italian is the most popular bee of commercial importance. It is black and yellow, noted for gentleness, ability to work and good health where properly bred. The Black or German bee, which the Italian is steadily replacing, is the next most popular. It is noted for nervousness, excitability, ability to work and greater susceptibility than the Italian to disease. The Carniolan, considered to be a variety of the black bee, swarms very profusely, and is thus undesirable for commercial purposes. The Caucasian, which resembles the Carniolan closely, is a good honey gatherer, but uses bee glue too freely to suit the apiarist. The Banat bee resembles the Caucasian, though there is a yellow variety. Tunis or Punic bees are very cross and so inclined to daub everything with red bee glue that they are not suited to comb honey production. The Egyptian bee, cultivated for thousands of years in Egypt, is much smaller than the Italian. It is a fast excellent worker, but very irritable. It does not mix with other bees. Albinos are either "sports" from the Italian or crosses between Holy Land and Italian bees. There are also Cyprian, Holy Land or Syrian bees that have been imported into America, but have not become specially popular. In India are several species that have not been domesticated in other parts of the world.

15. Bee diseases.—Dysentery, a winter disease, due to long, low temperature and bad food, is usually cured by free flight in the spring. Paralysis, rather common in warm climates, seems to be constitutional and due to the queen. A new queen usually proves effective as a cure.

American foul brood, a bacterial disease, reaches healthy larvæ in infected food. The grubs soften, settle to the lower sides of the cells in shapeless, yellowish masses, which later turn brown, sticky and ill smelling. To cure it infected comb and honey must be removed in the evening during a honey flow and healthy food given. The bees must be encouraged to build new comb. It is wise to guard against robbing by other bees. Brood from badly diseased colonies should be burned at once. Combs may be melted into wax, hives cleaned and disinfected with a gasoline torch inside.



SECTION OF COMB INFESTED WITH FOUL BROOD

In European foul brood, also bacterial, the larvæ turn yellowish or gray, become slightly translucent and usually flatten against the bases of the cells. The dead ones appear as moist collapsed masses, which become dry, brownish scales. Italian bees are better able to resist this disease than any other race; black bees least of all. Treatment is the same as for American foul brood, but must be applied to the whole apiary at once. The cure is permanent only when pure-bred Italian queens are introduced in black or hybrid colonies. In sacbrood, also bacterial, the larvæ decay from the inside, leaving the skin tough and in natural shape. Often they dry up, become loose in their cells and drop out when the comb is inverted. Re-queening with vigorous queens from other apiaries often cures the disease.

LESSON THIRTY.

FISH FOR THE FARM.

1. Pond culture.
2. Carp.
3. Care of carp.
4. Catfish.
5. Catfish ponds.
6. Sunfish.
7. Raising sunfish.
8. Black bass.
9. Black bass ponds.
10. Small bass.
11. Brook trout.
12. Raising trout.
13. Trout ponds.
14. Feeding fish.
15. Eggs and hatching.

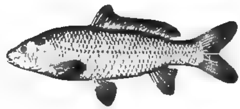
Note to the Teacher.—This lesson describes the more important kinds of fish that may be used in pond culture, The habits and requirements are pointed out and the fundamental considerations for raising farm fish are discussed. The purpose of the lesson is obviously to indicate what classes of fish are best adapted to particular kinds of water and to particular sections from the standpoint of climate and water supply.

LESSON THIRTY.

FISH FOR THE FARM.

1. Pond culture.—Three fundamental principles are involved in the commercial production of fish on the farm: (1) A never-failing water supply; (2) selection of fish adapted to the waters available; and (3) a continual natural food supply. Any small body of water used for the production of pond fishes should produce naturally a considerable amount of aquatic food to meet the requirements of the fish. One of the provisions of nature in all primitive bodies of water is the production of multitudes of tiny plants and animals that fish feed upon. Baby fish depend upon microscopic forms; and larger fish upon these and larger aquatic plants and animal life.

2. Carp.—Some years ago the German carp was introduced into the United States from Germany, where it had long been cultivated in ponds for commercial use. This fish is adapted for life in farm ponds where there is a muddy bottom and an abundance of water weeds. It never does well in either spring ponds or clear streams. The carp lacks the fine flavor of the native game fishes, but when kept in ponds free from filth and when properly cooked it is highly appreciated. These fish subsist on mud containing organic matter, soft parts of dead plants, aquatic weeds and grasses, and all kinds of insect and crustacean life.

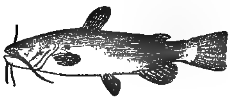


Carp

"To prepare carp in the best manner for the table it should be both skinned and drawn, soaked in salt water overnight, then boiled and finally baked with proper dressing."

3. Care of carp.—Carp culture does not require expensive arrangements, either for rearing the young or for raising the old. Where carp have fallen in disfavor it has been due largely to insanitary quarters. The best authorities claim that the stock ponds should contain good water and be drained and aired at least once a year. For best results three kinds of ponds are desirable: (1) Spawning pond in which the water is shallow and easily warmed by the sun for the spawning fish; (2) rearing pond, to which the little fish are transferred until a year or two old; and (3) the raising pond, in which the large fish are kept until fit for market and table use, or when they have reached a weight of two and a half or three pounds.

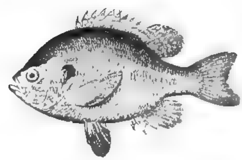
4. Catfish.—The two varieties of catfish that most fully respond to pond culture are the common bullhead and the yellow catfish. A third variety, the spotted catfish, does not take kindly to domestication. When transferred to hatchery ponds these fish refuse to breed, even when handled by the greatest experts. On the other hand the common bullhead and the yellow catfish when transferred readily adapt themselves to their new environments and multiply rapidly. This is because of the great care the parents exercise during the period of egg incubation and babyhood of the young. These catfish offer great possibilities in agriculture. Low, wet land, fed by springs, drains or creeks can be easily converted into a catfish pond, thus furnishing an abundant supply for table use and market. Under favorable con-


BULLHEAD CATFISH

ditions these fish will be ready for consumption in from two to three years.

5. Catfish ponds.—Where catfish are raised commercially a single pond hardly suffices. It is advisable to use about one-half of the available pond land for breeding and for the maintenance of fish more than a year old. Two or three smaller ponds should be set apart for the rearing of young fish. In commercial establishments sorting fish into sizes is advisable, otherwise the big and strong will feed at the expense of the smaller fish. When big and little fish are raised together the loss of the young is large, for the reason that the older fish prey on the little ones.

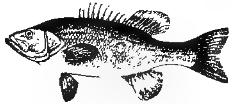
6. Sunfish.—In large or small bodies of fresh water the sunfish are generally found. While these fish are small, their flesh is sweet, tasty and of high flavor. These fish can be raised in very small bodies of water and yield to farm culture for home use or to a more extensive production of commercial importance. Eggs may be fertilized artificially, but more satisfactory results are obtained from natural spawning. The three principal varieties are: Common or "pumpkin seed" sunfish, (2) the common long-eared sunfish, and (3) the blue gill. In spawning the pumpkin seed variety seeks a gravelly spot where the water is shallow, the common long-eared locates in deeper water, and the blue gill in the deepest spot it can find.



SUNFISH

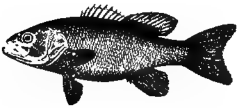
7. Raising sunfish.—For best results in pond culture the small fry should be separated from the mature fish. Otherwise large numbers of the young will be devoured by adults. When thus separated into a rearing pond, development is rapid. For farm culture sorting is not necessary, but the yield of fish is certain to be much smaller than would be the case were sorting done and both a rearing and a stock pond maintained. During the hatching and nursing period these fish are excellent mothers and guard their young with unusual care and attention. Intruders are attacked savagely and driven away.

8. Black bass.—Of the larger varieties of black bass the two of most common importance in pond culture are (1) the large-mouthed bass and (2) small-mouthed bass. On account of their habits and nature, they do not lend themselves often to pond culture under ordinary farm conditions. They are most at home in large bodies of water such as artificial reservoirs, lakes, rivers and large streams. Where pond culture is resorted to a relatively large area of ground is necessary.



BIG-MOUTHED BASS

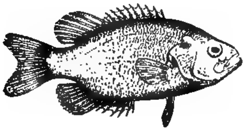
9. Black bass ponds.—Success with black bass is dependent upon a favorable site, properly constructed ponds and suitable water. These fish thrive in the same waters with carp. The feeding habits, however, are different; black bass are carnivorous and depend upon other water animals for food. Young carp often are propagated in the same waters with black bass for the purpose of supplying the food. Because of large area required and close attention to all details of management, black bass are not commonly chosen for stocking small ponds or for use except as a commercial enterprise of large proportions.



SMALL-MOUTHED BASS

The large-mouthed bass lives in still water where weeds, flags and pond lilies are plentiful. This variety is less valuable as a table fish than the small-mouthed bass. The small-mouthed bass is partial to pure lake water or river water with rocky bottom.

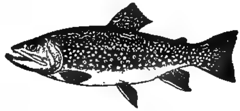
10. Small bass.—The rock bass and calico bass are two varieties among the smaller fishes that may be selected for farm culture. Small ponds may be devoted to them, but it is advisable to keep the young and old apart. Otherwise, large numbers of the baby fish and small fingerlings will be devoured by their elders.



ROCK BASS

The rock bass is especially destructive, but the calico bass seems to hanker less for the flesh of its kind than either the sunfish or the rock variety. Of the two varieties, the calico requires much the deeper water for nesting purposes. Rock bass and sunfish are often cared for in the same pond ,and frequently place their nests close without disturbance or annoyance to either.

11. Brook trout.—These fish abound chiefly in cold, swift-running, gravelly brooks, but they thrive in all pure cold waters which contain sufficient air. They seem to be at home equally well in brooks, ponds, lakes or rivers. Unquestionably they stand at the head of the fresh water game fishes in the popular estimation. Furthermore, trout are "peculiarly suited to domestication, being very hardy, easily tamed, conveniently confined, satisfied with plain food, well adapted to artificial breeding prolific enough to increase rapidly, and having a sufficiently high value as live game or as a table luxury to make it worth while to raise them." Rainbow trout are also adapted to pond culture.



BROOK TROUT

12. Raising trout.—Rather extensive arrangements are required for best success with trout in artificial ponds. What adds to the difficulty is the necessity of using running water both for hatching the eggs and rearing the young. Spring water is preferred for hatching and brook water for raising trout. These requisites limit the area in which trout can be raised. Where natural advantages prevail in way of water, shelter and lay of land, it is much easier to stock a stream with small fingerlings raised in a hatchery than to try to raise them in ponds. In stocking a stream the young fish should be taken to its headwaters, or put into the springs and rivulets which empty into it. As they grow larger they will gradually settle down stream, and run up again to headwaters in the fall and winter to spawn. No brook that has once contained trout need be without them, if the waters remain pure and cold.

13. Trout ponds.—Pure, spring water is the most important factor in the construction of a trout pond. The spring or springs should have a fall of 2 or 3 feet, and if more than one pond is made, a fall of 5 or 6 feet would be an advantage. The more the water the less the need for a considerable fall. In building a pond it is advisable to cover the immediate area over the springs with gravel for the fish to spawn on. The borders of the pond should be shallow, so that the little fish may run up into the shallow water and escape the large fish; or have the pond so arranged that after the fish have spawned the large ones may be removed. This plan allows the eggs to hatch out and the young to develop without danger of being preyed upon by the older fish. After the fingerlings have reached a good size they may be removed from the spawning section to the rearing section, the old ones being returned for another spawning season. In this way a good many fish can be raised without much trouble.

WHERE TROUT THRIVE UNDER ARTIFICIAL CONDITIONS

Note the cloth spread across the water to shade the very small trout from the sun. The creek itself is not shown in the picture. The pools are provided with water from a small dam just above their head. This plant contains 900 feet of pools, and is capable of harboring a million trout.

14. Feeding fish.—In stocking ponds some food in addition to what the pond provides in low forms of plant and animal life is often necessary. In the list of approved foods may be mentioned the following: Heart, liver and lungs of slaughtered animals, sour milk curd, dry bread, oatmeal, worms and insects and fish flesh. These should be finely ground and be given in moderate quantities and at regular intervals. Live minnows and ground flesh of wornout farm animals may also be used for growing fingerlings and mature fish.

15. Eggs and hatching.—A female fish is capable of developing a vast number of tiny eggs. These are spawned in the nesting place and if properly fertilized and not destroyed by other fish of the same tribe or by other natural enemies a very large family of young fry results. After breaking through its shallow shell and emerging from the egg the young fry is still encumbered with the yolk sac, which extends all along the abdomen. The yolk is the baby fish's nourishment and as long as it remains no other food is required. The length of time the sac remains on the fry varies with different kinds of fish. The fall-spawning varieties possess the yolk sacs for a month or two, but those varieties that cast their spawn in the spring do away with their little nursing bottles in a few days. Eggs from fish that spawn in the spring hatch in a short time and the young are soon able to escape and hide from their enemies. Fall spawners, like the brook trout, require two or three months for hatching and leaving the yolk. It is evident that all tribes subject to slow development are most liable to be destroyed during their days of infancy and early youth.

Fish hatcheries.—Most states now support establishments in which are artificially hatched many millions of fish eggs for stocking streams, lakes, rivers and ponds. These meritorious enterprises are supported by public funds. When the small fish have reached the proper size they are furnished to the public at cost or free. The federal government also hatches vast numbers of different varieties of fish, which are given to interested persons on request. The application for fingerlings for stocking purposes requires a description of the pond, lake or stream and the kind of fish desired. Those in charge give suggestions as to what variety is most suitable and directions as to handling, care and culture.

PRACTICUMS.

1. Observing Bees and Their Work.—For this purpose use freshly killed specimens, or specimens from alcohol, or pinned specimens. (*a*) Study the number and arrangement of wings. Make a drawing of each wing. Study the number and structure of the legs. Draw one of each, showing the differences. (*b*) Note the antennæ cleaner and wax pliers in the front pair. Note the pollen baskets in the hind pair. If a drone and queen can be obtained, note if they each have these features of leg structure. What is the function of the hairs on the legs? Examine these under a microscope. (*c*) Study the eyes under a hand lens and under a low-power compound microscope. Draw them, enlarged Describe them. Are there any single eyes or ocelli? Draw them. Where? Show in drawing. (*d*) Length of antennæ. How many parts or joints? Where attached? Make enlarged drawings. (Always enlarge drawings to a certain definite scale, and state the scale of enlargement.) (*e*) Examine, then describe, the mouth parts. Are there any sharp teeth on the maxillæ or jaws? Is there any sharp point in connection with the proboscis? Note that there are no structures in the bee's mouth by which it can cut open or puncture fruits. Examine the proboscis or tongue under a microscope and draw the same. If a live bee can be obtained, feed it honey or syrup, or moistened sugar, and see how it feeds. (*f*) Note the hairs on the thorax. Are any foreign particles to be found upon them? Scrape or brush the legs and thorax over a glass slide and examine the dust with a microscope. Are the particles regular (uniform) in shape or size? If any bee can be found with material in the pollen baskets of its legs, examine this material under a microscope. If at a time of year when the bees are collecting pollen or visiting flowers, be sure to collect some of them that are covered with dust and examine the dust. Collect some of the flowers they are visiting and examine their parts, and especially the flower dust or pollen. What was the material the bees were carrying? Bring out the point that the pollen is an essential fertilizing or fructifying element of the flower, and that it is essential for this to be carried to another flower or another plant. This is called cross-fertilization. Stronger plants arise through this crossing; also new strains, races, or varieties originate as the product of such crossing. (*g*) What is the fundamental function or purpose of the bee in nature? If possible kill and cut or break open a bee that has been for some time at the flowers. Note the clear drop in the sac in the abdomen. What is this? Discuss the source of nectar and how it is carried with the bees. Kill, and examine the contents of the honey sac of a bee that has just come to the flowers and note its size compared with the former. What is

the relationship of the bee to the flower? What does it take, and what does it give? Can it injure fruits if they are not first punctured or opened by some other agency?

2. Where Bees Work.—Visit the fields where bees are attending flowers, and note the kinds of flowers on which the bees work and the kinds on which they do not. (*a*) Are honey bees found on white clover? Are they found on red clover? What is the length of the proboscis of a bee? Measure it accurately. (*b*) What is the length of the corolla tube of white clover? What is the length of the corolla tube of red clover? Why do bees visit the former and not the latter? Make a study of the various flowers visited by bees in relation to kind, the shape of the blossom, length of corolla tube, etc. Do bees visit one kind of flower only while on one trip, or do they visit several kinds?

3. Honey and Its Production.—If honey and comb from hives cannot be obtained, a section can be purchased from almost any grocery. (*a*) What is the thickness of honeycomb? How is it supported? How is the honey retained? How are the cells of the two sides placed in regard to each other? Upon what do these cells rest? Measure the exact depth and diameter of a cell. Are they all of the same diameter? What is their shape? Are they of the same shape? How are they covered? Is there any space between the wax capping and the liquid honey? Puncture it and let out the air, and turn it with the covering of the cell downward, or press it with the finger. What is the difference in appearance? Why was it white before and watery afterward? What are the advantages of hexagonal cells? Note both economy of material and strength of structure. (*b*) Examine the honey under a microscope. Melt the wax capping of a cell very gently on a microscopic slide by holding a match under it. Keep it warm and melted while examining with a microscope; what is to be found? As a rule pollen grains will be found mixed with the honey, and always with the capping. Are these all of one kind, or of different kinds?

The teacher should have some blossoms of different plants and trees producing honey, even though they are dry and preserved in envelopes for this purpose. The anthers can be softened up by moisture, and a few pollen grains obtained; and by careful microscopic study one can determine the kind of plant from which the honey was produced by the kind of pollen grains with it.

The salient points to be brought out are that workers and queens are alike in structure and drones different. There are special structures by which a bee is able to perform its peculiar functions of visiting and pollenizing certain flowers and gathering nectar. This nectar is transformed by the bee into honey, and is stored in their waxen cells. The pollen masses are put into other cells as bee bread, but accidentally some pollen grains find their way into the honey. Pollen grains are used also with the cappings of the comb.

Bees are unable to bite open fruits, although they may suck them after other insects or agencies have opened them. Bees visit certain kinds of flowers for nectar or pollen or both, but others they do not visit. The latter may be pollenized by other insects or by other means. (After Surface.)

4. Choosing the Best Animals.—Continue the judging of live stock, using for material any class of horses, cattle, sheep or swine most available and of most importance in the community. If possible have four or five animals to score and judge.

5. Reasons for Choosing.—In case several animals of any one class are available, let each student examine all individually and place them in accordance, as his judgment indicates. They should be ranked as first, second, third, fourth and fifth, etc., so as to include all in the exhibit.

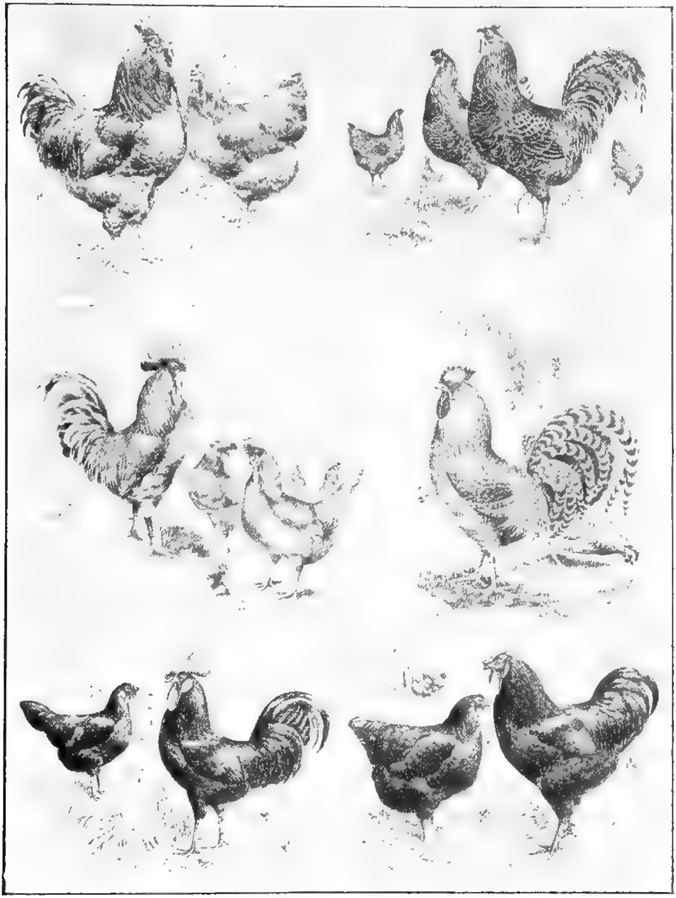
Now write your reasons for so placing the animals. State why one was given first place, and in what way it is superior over the one placed second. It is important to place animals properly, but it is equally important to know why the animals have been so placed. The more drill that it is possible to give in placing animals and in stating the reasons for so placing, the greater the interest in the work becomes and the more valuable the work develops to be. A great deal of practice is required of this sort to become an accomplished judge of live stock.

LESSON THIRTY-ONE

EGGS AND THE HEN

1. Purpose.
2. Character of an egg.
3. Egg shells.
4. White of an egg.
5. Yolk.
6. Germ.
7. Development of embryo.
8. Handling incubating eggs.
9. Eggs for hatching.
10. Broody hens.
11. Selecting layers.
12. Laying type.
13. Laying ability improved
14. Management of laying flock.
15. When hens molt.

Note to the Teacher.—Interest in poultry raising is steadily growing. Poultry products are in greater demand than ever. The obvious purpose of this lesson, however, is not directly to cover these points. It is rather to define the meaning of an egg, to learn of the parts comprising it, and from this information to deduct the proper meaning that the best results in the more practical operations of raising fowls for eggs and meat may be secured. The composition and nature of the egg must be fundamentally considered in order to attain the best success with laying flocks.



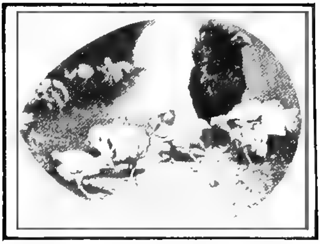
SIX POPULAR VARIETIES OF DOMESTIC FOWL

Top row: At left, Rhode Island Red; at right, Black Java. Middle row: At left, Buff Leghorn; at right, Dominique. Bottom row: At left, Black Minorca; at right, Black Orpington.

LESSON THIRTY-ONE.

EGGS AND THE HEN.

1. Purpose.—In most kinds of animals reproduction takes place by means of eggs. Mammals give birth to and suckle their young. Birds and many of the lower species produce eggs. Great variation exists as to the manner of reaching adult life. With some members of the animal kingdom many changes occur, the little creature on hatching being altogether different than at other stages of its existence. The life history of a butterfly or moth is a story quite different from that of a snake or fish, and that of a bird from that of a tadpole or lobster. In domestic poultry, on hatching from the egg, a baby bird is born, identical in every way with its subsequent enlargement. The egg is for the purpose of reproduction. It is the beginning and the end of the life cycle. Birds, according to their sex, produce eggs or contribute to their fertilization in order that their species may be perpetuated. Egg laying is not to provide a nutritious food for the breakfast table.

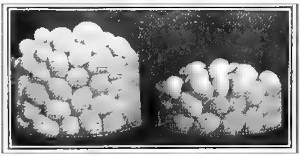


BIDDY AND HER FAMILY

2. Character of an egg.—An ordinary good-sized hen's egg weighs about two ounces. The weight varies according to the breed, some eggs weighing 2¼ ounces.

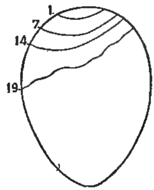
and others 1¾ ounces or less. An egg consists of four parts—the outer covering or shell, the yolk or food supply of the chick at hatching, the white, or mass of albumen for developing the embryo, and the germ, or life substance. The white material comprises about 60 per cent of the entire egg, the yolk about 30 per cent and the shell about 10 per cent.

3. Egg shells.—The outer covering of an egg is sometimes brown and sometimes white, the color depending in a large measure on the breed or variety of the hen. Color is due to a pigment developed in the shell and is a fixed character of the breed. The shell is composed of carbonate of lime, phosphate of lime, and animal gluten. It is very porous. It has between the particles of lime an innumerable number of very small holes, which allow the air to pass freely backward and forward during the process of incubation. If it were not for these tiny holes the embryo within would die for want of oxygen to revive the impure blood that it produces.



EGGS SHOWING GOOD SIZE AND SHELL

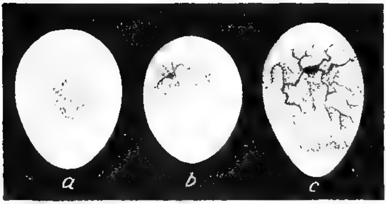
Moisture is evaporated through these holes. The rapidity will depend on the conditions and the temperature under which the egg is kept. The air space at the broad end of the egg indicates the amount that has been evaporated. The longer an egg is kept the larger the air space becomes. This is one way to tell the age of an egg.



EGG SHOWING ENLARGEMENT OF AIR SPACE UP TO 19 DAYS.

4. White of an egg.—The white of an egg is a strong solution of albumen in water, and while readily mixable with water in its ordinary state, it becomes insoluble when subjected to heat. In 100 parts, the white consists of 80 of water, 15½ of pure albumen, and 4½ of salts and ash. It is formed in three layers, which can be plainly seen when a hard-boiled egg is cut in two.

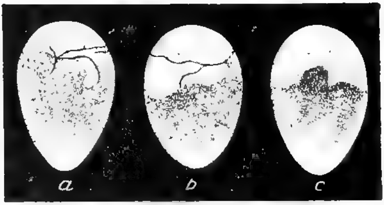
5. Yolk.—What is known as *yolk* is a strong solution of albumen, through which multitudes of globules of fat are suspended, the whole being inclosed in a sac that floats in the white. In 100 parts, water composes 53¾, albumen 17½ and fat or oil 28¾ parts. The yolk is lighter than the white and therefore rises to the upper side whichever way the egg is turned. The yolk serves as food while the chick is developing inside the shell and for the first days after hatching. This explains why a chick requires no food for a short period after it leaves its shell.



SEVEN DAYS OF INCUBATION

a, fresh egg; *b*, weak germ; and *c*, strong germ.

6. Germ.—Next to the shell, and fastened to the yolk, the germ or true egg is to be found. It is known as the *blastoderm*, the minute nucleus of what is afterward to be the chick. This word means sprouting skin. The blastoderm is present whether the egg is fertile or not, so that it is impossible to tell beforehand whether an egg will produce a chick. A fertile and infertile egg to the naked eye are the same in appearance. The application of a



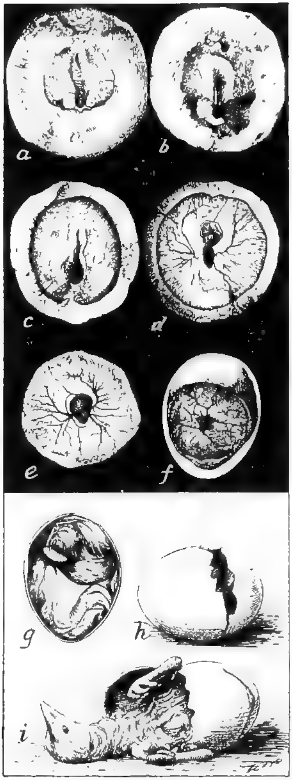
FOURTEEN DAYS OF INCUBATION

a, strong, live embryo; *b*, weak, live embryo; *c*, dead embryo.

few hours' warmth of the required temperature brings into activity all the power lying dormant from the time the egg was laid. Afer five or six hours, little finger-like processes begin to creep out from the blastoderm and gradually distribute themselves over the whole of the yolk.

Eggs raised for commercial purposes should not be fertilized, and they should be stored in a cool place during collection for shipment. Fertile eggs in the hot days of summer show signs of incubation very quickly. If roosters are kept away from the laying flock and a cool basement is chosen for the storage place, the eggs will remain fresh much longer and they can be shipped a longer distance.

7. Development of embryo.—A fertile egg incubates very rapidly if provided with the proper degree of heat. After only 18 hours the head of the future chick, with eyes enormously developed, and the spinal column, are plainly discernible under the microscope. After 40 hours there is a complete blood circulation, the heart is formed and beating commenced, and the blood vessels have spread over a considerable portion of the upper yolk. These are of a dual character; some are arteries, taking blood away from the



DEVELOPMENT OF CHICK

a, eighteen hours; *b*, second day; *c*, forty hours; *d*, third day; *e*, fourth day; *f*, fifth day; *g*, just before hatching; *h*, at peeping time; and *i*, nearly out of shell.

embryo, some are veins bringing the blood back again. The heart commences pulsating about the second or third day. When blood circulation begins impure air is revived by the oxygen, obtained from the air that passes in and out of the holes of the shells. Were you to coat over with wax an incubating egg, the embryo would die from want of fresh air.

8. Handling incubating eggs.—Eggs during incubation require cautious handling; otherwise the delicate blood vessels, which form a perfect maze of tracery over the yolk, may be disturbed or injured. The less that eggs are moved about, the less danger of damaging the fragile and delicate interior. Many dead embryos in the incubator are the result of careless turning and handling. In testing out a hatch to remove the infertile eggs, it is very important that the work be done with careful movements in order not to shake or twist the sensitive and delicate organs inside the egg.

EGGS TO AVOID FOR HATCHING

Note the ridges and imperfect shape of the shell: avoid such in selecting eggs for hatching.

9. Eggs for hatching.—In selecting eggs for hatching use only those of uniform size and color, with smooth, strong shells. Abnormal eggs are likely to produce weak or crippled chicks. The eggs should be stored in a room where the temperature ranges from 40 to 50 degrees. Eggs for hatching should be turned two or three times a week until the required number has been collected. Never set dirty eggs. If they are dirty, carefully wipe with a damp cloth until all spots are removed. Eggs are at their best, both as to fertility and vitality, when natural hatching is in season. Before this time fertility is poor

EFFECTIVE CARE FOR BROODY HENS

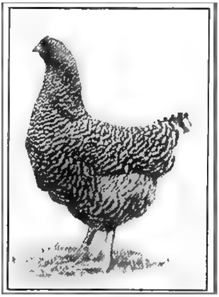
It will be observed that there are nothing but roosts, and the hens, therefore, cannot sit in a broody position.

and vitality excellent. In summer, more eggs are fertile, but the vitality of the chicks is lower than earlier in the year.

10. Broody hens.—Hens kept mainly for producing eggs often annoy the poultryman by persistent broodiness. These should be culled out and never used for breeders. In otherwise normal hens broodiness may be broken when necessary. It is usually an advantage to allow the hens to hatch broods, since this gives them a rest from laying. Hens of the general purpose varieties usually lay better during the molt than hens of the noted egg breeds. These egg layers generally take a long rest, the sitters two or three short ones.

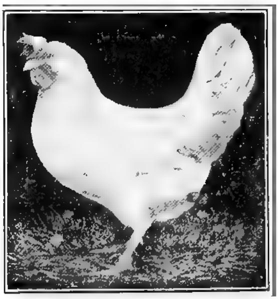
To break up broodiness, a quick way is to confine the hens with a reserve male in a pen where there are no nests. While so confined, the hens should be fed well on an egg ration. Often the hens will begin to lay within a week or ten days. Under no condition should starving be practiced. It is not only cruel and ineffective, but the poultryman who practices it pays the penalty by injuring the laying proclivities of the hen.

11. Selecting layers.—Laying hens are nearly always singers. They work and hunt for food all day, and are the first off of the roost and the last to go to roost. They are nervous and very active, keeping themselves up to the greatest possible pitch. In selecting layers, seek out the active, hustling kind and reject those dull, lazy and inactive.



Selected Barred Plymouth Rock Layer

12. Laying type.—The ideal laying hen should conform as nearly as possible to the following. She must be healthy; comb, wattles and face red; eye bright and lustrous; neck not short, but medium to long; breast broad and long, sloping upward; back, long and broad; abdomen, wide and deeper than breast; shanks well spread and rather long; V-shaped in three ways—on sides from front to rear, top and bottom from front to rear, and from base of tail, downwards; and well-spread tail.



Laying Type
A White Leghorn hen.

13. Laying ability improved.—Hens should be brought into laying as early as possible. When hens begin to lay in the fall, they are more likely to continue laying than if they are expected to start laying some months later. Many pullets which begin to lay in the fall are naturally poor layers and soon play out. The sooner such fowls are taken out of the flock the better. They should not be used for breeding. An important thing to remember in rearing fowls for winter laying is to have the pullets mature between September and November. This can be determined by the date of hatching and by the method of rearing.

FOWLS SELECTED FOR LAYING ABILITY

These are White Wyandottes and are an excellent type of layers. The trap nests have testified as to their laying qualities

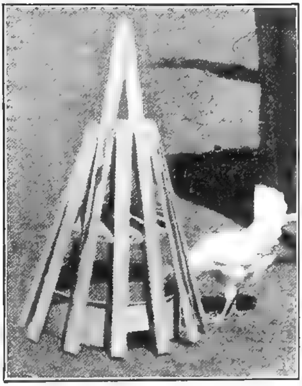
14. Management of laying flock.—So far as egg laying is concerned, the egg farmer's year begins in October. Everything should then be put in readiness for egg production. The pullets and hens should be placed in their permanent winter quarters and special care taken to prevent overcrowding. The sooner the flocks are made up, the better, as a rule, because they then get accustomed to their quarters, and there is less danger of upsetting them when they begin to lay. None but mature pullets should be selected for laying. All that are puny, undersized, lazy, weak or otherwise undesirable should be weeded out and sold for the table. They will not pay their board.

Only such hens as have proved their worthiness in the previous season should be kept over for a second or third winter. They usually make good breeders and the breeding flock should be selected from them rather than from pullets. Too often, however, in the farm flock, the reverse practice is followed. The hens that are in best condition are sold; the inferior ones are kept for egg production.

Laying Flock Taking Daily Exercise

These are early hatched birds which began to lay long before the approach of winter. They are healthy, thrifty, have good appetites and are carefully managed.

15. When hens molt.—It is just as important to feed well for eggs as it is to breed well for them. Contrary to popular opinion, hens that are molting should be fed well. It does not pay to stint molting hens. However, they should not get a ration too rich in nitrogenous matter, because they are not, as a rule, laying, and they do better when given a ration richer than usual in carbonaceous ingredients. Even if this is a fattening ration, it will do no harm. By this it is not meant that the nitrogenous matter should be cut out of the ration altogether. Feather production demands protein, which must not be fed too sparingly. It is preferable, as a general rule, to have fowls somewhat too fat than poor or even in merely good condition. By proper management many good laying hens will lay an occasional egg, even while going through molting, but this is not general.



PROTECTED WATER VESSEL

Pullets can be fed more highly than hens during the early fall months, because they already have their feathers and are still growing. At this time, they need abundant protein, because they are not only growing in flesh, but are filling out their bones and either preparing for, or actually laying. A pullet is by no means fully matured when she starts to lay. Ample food is needed to complete the development. For best results, however, pullets should not be unduly forced to begin laying early. Indeed, it is often advantageous to delay laying somewhat by frequently changing the pullets' quarters. This is the only method that can be practiced with safety. It will not do to withhold food.

LESSON THIRTY-TWO.

INCUBATION AND BROODING.

1. Hens for hatching.
2. Artificial incubation.
3. Incubator essentials.
4. Placing the incubator.
5. Eggs for hatching.
6. Trying out the machine.
7. Turning the eggs.
8. Testing the eggs.
9. Last days of hatch.
10. Transferring to brooder
11. First day in brooder.
12. First week in brooder.
13. From second to sixth week.
14. Hen-hatched chicks.
15. Sanitation.

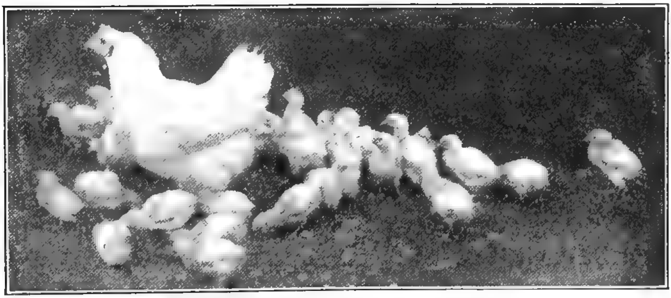
Note to the Teacher.—The purpose of this lesson is not to compare natural incubation with artificial incubation, but rather to define the essential factors that have to do with the proper handling of incubators and brooders. Certain fundamental principles are involved in all styles of incubators, and these should be understood as a first step in their successful operation. Make plain the importance of cleanliness and sanitation in hatching chicks regardless of the method of hatching the eggs.

LESSON THIRTY-TWO.

INCUBATION AND BROODING.

1. Hens for hatching.—The natural method of incubating or hatching eggs is by hens. Hens have the natural instinct of perpetuating their species, and after laying for a time they desire to raise a brood of their kind. Before breed specialization became an art and science, the hen laid a number of eggs and then was ready to sit and hatch them. But this system meant few eggs and many mothers. By breeding and selection the egg-laying habit has been fostered, and the egg-hatching instinct lessened. As a consequence some breeds of fowls have been developed in which the mother desire has been largely eliminated. This is an advantage where hens are raised largely for eggs. Where only a few chicks are raised each year, hatching by hens is a popular custom; on farms it is the most common.

2. Artificial incubation.—When it is necessary to hatch on a large scale and as rapidly and as economically as possible, the system is very different. To realize good



COMMON METHOD OF HATCHING ON THE FARM

profits recourse must be had to an incubator. The incubator is simply a machine or artificial hen that does for the eggs what nature demands. With eggs well fertilized a good hen will produce good chickens. A good machine well managed will give the same and even better results, but more care and attention will be required for machine-

TAKING THE HATCH FROM THE INCUBATOR

Having given close attention to all the details of selecting the eggs and running the incubator, this man hatched 93 chicks out of every 100 fertile eggs.

hatched than hen-hatched chicks. A great deal depends upon the incubator used. The closer it approaches nature in its work the better. Of the two types—hot water and hot air—either is satisfactory, providing the machine is well built and properly adjusted.

3. Incubator essentials.—Without proper and well-regulated heat there could be no incubation of the eggs. Top heat is essential; otherwise, rising from the bottom, it would evaporate the moisture from the eggs too quickly. Heat must therefore start not at the bottom of the machine under the eggs, but at the top over them. This heat must be stable. When a hen is brooding her temperature is about 104 degrees. The successful incubator must be capable of developing a top heat of 104 degrees to the eggs and keep it steadily at that point. While it is true that eggs under a hen vary in temperature according to position, they are changed in the nest

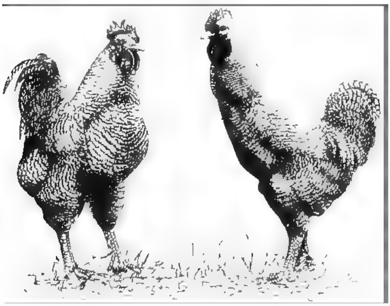
INCUBATOR CELLAR
Showing the incubators in place.

from time to time by the hen, as every farm boy knows, thereby, on an average, ranging from 102 to 103 degrees. Each machine must also possess sufficient ventilation. Fresh air is a perpetual necessity. Moisture is essential in successful incubation, but a saturated atmosphere is not wanted. The idea is to replace what has been evaporated through the machine.

Every reputable maker of incubators sends out instructions with his machine, and the purchaser should follow these implicitly. If he does not, he is running a risk. The instructions sent out with any machine are the result of experience with that particular make, and as the manufacturer's interest lies in obtaining satisfactory hatching, so the directions are to that end and should be valued.

4. Placing the incubator.—The incubator should be placed in a sunless room, or any place where the temperature is equable day and night, or fairly so. This should be airy, but sheltered from currents of air. Thus a cellar, an unused room, or a stable, is satisfactory. Where the raising of poultry is carried on on a large scale, a special incubator cellar or room is built. Whatever place is selected, it should not be damp or used as a dumping ground of decaying vegetables or filth. The whole secret of incubation is to maintain around well-fertilized eggs an even temperature and a regular circulation of sufficient fresh air. The placing of the incubator in a well-protected place has much to do with a successful hatch.

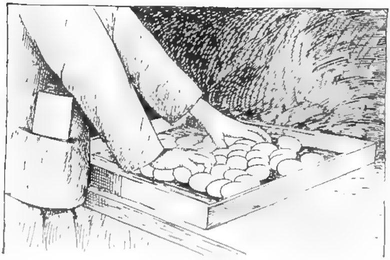
5. Eggs for hatching.—Whether the hen or the incubator is used, choose the right kind of eggs. Not only must eggs be fresh, but they must contain all the elements and germs that go toward making good, strong chicks. Unless they are carefully selected from stock birds, kept in such a manner as to insure a certain amount of animal vitality, they cannot turn out strong, lusty chicks. Always get eggs from the best sources and use eggs that are from pure-bred and selected strains.



Good and Bad Stock

Strong cock at left, but weak, undesirable individual at right.

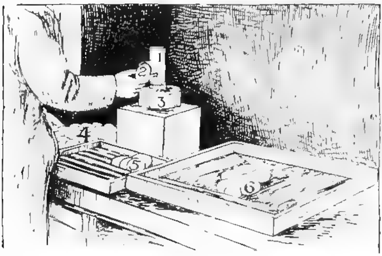
6. Trying out the machine.—Before filling the incubator after purchase or at the beginning of a season, try it out first to see if it runs properly and maintains a stable heat. First see that it sets level. Now the lamp is to be cleaned and filled with a good grade of kerosene to get a steady flame and no smoke. The lamp should be lighted and placed in position, as several hours will be required to dry and warm the woodwork thoroughly. When the thermometer registers 100 degrees, it will be necessary to examine the machine every 15 or 20 minutes in order to adjust the thumb screw in the regulator. When the thermometer registers 102 degrees adjust the thumb screw so the tin disk on the regulator arm will be just trembling on the rise. The machine should be run at least 24 hours before putting the eggs in. After the eggs are added the temperature will fall for a time until they have been warmed up to the rest of the internal parts.



TURNING THE EGGS

7. Turning the eggs.—Punctuality more than science is required for cooling and turning the eggs. The turning should be done regularly twice a day, from the third to the eighteenth day, after which the eggs should not be turned. The cooling of the eggs requires practice. At first it is done simultaneously with the turning, but as the hatch progresses the amount of cooling must be increased. After the seventh day, at one turning each day, the eggs are removed from the machine until they become cool to the touch. The time required for cooling will vary with the temperature of the room and the development of the embryos. The larger the embryos in the eggs the longer the heat is retained. Incubator eggs are not cooled after the eighteenth day.

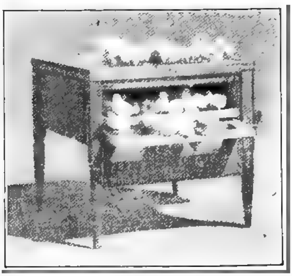
8. Testing the eggs.—When the eggs have been hatching seven days they should be tested. The testing of eggs is very easy, and after a little experience one should experience no difficulty in distinguishing the good from the bad. The proper way to tell a fertile egg is to take it between the thumb and forefinger and hold it before a strong light. If it is perfectly clear within, it is not fertile; if, on the contrary, a little black speck with red lines is seen to float inside of it, looking more or less like a spider in its web, it is certain to be fertile. The same examination should be made on the fifteenth day. The infertile eggs should be removed and kept to feed the chicks later.



TESTING EGGS

1, common tester; 2, egg properly held; 3, incubator lamp; 4, untested eggs; 5, infertile eggs; 6, good eggs.

9. Last days of hatch.—After the eighteenth day the machine is closed and not disturbed, except to fill and trim the lamp until the hatch is complete. While the eggs are hatching the temperature of the machine may go as high as 105, or even 107 degrees; this is caused by the animal heat given off by the chicks, and no attempt should be made at all to lower the temperature if the machine has been



THEIR LAST DAY THERE

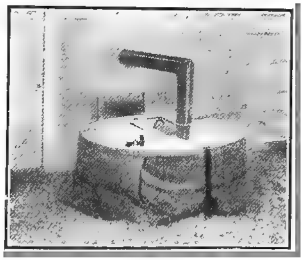
running properly just previous to the time of hatching.

As the chicks hatch they find their way into the nursery space or drawer of the incubator, which provides them all they need for 36 to 48 hours. They continue the absorption of the yolk, which serves as food, and find that the warmth of 95 to 98 degrees is pleasant and agreeable. This slightly lower temperature somewhat hardens their bodies and prepares them for the brooder temperature.

10. Transferring to brooder.—The newly hatched chicks should not be fed or watered in the incubator. About 24 hours before using the brooder let it be heated, making sure of its being dry and warm. The brooder lamp is now adjusted so as to get an even temperature of 95 degrees in the hover-covered space of the brooder. This temperature will be raised two or three degrees after the chicks are placed in their new quarters. During the first week the temperature is maintained at 96 to 98 degrees; after that time it is gradually lowered to 90 degrees at the end of two weeks. From now on a temperature of 75 degrees in the hover is sufficient.

Day-Old Chicks Ready for Shipment

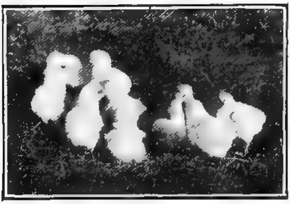
11. First day in brooder.—The first meal is due after an hour or two in the brooder. Nothing is better than a mixture of stale bread, rolled oats and infertile eggs from the incubator. Use for the mixture one-third stale bread, one-third rolled oats or oatmeal, and one-third hard-boiled eggs, shells and all, stirred up in milk. A sprinkle of chick-size grit or



Interior of 100-Chick Colony
Showing adaptable hover.

sharp, clean sand on the nursery food is advisable. Feed five to six times a day, from two to three hours apart. Give what the chicks will eat up clean in a period of 15 to 20 minutes. See that the backward ones are not crowded aside. Pure, clean water must be kept before the chicks; if the weather is cold, use lukewarm water. Drinking fountains are preferable to shallow pans because they prevent the chicks from getting wet.

12. First week in brooder.—After a couple of days the nursery food may be dropped for a less expensive ration. Many chick feeds are now on the market and these are excellent. Home-made mixtures may be secured by using ground wheat, ground oats, or barley and ground corn, and bran. Some green food is desirable. If green clover, alfalfa or grass is not available, steamed alfalfa meal, with an equal amount by bulk of bran and middlings, serves as an excellent substitute. The grain and other seeds comprising the chick feeds may be thrown into finely cut grass, hay or clover, or other loose material after the chicks are five or six days old, so they may get the fun and exercise of scratching it out.



WHITE WYANDOTTE CHICKS FIVE DAYS OLD

13. From second to sixth week.—By the time the chicks are seven or eight days old they should be allowed to run out of doors, especially on clear days, even if it is cold and raw. It is important that they be taught to go to their hover, however, before they

OUT OF DOORS

get chilled. They soon learn to go to the heat when they need it. Beginning with the second week meat scrap and charcoal ought to be added to the food. Chicks a week old crave both, the first for its muscle and ash materials, and the second for its aid in digestion. Charcoal prevents sour crop and bowel trouble.

A shallow tray containing a mixture of high-grade meat scrap, bran and charcoal should be in easy access of all the chicks. From the second to the sixth week this manner of feeding will yield healthy and vigorous stock, after which time other requirements having been met, little trouble should arise.

MOTHER AND HOME
The old, original fireless brooder—with brains to it.

14. Hen-hatched chicks.—If chicks are raised by hens, dust the mother hen thoroughly and often to destroy lice and mites, examine the chicks frequently for head lice, and if any are present touch the head with kerosene, and feed as outlined above for brooder chicks. When the chicks are a week old give the hen her liberty for part of the day. As she moves about some food will be secured, possibly bugs, insects and worms. There is nothing like a sensible mother hen to look after the wants of her young. She will scratch faithfully and find just the kind of grit, small seeds and grass conducive to the proper development of the baby birds. With good foraging ground, supplemented with grain or mash at the coop and a bit of charcoal and animal meal, it is pleasing to see how bright and smart the young chicks become, and how they grow day by day.

15. Sanitation.—Whether reared by hens or by incubator and brooder, final success will be due in no small degree to cleanliness, pure food and clean water. Filth in coop or brooder is a sure road to trouble; it invites disease germs and insects, and both are disastrous to

OUT-OF-DOOR HOUSE AND RUN

These may be readily moved, insuring cleanliness and sanitary quarters.

young chicks. If brooder chicks are fed in deep litter, a custom gradually extending, the litter should be removed at least once a week. The hover space should be kept clean at all times and disinfectants used fully to keep away germs and other poultry pests. In feeding, make sure, first to last, that no musty grain or sour food is given. Musty grain causes bowel disorders, and sour food diarrhea. Food and water should be kept scrupulously clean and pure.

LESSON THIRTY-THREE.

BREEDS OF THE DOMESTIC FOWL.

1. Origin.
2. Classification.
3. Egg breeds.
4. Meat breeds.
5. General-purpose breeds.
6. American races.
7. Asiatic.
8. Mediterranean.
9. English.
10. Polish.
11. Dutch.
12. French.
13. Indian.
14. Game.
15. Fancy fowls.

Note to the Teacher.—In this lesson the leading breeds of fowls are named and their most important characteristics pointed out. With this information in hand, each student will be able to select a variety best fitted to his own particular needs, and one that best suits his fancy and personal tastes. Whatever breed is chosen make certain that the foundation stock is well bred and of strong vitality.

LESSON THIRTY-THREE.

BREEDS OF THE DOMESTIC FOWL.

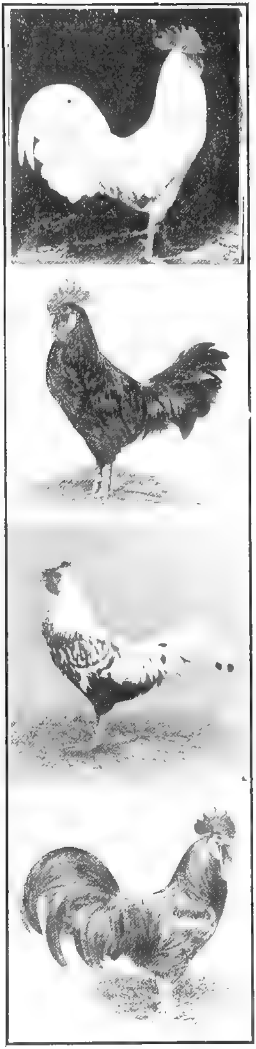
1. Origin.—Two wild species are involved in the ancestry of the domestic fowl, or chicken, as this class of scratching birds is popularly called. One is the jungle fowl of India, China and the East Indies, and still common in those lands. The other race, now extinct, was the Malay or Aseel fowl. The Aseel is thought to have been the first fowl domesticated. It was of stocky body and broad, and not given to flight. On the other hand, the jungle fowl is active, slender and flies with ease and pleasure. The early rearing of these heavier birds was in Oriental lands and of the lighter type along the Mediterranean coast.

Cock-a-doodle-do

Single Comb White Leghorn

2. Classification.—In this country 104 varieties of the domestic fowl have been recognized and described as standard breeds. These have been classified in various ways. According to whether they are fancy or practical; to their tendency to produce meat or eggs; to their tendency to be broody; and according to their place of origin. Games and bantams are known as fancy or ornamental, all the others as practical fowls.

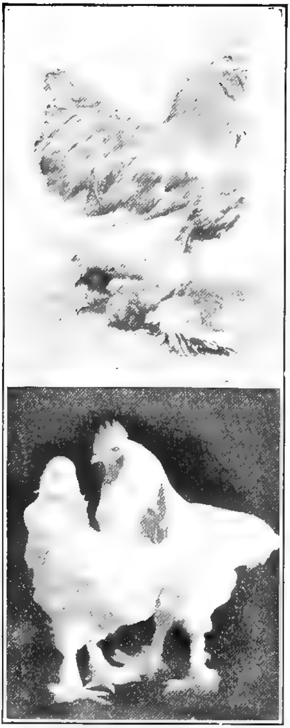
3. Egg breeds.—Most of the egg breeds are originated in the vicinity of the Mediterranean Sea. They are active birds, largely non-sitting, and not inclined often to enjoy close confinement in yards or runs, although they do well when so confined. Their preference is for the open fields where they have the chance to gather their own food. They are most at home in the warmer climates, but if proper provision is made for winter protection they do excellently, even where the cold is severe. In case the combs become frozen, they will stop laying for a time. They are excitable and nervous and fly at the least disturbance. The egg breeds most in favor are the Leghorns, Minor-



EGG BREEDS
From top down: White Leghorn, Minorca, Hamburg, Brown Leghorn.

cas, Spanish, Andalusian, Hamburg, Houdan and Polish.

4. Meat breeds.—Fowls of this class are not inclined to forage for food. They prefer quiet and ease, and therefore bear confinement well, and are not annoyed when handled or disturbed. They are great sitters, fly unwillingly and lay sparingly. Their phlegmatic nature is favorable to meat production when food is generously provided. The heavy coat of feathers protects in the coldest weather, making them at home in regions where the climate is severe. Asia is the land of their origin, which explains why they are called the Asiatic breeds. The best known meat breeds are the Cochins, Brahmas, Langshans.

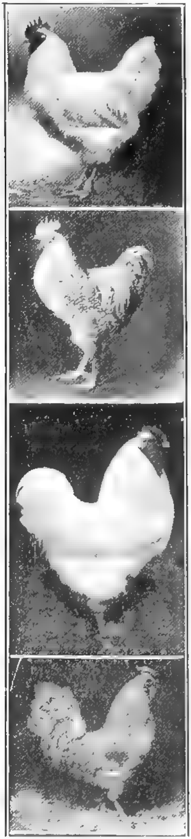


MEAT FOWLS

White Langshans at bottom; Buff Cochin at top.

5. General-purpose breeds.—A middle ground between the egg type on the one hand and the meat type on the other is occupied by the general purpose breeds. These are birds of medium size, and have blocky, compact bodies. They yield more eggs than the meat breeds and nearly as many as the egg breeds. Their flesh, while less in quantity than the meat breeds, is of excellent quality and cheaply grown. They adjust themselves to confinement or range conditions, make good mothers, are less persistent in sitting than the

Asiatics, and most nearly meet all the requirements demanded for a general farm fowl. The leading breeds of this class are the Plymouth Rocks, Wyandottes, Rhode Island Reds, Orpingtons, Javas and Dominiques.

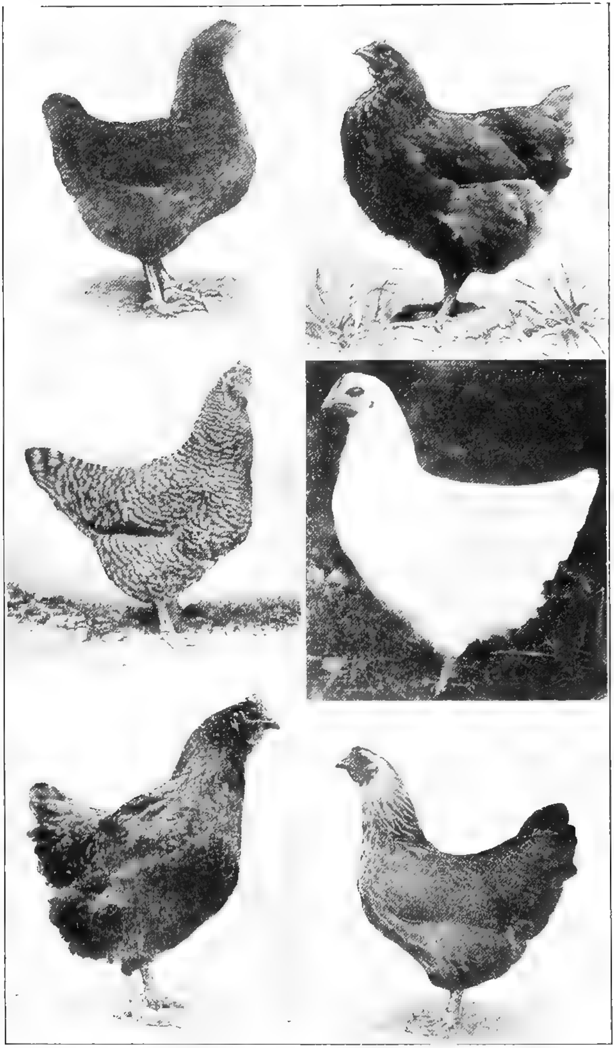


General Purpose

From top down: White Orpington, Barred Plymouth Rock, White Wyandotte, Rose Comb Dominique.

6. American races. — The general purpose breeds are American in origin and development, the Orpington, which is English, being an exception. The six American breeds comprise many varieties, the Dominique being the earliest of origin. In form they are compact and deep, cocks averaging eight and hens six pounds. Next in antiquity is the Java, in two varieties, Black and Mottled. They have single combs and clean shanks. The Plymouth Rock, the most popular American fowl, is of mixed origin, the Dominique and Java both being a part of the combination. This breed contains several varieties— the Barred, White, Buff, Silver-Penciled and Partridge. The original Wyandotte was the silver variety, but now the breed includes White, Buff, Silver-Penciled and Goldens. This breed has spread over the whole of Europe and America. They are hardy in cold weather, and their crests and combs never freeze. New England furnished the Rhode Island Reds. These are splendid birds, in three varieties, Single Comb, Rose Comb and Buckeyes.

7. Asiatic.—The Cochin China fowls



SIX LEADING GENERAL PURPOSE BREEDS

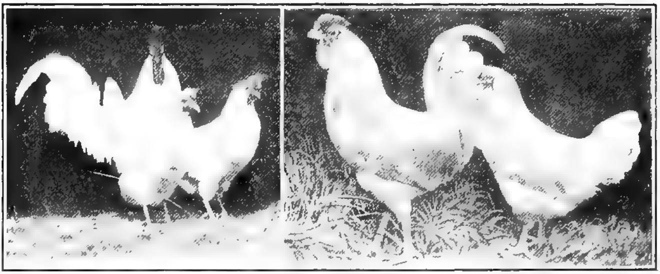
Top row: At left, Rhode Island Red; at right, Buff Plymouth Rock. Middle row: At left, Barred Plymouth Rock; at right, White Plymouth Rock. Bottom row: At left, Buff Orpington; at right, Silver Penciled Wyandotte.

are among the largest of the breeds. The meat is fair, the eggs small and few. The cocks attain a weight of 10 to 12 pounds. The Brahmas, also ponderous, are better rated as layers. Their keep is expensive on account of size. The Langshans are also fine, large fowls. Formerly they were black only, but now white and slate colored are seen. A cock weighs 10 to 12 pounds, a hen eight. They are fair layers, and the flesh is much esteemed.

Asiatic Breeds

Brahmas at top, Cochin hen in center, and Black Langshans at the bottom.

8. Mediterranean.—Among the important breeds coming from the region of the Mediterranean are Leghorns, Minorcas, Spanish and Andalusian. These are all small birds and noted for their laying qualities. The Leghorns are the best known of the group. There are several varieties, of which the white, brown and buff are the most common. Their combs are either single or rose, the single comb on the hen falling over to one side. All the Leghorns are hardy, their feathers lay snugly to the body, and they weigh three to five pounds, depending on sex and development. The skin is yellow, the breast prominent, the back of medium length and breadth. The Minorcas have long bodies, large combs, single or rose, dark-colored legs and a



Two Varieties of Leghorn Fowls
Single Comb White Leghorns at the left; Rose Comb Buff Leghorns at the right.

pink flesh skin. The back is long and sloping. This breed is more docile than Leghorns, but less able to stand severe cold. The Spanish breed is black in color, although a white variety is propagated. The comb is single. They are good layers, but are not common. They suffer in comparison with both Leghorns and Minorcas in hardiness. The Andalusians are larger than Leghorns and carry a bluish tone in color. They are prized as layers, but are not extensively bred.

9. English.—One of the best English meat breeds is the Dorking, a bird of massive appearance. The body is long, deep, wide and well rounded. Cocks weigh nine pounds, hens six to seven. The predominating colors are red, brown and buff. A breed known as Red Caps is popular in England for the many eggs they lay and the superior quality of their meat. They are smaller than the Dorking. The comb is rose and very large. This breed is rarely seen in this country. The Orpingtons possess many fine qualities. They are to England what the Plymouth Rocks are to the United States. They look very much like Plymouth Rocks and possess the same qualities, but differ most in their legs, which are reddish or black. The color variations are black, buff, white, variegated and spangled. They are single and rose combed. They are classed as a general-purpose breed and noted for their egg-laying and meat qualities. They are spreading rapidly and growing in popularity for farm use.

BUFF ORPINGTON

10. Polish. — Eight varieties constitute the Polish family, as follows: White-Crested, Black, Bearded Golden, Bearded Silver, Bearded White,

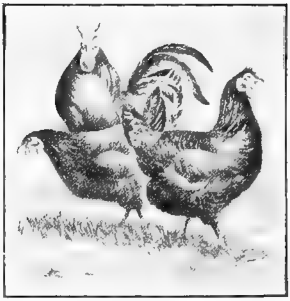
POLISH FOWLS

Buff Laced Nonbearded Golden, Nonbearded Silver and Nonbearded White. All are docile birds, and are exceedingly beautiful from the fanciers' standpoint. They lay a white egg, and if well fed and sheltered, give a generous supply. On account of their immense crests snow and rain are harmful to them. Hence, confinement and protection are necessary for their successful rearing.

HAMBURG

11. Dutch. — In the Dutch group the one breed of fame is the Hamburg. It has long been famous for its laying qualities. For years the term "Dutch Everlasting Layers" has been applied to these fowls. In size the Hamburg is about equal to the Leghorns, and, like them, lays a large white egg. The varieties of Hamburg are Golden Spangled, Silver Spangled, Golden Penciled, Silver Penciled, White and Black.

12. French.—The Houdan is the best-known breed in France, and nothing but good can be said of it. They are esteemed for their nesting qualities and lay a great many large, white eggs. The enormous topknots are against them in rainy weather because of danger from disease if frequently wet. The La Fleche breed yields in a way to the Houdans. Instead of a topknot they have two little horns, which give them a com-

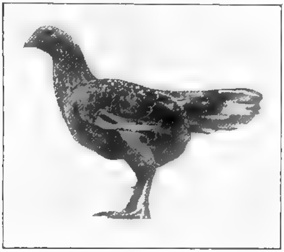


LA FLECHE

ical appearance. The usual color is black, although steel

FAVEROLLE

blue occurs, but is not common. They weigh six to eight pounds, according to sex. The flesh is white. The Faverolle has a topknot and a little above the beak two small horns protrude. They are hardy, handsome and good layers. Only three colors are considered in this country—salmon, light and black—although in their native district all colors are found. They weigh from five to nine pounds, according to sex.



WHITE LACED RED CORNISH

13. Indian.—The two varieties of this family are the Cornish and White. They are excellent market birds, the meat being of excellent quality and weight. The cocks weigh nine pounds and the hens six to seven. The shanks are yellow, the tail, breast and back are black in males and penciled black in hens. This breed bears a striking resemblance to the old Aseel of Indian origin.

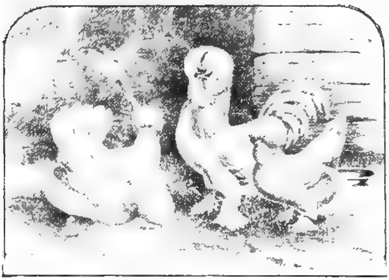
MALAY GAME

14. Game.—This family, embracing both fighting and exhibition fowls, is of peculiar formation. The Pit Game or English Game is bred for his belligerent qualities. The Games bred for exhibition purposes must show height, fierceness, strength and an extremely upright stature. Correct plumage is also of importance in winning prizes.

Red Pit Game

15. Fancy fowls.—Many distinct breeds and types belong in this list. The most prominent are the Bantams, Silkies, Sultans and Frizzles. The Game fowls belong to the fancy classification, as do also Polish and Hamburg varieties. The Bantams are the smallest, and are not only proud little creatures, but handsome also. Birds of this class are bred as pets or ornaments and not for eggs or meat.

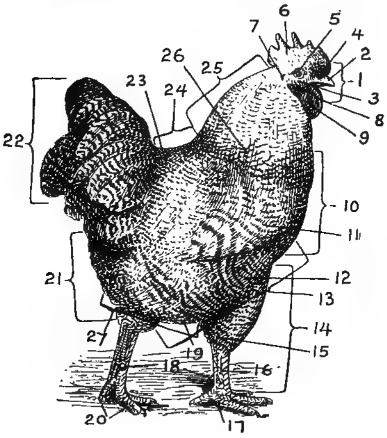
It must be said, however, that Polish and Hamburg varieties while too small for the table are excellent layers of fair-sized eggs. They are almost non-sitters, so cannot usually be relied upon for hatching. Polish fowls are undesirable on the farm because their topknots prevent their seeing hawks. Game fowls are specially good as mothers, because they will fight enemies. They are rather poor layers but fair table fowls.



Sultan

PRACTICUMS.

1. Parts of Fowls.—Have one or more live fowls for class work. Use the diagram in this practicum to locate each part on the fowl. Require each student to make sketch, and as the part or region is located, mark the name of the part on the sketch at the proper point. Continue this practice until each member of the class has learned the regions and is able to name the location without referring to his sketch. Definitions of each term should be learned and memorized.



Parts of Fowl

1. **Head**
2. **Beak**
3. **Face**
4. **Nose**
5. **Eye**
6. **Comb**
7. **Ear**
8. **Wattles**
9. **Ear lobes**
10. **Breast**
11. **Wing**
12. **Thigh**
13. **Body**
14. **Leg**
15. **Hock**
16. **Shank**
17. **Foot**
18. **Spur**
19. **Keel**
20. **Toes**
21. **Fluff**
22. **Tail**
23. **Saddle or Cushion**
24. **Back**
25. **Neck**
26. **Cape**
27. **Abdomen**

2. Egg Structure.—(1) Break an uncooked egg in a plate or saucer, separating the shell at the middle. (*a*) Note the germinal disk that lies on the upper surface of the yolk. (*b*) Note the whitish cords at the sides of the yolk toward the ends. These cords consist of densely formed albumen that hold the yolk in suspension. (*c*) Note the albumen or watery fluid, known as the white of the egg. (*d*) Note the shell, its construction, color; if a microscope is available, the pores may be clearly detected.

(2) Break the large end of a hard-boiled egg. Remove the shell carefully, not tearing the shell membrane. (*a*) Note the air space. (*b*) Try to separate the two membranes, at least a portion of each; the outer is much tougher and thicker than the inner. (*c*) Cut the egg lengthwise at the middle and observe the yolk layers and colors; also the germinal disk and its location. (*d*) Make a drawing of the

longitudinal section of the egg and include all the parts touched upon either in the text or in the observations noted above.

3. Scoring Eggs.—Provide several dozens of eggs. Use the score card below. After class practice the eggs may be disposed of by the owners in accordance with their custom. Local grocers usually will be glad to loan a reasonable number for this exercise.

Score Card for Eggs.

Points Considered	Perfect Score	Student's Score	Corrected Score
Size—large, weigh two ounces or more	25		
Shape—uniform	5		
Color—uniform, according to breed	10		
Shell—good texture, hard, no wrinkles, even	10		
Condition—bright luster, clean	5		
Air cell—small, enlarges with age	20		
Contents—opaque; thick white; light yolk	25		
Total	100		

4. Storing Eggs.—Storing eggs when prices are low and holding them till prices are high is a form of economy that everyone who has a cool cellar can practice. None but newly laid eggs should be stored. Preferably these should be laid by hens which have not run with a male bird for at least two weeks, because such eggs, being infertile, will keep better than fertile ones. Two very satisfactory methods have long proven useful. In either case, place the eggs in a stoneware crock or a wooden keg and cover with one or the other of the following solutions:

(*a*) *Water glass*, silicate of soda, a syrupy liquid, can be obtained at most druggists for 10 to 30 cents a pound. To each quart of it add ten parts of pure clean rain water. After mixing pour over and cover the eggs. Cover the vessel and keep in a cool place.

(*b*) *Lime-salt solution*.—Slake fresh stone lime with boiling water, adding a little at a time until it breaks into small pieces and forms a thin paste. Then add salt and more water so the final mixture will be at the rate of 1 pound lime, ½ pound salt and four quarts water. Stir several times after the lime has dissolved, then allow to stand overnight. In the morning siphon off the clear liquid and pour over the eggs.

Eggs stored by these methods will keep for 6 to 10 months. Those stored in water glass can be used for boiling, but unless those stored by the lime process are pricked with a needle they will crack because of the lime deposit upon them. For cooking outside the shells they should be almost as good as newly laid eggs.

Require each student to use from one to five dozens of eggs, testing each method at home. The eggs are to be kept, and after several months used in the home. Report later when eggs are used.

LESSON THIRTY-FOUR

FLOCK MANAGEMENT FOR EGGS AND MEAT

1. Grit.
2. Dry mash or wet mash.
3. Green feed.
4. Animal feeds.
5. Exercise.
6. Fresh air.
7. Ventilation.
8. Colony houses.
9. Permanent houses
10. Scratching pens.
11. Nests.
12. Broilers.
13. Roasters.
14. Winter layers.
15. Feeding the layers.

Note to the Teacher.—The obvious purpose of this lesson is to define the important factors in successful flock management, regardless of whether fowls are raised for eggs or meat, or both. The first seven paragraphs should be made emphatic because success with poultry is dependent upon good feed, grit, exercise, fresh air and cleanliness. More failures are due to disregard of one or more of these factors than to other causes.

LESSON THIRTY-FOUR

FLOCK MANAGEMENT FOR EGGS AND MEAT

1. Grit.—Fowls at liberty usually pick up enough grit except where the land is deficient in sand and gravel Where gravel is scarce grit must be supplied. Besides ordinary grit, it is desirable to supply other material for

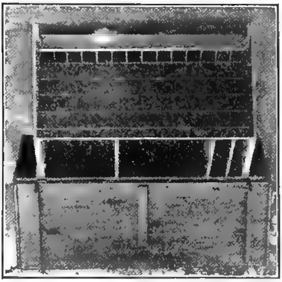
INTERIOR OF FARM CHICKEN HOUSE

Note the grit box and feed boxes at the side. They are built just high enough to make chickens reach for food. No dirt can enter.

forming the egg shells. Grain does not contain sufficient lime for great egg layers. Oyster and other sea shells are largely used, since they are very readily dissolved in the gizzard.

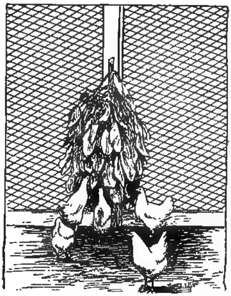
Lack of lime or other shell material in the ration often leads to the egg-eating habit among hens. Charcoal is useful as a bowel regulator. Many poultry keepers keep it constantly before the hens. Salt in moderation aids digestion. An ounce or two daily is sufficient for 100 hens. Pepper, which acts as a stimulant, should be fed sparingly. Vigorous hens do not need it.

2. Dry mash or wet mash.—Fowls enjoy wet mash more than dry, but dry mash saves labor, since enough may be put in the hopper to last a week. When fed wet at least one feeding must be given daily. Since fowls eat wet mash more greedily than dry, more care must be exercised to avoid overfeeding. Where skim milk is available the ration may be cheapened by using it to wet the mash. Bran and middlings may be made to take large quantities of milk, and thus to balance and cheapen the ration. When skillfully fed, wet mash should give better results in egg yield than dry.



Range Feed Hopper, with Lid Open, Showing Divisions

3. Green feed.—Lack of green food is sure to affect egg production unfavorably. Flocks at range secure abundant green food, but flocks in yards and in winter quarters must be supplied. It may be fed without stint at all times. Among the best feeds are clover, alfalfa, grass, vetches, pea vines, rape, rye, mangels, kale, cabbages, sugar beets, turnips—in fact, anything and everything the hens will eat. During the winter cabbage is especially useful. Root crops are also good. The leaves and broken heads from the hay mow may be steamed if desired. Alfalfa and clover give good flavor and quality to eggs.



Green Feed

Fastened up as here shown is the best way to feed coarse green stuff.

4. Animal feeds.—Animal food of some sort is desirable to maintain fowls in vigorous health and productivity.

Probably no one thing has done more to increase profits than feeding animal food. Chickens when at liberty during summer secure abundant animal food in the form of bugs and worms. Something to take the place of this feed is necessary, especially when snow is on the ground. Lean meat is the best form to feed. It furnishes ample protein. The presence of a little fat does no harm and may be an advantage. Fresh meat scrap from the butcher is an excellent egg maker.

FISH NET
Green feed holder.

Skim milk is a good substitute for animal feed if given liberally, but it is not concentrated enough. When used as a drink hens will not take enough to supply their demand for animal feed. Milk is well used for mixing the wet mashes by feeding it clabbered, and best in the form of cottage cheese, which is a particularly good form when well made. The most convenient form of animal food is beef scrap, a by-product of the packing houses. It has been boiled and dried and contains meat and bone in varying proportions. It should always be light colored, have a meaty flavor and be rather oily to the touch. When boiling water is added to it, it should smell like fresh meat. If a putrid odor is given off it should not be fed.

5. Exercise.—A roomy scratching shed covered with 8 to 12 inches of straw is splendid for exercise. This straw should be dry and whole grain should be scattered in it. There will be no waste; the fowls will find the last kernel. The aim is to feed enough at a time without having to feed too often, so as to keep the hens busy most of the day. When too much feed is given at a time the fowls soon become satisfied and will stop eating. It is not essential to keep fowls scratching all the time. The more active breeds do nearly as well when fed from hoppers. When given a yard and a floor they will take sufficient exercise whether forced to scratch or not. For the larger, less active breeds, however, it is necessary to force exercise. Idleness ruins both health and egg production. No breed of fowls is injured by having exercise and most breeds profit decidedly.

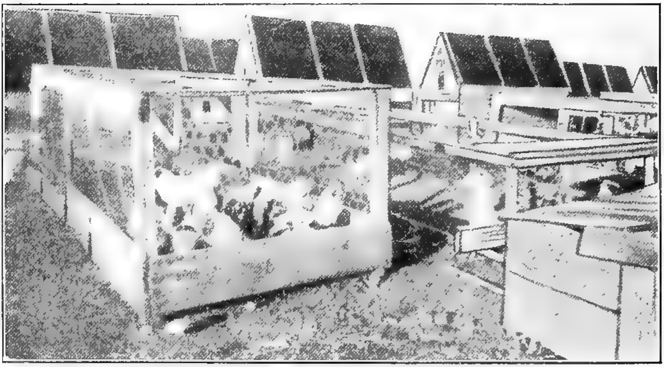
COMING OUT FOR DAILY EXERCISE
The fowls are permitted to roam about for exercise. At night they return to the colony house for food and shelter.

6. Fresh air.—Properly constructed poultry houses will not need special ventilation. But for good egg production there must be abundant fresh, dry air to remove dampness given off from the fowls' breath and from droppings. No way has been found so satisfactory as to have the house rather open on the front and tight on all other sides and the roof. The opening should be covered with burlap or other material to check draft and keep out snow and rain. Such houses may

IDEAL FRESH AIR HOME
Rats cannot enter, and the floor is never damp

be somewhat cooler than houses more tightly closed, but the air will be pure, and pure air is far more important than warmth. This does not, however, mean that warmth is not also good.

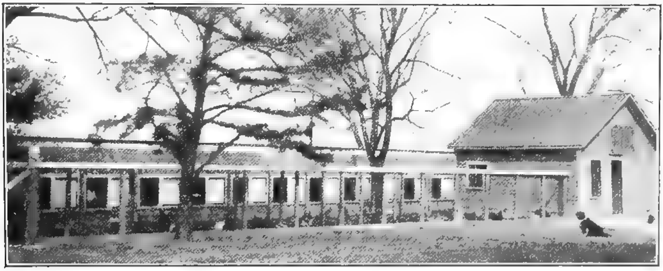
7. Ventilation.—No ventilating system compares in good results with one open at the front, but where one must be put in, it is best to have the vent near the floor with a tight box leading through the upper part of the house and through the roof. The inflow of air should enter near the bottom on the outside and be conducted to the ceiling so that it will be comparatively warm before it enters the house. Thus drafts will be reduced to a minimum and yet there will be sufficient circulation of air to remove moisture and impurities. Under no circumstances should a ventilating system be given preference over the more natural diffusion system already mentioned. The difficulties of making the thing work increase as the temperatures inside and outside approach each other, and also as the openings in the house increase.



Piano Box Colony Houses at the Farm

Each of these houses was built of common piano boxes. They are simple, inexpensive and serve the purpose as well as the more expensively constructed buildings.

8. Colony houses.—Where fowls are kept in considerable number two plans are common—the colony plan and the long-house plan. The colony affords good range. The houses are exceedingly convenient for placing in orchards and fields, where by the aid of hoppers and drinking fountains the flock may be encouraged to take care of itself to a large extent. After the chicks reach a fair size and the hen has left them, roosts should be placed in the house.

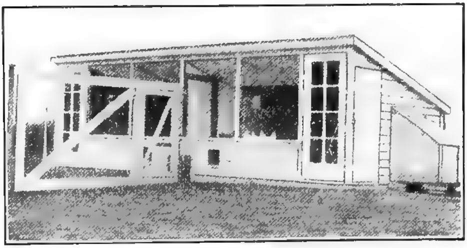


LONG-HOUSE PLAN OF FARM POULTRY BUILDINGS

Permanent buildings of this kind cannot be moved from place to place as can the small colony house.

9. Permanent houses.—These may be built in any style and shape. It is best to have the ceiling rather low. This favors warmth, because the fowls can keep the temperature comfortable if sufficient numbers are kept together. For permanent houses foundation walls should extend below the frost line and high enough to prevent the inflow of water during wet weather. Have the foundation rat proof and strong enough to support the building economically. Brick, stone, or concrete foundations are best as a rule. Floors should be smooth, hard, easy to clean, dry and durable. Unless ground is naturally dry it should be drained. Too much emphasis cannot be laid upon securing dryness. A tight wall is essential.

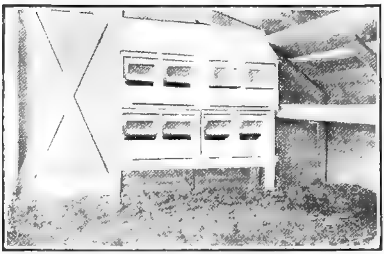
10. Scratching pens.—The styles and arrangements of pens are legion. The open scratching shed is favored by



COLONY HOUSE IN TWO DIVISIONS

One division may be used for scratching pen in winter, the other retained for roosting and nests.

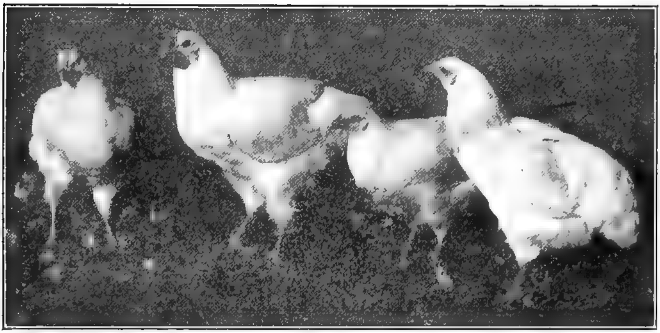
many, since it provides space for the fowls to exercise in spite of any kind of weather. All sorts of modifications are found. Its chief advantage is that the fowls may go from house to shed, or the reverse, and thus feel more at liberty than if confined closely. They are also less likely to become excited if they have a means of escape when they want to get away from an attendant. Everything that makes for comfort should be secured when possible. The scratching pen is considered essential to good health of the fowls because it insures exercise and the fowls are not confined in too warm a room while they are busy.



TRAP NESTS

11. Nests.—Nests may be made of any

kind of material, style or character. Preferably they should be darkened and placed in secluded parts of the house or yard. A favorite place for them is beneath the roosting platform. Where egg eating is discovered the dark nest is one of the best ways to eliminate the habit. Trap nests show which hens are the layers and which the drones. Where one is breeding for egg production they are a necessity.



BROILERS PROPERLY FITTED FOR MARKET

12. Broilers.—More than 90 per cent of the chickens sold as broilers come from poultry produced on egg farms, fancy yards and general farms where they are a by-product and must be got rid of quickly to prevent loss. Cockerels may pay more than the cost of feeding, but unless they can have free range they are not likely to pay the whole cost of their production, counting the value of the eggs, the cost of hatching and the labor and the feed, up to the time of their being marketed. Unless one has facilities for fattening and thus disposing of his cockerels as roasters or capons, it would be more economical to sell the broilers as soon as they are of marketable size.

13. Roasters.—What is known in the market as a roaster is a fairly matured fowl large enough, either alone

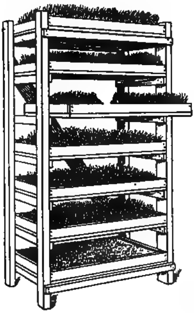
DRESSED FOWL FOR THE ROASTER TRADE

One way of finishing for the roaster market. The fowls are White Wyandotte cockerels less than four months old. Such choice individuals are obtainable by rational methods of feeding and with general purpose and meat breeds.

or with another roaster, to supply a family dinner. These fowls are most profitably raised by being allowed free range of the stubble fields, pastures, meadows and orchards, where they pick up a large share of their living between the time that they can leave the brooder or the mother hen and the time they are sold. Frequently they are fattened for two weeks or so before going to market so as to add a pound or more to their weight. They are more profitable than broilers raised in the ordinary way on the farm.

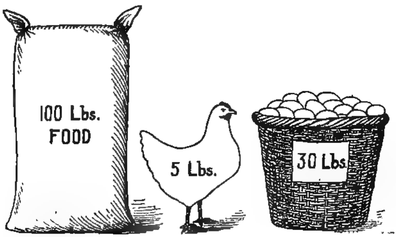
PROPERLY FINISHED PLYMOUTH ROCK HEN

14. Winter layers.—It is a much disputed question whether pullets or hens do best as layers. Many poultrymen claim that pullets are superior, and, therefore, the more profitable, but there is nothing decided on this subject. Many egg farmers get excellent egg yields from hens two to four years old—fully as good as from pullets. Because of this fact, it is evident there is much in the method of management and in the breeding. For this reason a hen should not be sold so long as she lays well. A hen on the nest is worth two pullets in the field.



SPROUTING OATS

15. Feeding the layers.—In winter quarters and fed for eggs three special meals a day are desirable. For breakfast give a combination of several grains scattered deep in a loose litter. At noon give a mash, wet or dry, and with or without alfalfa and meat meal. For supper give grain in the scratching litter, feeding enough so that there will be some left for the fowls to begin on in the early morning when they come off the roosts. Layers of the egg type will consume about three ounces daily of the grain mixture, or about 18 pounds to each 100 fowls. Of the noon mash about five quarts will be required for each 100 fowls. It will take from 15 to 20 minutes for that number to clean up this quantity. If meat scrap is not included in the mash place in hoppers as a



HEN, FEED AND EGGS

The hen is the means of changing raw food material into a highly concentrated finished product.

steady dish. Some green food should be fed each day.

A ration recommended by one of the leading poultry schools for winter egg production is as follows: For grain, a mixture of 100 pounds of cracked corn, 100 pounds of wheat and 50 pounds of oats fed in deep litter sparingly in the morning and freely at night. Mash is fed in the afternoon in hoppers. The mash mixture consists of the following: 60 pounds of wheat middlings, 60 pounds of corn meal, 50 pounds of beef scrap, 30 pounds of wheat bran, 10 pounds of alfalfa meal, 10 pounds of linseed oil meal and a half pound of salt.

LESSON THIRTY-FIVE

DUCKS AND GEESE

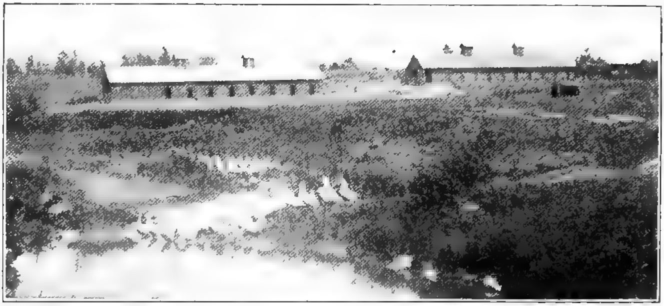
1. Duck growing.
2. Farm ducks.
3. Hatching and first care.
4. Three types of ducks.
5. Meat breeds.
6. Indian runner duck.
7. Marketing ducks.
8. Raising geese.
9. Characteristics of geese.
10. Toulouse geese.
11. Embden geese.
12. Chinese geese.
13. African geese.
14. Rearing the goslings.
15. Goose and duck feathers.

Note to the Teacher.—There is a place for ducks and geese on many farms. Ducks may be grown successfully in larger flocks than can any other kind of poultry. Geese will utilize waste, marshy land and thus make a profit where there would be no income at all. Unless the grazing area is ample, geese must be kept in small flocks.

LESSON THIRTY-FIVE

DUCKS AND GEESE

1. Duck growing.—It is easier to raise ducks than fowls. They are less sensitive to filth in food, give less trouble and are almost completely free from disease. If sufficient space is available they lend themselves to rais-

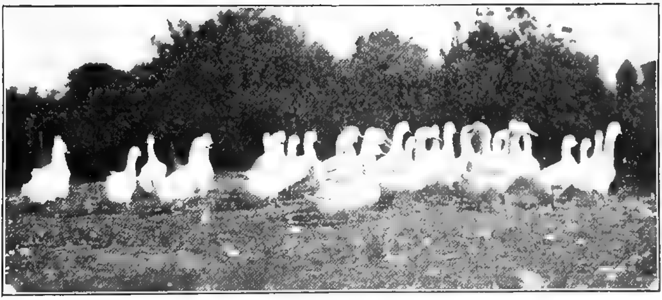


Brooder House on Duck Farm
Where thousands of ducks are annually raised.

ing in very large flocks. Indeed duck rearing is about the only branch of poultry culture in which plants of large capacity have been successfully established. In a number of such establishments 5,000 to 10,000 ducks are annually produced. In others there is a still larger output, from 15,000 to 20,000 being common, and in a few from 40,000 to 60,000 as the yearly production.

These large plants call for much capital, large experience and great skill and knowledge. Such plants are located on large areas where streams or the ocean coast provide natural comfort. In such locations the breeding ducks are in their element. Ducks intended for market rarely have a chance to swim. They are confined to yards and fed special rations until about 10 weeks old.

2. Farm ducks.—But ducks lend themselves to farm culture also. They dislike coops or inclosures; and as soon after hatching as it is safe to let them out they should be allowed the open fields and orchards, but not access to any but drinking water until they are feathered. If a running stream is near they will in a large measure gather their own food. The farm flock generally takes care of itself, but provision of housing so as to secure the eggs during the laying season is necessary, else many will be lost. Laying ducks usually are confined indoors at night and until they have laid in the morning. To have well-fertilized eggs from the old ducks not more than six to eight should be given to one drake.

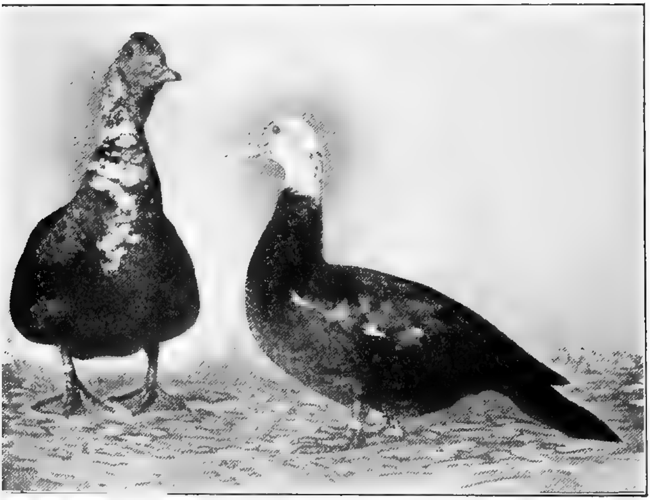


FARM FLOCK FOR EGGS, MEAT AND FEATHERS

3. Hatching and first care.—While it is not uncommon to allow old ducks to hatch their eggs and to brood the young ducklings, the eggs are generally hatched by hens. This is because of the better care these false mothers give during the early days after hatching. Four weeks are required for incubation. After quitting the eggs the ducklings are shut up for a few days and fed on soft food or moist mashes. Frequently, hard-boiled eggs are mixed with the soft food. The first feeds of the soft mash and an occasional feed for a week or more should contain coarse sand or small grit. This is not only to supply grinding substance but also mineral matter. After this the ducklings may be let out into the yard or field. Animal food should not now be denied as it is essential to growth; earthworms, insects or meat meal are excellent.

Hen and Ducks

A good ration for ducks, and one used by many successful smaller duck growers, consists of one part of corn meal and two



Muscovy Ducks

parts of bran. To this is added five per cent beef scrap and a little fine grit or coarse gravel. Feed five times a day for the first five weeks then three times a day. An occasional feed of green food is desired. The birds are fattened by allowing all they will eat.

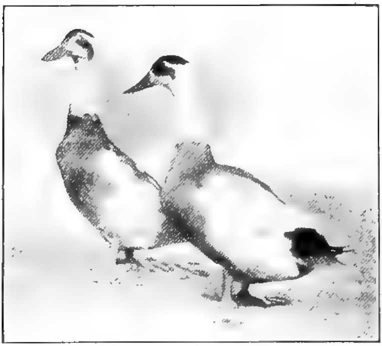
4. Three types of ducks.—The races of improved ducks are of three distinct types: The meat breeds, of which the most common are the Pekin, Aylesbury, Muscovy, Rouen and Cayuga; the laying breeds, the best representative of which is the Indian Runner; and the Ornamental, such as crested white and call ducks.

5. Meat breeds.—The Pekin occupies a foremost place in the duck world. It comes originally by way of England from China, is white in color, very docile in disposition and very hardy. Most of the ducks raised for market in America are of this breed. In the special duck plants this race only is selected.

PEN OF PEKINS

The Aylesbury, which the uninitiated can seldom distinguish from the Pekin duck, has also made itself a reputation for excellence. In England, the land of its development, it is famous, and is preferred over all other races. Rouen ducks originated in France, and are prized as layers as well as for the high quality of their meat. The male is gray to brown with green on head and wings; the female from gray to brown. The Muscovy duck is originally from South America. In color they are white, or black and white. The Cayuga, a black duck of New York origin, is very similar to the other races.

6. Indian Runner duck.—Not long ago this breed was comparatively unknown. Its fine merits have made for it a world-wide reputation. It is one of the most fertile of ducks, selected strains laying as many eggs as the best laying strains of hens. It is also very good, though small, for the table, its flesh being extremely delicate. It is very active and can fly far. These birds have no absolute need of water; they prefer to roam the pastures and grain fields in search of worms, insects and grain. For the reasons mentioned this race is fast becoming the most popular and most extensively farm-raised duck.



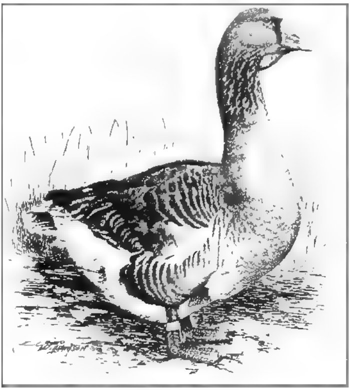
INDIAN RUNNER DUCKS

7. Marketing ducks.—Ducks may be kept for layers, or meat, or a combination of the two. As such they are a side issue and no rule is followed as to the best time

RAISING MARKET DUCKS ON A LARGE SCALE
A plan where fattening ducks is carried on extensively. Here thousands are annually raised and sent to market.

of marketing. On many farms ducks are consumed on the home table and none are ever sold. A different condition obtains in the commercial plants, whether large or small. The effort is to bring ducks to a marketable size at as early an age as possible. Most of the young ducks are not kept longer than 12 weeks because they are large enough then to sell and have not usually started their second crop of pin feathers. For this reason they are easier to pluck than when somewhat older. At this age they should weigh, dressed, five to six pounds. They are sold as "green" ducks. The profit to the grower is in this form. Ducks fed and fattened to a maturer age, when a greater proportion of the weight is meat, bring no more on the market than these soft-fat and cheaply produced green ducks.

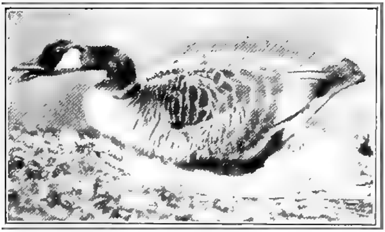
8. Raising geese.—Geese are not as generally grown as ducks. A considerable demand for "green goose" gives rise to much activity in geese raising in some places. Mature young geese are relished, but their cost is usually greater than the returns they bring when marketed. If geese had to be fed on grain it would not pay to raise them; the expense would be greater than the price received.



POPULAR TOULOUSE

Only during the first three or four weeks is it advisable to give the goslings a little meal, carefully mixed. As a farm race they have their place, not for eggs, for the best breeds will seldom give more than 30 a year, but for the tasty meat any of the breeds will provide.

9. Characteristics of geese.—It is believed that to have eggs well fertilized the geese must live near a pond or running water. A gander over two years of age is preferred in breeding. Hens are best for hatching these eggs. Mature geese are strong physically and usually manifest a combative nature. The improved races are of large size and may be kept at no great expense. They will thrive on grass alone during the growing season. In some parts of Europe vast numbers of geese are raised for the city markets. The goose girl goes to the fields every morning with her flock, returning at night to her home where her charges are stabled.



DEFENDING THE NEST

At brooding time geese are generally hostile and combative.

10. Toulouse geese.—The giant of all the goose races is the Toulouse, a native of France. Its ordinary weight is from 15 to 20 pounds, but many specimens have been known to reach weights from 25 to 30 pounds or more. Where range is not ideal, these are probaby the best geese for the farm. It is thought to do better without a swimming area than other breeds. In general ap-

TOULOUSE GEESE

pearance it resembles the common farm goose more than the other breeds, but is much larger than these scrub geese. It is gray, though beneath and behind there are white areas in the plumage; the legs and the bill are orange. During their first year young geese lay 15 to 25 eggs. When older they may lay from 25 to 40. The breed is very quiet, but in spite of its wide popularity, is not ranked very high in the market.

11. Embden geese.—The Embden is the chief rival of the Toulouse. While its standard weights are the same as for the Toulouse, a smaller proportion of the birds attain these weights. The plumage is white; legs and bill yellow. The Embden when well bred and properly prepared not only makes the best looking carcass, but is superior to other breeds for marketing. One of the chief disadvantages in purchasing specimens is that there are many poor flocks in this country, poor not only in breeding, but poor in ability to lay. Intending purchasers should be careful in buying for these reasons.

EMBDEN GEESE

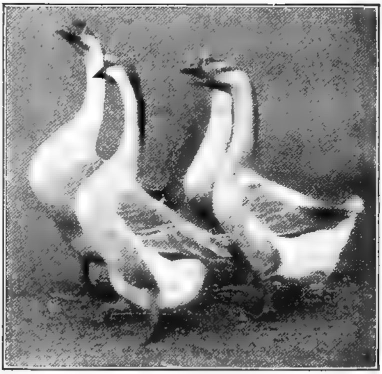
12. Chinese geese.—Of these there are two varieties—Brown and White. Their form and carriage are different from the two breeds already mentioned. They stand much more erect, have much longer and slenderer necks. In the Brown Chinese, at the base of the bill is a peculiar dark-colored knob. The standard weights are 14 pounds for the adult gander and 12 for the geese. The Brown variety is considered the most prolific of all geese.

Under ordinary management the females will lay 40 to 50 eggs, or even more, and these eggs are noted for their fertility.

Brown China Geese

One of the chief disadvantages is that the carcasses are exceedingly hard to pluck and, when dressed, make the poorest appearance of all kinds of geese. In the White Chinese the plumage is white throughout, the bill and legs are orange colored and so is the knob at the base of the bill. While the geese lay as well as their brown cousins, their eggs are less fertile. White Chinese geese rival the Embden geese in the market. Their carcasses make a far better appearance than those of the Brown.

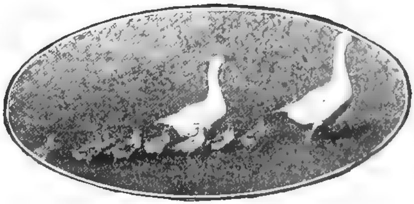
13. African geese.—These are not nearly as common as other large varieties. Their color is gray, dark above, light below. On the back of the neck there is a dark stripe. Their weights are the same as for Embden and Toulouse. The bill is black and has the same kind of black knob characteristic of the Brown Chinese variety. The eggs are orange colored. As a rule, the geese lay better than the Embden, but not so well as the Toulouse, and the carcasses, especially of old birds, are hard to make look



African Geese

well for the market. The skin is dark, and this unfavorable color is not improved by the presence of down and pin feathers which are usually very hard to remove.

14. Rearing the goslings.—Little goslings are very dainty eaters at first. During the first few days bread crumbs, soaked in milk or water and squeezed nearly dry are very good and are relished. This feed may be given three or four times a day with plenty of water to drink. The drinking fountain should be arranged so the goslings cannot wet more than their bills. During the second week a mash of equal parts ground oats, bran and corn meal, mixed with hot water, may be fed cold five times a day and continued until the goslings are a month old. After the first few days they may have the freedom of a small pen where there is plenty of grass, and when two weeks old, their range may be extended. Clover and alfalfa are especially good.



ON THE WAY TO THE POND

When one month old the same mash may be used morning and evening, with perhaps a meal at noon. Some breeders prefer to feed the mash at morning and noon with cracked wheat at night. Until the goslings are fully feathered they should be kept out of water and only those intended for breeding should learn to swim. When two months old, feeding may be reduced to twice a day —soft feed in the morning and cracked corn or wheat, or a mixture of these two grains, at night. From this time forward the goslings may be allowed to roam at will.

15. Goose and duck feathers.—There is probably less waste of geese and duck feathers than of chicken and turkey. The prices are considerably higher and the uses more numerous; yet it is probable that many bring a lower price than they should because of the imperfect methods of sorting and curing. The birds should be dry picked, to save the animal oils which give the feathers their "life." The reduction in grade because of scalding is not as great with geese and duck feathers as with turkey and chicken. The birds should be immersed for only a very short time and the drying properly attended to. The feathers from the two kinds of birds should be kept separate, but otherwise the method of handling is simple.

LESSON THIRTY-SIX

TURKEYS AND GUINEAS

1. Wild turkeys.
2. Mammoth Bronze turkeys.
3. Narragansett turkeys.
4. Black or Sologne turkeys.
5. White or Holland turkeys.
6. Buff and Red turkeys.
7. Laying season.
8. Confining the layers.
9. Breeding stock,
10. Hatching.
11. Rearing.
12. Shooting the red.
13. Feeding.
14. Johnnycake.
15. Guineas.

Note to the Teacher.—Turkeys and guineas are least removed from their natural wild state. For this reason emphasize the necessity of somewhat "natural" conditions for raising them. They have a place on farms where such conditions, notably free range after the baby stage has been passed. Neither fowl is adapted to "commercial methods" such as yarding in large flocks.

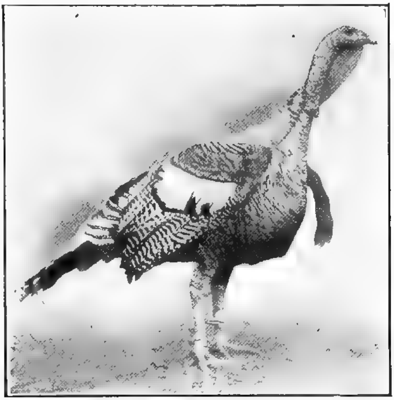
LESSON THIRTY-SIX

TURKEYS AND GUINEAS

1. Wild turkeys.—The wild turkey is a native of America. It was taken to Europe by sailors and explorers and early brought into a domestic state. There are villages in France where turkeys are kept at the public expense. The birds are individually owned, but the care of the village flock is in the charge of a paid employee, who takes them to the open fields in the morning and returns them to their homes at night. Wild turkeys still exist, but their numbers are few. At one time flocks of 50 or 100 were common, but the constant spread of settlers and the continuous hunting expeditions have scattered these beautiful wild birds, depleting their ranks and destroying their haunts, until their glory has become a thing of the past.

YUM, YUM

2. Mammoth Bronze turkeys.—Unquestionably the best known variety of turkeys is the Bronze or Mammoth Bronze. This is not only the most striking in appearance, but also the largest. The adult tom has a standard weight of 36 pounds and the hen 20 pounds. Much greater weights than these are often reached. Usually, however, these heavy weights are not for sale by fanciers. One objection to the Bronze variety is that the hens are considered poorer layers than hens of the other kinds. In color the sexes are alike, except that in males it is more vivid. The feathers are bronze or dull black with bands of white across. The bronze tints give pleasing color effects. This variety is the domesticated type of the wild turkey. Through selection and breeding the color tones and markings have been made more vivid and brilliant. In size the domesticated variety is also larger.

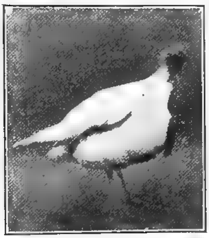


MAMMOTH BRONZE TURKEY

3. Narragansett turkeys.—This variety is a close second to the Bronze in size and popularity. Its standard weights are 30 pounds for the males and 18 pounds for the females. In general, the color is gray, mixed with black. They get their name from the bay near which their development as a breed occurred.

4. Black or Sologne turkeys.—In Europe this breed is very popular, and there it is considered unsurpassed by any variety. It is a superb animal of brilliant black color and often reaches a weight of 30 to 40 pounds. Turkeys of this variety in this country are known as Norfolk turkeys.

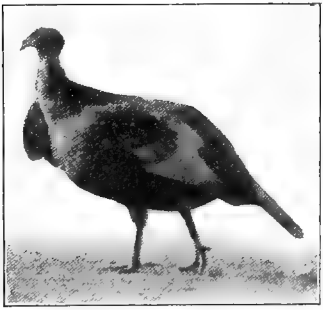
5. White or Holland turkeys.—This is the smallest variety of turkey. Its standard weights are 26 pounds for toms and 16 pounds for hens. Locally, in many places they surpass the Bronze variety in popularity. They are reputed to be better layers and more home loving than some of the other breeds.



HOLLAND TURKEY

6. Buff and red turkeys.—The turkeys of these varieties are uniformly colored, as their names imply. They weigh 27 and 18 pounds respectively for cock and hen. Though fairly well distributed throughout the country they are by no means as popular as either the Bronze or Narragansett.

"The Bronze turkey is everywhere recognized as altogether the best existing type. Considering its qualities collectively, it may be doubted whether the type can be improved upon. It is a rugged race, growing sometimes to great size, but on the average not up to the standards for exhibition weights for other varieties."—Robinson.



BOURBON RED TURKEY

7. Laying season.—As a rule turkey hens begin laying very early in the spring. For best results it is desirable that they be encouraged to lay in places convenient for gathering the eggs. Turkey hens, especially young ones, rarely lay more than a dozen eggs before becoming broody. They may be broken and made to lay a second clutch of eggs. Older hens seldom lay more than 18 for their first litter and not quite as many in the second of the season. The eggs should be collected daily and stored in a cool place until they can be set. Eggs from specially productive and otherwise desirable hens should be marked and set separately, so their progeny can be marked when hatched and thus be given preference when selection for breeding takes place the following autumn. It is a safe precaution to put hens' eggs in the turkey nest to keep the turkeys contented when laying.

8. Confining the layers.—During the laying season, many turkey raisers confine their flocks to comparatively small yards, at least until the hens have decided upon a place to lay. After the first two or three days of laying, the hen turkey will rarely desert her nest, so that when the whole flock has begun to lay it may be allowed full freedom. As a modification of this plan, breeders keep the flock confined until about noon each day, until the hens are laying. This practice saves much time which otherwise would be needlessly wasted in watching turkeys to find out their nesting places and then walking daily from nest to nest to collect the eggs. A score of

BREEDING FLOCK OF BRONZE TURKEYS

This farm flock has the run of the feed lots and fields. Ordinarily, best success with turkeys is attained when range conditions are resorted to. The eggs hatch better and the birds are stronger and more thrifty.

hens may be kept without difficulty in a yard 75 feet square. This inclosure need not be fenced very high. Few turkeys will attempt to fly over a woven wire fence 5 feet high.

9. Breeding stock.—For best results turkey hens should be two years old and cocks three years old or more. They will prove useful for eight or 10 years, or even longer. The customary size of a flock is 10 to 12 hens to one tom, though often as many as 18 or even 20 hens are used.

None but the very choicest, quickest growing, and best birds in every respect should be selected from each year's young flock to replace the old ones that have survived their usefulness. In this way the flock can be steadily improved in size of birds, in precocity of development and in stamina.

It is usual for turkey eggs to be fertile. On this account eggs are not often tested out when set. Ordinarily the only test is made about the twenty-sixth day. Then the eggs are placed in warm water and the infertile ones removed. Live ones can be recognized from the fact that they move in the water.

10. Hatching.—It is generally necessary to let turkey hens sit where they wish. They choose their own nests and object to being moved. If it becomes necessary to change the nest, night is the best time. Supplied with nest eggs for a day or two, the hens may be tried out and if satisfied the regular clutch may be given her. Small turkey hens will cover 13 to 15 eggs; large ones 18 or 20. Hatching usually commences on the twenty-eighth day, though it may last or even not start until the thirtieth day. It is just as important to remove the hatchlings as little chicks. They should be placed in a box lined with flannel or woolen goods and kept in a warm room.

11. Rearing.—During the first day or two the turkeys do not need any food. The mother hen must, however, be fed liberally. It is a decided advantage to place the coop over the nest if possible so the turkey will feel at home and contented. Where this is not possible the brood and mother should be moved to desirable quarters; a coop with a board bottom should be given preference. After the first three days, when the young ones are beginning to run around, a small yard should be provided. A convenient yard may be made of three boards 14 inches wide set up on edge in the form of a triangle, with a coop in one corner, and the mother turkey allowed her freedom. She will not go far from her brood. The little ones may be kept in this kind of inclosure until they are large enough to jump up and make their escape.

12. Shooting the red.—Where the coop cannot be placed upon short grass, ample green feed should be supplied daily. It is also important to give plenty of grit and charcoal and especially necessary to fight lice from the very start. It is not safe to use kerosene on turkeys. Insect powder is satisfactory and harmless. Pens should always be situated on dry soil. Nothing is so important as to maintain cleanliness and to keep the little ones dry until after their heads have become red. Up to this time of "shooting the red" is a trying period for poults. After they have passed it they are much more hardy. During the development of the red itself more animal feed than usual should be given.

REARING TURKEYS IN THE OPEN

13. Feeding.—Perhaps the most general favorite for turkeys a day old is hard-boiled eggs and stale bread soaked in milk but squeezed comparatively dry. Generally the egg is fed a day or two before the bread. When a week or ten days old, clabber is often used. When about two weeks old, many breeders give a mixture of equal parts of milk and corn meal, middlings or some other meal. This is allowed to swell for several hours before being fed, so as to prevent any possible danger of swelling after being eaten. About this time cracked corn and wheat are often given in the evening.

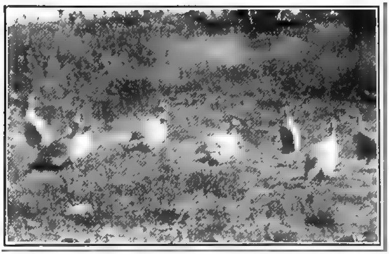
Three times a day seems to be enough to feed little turkeys until they are well grown, especially if allowed more or less range and given an opportunity to pick grass and insects. In fact, it is almost essential that they have something to pick at all the time. For this reason a grass yard should be given the preference to all other quarters. Milk may be given instead of drinking water if desired, but it seems best to have ample pure water before the brood at all times, whether milk is fed or not. It is also essential to have grit. Some turkey raisers, especially those who do not have grass runs, consider it necessary to feed every two or three hours until the birds are ten days or two weeks old. No more should be fed at a time than the poults will eat without waste.

WHAT WILL THE END BE?

14. Johnnycake.—Many poultrymen feed johnnycake made of cheap flour, preferably of the whole grain and corn meal mixed with milk and infertile eggs from the incubator, but without soda or baking powder. The ingredients may be of almost any ratio, but preferably about equal parts. After mixing to a rather soft batter, the cake is thoroughly baked and allowed to become rather dry. It is then allowed to become stale before being crumbled for feeding. This practice eliminates the danger of swelling after being eaten. The swelling takes place in the oven.

Gradually after the first week small seeds, such as millet, cracked wheat and corn, may be added to the daily ration acco ding as the poults grow in size. A good mixture of grains for fattening consists of one bushel each of whole and cracked corn and one-half bushel each of kafir corn and oats. Some raisers prefer to feed whole corn exclusively three times a day. When fed liberally on corn they do not forage as much as usual. In fattening they may be confined or not, as the owner prefers.

15. Guineas.—Since it has been discovered that the guinea fowl has a game flavor and can be sold as various kinds of more valuable flesh, it has been used in the large city restaurants as a substitute for various kinds of game, as well as being sold under its own name. This fact has encouraged the growing of guinea fowls to supply the demand. Broiler size guinea fowls are often sold as quail on toast, and larger ones for prairie chickens, pheasants or grouse. Like the turkey, the guinea fowls thrive best where there is ample free range, and are probably even more exacting in their demands than turkeys. The familiar varieties are the Pearl and the White Guinea. They are natives of Africa.



GUINEAS ON FARM RANGE

PRACTICUMS.

1. Scoring Domestic Fowls.—Provide two or more domestic fowls. Use the score card below. Every important feature is scheduled, with a description fitting the ideal of farm fowls for egg production.

Score Card for Domestic Fowls

Scale of Points	Perfect Score	Student's Score	Corrected Score
A. **General Appearance:**			
Form—compact, symmetrical, neck medium	8		
Size—showing vigor but not excessive fat growth	2		
Quality—fine comb, soft but firm flesh and mellow skin	7		
Temperament—vigorous, active, nervous and energetic	8		
B. **Head and Neck:**			
Head—medium to large and broad	3		
Eyes—full, prominent, bright	2		
Comb and wattles—medium to large, bright red	6		
Neck—medium, with full hackle	4		
C. **Body:**			
Hindquarters—well developed; V-shaped viewed from front, side and top	15		
Breast—full and wide	4		
Back—wide and deep	5		
Fluff—fine, abundant, close to body	2		
Tail—high and well spread	2		
Feathers—soft, close to body	3		
Wings—well up and close to body	3		
Leg Bones—pliable, widespread, soft; contracted and hardened	16		
D. **Legs:**			
Shape—straight, widespread	5		
Length—medium to short	2		
Color—yellow, flesh or bluish black	1		
Shanks—free from feathers	2		
Total	100		

2. School Poultry Show.—Much about poultry breeds and varieties, dressed poultry and eggs, can be learned at a school poultry show. Each pupil should exhibit living fowls, preferably of his own breeding and rearing; but failing this he should exhibit those grown by his parents. To compare with these should be fowls grown by the best breeders in the neighborhood. The breeders should also be invited to talk to the pupils about the varieties they raise, showing what are strong and weak points of the various breeds they raise and also the reasons why these breeds are or are not widely popular.

Special departments should be planned for eggs and dressed poultry—broilers, roasters, fricassee fowls, etc. These should be judged by commercial raisers, who should give talks to teach what and why exhibits are good or bad. Such points as cleanliness, uniformity of size and color of eggs and neatness in dressing fowls should be emphasized. Preferably a simplified score card should be used in judging, and all cards should be placed on the exhibits so pupils may learn why this exhibit is good and that one poor. Every exhibit of living or dressed poultry, also of eggs, should be conspicuously labeled so everyone may know exactly what he is looking at.

Preferably the show should continue more than one day, so parents and friends may have ample chance to visit it.

LESSON THIRTY-SEVEN.

SECRETION OF MILK.

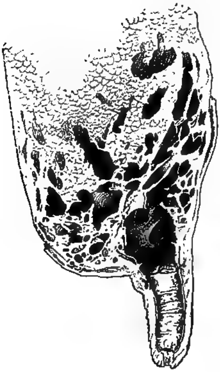
1. Source of milk.
2. Structure of the udder.
3. Mammary glands.
4. How the udder is supported.
5. Milk veins.
6. Factors influencing secretion.
7. Why milk is secreted.
8. Colostrum.
9. Length of milking period.
10. Evil of improper milking.
11. Regularity of milking.
12. When cows hold up their milk.
13. Hard milking cows.
14. Milking by hand.
15. Machine milking.

Note to the Teacher.—A large milk yield is a basic principle in profitable dairying. The milk factory is the udder. A study of the udder and of milk secretion should be useful to every person who expects to own a cow. The teacher should emphasize the importance of good udders and well-developed milk veins. In judging work these points are discussed in detail. Consult the score card on page 191.

LESSON THIRTY-SEVEN.

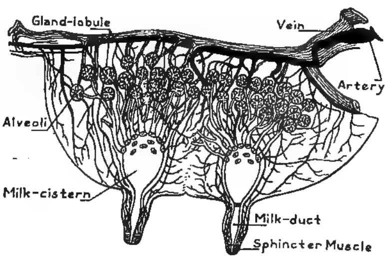
SECRETION OF MILK.

1. Source of milk.—Milk is secreted from the blood. The change from blood to milk occurs in the udder. The blood, therefore, is the source from which all milk is derived. No matter how perfect the udder, if the blood is impoverished because of poor food or ill health, a generous flow of milk is not possible. A generous yield of milk is dependent upon good health and rich blood.



INTERIOR STRUCTURE OF ONE QUARTER OF THE UDDER

2. Structure of the udder.—The udder is both a factory and storehouse. It consists of many hollow spaces or cavities of varying sizes, muscular tissue, cells, veins, arteries, nerves, lymphatics and connecting canals. The blood is the raw material, the cells the manufactory agents, the nerves the stimulating force, and the canals the tracks of delivery. In normal activity these different creations unite in sympathetic relation, with the result that milk is secreted. Taken together, they



INTERIOR STRUCTURE OF UDDER

form a delicate mass, red to gray in color, and spongelike in texture.

3. Mammary glands.—The udder is a structure in which is housed the *mammary glands.* Located distinctly outside of the body cavity, it articulates with all that takes place within. The mammary gland is the organ of milk secretion, by means of which the nutrients of food, digested, assimilated and changed into blood, are converted into casein, fat and sugar, which, together with water and ash, form milk. In some species the primary glands subdivide in more than two, or many. In the sheep, goat and horse there are but two; in the cow, four to six; in the cat and dog, eight to ten; and in the hog, ten to fourteen.

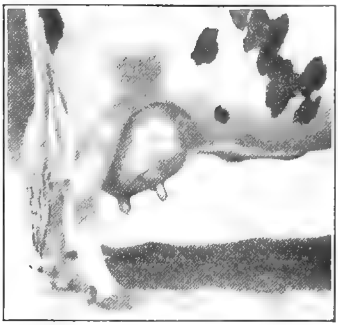
GOOD UDDER

4. How the udder is supported.—The udder is inclosed externally in a skin covering. It is held fast to its region of attachment by a band of fibrous tissue which issues from the flesh substance of the body and extends into and through the udder mass. This tender tissue, however, does not carry blood to the glands.

5. Milk veins.—Milk secretion is dependent primarily on the amount of blood delivered into the udder. Heavy milkers have large milk veins, which means that a large supply of blood is kept circulating through the glands. If blood circulation is weak or the blood impoverished of its serum and food constituents, the fact will be registered in the udder output. Cows that eat much food and that have a strong digestive power, will carry a rich blood in their arteries. It is this blood that nourishes the milk glands abundantly and that enables them to yield their product in generous quantities.

In choosing cows with large milk capacity look sharply to the extent of the development of the milk veins. These are the channels by which the red blood is connected with the organs of milk secretion. Large milk veins, therefore, are indicative of a large milk yield.

6. Factors influencing secretion.—The three most important things to look for in a good dairy cow are indications of robust health, a large digestive capacity and proper mammary development. The amount of the blood, and its richness, which passes through the udder has much to do with milk secretion. The udder is naturally of first importance. It is not the size or shape or appearance that matters most, but the internal structure; and this touches on the inheritance, breeding and training of the cow. Hence, the cell structure and number and size of blood vessels of the udder influence in greatest measure the yield of milk.



MILK VEINS

Note the fine development of the milk veins along the abdomen and on the udder.

7. Why milk is secreted.—During fetal life an offspring is nourished by its mother's blood. At birth this consumption of blood food is cut off entirely. The course of the blood is changed and directed into the udders. This is a simple turn from the arteries of fetal nourishment to the arteries of milk secretion.

The blood surging through the udder just after the birth of an offspring stimulates the cells to great activity and milk is secreted.

8. Colostrum.—The first milk at birth has a rather pungent taste and also a peculiar smell. It is known as *colostrum.* It exercises a purgative action in the intestines, and is a natural medicine for removing the material accumulated in the intestines before birth. On account of this a newly born offspring should not be denied

IN MUD UP TO THEIR KNEES

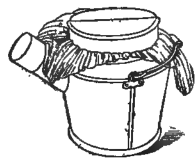
If it is this way outside, it must be just as bad inside the barn, and under such conditions big yields over a long milking period cannot be expected.

its mother's milk during the first two or three days after birth. Colostrum contains less water and much more albumen than ordinary milk. In the course of four or five days albumen normally changes into casein, water proportionately increases, and ordinary milk from now on is secreted.

9. Length of milking period.—Before the milk-giving tendencies of cows were cultivated by breeding, selection and stimulation just enough milk was secreted to nourish an offspring until it was sufficiently strong to take care of itself. Under man's nurture and care the cow has been brought to give not only much more milk than a calf would require, but to produce it for a very long time. Some cows continue to give milk up until even another freshening time. Not all cows are of this class. Some go "dry" in five or six months; others are persistent milkers for many months. Persistency of the milk function can be encouraged by care in management, by feeding rich rations and succulent forage.

10. Evil of improper milking.—One of the easiest and surest ways of checking the milk flow is to leave some of the milk in the udder. The least bit of milk remaining in the udder cavities is certain to check the activity of the secreting cells and to make them lazy. It is a very important matter, in getting best results from cows, to remove all the milk, even if considerable stripping is necessary. Clean milking is a positive necessity for extending the milking period.

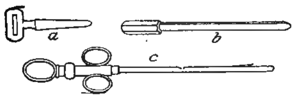
11. Regularity of milking.—When milk is being drawn from the udder, secretion is most active. Milking, therefore, is not solely the removal of the milk secreted between milking times, but the removal also of what is secreted while milking is going on. Mere manipulation of the udder is inducive of secretion, although the amount secreted by such operation may be small and not warranted in comparison with the value of the time so expended. The point of most practical importance is regularity in the time of milking. Early milking, morning or evening one day, and later milking, morning or evening another day, not only lessen the output, but tend to disturb functional activity and prevent a maximum yield for that lactation period.



SANITARY MILK PAIL

12. When cows hold up their milk.—Cows are able to "hold up" their milk by controlling the muscles that guard the milk reservoirs. Some cows acquire this habit, and at every milking refuse to deliver it for a time. The habit is a bad one and the usefulness of cows is often destroyed by it. Various causes may be responsible, such as irregularity of milking or feeding, loud talking, harsh treatment, or the presence of strangers, or unfamiliar objects. It is of great importance that young heifers be carefully and tenderly managed, so that they will early learn to give down their milk and continue so to do. Some one has said that a cow should be treated as tenderly and lovingly as a lady.

13. Hard milking cows.—A cow that milks hard is not really an individual who does not like the milker. The trouble is not with the cow, but with one of the muscles of the teat which closes the teat opening tighter than it should. In most cases the use of the teat plug will be sufficient. Such plugs may be purchased or made at home of rubber or wood. They are placed in the teat duct and held fast by a cord or tape. During milking the plugs are removed and then replaced when milking is finished. This is continued until the opening is enlarged.



MILK PLUGS

a, common teat plug; *b*, wooden plug; *c*, instrument for opening the teat.

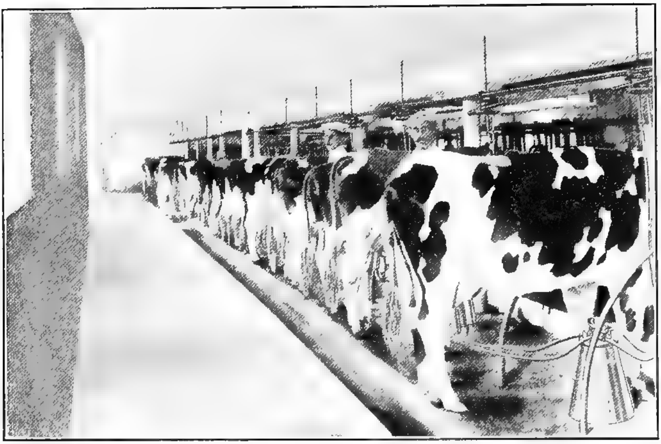
In case this treatment is unsuccessful, a simple operation known as slitting the teat may be necessary. This is performed by passing an instrument with a small concealed knife blade into the teat duct, which on being withdrawn cuts the troublesome tightness and allows the milk thereafter to be properly delivered.

14. Milking by hand.—The greater part of all milking is done by hand. To milk well, both knack and concentration of attention are necessary. Milking is an art, but many milkers never learn it. On setting down the stool and taking his position the operator should speak gently to the cow and put her at ease. The teats are then firmly grasped with dry hands and pressed tenderly until they fill up with milk. In closing the hand on the teats the ends of the fingers should be placed only part of the way around, so that they will be in a position to press in unison with the palm of the hand.

MILKING
The right way of placing the hands.

It is not the best practice to put the fingers wholly around the teats, as many do; less force results and the work is less effective. What is desirable is to imitate the calf in sucking; the hand is to be not only sharply closed against the teat, but vigorous uphand pressure against the udder is to be made at the same time. The hand movement should be rapid and continuous. It spoils the cow to stop and start or otherwise to check in any way the milk flowing from the teats. Even if the teats are small, this manner of milking is best. First strike up, then down with snap and vigor. It is wrist work, not arm movement. As the udder empties let the hand creep upwards, with more of the udder inclosed in the hand, and keep doing this until the last drop is drawn. It is to be remembered that clean milking and quick movements are of first importance in success in securing much milk and in maintaining the milk flow for long periods.

15. Machine milking.—From four to six minutes are required by use of the machine milker to milk a cow. This rapid as well as steady removal of milk from the teats is an advantage, since it is less annoying to the cow than much of the hand milking. If the machines are well cleaned the sanitary effect naturally is more pronounced because there is less opportunity for dirt or germs to get into the milk. While, therefore, equal or better sanitary results may be obtained by machine milking under ordinary conditions, the lowest bacterial counts are obtained in certified dairies by hand milking.



Milking Cows with Mechanical Milker

Three decided objections are advanced against the mechanical milker—the initial cost, the necessity of skilled operators, and the impracticability for use in small herds. A vacuum system, operated by power, is fundamentally connected with the appliance. Teat cups attached to the teats are caused to give action as pulsators to force the milk out of the udder. This pulsator is a clever mechanical adaptation of the principle a calf follows in taking milk from its mother. While the problem of machine milking has not been solved in every respect, great progress is being made, and in time perfection will be as nearly obtained as with the self binder, corn planter or egg incubator.

LESSON THIRTY-EIGHT

MILK

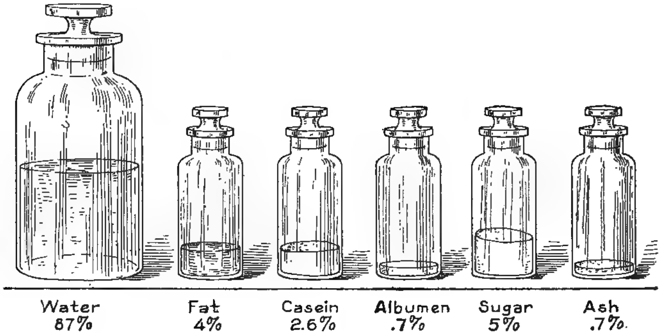
1 Composition.
2. Fat globules.
3. Casein and albumen.
4. Sugar.
5. How milk sours.
6. Pasteurization.
7. Cooling.
8. Cream.
9. Shallow pan separation.
10. Deep setting.
11. Cream separators.
12. Skim milk.
13. Market milk.
14. Grades of milk.
15. Testing milk.

Note to the Teacher.—Milk is so cheap and common in the country that its food value does not receive the consideration that it deserves. Compare its nutriment content with eggs and meat. Emphasize its effects on thrift and growth when fed to young animals. Call attention to the ease with which milk absorbs odors. Point out the necessity of cleanliness in producing and handling it. Why are healthy cows and healthy milkers so important? Several practicums are suggested by paragraphs 5, 6, 7 and 15, and these should be performed by members of the class.

LESSON THIRTY-EIGHT

MILK

1. Composition.—Milk contains water, casein, albumen, fat, sugar and ash. The average composition is as follows: Water, 87 per cent; casein, 2.6 per cent; albumen,

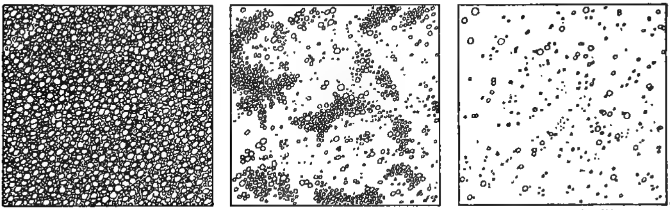


COMPOSITION OF NORMAL COW'S MILK

0.7 per cent; fat, 4 per cent; sugar, 5 per cent; and ash, 0.7 per cent. The greatest variation is in fat, which fluctuates in individuals and varies widely with breeds. Some breeds yield milk low in fat, and others milk much richer in this constituent. In general, about 3 per cent is the minimum, and 6 to 7 per cent the normal maximum, although some cows, during the close of the lactation period, may yield milk containing 8 or 9 per cent of fat.

2. Fat globules.—Butter fat consists of a number of separate and distinct fats which unite into particles, or *globules*. These fats are of two kinds—the volatile and non-volatile oils. The former give to milk its distinctive flavors, while from the latter are derived its texture and physical character. The milk globules occur in different sizes, those of some breeds being small and numerous and of others large and less in number. In Holstein-Friesian milk the globules are small, in Jersey and Guernsey milk they are large. The largest globules are most easily brought together in churning.

Butter of the very highest quality in flavor, color and grain may be made from the milk of any breed of cows, regardless of the size of the globules, providing proper feed is used and the right kind of care exercised in handling the milk and cream.

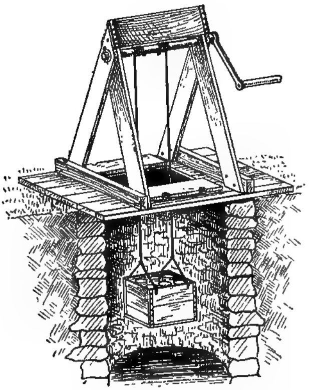


Fat Globules as Seen Under the Microscope

3. Casein and albumen.—The two protein bodies of milk are *casein* and *albumen.* Casein exists in milk in the form of tiny gelatinous particles in suspension, while milk abumen is in solution. When milk sours, the casein is changed into curd; when rennet is added, the milk coagulates, making it possible to manufacture cheese. Milk albumen is neither affected by rennet, nor is it coagulated by acids at ordinary temperatures. It is, however, coagulated by heat.

4. Sugar.—Milk sugar is the largest single, solid substance of ordinary milk. The amount varies from 4 to 6 per cent. Its importance in dairy work, especially in connection with butter and cheese making, comes from the ease with which it is converted into lactic acid by bacteria. When milk sours, the amount of sugar decreases something more than a quarter of its original quantity. The sugar of milk passes largely into whey in cheese making and forms over 70 per cent of the solids in whey.

5. How milk sours.—If certain bacteria of air, water or barn dust are admitted to milk in any manner, they grow, multiply and very shortly change the sugar of milk to an acid. These bacteria are most plentiful in sour milk, and they adhere to the sides of any vessel in which sour milk has been stored. When sweet milk is poured into such pails or jars or cans, the germs are planted or seeded in the fresh milk. The consequence is, this milk also sours. To keep milk from souring, it is necessary to exercise great care in milking, to sterilize or scald all utensils used in its storage, and then to keep it at a low temperature.



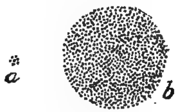
Device for Cooling Milk Where Ice is Not Obtainable

In a few dairies so careful are the attendants in milking and handling this milk that they secure a product largely free from any germs or bacteria whatsoever. Milk as ordinarily produced contains tens of thousands and often millions of bacteria in each cubic centimeter. A cubic centimeter is only about the size of a thimble.

6. Pasteurization.—Bacteria are readily destroyed by heat. Hence, if milk is warmed to 145 degrees, and the temperature is held at that point for 40 or 50 minutes, not only the germs that cause milk to sour are destroyed, but disease germs, if in the milk, will be killed also.

This process is known as *pasteurization*. A few of the larger cities now require all ordinary milk to be pasteurized before it is permitted to be sold. Several forms of apparatus have been devised for this purpose, some of which are expensive and complicated and others very simple. After milk has been properly heated, for best results it should be quickly cooled and held at a temperature of 50 degrees or less until it is consumed.

7. Cooling.—The cooling of milk is for the purpose of checking and lessening the growth and multiplication of the lactic germs that sour the milk. When milk is warm it is in the condition that most satisfies these tiny creatures. They are less active in milk cooled down to a low temperature, and in frozen milk they are content to sleep and rest and wait for better fortune. On farms where market milk is produced the custom is to cool the milk with ice immediately after milking. Even though the greatest care is exercised in handling milk, unless cooled to a low temperature, the milk will not keep sweet longer than a day or two.

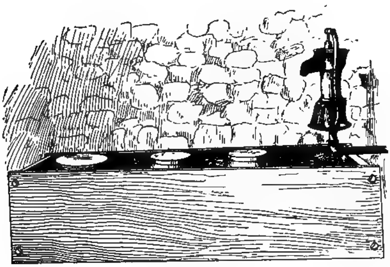


GROWTH OF BACTERIA

Showing the growth of bacteria at different temperatures during 24 hours, each dot representing a single bacterium. *a*, at 50 degrees, 7 bacteria; *b*, at 70 degrees, 700 bacteria.

8. Cream.—The lighter portion of milk, or that which rises to the surface when the milk is allowed to stand, or which can be otherwise separated by centrifugal force from untreated milk, is the product known as *cream*. It contains a much higher percentage of fat than milk, the other constituents being correspondingly lower, due to removal of water. In cream the fat globules are in suspension as in milk. The methods in use to obtain cream are shallow pans, deep setting, and centrifugal force or cream separators. Cream may be thick or thin, or any degree between the two extremes. An average cream contains from 18 to 20 per cent of butter fat. A rich cream contains 35 to 40 per cent of fat.

9. Shallow pan separation.—In the *shallow pan* system milk is placed in pans to a depth of 3 or 4 inches. It is the oldest method of cream raising in use, and while it accomplishes its purpose it does so at the expense of much valuable butter fat. Under ordinary conditions from 15 to 20 per cent of the fat of milk is never recovered in the cream at all. If the people who use this system were aware of the extent of the butter fat loss, they would quickly abandon it for a high grade cream separator.



Deep Setting of Milk
Deep cans are set in cold water.

10. Deep setting.—A step in advance in creaming over shallow pans is the *deep setting* system. Cans about 20 to 22 inches in height are used, the milk is cooled to a tempera-temperature of 40 degrees, and at that temperature maintained for 24 hours or thereabouts. On farms where running cold water from springs is available fairly good results are obtained by deep setting. In the absence of such natural advantage ice is necessary if best results are to be secured. If these conditions are met, it is possible to save most of the fat. At the very best, however, from 5 to 15 per cent of the fat of the milk is not recovered in the cream. Usually the loss of fat is much greater.

11. Cream separators.—The perfection of creaming is possible in the use of centrifugal force as generated in a *cream separator*. Many such machines are now on the market, some of which are excellent and skim to the merest trace of fat in the skim milk. The first practical cream separator was invented in 1879 by Dr. Gustav De Laval, a citizen of Sweden, who died in 1913. In the process of separation the milk flows into the bowl, and, partaking of the centrifugal force, its heavier portions are carried into the skim milk outlet at the outer edge, and the lighter portion into the cream outlet at the center. The cream separator has revolutionized the practice of butter making in this and other lands. On every farm where two or more cows are kept the separator will prove an economical purchase. Other systems of cream raising will sooner or later become obsolete, because their use means a money loss.

DR. GUSTAV DE LAVAL

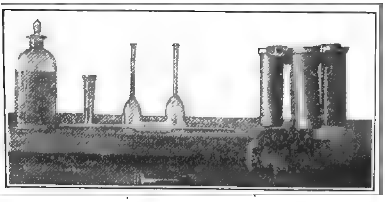
12. Skim milk.—This milk product is a valuable food for man and beast, since only fat is largely removed in creaming. The other constituents, casein, sugar, ash and water, are a right combination for pigs, calves and chicks. By substituting corn meal or wheat middlings for the butter fat removed in separation, an ideal ration is obtained. The best time to use skim milk is immediately after it comes from the separator. It is then sweet and warm, the milk sugar is not yet destroyed by lactic acid germs, and the full feeding value will be secured. When milk is fed fresh and sweet, digestive disorders seldom occur.

13. Market milk.—There is no substitute for clean, pure milk. It is nutritious, palatable, cheap. Its consumption annually increases, and better methods in production, handling and distribution are constantly being devised. Not only should cows be healthy, but the milkers should be free from any disease. Milk is a sensitive fluid to its surroundings and quickly absorbs injurious odors. Hence, sanitary quarters, clean utensils and cool storage places are fundamental requisites of pure and wholesome milk. Fresh milk is readily obtainable on farms and in villages and towns. It must be shipped by train to the larger cities, and often is 24 to 40 hours old before consumed. Some cities now require milk intended for table use to be pasteurized before being offered for sale.

CREAM SEPARATOR

14. Grades of milk.—For commercial purposes several grades of milk are now recognized. Among these are: (1) Certified milk, or milk produced under all conditions necessary to avoid infection; (2) inspected, or clean, raw, milk from healthy cows as determined by the tuberculin test and physical examination, the milk being kept at a low temperature and restricted as to the number of bacteria it contains; (3) pasteurized milk or milk from dairies not able to comply with the requirements of certified and inspected milk; the cows must show no signs of tuberculosis or any other disease; (4) cooking milk, or milk not produced under close regulation and not pasteurized, and which cannot be sold, except for cooking purposes. The best grades of milk are sold in bottles.

15. Testing milk.—Whether a dairy cow is profitable or not depends as much upon the quality of the milk as upon its quantity. The quantity may be determined by weighing and recording the amount of milk yielded from day to day. The quality of milk may be readily ascertained by the Babcock tester, a device for separating the fat from the rest of the solids in milk, and for measuring it. By means of this tester and the milk record the worth of every animal in a herd can be determined. Every farmer who produces milk or butter should own a Babcock tester.



Babcock Tester Outfit

The method of selection and breeding of dairy cows has been almost revolutionized since the introduction of the Babcock test. Not only have dairymen been able to remove from their herds the cows that are unprofitable, but breeders have been able to mate intelligently only the very best and thus increase the standards of the several breeds.

LESSON THIRTY-NINE

MILK PRODUCTS

1. First churn.
2. Butter.
3. Cream ripening.
4. Temperature.
5. Churning.
6. Washing the butter.
7. Working butter.
8. Salting.
9. Packing.
10. Cheese.
11. Kinds of cheese.
12. Ice cream.
13. Condensed milk.
14. Milk powder.
15. Other milk products.

Notes to the Teacher.—It may not always be possible to introduce practical exercises covering the topics of this lesson, but the teacher is urged to ask the student to give attention to the paragraphs relating to butter making where the home churning is done. If the school is in the neighborhood of a creamery, or good farm dairy, a visit to such will be both interesting and instructive.

LESSON THIRTY-NINE

MILK PRODUCTS

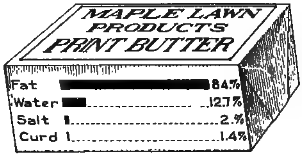
1. First churn.—Thousands of years ago, long even before the time of Abraham and Isaac and Jacob, cows, goats and mares were kept for the skins their bodies gave for clothing and their flesh and milk for food. Milk in those early days was churned into butter or made into cheese. The appliances were few and simple. The first churn* was the skin of a beast, and, rolled back and forth the fat globules were gathered, butter resulting.

OUT OF DATE

2. Butter.—The average composition of butter is: Fat, 85 per cent; water, 11 per cent; salt, 4 per cent; and casein, 1 per cent. Its quality is judged upon flavor, texture, color and general appearance. The true bouquet of flavor is impossible of description. Texture constitutes the grain, and in butter should carry the granular structure of the fat globules of the milk. In color, a bright, golden yellow is demanded. On fresh

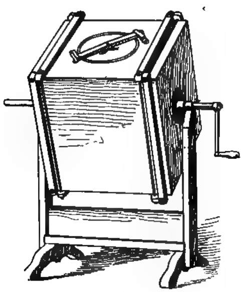
* The Arabs first discovered the art of butter making by carrying milk in goats' skins on a camel's back.

pasture grass the color is ideal, but in winter when cows are fed dry provender coloring matter is often necessary. Salt is usually demanded, but not always. When marketed, a clean, neat package of attractive appearance commands a price above ordinary grades.



COMPOSITION OF BUTTER

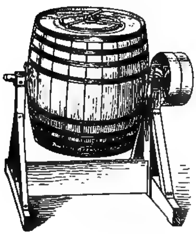
3. Cream ripening.—Before milk or cream is churned it undergoes a treatment known as *ripening*. It must not only be sour, but so treated as to impart high flavor to the cream mass. The rapid production of lactic acid is desirable, and to this acid condition of cream is due to a great extent the quality of the butter subsequently made of it. In factories where large quantities of butter are made the cream is ripened by a "starter," which gives to all the cream an even ripeness. In making farm butter the usual custom is to add a bit of cream from the cream crock to the fresh cream which is to be ripened.



BOX CHURN

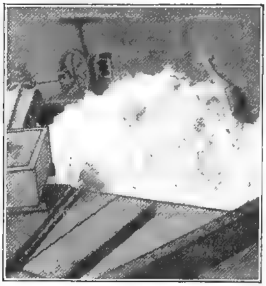
4. Temperature.—If cream is held at a very low temperature, it will ripen or sour very slowly. The ripening germs would develop much more rapidly at a high temperature, but the effect would be less desirable on flavor and less favorable to the texture of the butter. It is recommended that cream be ripened at a temperature of from 60 to 70 degrees. In case only a small amount of starter is available in the beginning, a higher temperature is advisable; but once the inoculation is well under way, the development must be checked by lowering the temperature if the best flavor and texture are to be secured.

5. Churning.—Various types of churns are in use, but those that agitate the cream in such manner as to cause concussion of the fat particles stand in highest approval. The whole purpose of churning is to bring the fat globules together in granular masses. A rapid agitation is favorable to quick churning. The barrel and box types of churn are preferable because they meet these two conditions. A cold cream makes difficult churning, as does a cream that has not been fully ripened.



BARREL CHURN

6. Washing the butter.—When the globules have been gathered into particles about the size of grains of wheat and the buttermilk is blue and watery, the churning should be stopped. A dash of cold water to the contents of the churn will hasten the rise of the smaller particles floating in the buttermilk. The buttermilk is now drained out of the churn. Cold water is added, a quarter less than the amount of buttermilk withdrawn, and the churning continued gently for a few minutes. The water is now drained out of the churn and a second washing given the butter.



WASHED AND UNWORKED
Showing granular condition.

If the water drained away from the second application is clear, the washing operation is ended, but if a milky color remains, add water a third or even a fourth time as before.

7. Working butter.—Just two ends are sought in working butter—to incorporate the salt and to bring the particles into a compact mass. In working, some of the water will leak away, which is desirable. If butter is worked too much, the grain may be injured. More butter is spoiled by being worked too much than too little.

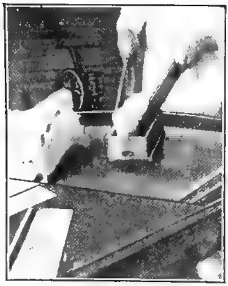
Working Butter

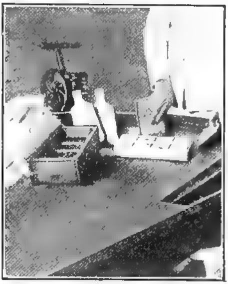
8. Salting.—When salt is added to butter, it helps in a small way to keep it sweet, but the real purpose of salting is to improve flavor. The amount to be used depends on market demands. Some people like a very salty butter, others just a reminder of its presence. Ordinarily, an ounce is used for each pound of churned butter. Salt is most conveniently added when the butter is worked. This operation must be continued until the salt has completely dissolved, otherwise streaked butter may result.

9. Packing.—When the buttermilk or water has been pressed out the salting work is finished and the butter is ready for packing and storing. A very dry butter is preferable for long-time storing, but that to be used soon will admit of more moisture. Butter to be delivered to consumers is more attractive if pressed into small prints by means of molds made for the purpose. The prints are wrapped in parchment paper and placed in heavy cardboard packages of a similar shape and size.

Salting Butter

10. Cheese.—This product of the dairy is made by coagulating milk with rennet, a ferment of the calf's stomach. Milk that is rich in fat makes more and richer cheese. Full cream cheese contains 37 per cent of water, 34 per cent of fat, 24 per cent of casein and 5 per cent of ash. Ninety-five per cent of the nutrients in cheese are digested when eaten.



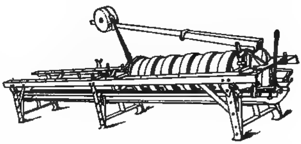


MAKING PRINT BUTTER

Placing butter in print with paddles at left; finished prints at right.

Cottage cheese is largely homemade. The most common kind of cheese in our country is known as cheddar, or some modified form of it. The process of making involves a varied and distinct procedure which includes setting or making the milk acid, then coagulating with rennet; cutting, or breaking the curd into little blocks by knives; cooking, or toughening by heat; cheddaring or matting into blocks; grinding, to enable salting and pressing; salting and pressing, to prepare for use; and curing or ripening, for final consumption. Many other forms of cheese are made in accordance with specific processes and require much experience and great skill to secure superior products.

11. Kinds of cheese.—The varieties or kinds of cheese are almost legion. Nearly every nation has a favorite, its character and quality being due to food given in producing the milk, but in greater part to the differences in the mode of treating the milk.

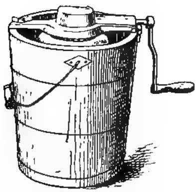


ROUNDING OUT THE CHEESE

One of the final steps in cheese-making is pressing the cakes. They are now ready for storing and ripening.

Limburger is the result of specific fermentation brought into the cheese during ripening. Swiss cheese is flavored with herbs, and the native pastures and curing fermentations give a character and flavor world wide in fame. In France the delicious Roquefort is made, the milk of both the sheep and cow being used. The cheese is made by mixing clotted milk with moistened bread. The mixture is pressed into porcelain molds with holes at the sides. It is then dried and salted in a peculiar manner and placed to mature in caves in the mountains. England makes many cheeses, the most famous being English cheddar, Cheshire and Stilton. The round Dutch cheeses, colored red, are common in all markets and take the name of Edam, from a small Holland town; partly skimmed milk is used. Brie is a soft French cheese, somewhat like the Camembert, also a French soft cheese of fine flavor. In all, more than 150 varieties of cheese are manufactured in various parts of the world.

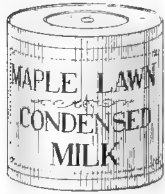
12. Ice cream.—As now used, ice cream is a rather broad term which applies to all frozen mixtures based on milk products. In its restricted meaning ice cream is cream sweetened, flavored and frozen. It may be made of cream, thin or thick, or of cream and milk, or of cream and condensed milk, or of plain milk alone. Sometimes eggs, milk powder, and gelatine are added to the milk stock. A great many receipts are contained in the cook books, some providing for elaborate and fancy mixtures and others for a plainer product. In many cities large factories have been built in which ice cream is manufactured in immense quantities for supplying a local as well as a diversified trade.



ICE CREAM FREEZER

13. Milk powder.—There are various methods of preparing dried milk. The object of drying is to get the solids of milk in powder form. This is accomplished by evaporation. In a dry form milk may be transported at small cost compared with the usual liquid and condensed forms. Milk powder is much liked in baking and may be used directly with flour or be mixed with water and used as ordinary milk. There is much demand for dried milk by confectionery establishments. At present most milk powder is manufactured from skim milk since certain difficulties are encountered in preserving a product containing a large percentage of butter fat.

14. Condensed milk.—Two kinds of condensed milk are prepared—sweetened and unsweetened. The first is preserved with cane sugar. In both forms milk is heated to about 180 degrees, sterilized with steam under pressure, and evaporated until a suitable consistency is reached. Unsweetened condensed milk is not usually concentrated to quite the same degree as the sweetened. It is used mostly in the ice cream trade, although to some extent for home use. The sweetened forms, if properly manufactured, will keep for months or years even and are used largely in bakeries, candy factories, steamships or other places where fresh milk is not easily obtainable.



CANNED!

15. Other milk products.—Milk sugar is made by evaporating to a small bulk whey, clarified by boiling and treatment with alum or other substances. Buttermilk, which so recently was largely used as a food for pigs and poultry, is now a fixed product of human dietaries. The lactic organisms in milk are utilized in the preparation of various milk drinks which are sold under various names, according to the particular organism used to turn the milk sour. Some medical authorities claim that the lactic milk preparations are healthful and tend to prolong human life.

PRACTICUMS.

1. Pasteurization of Milk.—Secure fresh milk from clean and unclean stables, or prepare from the same milk clean and unclean samples.

Pour in four small clean bottles or test tubes—eight in all—about one-half full with milk from each sample. Hold one bottle of each class of milk without further treatment at the temperature of the room. Now put the six remaining bottles or test tubes containing the milk in a vessel of water previously heated to 145 degrees. At end of three minutes remove one of each kind; in ten minutes one more of each kind; and at end of 20 minutes the other two, one of each kind. Now cool all the samples under test to a temperature of 65 to 70 degrees and leave these for future observation. What changes do you note in appearance after 24, 48 and 72 hours?

Filling the Bottle

Proper position of holding the pipette.

2. Making the Babcock Test.—A simple Babcock testing outfit should be included in the regular equipment of every school. At different times during the school year, milk from all the neighborhood farms should be tested by the students themselves under the teacher's direction. In this way it is possible for the school to determine the quality of the milk of every cow of the neighborhood.

(*a*) *Sampling the milk.*—Secure a sample from each cow of the herd as soon as milked. Pour the milk from one pail to another three or four times so as to get it thoroughly mixed. Have clean bottles properly labeled with each cow's name, one bottle for each cow. When the milk has been drawn and mixed, a sample is taken and emptied into the bottle marked for that cow.

(*b*) *Testing sample.*—Before the milk in the sample bottle is added to the testing bottles, it should be thoroughly mixed again. A milk pipette which accompanies the testing outfit is used for securing the exact quantity. This amount is 17.6 cubic centimeters, and on this pipette is placed a mark showing just how much is to be sucked up into the tube. The pipette may be filled and then the milk allowed to drop out until the exact quantity is obtained. By firmly pressing the tip of the finger upon the top of the pipette the milk will be retained in it. Slightly releasing the finger will cause the milk to drop out until it reaches the mark indicated on the pipette. The point of the pipette is now placed in one of the test bottles and the finger removed to let the milk flow into the bottle. Let the pipette drain and then blow in the upper end to expel all the milk.

(*c*) *Adding acid.*—The test bottle containing the milk is now ready for the acid. The exact amount is 17.5 cubic centimeters. The acid may be poured into the test bottle by means of an acid measure, the exact quantity having been measured. The test bottle is held in a slightly slanting position and the acid poured into it. The acid being heavier than the milk, sinks to the bottom at once. By gently shaking with a rotary motion, the acid and milk are now mixed. Continue this motion until the material in the test bottle is dark brown and quite warm.

MIXING MILK AND ACID

Bottle should be given a rotary motion.

(*d*) *Whirling the bottles.*—The bottles, mixed with milk and acid, are now placed in the tester. An even number of bottles should be whirled at the same time and placed opposite each other in the tester. When all the samples have been placed, the cover of the tester is put on the machine and the machine turned at the rate described in the directions accompanying the machine. Ordinarily, the bottles should make from 750 to 1,200 revolutions a minute. The machine should be whirled at this rate for about seven minutes.

(*e*) *Adding hot water.*—After whirling the bottles as directed, hot water is poured into each test bottle so as to bring the mixture up to the bottom of the neck. The bottles are then put back into the machine and the whirling continued for two or three minutes, and then water again is added to the test bottle to bring all of the fat up into the neck of the bottle where it may be measured. As each bottle is taken from the tester, it is held in a straight position in front on a level with the eye. The division marks on the neck of the bottle indicate the measures for each per cent of fat. Counting the spaces occupied by the yellow substance in the neck of the bottle will give the total per cent of fat in that sample of milk. If, for instance, the yellowish substance occupies a space between 1 and 5, that would indicate the percentage of fat in that sample to be 4. If a sample reads from 1½ to 5¾, then the per cent of butter fat would be 4¼.

WHIRLING THE BOTTLES

3. MORE BUTTER THAN FAT.—Since the Babcock tester gives the

amount of butter fat only, in estimating the amount of butter in a given sample, it is necessary to add something in addition, to make up for the other substances in butter besides butter fat. Butter contains, in addition to butter fat, also moisture, salt and other substances. To meet the increase, butter is approximately one-sixth more than the butter fat contained in the milk or cream. If, for instance, 150 pounds of milk showed a fat test of 4 per cent, there would be six pounds of butter fat in that quantity; but since butter is one-sixth more, the true amount of butter in the 150 pounds of milk would be not 6 pounds, but 6 pounds plus 1 pound, or 7 pounds in all.

4. (*a*) Suppose that by deep setting one-half of one per cent of fat is left in the skim milk and the skim milk is 80 per cent of the total product, what per cent of the fat of the milk is lost, if the original milk contained 3 per cent of fat? If it contained 5 per cent of fat?

(*b*) Suppose that with a cream separator two-hundredths of one per cent of fat is left in the skim milk, which is 90 per cent of the total product, what per cent of the total fat of the milk is lost if the milk contained 3 per cent of fat? Five per cent of fat?

(*c*) Suppose a creamery receives an average of 5,000 pounds of milk daily for 300 days, how much butter would be lost during the period in each of the four cases?

LESSON FORTY.

DAIRY FARMING.

1. First steps.
2. Kind of cows.
3. The dairy sire.
4. Grading up.
5. Hold fast to one breed.
6. Cattle barns.
7. Market milk.
8. Producing market milk.
9. Farm butter.
10. Selling cream.
11. Summer or winter dairying.
12. Silos are helpful.
13. Soiling crops.
14. Dairying a balance wheel.
15. What a dairyman should be.

Note to the Teacher.—The business of dairying steadily grows in importance. How to build up a profitable herd of dairy cows is the obvious purpose of this lesson. The teacher can use the same steps in applying this lesson to other lines of live stock farming. The important consideration is the necessity of firm adherence to one line of breeding once the start has been made. At the same time seek to know what animals are best in the herd or flock and use these as foundation stock.

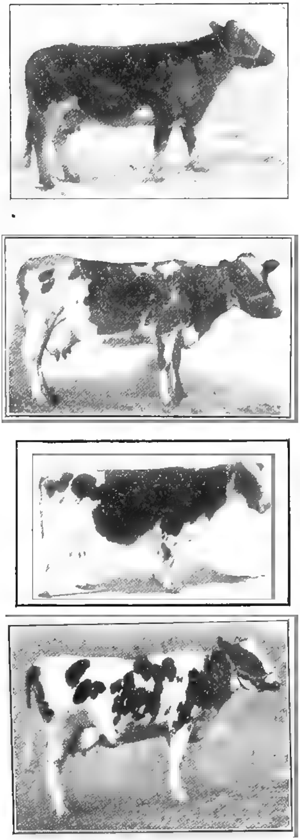
LESSON FORTY

DAIRY FARMING

1. First steps.—Success in dairying calls for special interest in the business, a location that admits of easy access to markets, farm and buildings adapted to the needs, and the right kind of dairy stock. A large outlay at first is not required. Many dairymen have started with small equipment and few animals. Those who have succeeded studied their business, enlarged their activities as the demand grew, installed conveniences of sanitation and followed carefully the recognized methods of clean milk production.

2. Kind of cows.—While the start may be made with cows of unknown or mongrel breeding, selected cows of a recognized dairy breed should sooner or later be chosen. High-grade cows are profitable dairy workers; so, too, are well-chosen individuals from pure-bred and recorded stock. A herd of pure-bred cows is always worth more than a herd of grade cows, but the pure-bred herd is primarily for the purpose of raising pure-bred sires. A young man can start with grades, and also secure one or more females of pure breeding; by preserving the heifers and using them to replace the least profitable graded cows, it is possible to secure a breeding herd at no great outlay in first cost. In this manner common cows in a few years can be entirely replaced by high-grade and pure-bred stock.

3. The dairy sire.—An old saying is: "The sire is half the herd." This is correct, because the blood of the sire is a part of the offspring of the whole herd. In practice the sire is more than half, since on account of his breeding he is more prepotent, has in his ancestry preponderating dairy qualities, and hence transmits these qualities to the progeny. Only sires of pure breeding should be chosen to head the herd. No dairyman or other live stock breeder ever employs a sire of uncertain or mongrel breeding if he seeks to improve his herd. Under no circumstances should a grade sire be used in breeding. A wise dairyman would prefer to sell part of his herd and purchase a choice dairy animal of pure breeding than to use a grade.



FOUR GENERATIONS

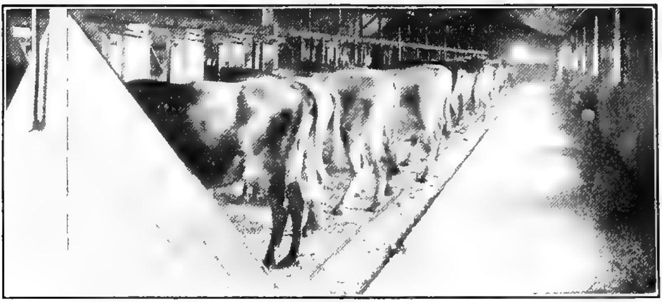
The foundation cow was worth \$100. By breeding up, in the fourth generation a cow, with a seven-day record of 24 pounds of fat was valued at \$1,000.

4. Grading up.—The greater number of dairy herds are composed, not of pure stock, but of grade stock. Such herds can be quickly improved by following the plan of "grading up." This is a simple matter and involves a pure-bred sire of the chosen breed. The male calves are disposed of as veal or raised and fattened as butcher stock. The heifer calves are reserved for replacing the aged cows or others that are otherwise not profitable. As the herd grows in numbers only the female offspring of the very best cows should be preserved. The offspring of the less valuable cows may now be sold as veal or to others to raise as butcher stock.

5. Hold fast to one breed.—In grading up a herd, new sires will be required from time to time in order to avoid close or related breeding. When such times arise, the mistake of changing breeds should not be made. Cling fast to the breed that was used at the start.

A change in breed or race involves a mixture of blood, and this is not only unwise, but destructive. Such changes defeat the very purpose of a fixed plan to establish a herd with a single and uniform line of qualities and characteristics. To admit Holstein blood in an improved herd of Jerseys or Ayrshires that has been graded and bred up, introduces qualities and characters that are antagonistic to the very things that the previous breeding had sought to fix and make stable. The same happens when Ayrshire or Guernsey or Jersey blood is introduced into a herd of Holsteins or other breed. After a breed has been chosen and purebred sires of that breed been used, one must adhere to that breed and never thereafter choose a male from another breed.

6. Cattle barns.—Let the barn be able to accommodate the herd. It may be of costly construction or not, as the purse and inclination may decide. Good ventilation, sun-



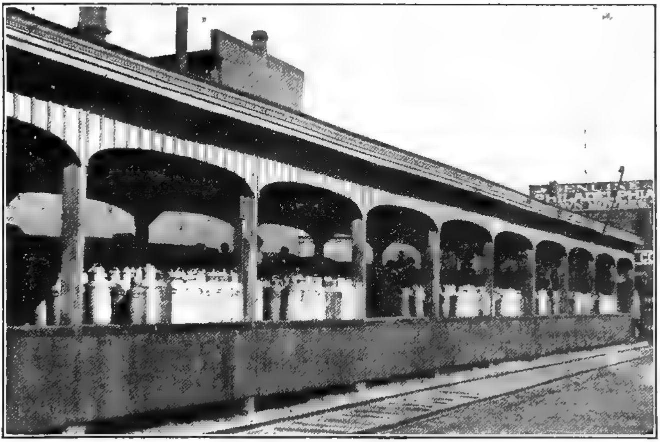
IDEAL CATTLE BARN FOR DAIRY HERD

It is light, clean and sanitary

light, sanitation and comfort are not the result of money outlay. The humblest dairyman can procure these simple stable requisites. They may call for extra labor, ingenuity and enterprise, but his own hands can do the work at times when other work is not pressing.

Fresh air should be at all times admitted; windows, so placed as to let the sun fall on all parts of the stable, should be in generous numbers; and floors and mangers should be built that they may be quickly and frequently cleaned. Finally ample bedding should be provided, that the cows may rest in comfort. Remember this: Cows respond best when kindly cared for, when fed appetizing and nutritious food, and when made to feel completely at ease in their stable quarters.

7. Market milk.—The choice of the dairy line will depend on circumstances and on the personal preference of the individual. Dairymen near large milk markets usually prefer to sell their product as milk. Some sell to their own customers and cater to them. This is



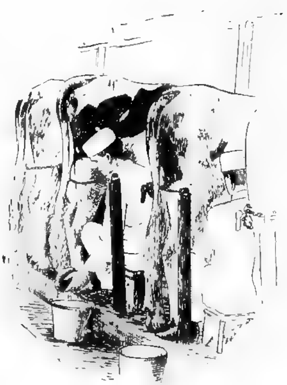
RECEIVING STATION FOR MILK MARKET

Milk trains gather milk from producing centers and carry it in large cans to the milk-consuming centers. As a rule, the milk is received by milk dealers, to whom it is consigned, and who make it their business to cool, bottle and deliver to customers.

usually the most satisfactory way of disposing of milk. Certain markets do not admit of this, and the selling through or to milk dealers is necessary. The milk traffic of our very large cities is handled in this way.

The concentration of market milk in a few hands has been due to several reasons. One is the impossibility of producing enough milk for dense population from nearby land and the necessity of ever reaching out into new territory, often scores of miles away, to keep up the supply for constantly increasing demands. In these cases milk is brought to the place of consumption by trains.

8. Producing market milk.—Whether one is in personal touch with his customers or markets his milk through dealers, he is equally concerned in producing a high-grade product that is clean, pure and wholesome. It is more and more the custom of city boards of health to set up standards that market milk must reach if it is disposed of in that city. This course has brought about many changes in the manner of producing, supplying and distributing milk. As these rules and regulations become understood their early aggravating features disappear and the entire milk traffic assumes a new importance. Milk of a high grade will always be in demand, even increase, and in time the interests of both producer and consumer will be one of common concern.

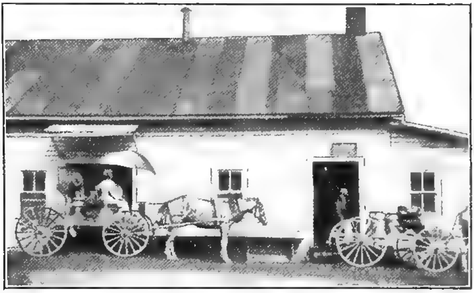


Clean Milk

No question about it here. The pail at the rear contains water for moistening the udder.

9. Farm butter.—One form of dairying is in making butter on the farm and in disposing of it to private customers. Before the days of the creamery, all butter was farm-made. Regular delivery days are observed, the customers knowing that they can depend on the quality of the product and can rely on fair dealing of the producer.

Attractive packages contribute much to the ease of finding customers, and if the product is high grade, an energetic dairyman can soon build up a very profitable custom trade. Pleased customers are a splendid asset of this trade, and they always assist in extending the business. Paper boxes of pound capacity or small earthen jars may be used in delivering the product. Choose a name for your farm and sell the product under such farm trade mark. When weekly visits are made for delivering butter to regular customers, it is frequently possible to sell eggs, fowls, buttermilk, fruit and other products on the same trip and to the same people.



AT THE CREAMERY IN THE COUNTRY

Milk and cream delivered to creameries for manufacturing butter. Farm butter making has been replaced in many parts of the country by factories.

10. Selling cream.—Many farmers who live some distance from regular markets prefer to sell cream rather than convert this cream into butter. They own a separator, sell the cream and feed the skim milk on the farm to calves, pigs and fowls. With many people dairying is a side business. A few cows are kept for family use, the milk surplus being gathered two or three times a week by creamery delivery wagons. This custom is not at all general, but where it prevails it saves labor and trouble. In some sections milk is separated on the farm and the cream delivered to some central point by the producer. This is not usually the most economical practice, especially if dairying is the chief business of the farm.

11. Summer or winter dairying.—Whether cows shall be bred to freshen in the fall, spring, or more or less evenly throughout the year, is a point to be decided by each individual farmer in accordance with local conditions and preferences. The man who has an even butter trade the year round will want an even production of milk to meet the demands of his steady customers. The prudent dairyman will seek to understand the general trend of the market and plan to have his cows freshen when milk is in greatest demand.

As a rule, prices are highest during winter. Cows that freshen in fall or winter maintain a steady flow for several months. Their daily milk flow will be stimulated when turned on pasture in the spring, and thus their annual production will tend to be larger than otherwise if they were to freshen in the spring and be subjected to dry winter rations during the late fall and winter. Taken from the pasture, they naturally quickly shrink in milk yield.

12. Silos are helpful.—Silage is a superior feed for dairy cows. It is an appetizing and nutritious feeding stuff and supplies the very necessary succulence that other winter foods lack. In successful dairying the silo is well nigh indispensable. It is only a matter of time when silos will be a part of the equipment of every dairy farm. Silage is a cheap and economical food, and when made the basis of the rations, dairying products are secured at the lowest cost a pound. By means of the silo, spring and summer conditions are made possible for the entire year.

13. Soiling crops.—In case the pastures are insufficient, either because of small area available in proportion to the size of the herd, or because of high value of lands, soiling crops may be resorted to. A much smaller area will be required than for pasture; no fences will be needed; and large quantities of green food can be had.

DAIRY HERD FED YEAR ROUND ON SILAGE

When feed is high, silage is practically indispensable in dairying. For winter feeding it is a fair substitute for summer pasture, since corn ensiled is more appetizing than if fed dry and in the rough.

The soiling areas are reasonably heavily manured and then seeded to the desired crops. As these reach maturity they are cut and fed green from day to day. As fast as these crops are used up the land is again plowed, and manured and at once seeded to another crop. In this way soiling becomes a substitute for pastures. More labor is required, but the large tonnage secured from such crops abundantly meets this expenditure. A given acreage will support twice as many or even more cows when employed in growing soiling crops than if devoted to pasturage.

14. Dairying a balance wheel.—Most lines of farming tend to exhaust the land and impoverish the soil. Dairying is an exception. Almost no fertility is removed when butter is sold—less than 50 cents of plant food in every ton of butter. When milk is sold the loss of plant food in a ton of milk is valued at $2.80. Considering the consumption of grain and forage in the production of that quantity of milk, it is readily apparent that the manure resulting balances this loss many times over. Dairy farms soon become the most productive of all lands if the manure is carefully preserved and properly distributed over the land. Instead of exhausting the

ALFALFA THE WONDERFUL

From early spring until frost this queen of the crops is available for all kinds of feed.

land of its fertility, as in the case of grain farming, dairying restores the fertility, acting in this way as a real balance wheel in preserving the productivity of the land.

15. What a dairyman should be.—It is trite, but true, that in all sorts of farming "there is more in the man than there is in the land." This adage applies particularly to the dairyman. The dairy farmer must not only be a good farmer, but a good judge of cattle; a careful and cautious man, he must be habitually regular in his habits; endowed with the virtues of patience and perseverance, he must possess good, sound, common sense. He must be studious and experienced, and able to judge wisely as to the points of his business which may be in dispute. No less in importance he must be a good business man, a neat, refined gentleman. These characteristics are indispensable if success would be attained in dairy work.

LESSON FORTY-ONE

FACING DISEASE ON THE FARM

1. Physical examination.
2. Taking the pulse.
3. Taking the temperature.
4. Taking the respiration.
5. Treatment of disease.
6. Helping the body fight.
7. Giving medicines in a ball.
8. Giving medicines in a drench.
9. Poultices and mustard plasters.
10. Blistering.
11. Food and drink.
12. Post-mortem examination.
13. Things to do.
14. Examining internal organs.
15. Examining the organs.

Note to the Teacher.—In caring for animals there are several simple accomplishments that are of importance and value. These are learned by observation and practice. No farm youth should neglect the opportunity of becoming proficient in taking the pulse, or temperature, or in following the movements of breathing in health or sickness. The post-mortem examination to locate the source of the disorder is always advisable. Each of these paragraphs in this lesson is important and should be well learned for the subsequent value in later years.

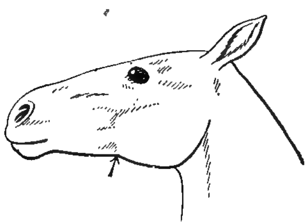
LESSON FORTY-ONE

FACING DISEASE ON THE FARM

1. Physical examination.—Every stockman should be familiar with the fundamental principles of health and of any departure from them that indicates disease. A superficial examination of a sick animal is the first step in diagnosing the disease.

Note the general condition of the body. Is there pain? If possible determine this point and locate the seat of it. Is the circulation natural? An examination of the pulse will tell if the blood is racing rapidly or gliding slowly, and whether it is regular or rough. Is the respiration as it should be? Make a count to see if the breathing is normal. On listening to the lungs, heart and blood vessels it can be told if the sounds are natural or unusual. Whether or not an organ contains air can be determined by percussion. Organs, like the lungs in pneumonia, give a different sound than when they are in a healthy condition. Air-containing organs—lungs and intestines—may thus be distinguished from the solid ones adjoining them. In this way their varying size in health and disease may be determined.

2. Taking the pulse.—Stand at the left side of the horse and run the finger along the lower jaw until you come to the point where the artery crosses the jaw on its lower edge. This will be found about 2 inches forward from its angle. Right here is situated the large muscle, and at the front edge the pulsations may be caught. To get the pulse of the cow, stand at the left side, reach over the neck and take it from the right jaw. In the horse the



PULSE IN THE HORSE
Showing point at which it may be taken.

normal pulse beats are from 35 to 40 a minute, and may go to 100 in disease. In the cow the pulsations run from 45 to 50 in health. The pulse relates a very accurate story, and with practice can be constantly used in diagnosing the ailment.

A soft pulse, one that is easily compressed by the finger, may indicate bronchitis. A hard pulse, one not easily depressed by the finger, indicates acute inflammation. A hard pulse may be quick and bounding and forceful. An irregular pulse, one that beats fast for a time, then slowly, may indicate a weakened heart condition. A slow, full pulse, one that comes up gradually to the finger touch, may indicate brain trouble.

3. Taking the temperature.—While the heat of the body may be surmised by touch and feeling, this is not a reliable guide as to temperature. A self-registering thermometer is the only reliable means for getting this desirable information. When the temperature rises, inflammation is indicated. A fall in temperature below normal denotes loss of strength, vitality and death. If the temperature rises three or four degrees above normal, the case is serious, and a rise of five or six is very dangerous. Animals seldom survive when the rise reaches above 107 or 108 degrees.

4. Taking the respiration.—In breathing two movements are observed—the taking in and sending out of air. In health, respiration is usually constant, ranging from 10 to 14 in horses, and from 15 to 20 in cattle. Breathing is faster in young animals. Exercise increases the number of respirations to the minute. Any disease of the respiratory organs will cause breathing to be short, rapid and labored. If the number of respirations seem more than normal, a disturbance may be under way. If at the same time the pulse runs fast, trouble is likely and the cause should be sought at once.

5. Treatment of disease.—The first effort in treating disease is to remove the cause. This sometimes is done very easily. Mange and lice are quickly destroyed by washes and disinfectants. Bright, fresh, wholesome food and pure water easily replace bad food and water, to the permanent good of the stock. Cattle ticks quickly disappear when the grease brush is applied. A first aim in fighting disease is to find the cause and remove it. This done, half of the battle is fought.

CATTLE TICKS AT DIFFERENT STAGES OF DEVELOPMENT

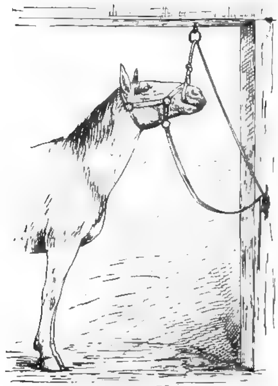
If disease germs cannot be killed at the moment, it is still possible to diminish their number or to modify their virulence. Thus, to open an abscess is to remove the pus-producing bacteria, and hence to hasten recovery. To wash a wound or open sore with antiseptics is the simplest way to remove, diminish and destroy the evil of the sore.

6. Helping the body fight.—When disease sets in a battle begins. One combatant is the disease, the other is the body. Medical aid consists in caring for, in nursing, and in making the body strong. Medicines are helpful if they diminish the work of the diseased organs, giving in this way time for the body cells to bring about a cure. Therefore, rest and quietness are advisable, that no organ may be called upon to do any other work than normal function and repair.

A disease of the heart calls for absolute rest; of the intestines, for little or no irritating or bulky or hard food; of the lungs, for no exposure. At times it is advisable to check the activity of an organ, in which case a drug may be given, like opium, to quiet the intestines; or like aconite, to diminish the rate of the blood flow. In the same way external assistance may be rendered; as, for example, sweating, to throw off poison in the tissue juices; and blanketing, to maintain an even temperature and to protect from chill and draft.

7. Giving medicines in a ball.—Many nauseous agents, as aloes, opium, arsenic, asafetida, may be conveyed to the stomach in balls without causing annoyance or disgust to the patient. The balls are wrapped in paper, dough, or gelatin capsules, and may weigh an ounce or two. The ball is held between the thumb and first two fingers. The tongue is seized at about its middle and gently drawn out to the side of the mouth, in such a way that the right hand may be inserted into the mouth and the ball placed far back on the tongue; the hand is now withdrawn, the tongue replaced and the halter or strap wrapped around the jaws until the ball is swallowed.

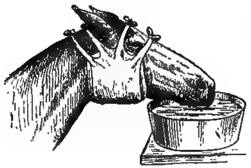
8. Giving medicines in a drench.—The drench is usually employed for liquid medicines. It is best to dilute the medicines with water, milk or oil that they may more readily reach the stomach and at the same time cause no injury to the structures through which they pass. In giving a drench use as much patience as possible. To horses it should be given slowly. If there is any disposition to cough, lower the head and then proceed as before.



DRENCHING THE HORSE

Simple way to hold up the head. Note the cloth hoop under nose band.

9. Poultices and mustard plasters.—Poultices are made of a variety of things; bread, bran and linseed meal being most common. Any substance that will hold water and retain heat will serve the purpose. Mustard and cold water are best for plasters. Mix to a thin paste. If the part to which the plaster is to be applied is covered with thick, long hair, a very thin plaster will more quickly soak into the skin. This kind of plaster is most commonly applied to the throat, the windpipe, the sides of the chest, the abdomen and over the region of the liver. To get the best effect on the liver apply on the right side at a point 4 or 5 inches behind the back ribs.



Easy Method of Applying a Poultice to Throat

10. Blistering.—The first step in blistering is the clipping of the hair over the diseased part and the removal of dirt and scurf attached to the skin. The blister is to be worked into the skin, and usually 10 minutes of rubbing will be necessary to produce the desired results. In the course of 24 hours blisters will form, and some swelling in the region is likely to show. On the third day bathe the part with warm water and soap. After drying, apply vaseline, lard or sweet oil. The blister should be repeated if the results of the first blister do not bring about a cure.

11. Food and drink.—During sickness only an easily digestible food is advisable. Offer something different from the ordinary, and let it be prepared in an appetizing way. Nothing is better than gruels and mashes. These are soft, nourishing, appetizing and easily digested. When active nutrition is demanded, milk and eggs can be added to the ordinary gruels or mashes. Water should be available at all times. Small amounts at frequent intervals are better than large amounts at intervals far apart. In treating dysentery, diarrhea and diabetes water is usually withheld, but in most diseases a free use is allowable and desirable.

12. Post-mortem examination.—A post-mortem examination is worth while, if for no other reason than that of familiarizing one with the organs of the body. With a little experience proficiency can be acquired in examining dead animals, and in learning the difference between healthy and unhealthy organs, between diseased and normal tissues, and the relation of the internal parts to the whole body. This examination is to be made as soon after death as possible; the longer the delay the greater the changes due to decomposition. Soon after death the stiffening process, or *rigor mortis,* takes place. This may occur within an hour after death, and again it may not be complete until after 25 or 30 hours. Soon after death stiffening, the tissues soften and decomposition rapidly follows.

SECTION OF BADLY DISEASED CARCASS

13. Things to do.—In making a post-mortem examination, in case the animal has not been moved, the position of the body is to be observed. Look all about you.

Is there any evidence of a struggle? Does either the body or the ground appear as if spasms had taken place? Now observe the discharges from nose, mouth and other natural openings of the body. External scars and wounds often bear a close relation to the disease, and these should be considered in examining the carcass. How do the eyes look? Is there a discharge from the ears? Is the swelling of the abdomen and the bloating more pronounced or in any way different than in ordinary death? Practice will indicate the lesson that each of these teach. The skin is now to be removed. If the blood be thin or black, with a disagreeable odor, you can expect some germ trouble such as blood poisoning or an infectious and contagious disease. If the white tissues are yellow, it is reasonably certain that the liver has not done its work.

In removing the skin and making other observations be cautious that you do not prick your fingers with the knife, since you may convey in this way disease to yourself. If by accident a cut or prick is made, cauterize the wound at once, so as to destroy any germs transmitted in this way to you.

14. Examining internal organs.—Place the animal on its side, remove the upper front leg, and the ribs over the chest region. The ribs should be removed as near as possible to the backbone so as to give an unobstructed opening over the important organs. While making this opening, observe the watery fluid as it escapes. If a large quantity is present, dropsy or a rupture of the bladder is indicated. If the trouble is due to the latter, a peculiar odor will be noticed. When the fluid is red, it indicates the presence of blood or of some inflammation of the abdomen or the bowels. A large amount of water in the chest cavity indicates lung trouble; this is further indicated by the tiny attachments running between the lungs and the chest wall inclosing these parts.

EXAMINING THE INTERNAL ORGANS

15. Examining the organs.—When the stomach and intestines are abnormally red, there has been congestion. If these are quite dark or purple, inflammation is indicated. If the stomach is hard and compact, indigestion may have been the trouble. The intestines may be hard and compact or in an otherwise bad condition. Pass the hands along to see if the intestines are knotted at any place or if nails are in the stomach. Often hair balls or parasites are found; either may clog the channel and may be the immediate cause of death. A very disagreeable odor of the urine indicates disturbance. Look the lungs over carefully. See if the color is natural and if the soft, spongy consistency responds to the same touch as does the thoroughly healthy lung.

In health the lungs are a very light pink color. Inflammation will be indicated by a dark color and hard density. A marble appearance indicates inflammation; and hard lumps or tubercles indicate tuberculosis, which, when cut open, show pus and a cheeselike material. Feel the heart to know if it is natural or not, or to see if any of the valves are broken, or if the lining is inflamed. Pink spots about the ribs indicate cholera in the hog.

LESSON FORTY-TWO

MEANING OF DISEASE

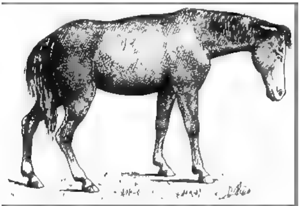
1. Sickness.
2. Disease both general and local.
3. Common causes of disease.
4. Heredity plays a part.
5. Germs and parasites.
6. Immunity by inoculation.
7. Some animals resistant to disease.
8. Course of disease.
9. How disease runs.
10. Period of incubation.
11. Period of eruption.
12. Patient improves.
13. Getting well.
14. Learn to recognize disease.
15. Avoiding danger.

Note to the Teacher.—The obvious purpose of this lesson is to show the nature of physical disturbances of the body, their meaning and nature. Impress strongly the fact that the greatest mischief in handling farm stock comes from improper food, filthy or impure drinking water, bad air in stables, overwork, lack of exercise and poor sanitation of the quarters in which the animals are housed. If close attention is given these things, there will be few disease outbreaks.

LESSON FORTY-TWO

MEANING OF DISEASE

1. Sickness.—An animal is in a healthy state when each organ or part forms its natural functions. Any departure from a normal condition of health is disease. Thus any disturbance of the brain or spinal cord is immediately manifested in the action of the animal; frequently also a disturbance elsewhere may later affect the mental system. Disease may result from an external cause, as from a wound; from food causing poison or derangement of the digestive system; from water introducing impurities; from parasites and bacteria which disturb normal functions, disorganize the tissue, or produce toxines; or from other abnormal conditions.



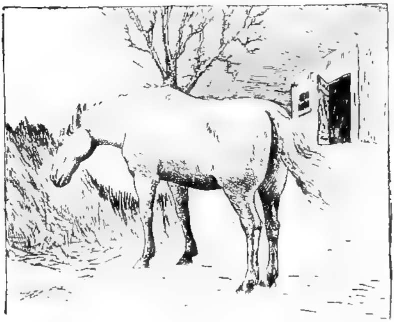
WHAT IS THE TROUBLE?

2. Disease both general and local.—A disease may lead to disturbance throughout the entire body. For instance, in case pus accumulates at some point, it may get into the blood and reach other parts of the body in time, affecting them also. Diseases with which fever is associated are general in nature. The nerve centers are influenced, body heat is increased, the body gets weak. Disease poisons are fundamentally the cause of fever.

When the temperature of the body, as a result of fever, rises to an extreme height, certain life principles are changed and death immediately follows. A temperature of 106 or 107 degrees is very high, and, therefore, very dangerous. In treating disease the temperature is watched, that the course of the fever may be followed.

creating a fever helps in the fight against the disease itself. The basis of the curative process rests upon the principle of proper circulation and the excretion of the impure substances.

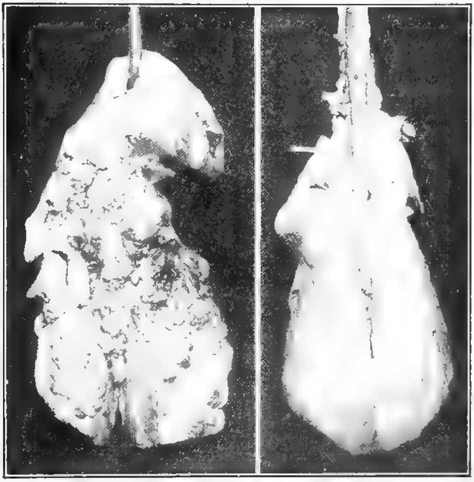
3. Common causes of disease.—Poisonous materials and poisonous plants cause death to thousands of animals annually. Of great importance to the stock interests is the rapid destruction of these harmful products. Fortunately, in the older sections the most of these have been eliminated. And more has been learned about the molds that lead to bad results when moldy forage is fed. In time disease will be considerably lessened; and particularly will this be the case when only clean, wholesome food is placed in the mangers and feed racks. With less disease there will be more rapid gains. Disease is largely due to causes within control of the man who owns or tends the stock.



Bad Management Is the Most Common Cause of Disease

4. Heredity plays a part.—Tuberculosis, once so dreaded in man and beast, is now known not to be handed down from parent to progeny; it is a germ disease, pure and simple, and makes its start just as many other ailments—through breath, or drink, or feed. There are hereditary troubles, however, that continue down through many generations. The narrow hock of the horse invites curb troubles; the narrow chest is a good breeding ground for tuberculosis germs; straight pasterns are bad for the feet; poor conformation is not consistent with efficiency or easy functional activity. Despite, caution and care, therefore, health is often disturbed because of hereditary influences. Thanks to science, many of the old bugbears of the past, however, have become dislodged, and their true import set right.

5. Germs and parasites.—Parasites and bacteria, or germs, cause much loss to live stock. Typical illustra-



DISEASED AND NORMAL LUNGS
Diseased lung at left; healthy, normal lung at right.

tions of such are hog cholera, a germ disease; tuberculosis, a germ disease; stomach worms, parasites; staggers, a mold disease; and abortion, a germ disease. These and hundreds like them are all due to parasites or germs. As disease agents they disturb and destroy, regardless of age, class or breed.

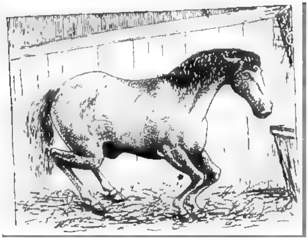
Remedies and treatment are being sought to meet these individual diseases as they occur. Nevertheless, the best treatment is prevention. It is far better to prevent than to cure; and that is the line of action especially for this class. Indeed, it is far easier to understand the simple laws of prevention than complicated curative processes. Especially is this true after germs become known and isolated, and their rapid destruction by air, sunlight and disinfectants understood and available.

6. Immunity by inoculation.—Many diseases are frequently combated by introducing into the blood a certain serum that enables the body to resist attack of that disease. Immunity in animals includes both natural and acquired powers which the body possesses to destroy bacteria and poisons. The serums or inoculating materials are carefully prepared in laboratories by using treated blood of other animals; when prepared the desired serum is injected under the skin. Thus immunity is secured in the animal so treated. A few of the many diseases now treated by inoculation are tetanus, Texas fever, hog cholera, black leg, anthrax and diphtheria. Each is a very destructive disease, and unless treated by inoculation, a large percentage of afflicted animals never recover. If, however, animals are inoculated before being attacked by the disease, the loss from death is relatively small.

INOCULATING THE HOG WITH SERUM FOR PREVENTION OF CHOLERA.

7. Some animals resistant to disease.—An infectious or contagious disease may inflict a herd or flock and destroy few or many of the individuals composing it. Some animals are never affected, although subjected to exposure and contagion. Such animals are immune and resist that particular disease. Others may suffer a mild attack and throw it off with no disastrous consequences; these are strong and their organs ably fortified against any injurious inroad from that disease. On the other hand, most animals are not able to throw off disease. Their very susceptibility invites attack, and if the infection is intensely virulent death may threaten or follow.

8. Course of disease.—Each disease has its own peculiar characteristics. These are more or less conspicuous in each individual case. Some diseases develop quickly and end quickly. Others run a course of several months or even years. The first class is acute, the second chronic. In both kinds nature always endeavors to effect a cure; and, unless other complications arise from improper food, insanitary quarters, bad air or conditions not conducive to health, recovery in most cases will result.



WHEN COLIC ATTACKS
A common position assumed during the course of this ailment.

9. How disease runs.—The course of a disease in a general way is known before it makes its attack. Physicians and veterinarians know when a fever, for instance, will begin, how long it will last, when it will be at its highest point, and when it will disappear. They know these facts even before they begin their treatment. Yet no disease invariably runs the same course in all animals. The virulence of bacteria has much to do with care in treating; mild cases occur usually when the germs are weak, and severe cases when the germs are virulent. This explains why some attacks of measles or Texas fever or hog cholera are more fatal than other attacks in other places or at other seasons of the year.

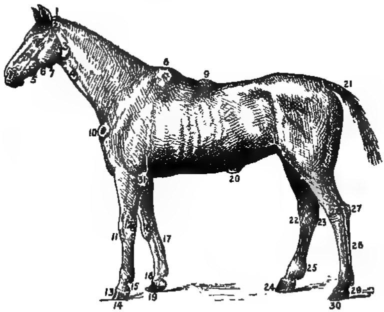
10. Period of incubation.—In the regular course of an infectious disease, the period of incubation follows infection. During this period, no change in the health of the animal is observed. It seems well, acts well, and does its work well. Nevertheless, the germs are developing, multiplying, gaining headway and so intrenching themselves that illness and disorder are sure soon to follow. The period of incubation varies in different animals and in different diseases. It may take two or three weeks for development, or only two or three days.

11. Period of eruption.—Following the period of incubation comes the period of eruption. At this stage the typical characteristics are observed. From now on the disease approaches and reaches its height, the animal being under its complete dominion. If properly nursed and treated, in most diseases, the animal will pass through the period and recover its usual health.

Milk Fever at Its Height

12. Patient improves.—The final stage of sickness is the period of improvement. In the battle between body and disease, the germs are destroyed and the body is victorious. All that now remains is to clear away the debris scattered throughout the system. The veterinarian seeks the repair and recovery of the injured parts or organs as near to the original condition as the nature of the disease will admit. The period of improvement varies in different diseases and in different animals. Recovery may occur in a few days, and in other cases weeks and months are necessary for restoring health and vigor. A change of feed or pasture or work is usually desirable for most rapid recovery. In some cases, nothing but absolute rest will suffice.

13. Getting well.—After a disease runs its course, the body usually is restored to its normal condition. You see, there is a limit to what an ordinary, common disease can do; a healthy body may be attacked, but in the end, the disease will be overcome. There are some diseases that are not readily mastered. Usually, however, nature is able to fight off an attack, but care, treatment and nursing are all helpful in lessening the time and in minimizing the severity. The stage of getting well calls for rest, light and nutritious food, pure water, a comfortable stable and freedom from annoyance or housing in insanitary quarters.



LOCATING COMMON TROUBLES

SOME COMMON AILMENTS OF THE HORSE

1. Poll evil
2. Swelling by bridle pressure
3. Inflamed parotid gland
4. Inflamed jugular vein
5. Caries of the lower jaw
6. Fistula of parotid duct
7. Bony excrescence
8. Fistula of withers
9. Saddle gall
10. Tumor caused by collar
11. Splint
12. Malanders
13. A tread on the coronet
14. Sand crack
15. Quittor
16. Knee bunch
17. Clap on back sinews
18. Ringbone
19. Foundered foot
20. Ventral hernia
21. Rat tail
22. Spavin
23. Curb
24. Quarter crack
25. Thick leg
26. Sallenders
27. Capped hock
28. Swelled sinews
29. Grease
30. Sand crack
31. Tumor of elbow

14. Learn to recognize disease.—Every stockman should familiarize himself with the common ailments of live stock. If experience tells him that his corn or potatoes or cotton is strong, vigorous and healthy or just the reverse, observation and experience ought also to tell him when his animals are in good health or when they lack thrift or are sick and need treatment. He recognizes smut when it attacks his wheat or oats; so colic, too, ought to be recognized when it attacks his horse. He recognizes the common ailments of the peach and apple and he should learn to recognize the common ailments of the cow and the pig. If ill health and lack of thrift, and the causes that induce them, are given the attention they deserve, much of the worry and trouble arising from disease will be avoided.

15. Avoiding danger.—Great loss of live stock annually occurs because infected animals are not quarantined. This explains why a disease may become epidemic. As soon as a disturbance from the normal is indicated, that animal should be separated from the rest of the flock or herd; in case a serious illness develops, exposure of the entire herd will then be less likely. If the disease is contagious, the wisdom of this action will be readily understood. Quarantine quarters need not be expensive, and they ought to be far enough removed from the healthy stock to render infection impossible. When new animals are added to a flock or herd, they should first be put in quarantine quarters and kept there long enough to determine if anything strange or unusual is developing. Such precaution is the surest way to avoid the danger of introducing a troublesome disease.

PRACTICUMS

1. Choosing Soiling Crops.—Require each student to prepare a table of soiling crops that will afford a succession of green food from early spring until late fall. In the table should be included the name of the crop, the time of seeding, amount of seed to the acre for that crop and the time of cutting for use as feed.

2. Locating Disease.—Every student of farm animals should be familiar with the common diseases and whether they are general or local in nature. He should know what regions or parts are affected by particular diseases. By means of the illustration on page 455 point out the diseases that affect each part of the horse. All animals being judged should be looked over for blemishes or other disease troubles. The student should be able to tell where every common disease is located. Often several of these ailments may be found in the same horse. Require each student to examine a number of horses in the neighborhood so as to become familiar with the superficial, regional diseases as they are located on various animals of the neighborhood. See illustration on page 455.

3. Co-operation of Local Veterinarian or Physician.—Ordinarily, the local veterinarian or physician will gladly co-operate with the teacher in a laboratory period to be arranged for. Frequently he will be able to provide the necessary material or live specimens for an invaluable exercise. Under his direction the places for taking the pulse, how to take the temperature and counting the respirations may be indicated. The facts brought out in previous lessons may be gone over and their practical application made interesting to the class. The veterinarian often has available cases under way that can be discussed and their treatment outlined. Teacher and students are urged to get in touch with the local veterinarian for the interesting and valuable information and suggestions that he can give.

4. Post-Mortem Examinations.—Follow paragraphs 12, 13, 14 and 15 in Lesson Forty-one, if an opportunity is offered for making a post-mortem examination. Often it is possible to arrange for such a demonstration with the local veterinarian. His advice and instruction will prove of invaluable and incalculable good for all years to come. On nearly every farm an opportunity is occasionally offered for such work. No student of this book should neglect making such an examination whenever the occasion arises permitting him to do so.

5. Pulse of Farm Animals.—The pulse of the horse is felt on the lower jawbone; and in the cow on the jaw, inside of the elbow and cannon and the base of the tail. Pulse beats vary. In the healthy horse the range is from 36 to 40 a minute; in the cow 45 to 50; in the pig 70 to 80; in the sheep 70 to 75. The pulse is slightly slower in males than females, and is more rapid in young animals

than in adult animals. Locate the pulse of the different classes of farm animals. If any difficulty is met, ask the local veterinarian or family physician.

6. Number of Respirations.—These will vary with the class of animal; as a rule, the larger the animal the slower the respiration. The ratio of heart beats to respiration is from one of the latter to four or five heart beats. Count the respirations of several animals in health. If sick animals, note the respirations and compare with the following normal rate for well animals: Horse, 8 to 10 respirations per minute; steer and cow, 12 to 15; sheep and goat, 12 to 20; dog, 15 to 20; pig, 10 to 15. Count the pulse and determine the ratio of heart beats to respiration.

7. Examining for Soundness.—Examine one or more horses. Starting with the head, examine all regions for defects, blemishes and unsoundness.

(*a*) Are there cuts or injuries known as blemishes that lessen the value but which do not interfere with usefulness?

(*b*) Do you observe any unsoundness, such as splints, curbs, ringbones or sidebones?

(*c*) Is the eyesight perfect?

(*d*) Is the hearing as it should be?

(*e*) Do you find poll evil at the top of head?

(*f*) Is the shoulder sound or sweenied?

(*g*) Do you find a fistula in any region?

(*h*) Are the hoofs of good shape and perfect otherwise?

(*i*) When made to run fast, how is the "wind" of the horse?

LESSON FORTY-THREE

WOUNDS AND THEIR TREATMENT

1. Kinds of wounds.
2. First step in treating.
3. Checking blood flow.
4. Cleansing the wound.
5. Making the bandage.
6. Stitching a wound.
7. Making the stitches.
8. Pins in emergency.
9. Antiseptic washes.
10. Nail puncture.
11. Treating nail punctures.
12. Drainage for the wound.
13. Treating bruises.
14. Leg wounds.
15. Maggots in wounds.

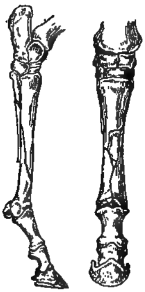
Note to the Teacher.—A neglected wound often leads to serious consequences. Show the importance of cleanliness and protection of wounds and cuts, even if the injury is slight and seemingly unimportant. Ordinary wounds are of frequent occurrence, making it possible to put in practice some of the suggestions made in this lesson. A teacher should never neglect an opportunity of putting into practical use useful information of whatever nature it may be and whenever it is possible so to do.

LESSON FORTY-THREE

WOUNDS AND THEIR TREATMENT

1. Kinds of wounds.—Wounds fall into four classes: (1) clean cut, made by something sharp; (2) torn or lacerated, where ragged edges are left; (3) bruised, the result of continued pressure or of a kick or a knock; and (4) punctured, caused by the entrance of a nail, splinter or gunshot.

2. First step in treating.—A flow of blood usually accompanies an ordinary wound. Other than a bruised and punctured wound this is always true. Frequently a nail puncture does not give off blood, or, if it does, it may not be noticed. However, blood is present; for, from the very nature of the trouble, blood rushes to the seat, this being nature's way of repair. The first step, therefore, is to check excessive blood flow.



FRACTURES

3. Checking blood flow.—Blood has the trick of coagulating or clotting; and this in time will check the flow. But you can assist in forming the clot very simply by applying some finely ground material, that the blood may be held on the spot. Absorbent cotton is the best material. In case this is not available, use something clean, not stored up with germs. Tea is good, as is flour also. Cold water acts favorably, and for the slight, ordinary surface wounds water is usually sufficient. A few drops of antiseptic in the water, such as carbolic acid, if available, is always advisable, for the freshest water carries its full quota of germs, some of which may cause trouble. A tiny bit of alum powder will be found effective and not painful.

4. Cleansing the wound.—After the flow of blood has been stopped, cleansing the wound is next in order. All dirt should be carefully removed, the injured flesh cleansed, the torn tissues brought together, and stitched if need be, and an antiseptic applied. The water used in bathing the wounded flesh should contain an antiseptic, that the germs present may be destroyed and no live ones admitted by water in cleansing the wound. Any good commercial antiseptic will do; or the old common ones, such as corrosive sublimate, one part in a thousand parts of water; carbolic acid, a teaspoonful in a quart of water; or salt water. A powdered antiseptic, such as iodoform, is very desirable for dusting into the wound.

LEG BANDAGE

Showing how to place and wrap.

5. Making the bandage.—Unless the wound is of little consequence it should be covered and bandaged, that no foreign elements may be admitted and that some pressure may be secured to keep the broken parts together. To secure this effect absorbent cotton, slightly moistened with the antiseptic, should be laid on the wound, and firmly fastened by strips of clean cotton cloth. By winding this bandage around and about the wound, dressed in this careful way, the wound will be protected, germs will be kept out, and nature thus reinforced will be enabled to make a rapid recovery. Unless the bandage is disturbed, there is no need of changing under

24 or 36 hours. If the bandage is displaced, dress as before and bandage again.

6. Stitching a wound.—When a cut wound is deep or large, stitching is sometimes required, that the broken parts may be brought together for more rapid healing. Nothing is better for doing this than a coarse needle and heavy thread. Before stitching, the wound should be bathed as previously described. The needle and thread should be soaked in the antiseptic that no germs may be introduced by either.

7. Making the stitches.—In making the stitches place the needle about an eighth to a quarter of an inch from the edge of the wound and carry across to the opposite side. Bring the two ends together and tie, leaving the lips of the wound as close together as possible. If more than a single stitch is necessary proceed in the same way, placing the second stitch about three-quarters of an inch from the first one; continue as with the first stitch if more are necessary.

8. Pins in emergency.—In case needle and thread are not available, pins may be used in the emergency. Insert the pin through the two edges and bring the lips together, making them fast by a thread or cord carried from one end to the other several times, alternating to the right and left as presented by the figure eight. Sometimes a wound enlarges and becomes feverish. In a case of this nature, remove the fastenings and bathe the wound very gently, using a mild antiseptic wash of tepid water in which carbolic acid has been placed.

9. Antiseptic washes.—Avoid any breaking of the healing tissue and do not have the washing solution too strong, else it may injure the delicate tissue. A teaspoonful of carbolic acid to a quart of water is strong enough. With lacerated wounds the treatment is very similar. If the wound becomes inflamed and spongy, add a tablespoonful of acetate of lead and a tablespoonful of sulphate of zinc to the antiseptic solution and apply twice daily.

10. Nail puncture.—If an animal becomes suddenly and severely lame and there is no evidence of an injury to any other part of the leg, such as swelling, heat and pain upon pressure, it is always well to look for puncture in the foot. If the animal stands with the lame foot extended, and when walking places the lame foot well forward and brings the well foot up to it, the evidence of puncture is still stronger. To examine the foot properly the shoe should be removed. It is not sufficient to merely scrape the bottom of the foot clean, for if the nail has pulled out and the horn sprung back in position, all trace of its entrance may have been obliterated. To examine the foot properly, tap the hoof with a hammer or knife and the exact spot may be definitely located. If the injury is of a few days' standing, additional heat in the hoof, and, perhaps, slight swelling of the coronet may also be present.

ANATOMY OF THE FOOT
Showing the delicate nature of the parts.

Locating lameness in the stifle joint is a common but inexcusable error, as the action resulting from lameness in the two parts is entirely different. The so-called gravel, which is said to enter the sole of the foot and then to work out at the heel, is usually the working out of the pus or the matter resulting from a nail puncture or a bruise.

11. Treating nail punctures.—In treating hoof wounds, pare away only such parts of the hoof as necessity requires and introduce a bit of cotton cloth rolled as a string by means of a probe of some kind. Both probe and cotton must be treated with the antiseptic solution. This solution should be a little stronger than for flesh wounds. Make the solution by using a teaspoonful of carbolic acid to only a pint of water. After the cotton has been inserted a few times and withdrawn, each time a fresh cord being used and fully saturated, leave the last one in for a few hours and then repeat the treatment. This should be done three or four times each day.

12. Drainage for the wound.—The main point in the treatment of nail puncture of the foot is to provide free exit to all matter that may collect, and to keep the parts clean. If this is done, the matter will not be forced to work out at the heels, and no separation or loss of hoof will occur. Often in case of a very severe wound the treatment acts slowly. In case proud flesh accumulates it may be burned away by a hot iron. After this operation has been performed, the cavity may be filled with balsam of fir and cotton placed over it, a piece of heavy leather fitted to the foot and held fast by the replaced shoe. This will usually end the difficulty. A veterinarian should be called for treatment of severe cases.

13. Treating bruises.—In treating bruises a different procedure is necessary. The broken tissue is concealed beneath the skin and usually under the surface muscles. Bathing with water and acetate of lead—a quart of water and two tablespoonfuls of the acetate—will tend to lessen the inflammation. In time it may be necessary to open the swelling to let the pus out. After operating inject a mild antiseptic wash for cleansing, using one quart of water and a tablespoonful of chloride of zinc. If the swelling remains, apply twice each month a salve made by using a small amount of biniodide of mercury and lard. Wash occasionally, using the chloride of zinc solution.

14 Leg wounds.—Cleanse the wound with a wash composed of one tablespoonful of acetate of lead, one tablespoonful of sulphate of zinc, four tablespoonfuls of tincture of arnica, and one quart of water. Use this wash frequently, every hour or so during the first day. After that three or four applications will be sufficient. The sore should be kept lower than the skin during the healing process. If it tends to crowd up, apply a tiny bit—as much as you can place on a one-cent piece—of bichloride of mercury. This will assist in getting an even heal and the skin will grow over, leaving no blemish or swelling.

15. Maggots in wounds.—If a wound has been treated as heretofore suggested, there is no possibility of any trouble from maggots. These come from a lack of cleanliness, and neglect. Of course an animal is often wounded and the owner is not aware of the mishap. When, for any cause, maggots are present, they must be got rid of at once. A good plan is to use chloroform, either by spraying or by throwing it in the wound in small drops from a sponge. The danger from maggots can usually be avoided if a mixture composed of one tablespoonful of turpentine, three tablespoonfuls of tar and two tablespoonfuls of lard or fish oil are smeared all around the border of the wound.

LESSON FORTY-FOUR

IMPORTANT INFECTIOUS DISEASES

1. Actinomycosis.
2. Anthrax.
3. Blackleg.
4. Fistulæ.
5. Foot and mouth disease.
6. Footrot in sheep.
7. Fowl cholera.
8. Glanders.
9. Hog cholera.
10. Rabies.
11. Strangles.
12. Tetanus.
13. Texas fever.
14. Tuberculosis.
15. Control of infectious diseases.

Note to the Teacher.—The term infection means the entrance of living micro-organisms into the body of an animal and their multiplication therein. Following such infection a local or general diseased condition results that may produce death. The general diseases described in this lesson will indicate how infections are caused, the kind and nature of the invading organisms, and more common symptoms that are manifested when animals are infected. The teacher will do well to emphasize the importance of guarding against infections and of using radical measures when such outbreaks occur or are prevalent in the community.

LESSON FORTY-FOUR

IMPORTANT INFECTIOUS DISEASES

1. Actinomycosis.—Called lumpy jaw, because of the frequency of the swelling located on the jaw. It is due to the entrance of a fungus into the tissues. Adult cattle are most commonly, but occasionally other domestic animals and man may be, affected. The disease is recognized by the characteristic tumor, usually observed on the jaw, either of the bone or of the soft tissues in that vicinity. It may, however, affect the tongue, or any of the organs of the body.

DISEASED BONE, THE RESULT OF ACTINOMYCOSIS

Its development is more or less of a slow, constant growth, beginning with a very small nodule, but, when allowed to run its course, may reach the size of a cocoanut, or larger. On reaching some size, it usually ruptures, and from it is discharged a thick, yellowish pus. If of small size in the soft tissues, it may be cut out, by the knife. Veterinarians have a system of treatment for advanced cases.

2. Anthrax.—An acute, infectious disease of plant-eating animals, caused by a microbe which enters the circulating blood and by multiplication therein causes its rapid destruction and the death of the animal. The disease is as old as history and exists in all countries. Soil is the prime factor in preserving and propagating the germs. They may get into the body in breath, food, drink, through abraded surfaces on the skin and by bites of insects. In combating this disease medical treatment is of little value. Fortunately a vaccine has been discovered that is very effective as a prevention.

3. Blackleg.—An infectious disease produced by the *blackleg* bacillus, a parasite that lives and propagates in the soil of infected districts and in the bodies of diseased animals. The disease is characterized in the appearance of large swellings on various parts of the body, usually on the upper portions of one of the legs, and never below the knees. Swellings vary in size and are always formed by the presence of gas formed in the tissue just beneath the skin. This gas is a product of the germ. A peculiar cracking sound is noticed as the hand is passed over the swellings. When punctured, these swellings emit a bloody fluid of disagreeable and sickening odor.

Associated with the disease are loss of appetite, high fever and lameness. Death follows shortly after time of attack. No medical cure for treatment has been discovered. The only safe practice in regions where blackleg is prevalent is in the use of protective inoculation or vaccination. Such vaccination renders the animals immune, and even if attacked, there is almost no appearance of the disease.

FISTULA OF THE WITHERS

4. Fistulæ. — A chronic discharge from some tubelike channel, with no tendency to heal and most common in horses. They may be located on the withers (fistulous withers), on the side of the face (tooth fistula), on the breast bone (sternal fistula), or on the lower jaw (salivary fistula). Fistulous withers are caused from external injury—the animal rolling on a rock, ill-fitting collars, or the saddle pressing on the withers. Tooth fistulæ are caused by a decayed tooth; sternal fistulæ by injury in the breast; salivary fistulæ by an injury to the tube which carries the saliva from the gland to the mouth.

At first a swelling appears, which enlarges and becomes soft. The fluid contained in it can be distinctly felt. If left to itself the swelling gets larger and softer, and in a month or so breaks and discharges the contents. The fluid that comes from the swelling is first thin and streaked with blood; later it contains yellow-appearing masses or pus. The inclosing sac is a hard, firm membrane that keeps the wound from healing. The wound may heal and there will be no pus discharged for a month, then the old opening will be broken and the pus will flow out again until the sac is emptied. This healing of the wound and then breaking again may be kept up for years unless the disease is properly treated by a trained veterinarian.

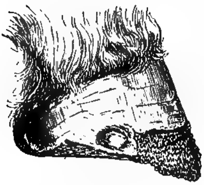
FOOT AND MOUTH DISEASE

Note diseased conditions of teats and hoofs.

5. Foot and mouth disease.—This malady usually affects ruminants, and spreads very rapidly. The virus which transmits the disease may be carried by railroad cars, bedding, feeds, dairy products, small animals and persons. In from three to five days after infection the animal has a moderate fever. The appetite is lost and the mouth is closed. There is a dribbling of saliva, and in two or three days yellowish white spots, the size of hemp seeds, appear on the gums, the lower surface of the tongue, lining of the mouth, and on the lips. These eventually attain the size of a silver dollar. They run together, burst and form painful, foul-smelling ulcers.

Usually, a short time after an appearance of the disease in the mouth parts, there is a redness, heat and swelling of the skin at its juncture with the hoof, and especially between the toes and upon the soles of the foot. Similar ulcers to those on the mouth appear on the feet and soon burst. Owing to the nature of the disease its contagion and danger, treatment should be in line of prevention and in destruction of infected animals.

6. Footrot in sheep.—A chronic inflammation of the foot, marked by ulceration, softening of the hoof, lameness and the discharge of a sticky material which has a very fetid odor. It is a contagious disease, and is produced by a germ that lives in the soil and gains entrance to the feet through wounds and surfaces chafed by barbed grasses and stones, or by gritty clay, which becomes lodged between the toes and hardens there.



FOOTROT

Mild cases are best treated by making the sheep stand for several minutes daily in a trough containing a disinfectant. In bad cases and where the hoof is underrun with pus, the horn and all overgrowths must be cut away so as to expose the diseased parts to the action of the disinfectant. The foot should then be dried, dusted with finely powdered burnt alum, and bandaged to keep out the dirt. This antiseptic treatment of the feet must be kept up daily as long as the disease exists.

7. Fowl cholera.—A germ disease and contagious, and attacking poultry of all kinds. Bad food may aggravate the trouble, but the germ introduced either in food or drink is the cause. At first the droppings take on a whitish color; diarrhea then results. The discharges become thin and watery, and at times are frothy and greenish. Fowls thus attacked soon lose their appetites, become stupid, and are of sickly appearance. The head drops toward the body, the eyelids fall, and the fowls stand around as if doped. Some recover, but unless checked the flock will be materially injured.

Dead fowls must be burned and lime and other disinfectants used to keep the disease from spreading. The well birds must be kept apart from the infected quarters. Care must be exercised that infection be not carried either by visitors or attendants from the sick to the healthy quarters.

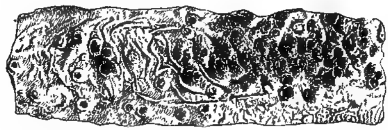
8. Glanders.—A contagious disease peculiar to the horse, ass and mule and may be communicated to human beings. The specific organism causing glanders is known as *bacillus malleus.* A discharge from the nose and ulcers in the partition dividing the nasal cavities are common external manifestations of the disease. A peculiarity of glanders seems to be a tendency for the symptoms to appear on the left side. Well-marked cases of glanders are not difficult of diagnosis; in cases of doubt a test, known as the *mallein test,* may be resorted to.

FARCY FORM OF GLANDERS

Farcy is akin to glanders, presenting different symptoms in way of farcy "buds" or ulcers on the skin. In the acute form, the disease develops rapidly and death occurs in a few weeks. In the chronic form, an animal may go for months without the disease being suspected; yet such an animal is a source of danger to other horses and to its attendant. Glanderous horses should be killed as soon as the disease is diagnosed.

9. Hog cholera.—This is the most disastrous and prevalent disease among hogs. It is due to a germ and is extremely contagious. The germ is so small as to be invisible to the highest available powers of the best microscopes.

The hog coming down with cholera is usually sluggish at first, lying around in the shade and refusing feed. The hair may become rough. The eyes early show symptoms of inflammation, with a sticky discharge. There is usually a suppressed cough. The gait may become irregular and uncertain, especially with

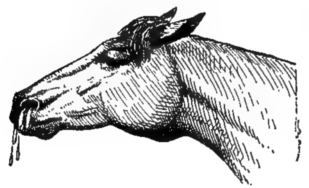


CHRONIC HOG CHOLERA, SHOWING ULCERS IN LARGE INTESTINE the hind legs. After these preliminary symptoms have been shown for a time, the skin becomes red, changing to purple, especially noticeable in white-haired hogs. The hog is then usually within a very few days of death. On opening the dead carcass small blood clots may be found in the fat cut through under the skin. The glands along the intestines are intensely inflamed. The mucous membrane of the stomach is frequently thickened and roughened, and in chronic cases there may be ulcers.

Treatment consists in prevention and inoculation. The greatest care is necessary to prevent the germs being carried from sick hogs to healthy herds. The owner of healthy hogs and his family should keep away from all pens and yards on other farms, whether sickness among hogs prevails or not, if there is any infection in the community. Care should be exercised that dogs, stray hogs and other animals be kept out of the quarters where the hogs are kept. In case of danger, communicate with the state authorities and have the herd inoculated.

10. Rabies, also called mad dog, is an infectious disease caused by an invisible organism. The disease is transmitted from one animal to another by the bite of an animal which is suffering with the disease or by direct inoculation. It is more common in the dog than in any other animal.

The dog at first seeks dark places, but is usually restless, and after a day or two may go 30 miles in a day. He will drink water, eat sticks, stones, and bite other dogs, horses and cattle, less often man. In a few days the dog becomes partly paralyzed, is unable to swallow, his legs may be affected and he will lie in one place, usually dying in a few days after. A horse that has been bitten by a mad dog becomes restless, usually violent and will kick and bite. He may break his teeth on the manger and oftentimes bites his own flesh at the place where he has been bitten by the dog. The symptoms usually develop in from eight to twenty-eight days, but may not develop for six months. The disease runs its course in from two to ten days



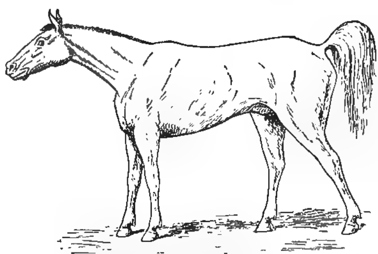
STRANGLES
Showing position of swelling.

with a fatal termination. There is no help after the symptoms have developed. In case man is bitten he should take the Pasteur treatment, which is a preventive, and it should be taken in a very short time after being bitten. After the symptoms begin to show it is too late.

11. Strangles.—This trouble, commonly called colt distemper, affects horses, and rarely mules and donkeys. It is such an infectious disease that nearly all horses contract the disease when colts, and usually remain immune to future exposures. The cause is a very small organism or germ, which enters the system when a healthy colt comes in contact with a diseased one, or when fed and watered in infected vessels. The seat of trouble is largely restricted to the respiratory organs.

The animal eats little, and does not care to take much exercise. A little watery discharge frequently appears from the eyes, and about the same time a watery discharge from the nostrils, which soon becomes thicker and yellower in color. Usually the glands between the lower jawbones become enlarged and undergo suppuration, with a rupture of them and free discharge of pus. When no complications occur, the disease usually runs its course in two weeks. A laxative diet, with something green, if possible, should be given, and the colt placed in clean, airy, and comfortable quarters, but not in a draft.

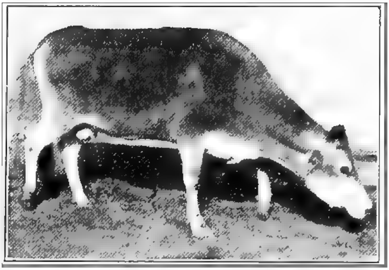
12. Tetanus.—An infectious disease in which the body muscles are spasmodically contracted or stiffened. The muscles that move the jaw are frequently affected and the animal is unable to open the mouth. The spread of the disease does not occur through healthy animals coming in contact with animals having tetanus, but by inoculation.



TETANUS OR LOCK JAW
Note the rigid, tense position of the muscles

The germ of tetanus is present in the soil, manure and dust. It enters the body by way of wounds. The germs grow and produce a poisonous toxin that is said to be the most powerful produced by any bacteria. This toxin acts on the nerve centers of the brain and spinal cord, causing extensive spasmodic contraction of the body muscles. It may be largely prevented by the careful disinfection of wounds, and the use of anti-tetanic serum. In most localities the proper treatment of the wound is a sufficient preventive measure, but in localities where the disease is common the anti-tetanic serum should be used as soon after the injury has occurred as possible. Many boys and girls lose their lives from this disease through firecrackers after a Fourth of July celebration.

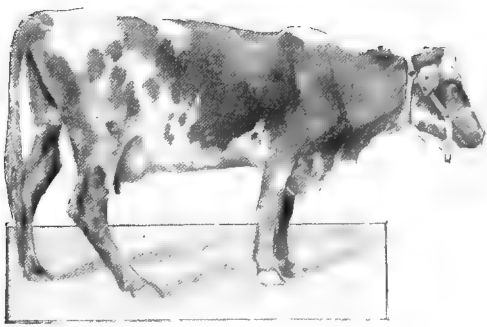
13. Texas fever.—Caused by an organism which lives within and breaks up the red corpuscles of the blood. It is transmitted by the cattle tick. The eggs laid on the ground by the female tick after falling off the cattle hatch, and the little creatures attach themselves, by preference, to the tender skin on the escutcheon, the inside of the thighs, and on the base of the udder. When very numerous they may be found on various parts of the body. They remain clinging to the cattle until mature, and then fall off and lay their eggs and hatch more new ticks.



ACUTE CASE OF TEXAS FEVER

The spread of Texas fever can be prevented in two ways: By sanitary arrangements and by vaccination. Where the cattle are infested with the tick, the ticks can be killed by smearing the animals with a solution capable of killing the ticks without harming the cattle. In large herds a vat of crude petroleum is used for immersing the cattle. Vaccination is for the purpose of immunizing cattle that are brought from a non-infected district to an infected district. Calves are more immune than adult cattle. Immunity is caused by introducing the germ into the blood in a weakened form. This may be done in two ways—by placing virulent young ticks on the calves or by artificial vaccination.

14. Tuberculosis.—A disease resulting from the growth of tubercle bacteria in the tissues of the animal. The bacteria, or germs of tuberculosis, gain entrance to the organs of the body through air, drink or food. They most frequently attack the lungs, bronchial glands, liver, kidneys and intestines, but tuberculous areas may be found in almost any part of the infested animal. The disease is spread by germs escaping from diseased animals and getting into the bodies of healthy ones. After the germs gain a foothold they will multiply and produce the disease, just as the seed of a noxious weed, if blown into a new field, will germinate and produce the weed there. Tuberculosis spreads from animal to animal on the same principle that weeds spread from one field to



TUBERCULOUS COW

Note the emaciated condition, sickly attitude and coarse rough coat.

another. By using tuberculin, affected animals can usually be located. The simplest way to prevent the spread of tuberculosis is to prevent healthy animals from coming in contact with the diseased ones or eating or drinking after them.

15. Control of infectious diseases.—From time immemorial it has been known that certain diseases were transferable from the diseased to the healthy. In many cases the older observers believed in the theory that there was "something in the air," whereby the maladies were communicated, and people or animals got sick. The science of bacteriology has since explained the reason. We know now that every disease of an infectious nature is caused by a specific micro-organism which in one way or other, must be introduced into the animal body to cause that disease. The principal ways by which such infection takes place are: (1) Through the digestive tract, in the food or drink. (2) Through the respiratory tract, inhaling air containing the disease-producing organisms. (3) Through abrasions of the skin, where organisms may be admitted in pricks, scratches, cuts or sores. (4) Through the bites of insects. All infective diseases are due to the presence of the invading organisms either circulating in the blood or manufacturing toxic material at the seat of injury, the poison then circulating in the blood. It is obvious that control of such diseases lies more in preventive measures than in treatment and cure afterwards. This is to be done by keeping unexposed animals from the vicinity of infected places; by keeping stock in good health and vigor; by providing pure food and drink, and exercise; and by housing in sanitary quarters where much sunlight and fresh air at all times are admitted. Furthermore, it is necessary to make certain that infectious germs are not carried to the flock or herd, either by affected stock, or by means of clothing, drinking vessels, feeding troughs, food, water, dogs, birds, bedding or other media by means of which these germs may be transmitted from affected individuals to healthy herds or flocks.

LESSON FORTY-FIVE

COMMON AILMENTS NOT INFECTIOUS

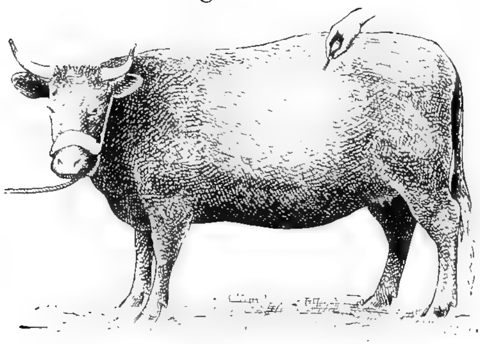
1. Bloating
2. Bog spavin.
3. Botflies.
4. Colic.
5. Curb.
6. Founder.
7. Gapes.
8. Gravel in foot.
9. Heaves.
10. Hollow horn.
11. Lice.
12. Ringbone.
13. Scab.
14. Spavin.
15. Splints.

Note to the Teacher.—The purpose of this lesson is to acquaint the student with the general characteristics and symptoms of the more common diseases of a non-infectious nature that affect farm stock. The more common of such diseases are described in the belief that every person concerned with the management of animals should know something about the ailments that most frequently occur. There is no virtue in ignorance, even if the subject is an unimportant disease.

LESSON FORTY-FIVE

COMMON AILMENTS NOT INFECTIOUS

1. Bloating.—A disease characterized by the distention of the paunch or rumen, due to the accumulation of gas. It most frequently occurs when cattle or sheep are pastured on clover or alfalfa, especially if moist, and when not accustomed to fresh green food. The animal shows



CASE OF BLOATING
Where to tap for relief.

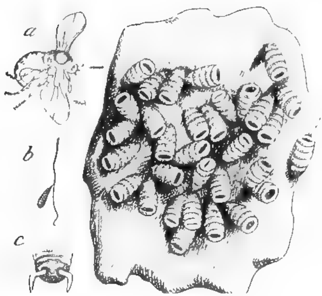
pain, goes off to itself, and breathes with difficulty. Unless relief is secured, the gas may continue to form, even over the back of the animal, and choking and death may result. In mild cases recovery is gradual, but in severe cases tapping to release the gas is necessary.

In tapping with trochar and canula the insertion is made on the left side, the instrument being pushed into the rumen or paunch, the incision being made half way between the point of the hip and the last rib. After the incision is made the trochar is withdrawn and the canula left in to furnish an opening through which the gas can escape. If this instrument is not available, a pocketknife will answer.

2. Bog spavin.—A round, smooth tumor at the front and on the inside of the hock. Bog spavins result from sprains, bruises, or other injuries. When the injuries occur, too much joint oil is secreted, causing a bulging of the ligament. Lameness seldom accompanies a bog spavin. If lameness is present other structures are certain to be affected, pain and heat will be noticed, and the joint will be stiff. Treatment consists of applications of cold water, liniment or blister.

Bog Spavin

3. Botflies. — Horses are often noticed biting their legs in summer when the yellow nit is attached to the hair or other parts. The young larva, and even the eggs, are thus transferred into the mouth, and swallowed. When in the stomach they attach themselves, causing annoyance and often digestive disorders. Until they have completed their development bots are hard to dislodge. If a rag made wet with kerosene is actively rubbed over the horse where the nits are attached the eggs will be destroyed. Bots usually respond to medical treatment.

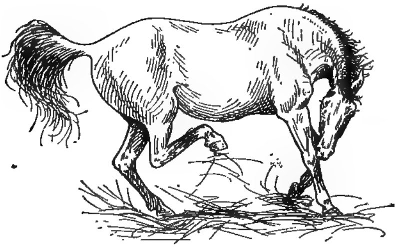


Bots in Stomach

At left, young bots attached to stomach wall. *a*, female botfly; *b*, the bot; *c*, magnified head of bot.

The botfly of cattle is taken into into the mouth and partly develops in the digestive tract. It then burrows through the tissue until it reaches the region of the back. The best treatm:nt is to destroy the grub as it develops under the skin. These are known as warbles.

The presence of botflies among sheep is easily told by the behavior of the sheep. This fly looks much like a house fly, and it always attempts to lay its eggs just inside the opening of the nose. When the fly succeeds, the larva works its way up the cavity of the nose, seeking the small cavities in the head, where development takes place. As the grubs enlarge, a discharge from the nostril occurs. Treatment may be either preventive or surgical. A mixture of tar and lard applied to the nostril with a brush and repeated every 10 days or two weeks during the summer months is a good preventive.



Colic Pains
A common attitude with colic.

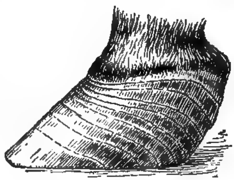
4. Colic. — A very common disease in horses and occasionally in cattle and lambs. It begins as an inflammation of the bowels, and is characterized by a spasmodic contraction of the intestinal wall. Feed and water are controlling factors. Cold water after hard work or after eating, or cold water given when the animal is hot, or a change of food, may bring on the disease. Some horses and cattle are more given to colic than others, some individuals never being affected. Two kinds are known—spasmodic, or cramps of the bowels; and flatulent, or bloating. When the spasms come on the horse paws with his forefeet, cringes, turns his head around, as if looking at his side, lays on the ground and rolls, as if in pain. Then he stands quietly for a while and repeats these performances. If the cramps are severe he breaks out with sweat. Treatment consists in the use of opiates and purges.

5. Curb.—A sprain or injury to the ligament situated on the back part of the hock joint. Anything that puts too much stress on this part, such as holding back heavy loads, going down hill or backing up too heavy loads, or the hind legs slipping too far under the horse's body, may cause curb disease. It may be caused also by kicks or by the whiffletree striking against the back of the hock joint. Sometimes there is swelling and heat in the part, and lameness; sometimes there is swelling but no lameness. Curb is treated by lotions and blisters.


CURB

6. Founder.—An inflammation of the sensitive or soft structures between the hoof and the bones of the foot. Stiffness in the legs and shoulders is but the natural results of soreness in the feet. Founder may be produced by a change of feed or excessive feeding; a change of work, or excessive work, which results in exhaustion; large quantities of feed or water when warm or fatigued; sudden cooling off when sweating and long drives on hard roads. It may occur in the fore or hind feet, or in both, but generally in the forefeet.

The position in which the animal stands is characteristic. The forefeet will be placed well forward, so that the weight will be borne by the heels, while the hind feet are brought well up under the body in order to take as much weight off the front feet as possible. Treatment consists in removing the shoes and applying moisture to the feet. The animal may be required to stand in water 5 or 6 inches deep each day, several hours at a time. Or an application of a poultice of wheat bran or some such material, or wet cloths thoroughly saturated with water, wrapped about the feet may be used. An animal once foundered often suffers from subsequent attacks. The disease most commonly affects horses.


FOUNDERED FOOT

7. Gapes.—Caused by worms in the windpipe; oftenest seen in young chicks and turkeys. Birds droop, cough, and lower their wings. A feather moistened, but not dripping, with kerosene or oil of turpentine is the commonest remedy. Cleanliness of food, water and quarters is the great preventive. Poultrymen who keep their chicks on the ground not used for chick raising the previous year, and who insist on strictest cleanliness, are seldom if ever troubled with gapes.

8. Gravel in foot.—A collection of pus, or other fluid, containing gravel or dirt. It occurs most frequently in the foot, and is associated with the horse and mule almost exclusively. The cause may be from a bruise, but more frequently it is due to a punctured wound of the foot by nail, wire or other pointed object. Nearly always there will be dirt carried into the wound with the offending object or shortly after its removal. This dirt, infected with germs, sets up inflammation of the sensitive structures, causing more or less lameness.

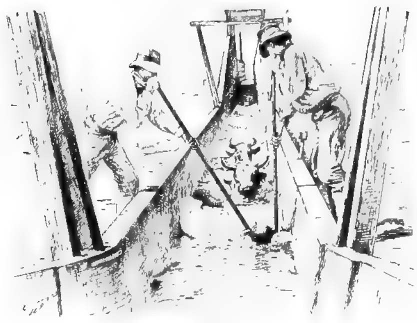
Treatment consists in making or enlarging the opening so that all secretions formed in the wound can find a ready escape to the outside. The wound should be thoroughly cleansed, and washed with a mild disinfectant, after which a small quantity of oil of turpentine should be injected, and the wound packed with calomel or iodoform and covered with a pledget of cotton. If the wound is very deep or extensive, a hot bran or flaxseed poultice, applied after thoroughly cleansing the foot, is often beneficial. Use poultice for several days and change daily.

9. Heaves.—An ailment of the horse characterized by a double bellows-like action of the abdominal muscles in breathing. In bad cases there is a short, suppressed cough, usually accompanied by passage of gas, gluttonous appetite, harsh, staring coat of hair, lack of endurance, sweating, panting or staggering during work, and dilated nostrils. The disease begins with indigestion, affecting in time the pneumogastric nerve of the stomach and then the branch nerves running to the lungs.

The distress may be relieved by treatment, but perfect recovery is impossible when the lungs have become badly affected. A substitution of wet oat straw for hay in winter and grass for hay in summer gives relief. Allow double the usual rest period after a meal. Work when stomach is not distended with food. Hay should not be fed at noon. Limewater for wetting the food is desirable. Once or twice a week raw linseed oil in a bran mash is recommended for keeping open the bowels.

10. Hollow horn.—The horn is not hollow, and never is. The old quack method of boring a hole in the horn with a gimlet and squirting turpentine into the orifice is both cruel and ridiculous. If the temperature of the horn is low, it is because of the general poverty of the blood of the animal. The most common symptoms are general debility, scanty flesh, scurvy coat and coarse hair. The appetite is also irregular and at times greedy. Treatment is in line of better food to improve and tone up the system. If lice are found they must be destroyed by disinfectants or washes.

11. Lice.—Farm animals, especially those housed in stables more or less infested with insects and rats, are commonly troubled with lice. Animals in good health resist the insects, but those already in a non-thrifty condition do not fare so well. Lice annoy farm stock by biting the skin, sucking the blood and causing irritation.



CATTLE BATH TUB

Permanent tank used for dipping for treatment of lice and mange.

Infestation, as a rule, takes place in filthy quarters, and the best means of disinfecting such places is by the use of a spray of kerosene. One of the best means of applying to hogs consists in rubbing posts, which are constantly smeared with kerosene and grease. In this way the hogs are induced to treat themselves. Infected hogs may also be treated by pouring the kerosene directly over the infested parts—the neck, shoulder and back. Dipping tanks made of cement or wood in the run yards containing disinfectant fluid serve as wallows and allow the hogs to disinfect themselves. Cattle and horses may be dipped or brushed with disinfecting cloths or brushes. Chickens may be dipped, but their quarters should be sprayed, and the roosts treated with a mixture of grease and disinfectants.

12. Ringbone.—A growth of bone on the pastern bone, just above the hoof. It causes lameness when it interferes with the joint or the passage of any of the tendons. Some horses are predisposed to bony diseases from the least injury, while others are not, and in selecting mares for breeding purposes the former should be rejected. This disease results from strains, bruises, or injuries to the cartilage of the joints.

RINGBONE

When the membrane of the bone or cartilage becomes inflamed there may be much lameness for several months before any enlargement takes place. The absence of other diseases of the foot, with some heat in the pasterns, and soreness on pressure or moving the joints, indicates this disease. Medical treatment, in the nature of ointments and blisters, is often necessary.

13. Scab.—Scab or itch or mange, is caused by minute mites that live upon the surface of the skin, burrowing into it. Different kinds afflict animals. Old cattle are less troubled, the attacks being more frequent on calves and yearlings and two-year-olds out of condition. In the early stages the itching of the skin in the region of the neck or shoulders is first noticed. This is indicated by the animals digging at the skin with teeth and horns and the constant rubbing against posts or barbed wire or anything that may give relief at the time. The disease gradually spreads along the back, sides and outside of legs.

In the early stages the coat looks rough and the skin has a scurvy appearance. In time, the hair comes off or is rubbed off, presenting bald patches of thick, glazed and wrinkled skin. After the hair comes off the parasites leave these regions, seeking other quarters, and then the hair grows in again. There is a dejected and debilitated condition in animals thus afflicted, and they fall rapidly in flesh. Their appetites are poor, and most of their time is expended in scratching themselves. Scab spreads rapidly. As soon as the disease is discovered the infected animals should be isolated, and both animals and infected quarters and rubbing posts disinfected with a solution of carbolic acid or one of the commercial dips.

14. Spavin.—Any condition which favors sprains, as fast driving over hard and uneven roads, bad shoeing, severe labor in early life, bruises or an injury to tendons or joints, may cause spavin. If not checked, the hock joint enlarges and free movement of the limbs is impaired. Preventive treatment consists in keeping the feet trimmed properly, not overworking colts while young, careful driving on hard or uneven roads, and avoiding all injuries that are liable to strain tendons, ligaments or joints of the limbs.

Even after a spavin has developed it may be cured by proper treatment of the feet, and applying a fly blister. If blistering fails to cure the spavin, point-firing may be resorted to. But this should be done by a veterinary surgeon.

15. Splints.—Any enlargement of the bone occurring on the inside of the leg between the knee and fetlock, comes under the name of splint. The usual cause is travel on hard roads, blows, a twisting strain, or faulty conformation. If taken in time, a splint can be cured. The first thing is to give the animal rest and place in quarters where there is a soft floor, preferably the ground.

SPLINT

Applications of cold water bandages act well. If the disease does not respond to this treatment, a blister may be necessary.

Dr. Williams of Cornell University believes that spavin, splints, ringbone and other bone troubles are either hereditary or due to soil conditions. Soils free from limestone, for example, may be a contributing cause. He points out that horses in fire departments are not more subject to bone troubles than other horses.

PRACTICUMS

1. DRESSING WOUNDS.—An excellent exercise will be possible if the local veterinarian or physician is asked to show the class how to treat a wound, how to make stitches with needle and thread, and how to use pins for making stitches in emergencies. Here is a splendid opportunity to drive home the virtue of cleanliness and the use of pure antiseptics to prevent further infection. After a wound is cleaned and washed in the proper manner the next step is to dress it for comfort, safety and protection. The importance of dressing wounds should be emphasized, and as opportunity arises on the home farm, each student should be influenced to put in practice what he has learned about the cleanly care of wounds.

2. ANIMAL DISEASES.—Each member of the class is to take an assignment of a leading disease of the community. Require the preparation of an essay on this disease, describing its symptoms, how it is spread, means of prevention, methods of control and treatment, and estimate the annual loss to the community. In what ways may the neighborhood co-operate to eradicate the disease and what precautions are necessary to prevent further epidemics and outbreaks.

3. OBSERVATION OF ANIMALS.—(*a*) Have each student choose a class of live stock for observation at home, limiting the choice to horses, cattle, sheep or swine. The object is to learn as much about habits, movements, likes and dislikes, and other characteristics as possible. For instance, how do animals of that class walk? Are they suspicious? Why do they move their ears? How do they eat? Lie down? Get up? In eating grass how is the head moved? Is it the same for other classes? Do cows ever "roll" like horses? How does a horse roll anyway? In galloping, does the horse leave the ground from one of its hind feet or from a front foot? Which? Do cattle ever gallop? Do hogs? Watch an animal and note its movements, ways of eating, ways of locomotion, resting and of other points that come under your observation.

(*b*) What is the most common disease that affects this class of farm animals? Is the disease contagious? How is it most generally spread? What methods may be employed to prevent infection? If an outbreak occurs, what is to be done to keep the disease in check? Now write an essay on your subject—telling in detail all the observations you have made. Make this as complete as possible.

LESSON FORTY-SIX

KEEPING ANIMALS HEALTHY

1. Health.
2. Fresh air.
3. Exercise.
4. Sunlight.
5. Water.
6. Disinfection.
7. Filth.
8. Damp quarters.
9. Ventilation.
10. Systems of ventilation.
11. Stalls.
12. Shelter.
13. Grooming animals.
14. House ventilation.
15. Outside sleeping rooms.

Note to the Teacher.—The object of this lesson is obviously to emphasize the importance of health and thrift in farm animals. Fresh air, exercise and sanitary quarters are fundamental factors of live stock success. When it is realized that an enormous loss of farm stock annually occurs, due to conditions easily within the control of the owners, the practical value of a clear understanding of how to keep animals healthy is apparent.

LESSON FORTY-SIX

KEEPING ANIMALS HEALTHY

1. Health.—Under normal conditions health is natural. And unless health is generally maintained, it will be impossible to succeed in any branch of live stock. The object of every stockman should be to keep his animals in such vigorous condition that they will thrive and produce their marketable products with the greatest profit. The majority of failures in stock raising is due to neglect or disobedience of those natural laws upon which normal conditions of health depend.

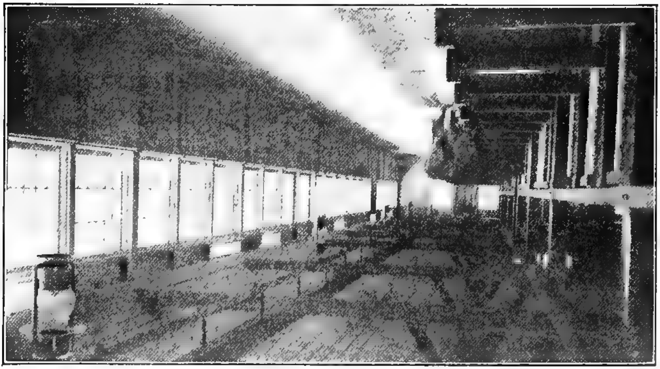
It is more important to understand the laws of thrift and vigor than to know about dopes and remedies. Our greatest stockmen seldom have to deal with disease in their establishments, except at times of community affliction and epidemics. Even then the fault is usually due to a thoughtless outsider, to dogs, birds, water, or to some other condition not under the control of the victims. Animals may be considered to be in health when they have smooth, glossy coats, are quick and active in their movements, have good appetites, do their regular work without difficulty or distress and when the organs of the body act in a normal way.

2. Fresh air.—Until costly and tightly closed barns were built by thoughtless and ignorant men of wealth,

FREE EXERCISE IN THE OPEN AIR OF THE PASTURE tuberculosis was not a serious ailment of dairy cattle. These men, attracted to the pleasure of breeding dairy stock, sought elegance in stables, and provided what is now known as badly devised comfort in way of warmth in winter. They assembled many famous cows, some of which were affected with tuberculosis, from all parts of the world. Their method of barn construction actually excluded fresh air. The infected cows, in close contact with others, gave the disease to healthy cows. Bringing together infected cattle, however, had more to do with the spread of tuberculosis than the kind of buildings. In this way the disease was bred and spread, and a most serious menace introduced to the cattle industry when breeding stock from these stables was sold and distributed to other farms. It was in this manner that tuberculosis was spread, which in time became not only the most serious dairy disease, but the source of an immense expense to eradicate it. No flock or herd is wisely managed if fresh air is improperly supplied to barns and stables, or if impure air, arising from breath, odors, or skin exudations, is not constantly removed. It is better to have cold shelters in winter with a generous supply of fresh, pure air than warmth without it.

3. Exercise.—Closely akin to fresh air is exercise. Lack of exercise is productive of many disorders. When farm stock are on free range in pastures and feed lots, other factors of health being provided, they keep active and robust. Exercise may be arranged for at little expense. Winter is the season it ordinarily is most often denied; but the scratching pen suffices for chickens, the open or covered barnyard for cattle, common winter work for horses, the sod fields for the sheep and hogs. Under whatever circumstances farm animals are kept, a reasonable amount of exercise should be required. Even work for boys and girls is not a hardship, but a blessing, that remains as long as life exists.

4. Sunlight.—Sunlight is a great stimulant to the skin and acts as a tonic to the red blood corpuscles. Men and beasts that live in darkness or dark quarters become debilitated and finally become victims of disease. Just as the plant obtains its green color only from sunlight, so does the healthy, red blood of animals form only through the influence of sunlight. Sunlight is a necessity to the healthy as it is to the sick. City people who work in dark shops or live in dark dwellings, and animals that are stabled in dark barns, live under unhealthy conditions. Sunny, large and airy buildings are important requirements for both people and live stock. Sunlight is not only of great importance to health in a direct manner, but it is the very best disinfectant. Disease germs cannot live where the direct rays of the sun strike. Every

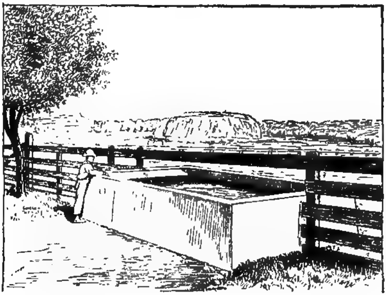


Where Sunlight Hits Every Nook and Corner

In quarters like this there is no place for vermin to hide or for disease germs to breed.

room where a boy or girl sleeps and every stall where an animal is quartered should be reached in every corner by sunlight during some part of the day. It is an old saying that "where the sun does not enter, the physician does."

5. Water.—Sixty per cent or more of the weight of the animal body consists of water; and this quantity must be maintained by a large daily consumption if good health is to be preserved. The action of water is mechanical, chemical and thermal. Mechanically, it distends the stomach, intestines and other organs; chemically, it dissolves certain injurious substances circulating in the body; and thermally, it reduces the pulse and lowers the temperature.

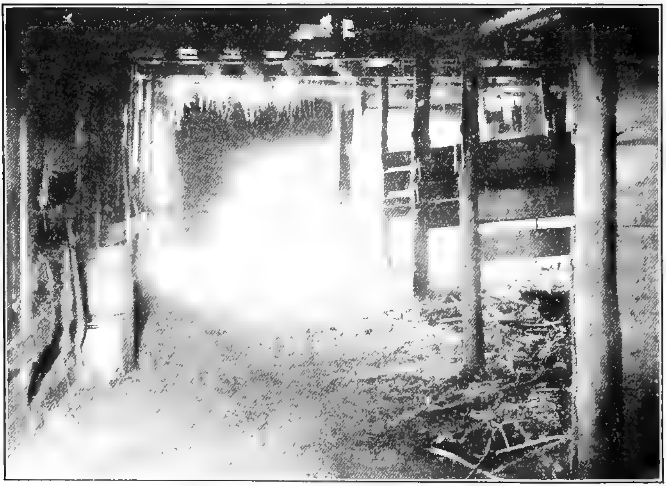


PERMANENT WATERING TROUGH

Drinking water should be absolutely pure, or it may become a menace to health. Many disastrous outbreaks of disease often are due to water contamination, as, for instance, typhoid fever and hog cholera. Farm animals are entitled to a better water supply than they frequently get. Wells, springs, cisterns and cool streams are satisfactory, providing they do not become contaminated in any manner by disease germs. It is also important that live stock be watered at regular intervals, that they be given water in abundance, and be allowed to drink in their own way, with plenty of time to do it.

6. Disinfection.—The best way of reducing the possibilities of contagion is by destroying offending germs. Such practice is not only absolutely necessary during and after an outbreak of disease, but during other periods when danger is not even suspected. On farms where disinfection is freely indulged in, and where stock are raised under good sanitary conditions otherwise, disease among live stock is not at all common. Premises, stables, stalls, chicken coops or houses may be disinfected by steam, boiling water, and chemical substances. Formalin is the best disinfectant for closed rooms and farmhouses. The stables and outbuildings may be sprayed or washed with solutions containing carbolic acid, kerosene or the now common coal-tar preparations. The method is first to remove all litter, dust or other obstruction and then freely to spray until every part of the quarters is made thoroughly wet.

7. Filth.—Disinfection must go hand in hand with cleanliness. Little is gained by using disinfectants, even though that be done very freely, if filthy quarters for live stock are permitted to exist. A maintenance of cleanliness precludes the necessity for much disinfection. Peo-



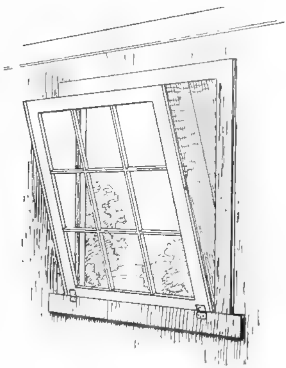
FILTHY AND POORLY KEPT COW BARN

The bacterial count of the milk produced in this barn is sure to be high.

ple who seek to avert disease by disinfection and still allow filth to accumulate are penny wise and pound foolish, for they must sooner or later pay the penalty. Successful farmers keep their farms clean and insist on cleanliness in every place where the farm animals are housed or permitted to live. In filth, flies, germs, vermin and other terrors are propagated and from such places they spread far and near.

8. Damp quarters.—Bacteria require moisture and darkness for their propagation. They rarely survive when dried or exposed to light. Hence, in damp houses and barns the occupants are not only constantly subjected to distress, but also to danger. The only thing to do with damp quarters is to correct the trouble. A drain pipe at the side of a barn often will make dry a stable floor. If the walls are damp, the fault may be with the form of construction or to lack of window space, or to a lack of fresh air. Whatever the source of trouble, let nothing delay its early correction. Good health is not often associated with damp quarters.

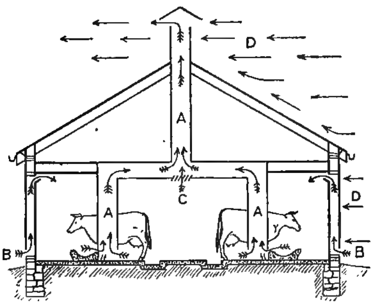
9. Ventilation.—Fresh air is not a fad. It is neither a luxury for humans nor a fancy for beasts, but a necessity. It is lung food for both, and should be pure and abundant. Every house should supply 800 cubic feet of air for each occupant, and every stable 1,500 cubic feet for each mature cow or horse, and this should be removed frequently. Ventilation is primarily



STABLE WINDOW
Fresh air is admitted from the top.

for two purposes: to admit oxygen, and to dilute and remove impurities. It is to come as near as possible to getting outside conditions in the house or stable. Provision for ventilation is always made when houses and barns are constructed, but too often, when winter comes, the door and windows are closed and the health of the occupants is imperiled. Yet it is an easy matter to ventilate a farm building. An opening 1 foot square will admit 15,800 cubic feet when air is passing at as slow a rate as three miles an hour.

10. Systems of ventilation.—In small barns window ventilation will suffice. The windows may be hinged at the bottom, allowing the top to open inward. At the sides, boards are placed, the width corresponding from top to bottom with the opened distance of the window. By this plan air is admitted at the top and not directly on the animals. If opened on the side away from the wind and according to the severity of the weather, fresh air will be provided and without serious drafts being caused.



King System of Ventilation

Showing intakes and outlets. A, ventilating shaft, through which stable air is carried out of doors; B, intakes for admission of outside air to the stable; C, ceiling register in the ventilating shaft; D, outside air.

The King system of ventilation consists essentially of air intakes and air outlets, in the form of flues, and tight inclosures. The intakes admit the fresh air near the ceiling where the air is warm, and where also the fresh air is warmed, and the outlets remove the old air at the bottom where it is colder and possessed of the impurities. For best success the intakes should be small but numerous, one, say, for every three cows; and outlets large, and carried up and out of the roof. The outlets should be airtight. One difficulty with this system is that the moisture given off by the lungs and skin of animals is partially condensed and is apt to cause a moist condition of the stable. When this occurs, the air should be allowed to escape at C shown in the diagram.

11. Stalls.—Naturally less space is required for small animals than for large, and less for cows than for horses. Pigs and sheep do not require individual stalls, but pens of varying sizes are provided in accordance to needs, and whether one or more or many are to be accommodated. The size of such pens is a matter of choice. From 6 to 8 feet is about as small as they are made. Cattle stalls vary in length and width, 3 feet being the usual width and 4½ to 5 feet the usual length for small cows, and

SIMPLE STALL ARRANGEMENT FOR DAIRY COWS

This dairy stable is quite sanitary and built to endure. There are no partitions to catch dust and filth. Note the rather wide, shallow gutter, the cement flooring and open mangers. Each cow knows her place, and on coming into the stable goes direct to it.

4 feet the usual width and 5½ to 6 feet the usual length for large cows. Horses require a stall 5 to 6 feet in width and 9 to 10 feet in length. Box stalls may be built 6 or 8 feet by 10 feet in size for cattle and 10 feet square or 12 feet square for horses. These sizes are, of course, subject to modification.

12. Shelter.—Even in a mild or warm climate shelter of some kind is desirable for the farm stock. Large or commodious buildings are not required, but protection against rain or snow or icy blasts or cold weather is of vital importance. Dairy cattle and work horses are best cared for in stalls in the stable. Sheep and hogs may be

Yard and Shelter for Feeding Steers

These steers are on a fattening ration and live out in the open. The cut hay and grain are fed in troughs. To the rear is seen an open shed under which the animals may rest during disagreeable weather. It should be absolutely tight on all sides except one.

reared in the open, but shelter for them during parturition and at seasons of inclement weather is not only desirable, but dry sleeping quarters are well nigh indispensable. Repeated trials with fattening cattle indicate that they may be fed to advantage and with better results in growth and increase in feed lots in which open sheds are available than when fed and housed in stalls in inclosed barns.

13. Grooming animals.—Not only are well-groomed animals more handsome in appearance, but they are healthier than similar animals not so treated. Dirt and dust in the hair or on the skin are conducive of uncleanliness, and uncleanliness means an inroad to disease. When animals are groomed, the pores of the skin are kept open, making it more easy for the skin to perform its excretory work. Grooming is not always necessary, but if horses and cows are stabled in winter the daily use of the currycomb and brush helps the animal and saves some feed.

14. House ventilation.—In building farmhouses windows are never overlooked, and usually are provided in sufficient numbers. The great trouble is, they are not used enough. In winter in some houses windows are seldom if ever opened, and too frequently the shades are kept drawn down to protect carpets and furnishings. This prevents sunshine from getting in. It is a bad cus-

FARMHOUSE WITH OUTSIDE SLEEPING ROOMS

Outside sleeping and living rooms have been added on to this old farmhouse. These rooms are protected from insects by fine bronze screening. Canvas and bamboo curtains may be let down during bad weather.

tom to keep both doors and windows closed for any length of time if several people are in a room. One should never sleep in a room with every window closed. On retiring, open the window, even if only slightly, and during the day open the windows wide for purposes of airing. An open fireplace in the living room is an excellent outlet for impure air.

15. Outside sleeping rooms.—The outside sleeping room may be built at any side of the house, over a piazza, a projection or a one-story room. One or more sides may be protected by the siding of the house, as the case may be. Canvas or wood shades are desirable also to protect against storms of rain and snow. An open sleeping room should be protected also against flies and insects by wire screening of small mesh. The roof may be made of canvas and painted frequently, or of tin, shingles or prepared roofing. In building a room of this kind it is important that outside architectural features be observed, and this addition be made to blend with other outside features of the house. And it should be absolutely tight on all sides except one.

LESSON FORTY-SEVEN

FARM BUTCHERING

1. Kind of animals slaughtered.
2. Condition and quality.
3. Making ready.
4. Producing death.
5. Sticking.
6. Dressing the steer.
7. Scalding hogs.
8. Dressing hogs.
9. Cutting up.
10. Sausage.
11. Curing.
12. Sugar-cured hams and bacon.
13. Smoking meats.
14. How much to smoke.
15. Storing.

Note to the Teacher.—The art of killing and dressing animals and of curing meat is an accomplishment that should be more appreciated than it is. It is both useful and necessary. The farm meat supply will quite generally come from home slaughtering. Hence, any study of the principles and practices in vogue in butchering farm stock should be encouraged in order that the quality and reputation of the farm-cured meats may be maintained, both to the profit and enjoyment of the husbandman, and to the delight of the town and city consumer.

LESSON FORTY-SEVEN

FARM BUTCHERING

1. Kind of animals slaughtered.—Many classes of meat animals are used for providing meat for use on the farm. Poultry, veal, lamb, mutton and beef are largely used as fresh meat. The flesh of the pig is most commonly devoted to various curing processes for preservation and use at seasons of the year following its preparation. The progressive farmer should not only provide his own fresh and cured pork for family use, but also should be able to supply at remunerative prices other persons in his neighborhood who are appreciative of the excellence and general merit of country or homemade pork products.

2. Condition and quality.—Animals selected for meat should be fed until reasonably fat. The meat of a fat animal is juicy and rich in flavor. It is nicely "marbled," that is, the fat and lean are well mixed together, giving

HOG-KILLING TIME ON THE FARM

a product of good texture and tempting tenderness. Lean animals are always rather tough in meat, even though of good breeding. Farm butcher stock are ready to be butchered when they cease to give a good account of the food they consume. That means when they are fat, but not overfat or overripe.

3. Making ready.—Two or three days before butchering, just enough food to appease the appetite should be given the animals to be slaughtered. Let them have all the water they may want. During the last 18 or 20 hours no food should be given at all. This checking of food will enable the blood to empty its supply of nutrients, the stomach and intestines will be less gorged and the carcass will handle better. So treated, better bleeding will result and no taint will affect the flesh.

CUT FROM CHAMPION CARCASS

Showing good marbling without wasteful fat covering on outside.

4. Producing death.—Most animals are stunned be-

MANNER OF BLEEDING A HOG

fore the knife is inserted for bleeding. The steer must first be fastened to a post or tree in order to avoid excitement and danger. Often the rifle is used to kill both steers and hogs. Unless the rifleman is a crack shot, this practice is cruel; another objection results in the penetration of the cartridge into the meat, often causing taint or trouble in curing. The stunning ax is a more humane way and is just as effective. The blow should be directed at the center of the face, midway between the eyes.

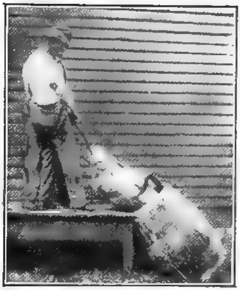
STICKING A STEER

5. Sticking. — When the animal drops as the result of the stunning blow, a sharp sticking knife is inserted at once in front of the breast bone. In cattle the skin along the lower region of neck is cut for a distance of 15 inches or so. This gives an opportunity to plunge the knife to a depth of 5 or 6 inches on either side of the windpipe and to sever the arteries leading from and the jugular vein leading to the heart. If this operation has been properly performed, the blood will flow freely and drain out from all parts of the body. In killing hogs, whether or not they are first stunned by ax or bullet or simply caught and bled, the knife should be inserted at the front of the breast bone and guided direct to the arteries.

6. Dressing the steer.—The first act is to skin the face and head. The tongue is next removed and cleaned in water with the knife. The head may be removed next and the skin taken from the front and hind legs. The rest of the carcass is left in the skin until raised by rope and pulley. When properly elevated, the skin is opened along the belly from the rectum to the breast. Now follow the opening of the carcass, the moval of the entrails and the completion of the skinning. The final work is to sponge off the blood, both inside and out, and leave the carcass to cool and harden.

DRESSING THE STEER

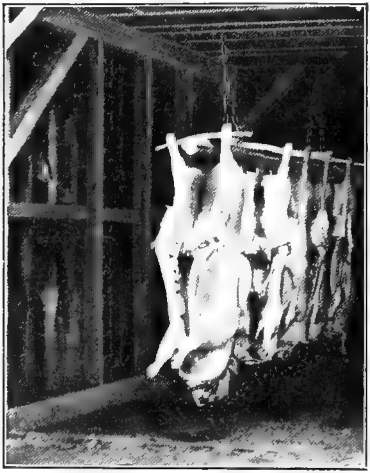
7. Scalding hogs.—When a hog no longer bleeds or moves he is ready for the scalding vat. A hogshead or large barrel is commonly used. The best temperature for the scalding water is about 25 degrees below the boiling point. If the water is too hot, the hair is hard to remove and the skin is injured by the cooking that the hot water gives. If hard wood ashes are put in the water, they serve to clean and brighten up the skin. Many farmers use ashes or common lye. Once in the water the hog is moved up and down, turned over and ends transferred, after which it is placed on the cleaning board and thoroughly scraped and cleaned. The carcass is now ready for dressing.



SCALDING HOG

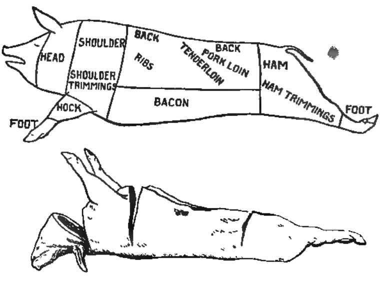
Before butchering day, have everything in readiness. For heating scalding water and rendering lard, when one has no kettles or caldrons ready to set in brick or stone, a simple method is to put down two forked stakes and lay in them a pole to support the kettles, and build a wood fire around them on the ground. In scalding keep the hog in motion by turning it about in water and occasionally try the bristles to see if they will come out readily.

8. Dressing hogs.—Various devices are used for hanging up the hogs. The rope and pulley is a simple arrangement and saves additional help. When hung, the carcass is opened along the midline of the belly, the breast bone and pelvic arch are split apart, and the entrails removed. The leaf lard or kidney fat should not be disturbed, but left to cool in the carcass. After the removal of internal organs, cold water may be dashed over the interior, and the carcass left to cool and set.



Cooling Off

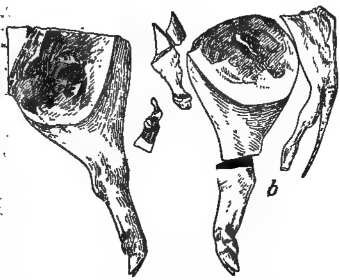
9. Cutting up.—When cool, the carcass is placed on a table or block and cut in pieces after the approved fashion for the kind of animal slaughtered. Beeves are usually halved but hogs may be halved or cut into parts, the two sides remaining together. Both methods are followed. If the carcass has not been halved, it is placed on the block, the head is removed, the shoulders separated from the body, and the hams cut from the rear about 2 inches in front of the pelvic bones. These parts are



Dividing the Hog Carcass
Showing the two most common methods of cutting up hogs.

now divided and each properly trimmed for its particular use. A handsome trim requires practice, but skillful work is desirable. A shaggy shoulder or ham may make a good meat, but it never looks as well as a neat trim.

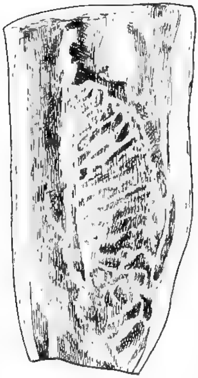
10. Sausage. — The cuttings from trimmings are used for sausage, with such additional portions of lean as the owner may desire. Usually the trimmings are so fat that it is necessary to throw the fatter portions into the lard vat. A pound of fat to three pounds of lean makes good sausage. The fineness of grinding sausage meat varies with the wishes of different people. On some farms sausage is put through the grinder twice. In seasoning use an ounce of fine salt and a half ounce of black pepper to each four pounds of meat. If sage is liked, it is customary to use a half ounce of leaf-sage with the salt and pepper. Prepared casings are now so cheap that they are largely replacing the home-prepared kind.



MEAT CUTTINGS

Trimmed and untrimmed hams. The trimmings are used for sausage.

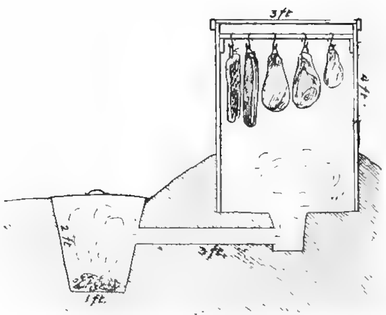
11. Curing.—Meat should be salted as soon as the heat is out. It may be dry cured or brine cured. In dry curing for every 100 pounds of meat, five pounds of salt, two pounds of granulated sugar, and two ounces of saltpeter are mixed and a third of the mixture is rubbed on the meat every third day, the meat being packed in a box or barrel. After the third rubbing the meat is packed and left for 10 days, after which time it is ready for smoking. In brine curing meat is placed in a barrel and the brine poured over it. On removal from the brine the meat is ready for smoking.



Cured Side of Bacon of Fine Quality

12. Sugar-cured hams and bacon.—Each piece should be rubbed with salt and allowed to drain overnight. The next morning pack in a barrel, using for the preservative eight pounds of salt, two pounds of brown sugar, and two ounces of saltpeter for each 100 pounds of meat. This amount of preservative is dissolved in four gallons of water, and the mixture is poured into the barrel on the meat. In packing, place the larger pieces first in the barrel and use the bacon strips and small pieces for filling in and to use on top. The bacon strips should be kept in the brine five or six weeks, and the hams and shoulders seven or eight weeks, depending on their size and thickness.

13. Smoking meats.—Smoke properly applied aids in preserving, and gives flavor to any kind of cured or pickled meat. The smoke must come into direct contact, but if the fire is close to the meat the heat will injure it. Often the fire box is built outside the smoke house and the smoke conducted into the smoking room by flue or chimney. An



Smoking Meat

A simple contrivance for use when but a small amount of meat is cured.

iron kettle may be used within the smoke house to contain the fire, but the heat should be kept away from the meat by some sort of iron protection. The best fuel is green hickory or maple, but any kind of hard wood will do. Corn cobs are much liked. An interval of two or three days is desirable between taking from the brine and smoking. Frequently it will be necessary to wash the meat in warm water to remove the coat of salt when taken from the brine.

14. How much to smoke.—If the fire is kept going all the time 30 to 40 hours will give sufficient smoking. If the fire is made only during the day a larger total of hours will be required, for the reason that the work is less effective. The meat must be warmed each day before the smoke penetrates it. In case the meat freezes overnight smoke will not enter the meat until it thaws out again. In moderate weather a light fire each day for 10 days or two weeks will give the desired color and produce the same effect as continuous smoking for a day and a half.

15. Storing.—After smoking it is desirable to place each piece in a canvas bag for protection. In case insects are troublesome dip the canvased meat in hot lime of about the consistency of ordinary whitewash. Use a whitewash brush to get the limewater all over the canvas. The meat is now ready for hanging in the storing place, which should be cool and dark. Meat is not always bagged, and frequently is hung on pegs in the smoke house or other storage place.

SMOKED HAM

LESSON FORTY-EIGHT

MARKETING LIVE STOCK AND PRODUCTS

1. Market end.
2. Classes of animal products.
3. Methods of shipment.
4. Cars.
5. On the road.
6. Live stock centers.
7. Selling exchange.
8. Cost of marketing.
9. Buyers and sellers.
10. Grading.
11. Weighing when sold.
12. Inspection.
13. Quarantine.
14. Live stock products.
15. Selling by retail.

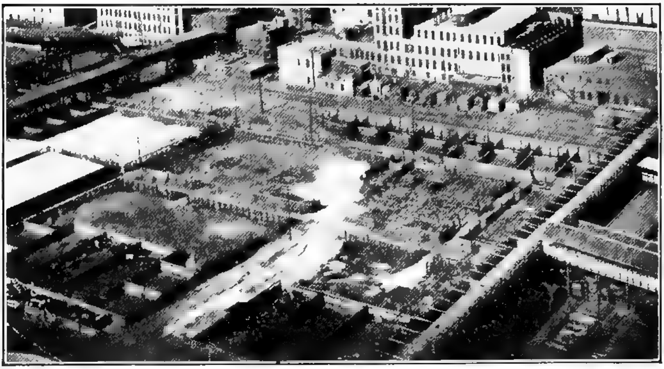
Note to the Teacher.—While farm animals are largely sold "on the hoof" at the market centers, it is desirable that the teacher lay stress on selling by retail wherever it is possible so to do. In this case the producer slaughters his own animals and disposes of their products direct to his customers in his nearby town or city. By dealing direct he is able to sell at the highest prices, and thus to secure the best profits.

LESSON FORTY-EIGHT

MARKETING LIVE STOCK AND PRODUCTS

1. Market end.—The stockman's work is to raise products for sale. The substances with which he works are the raw material of the fields, the tools by which he builds and manufactures are his animals, and the finished articles are the products yielded by them in their keep or growth. He cares for his animals, thinks in their interest, works for their comfort, and labors for their highest and best development, not because he seeks a congenial employment only, but primarily to market the products obtained for the financial reward these animals command, and to meet the food and other necessities of town and city inhabitants. Raising live stock is a fine business and worthy of the best minds and hearts of the land.

2. Classes of animal products.—There are two classes of animal products: the animals themselves and the products derived from them. The dairy cow yields milk, butter and cheese, the steer meat and by-products obtained at his slaughter, the sheep mutton and wool, the poultry tribe eggs, feathers, and meat, and the hog his flesh and fat. The problem of marketing the farm stock of the country and their products requires the combined effort of thousands of people and of millions of dollars of capital. On an average the animals sold from the farm and the animals slaughtered on it together number about 111,000,000 head each year. The farm value of the dairy products is $830,000,000 annually. The wool clip amounts to 318,550,000 pounds and is worth $56,000,-000. The total value of the farm animals and their products each year is approximately $3,400,000,000.



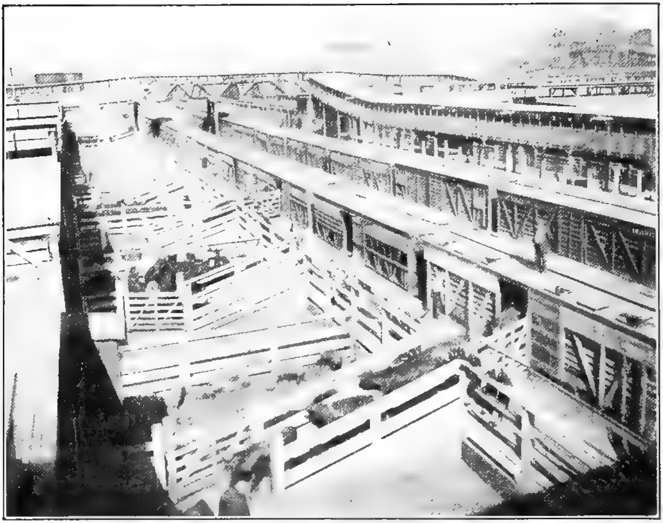
PACKING PLANT ADJACENT TO STOCK YARDS
In the foreground are storing and selling pens.

3. Methods of shipment.—Animal products are shipped by freight and express and sent either direct to consumers or reach them through middlemen. Animals are marketed "on foot," that is, alive; or as dressed meat, that is, slaughtered on the farm. The greater part of live stock, however, is sold live and shipped in freight cars to large cities, where the slaughtering is done in huge establishments intended for that purpose only. So large has the business of shipping live stock grown to be, that special freight cars have been built to take care of this traffic. Thousands of these cars are used for practically no other purpose.

4. Cars.—For short shipments ordinary box cars are often used, but for long distances regulation stock cars are provided. These contain feed racks and watering troughs. The regulation live stock cars are of two kinds of construction—open or slats, and closed. The closed cars have doors at either side with proper provision for ventilation. The open cars have provision for a second floor about 3½ feet above the bottom. In these, the smaller classes of live stock, such as veal calves, hogs and sheep, are shipped. These are called "double deckers," and will accommodate 100 to 150 hogs or 200 to 250 sheep. In the single floor cars but half of that number can be shipped. The animals are able to lie down. Cattle and horses are placed in cars and so packed that they cannot move about or lie down. The palace stock cars contain stalls, feed racks and watering troughs and are used largely in shipping the better classes of horses and cattle.

5. On the road.—On long hauls, it is a requirement of law and regulation that stock be fed and watered. Hay is the common food for horses, cattle and sheep, and ear corn for hogs. At different points along the way the cars are stopped and water is put into the troughs. Heavy feeding or watering is not advisable. In case only a few animals are shipped, the food and water may be carried at one end of the car, the water in a barrel, and both may be given more frequently, but still in moderate quantities. In shipping by express the hay and grain are commonly tied on the top of the crate or inclosure, the station agent giving the water and feeding as directed by the instructions attached to the crate.

6. Live stock centers.—The greater part of the farm-raised meat animals are shipped to a few large live stock centers, where huge establishments, known as stock yards, are maintained. As a rule, near to these stock yards are other establishments, known as slaughtering or packing houses, where the stock is slaughtered and prepared for human consumption. Starting out in the small districts, a car or more is picked up here and there, and combined with other consignments, when all are hauled to their destination. On arrival, these cars, or often a full train load, are sent to the stock yards, where the unloading and placing in pens take place. In each of such yards there are vast numbers of unloading chutes, connected with alleyways and pens, where each individual shipment is stored until sold.



STOCK YARDS, SHOWING UNLOADING CHUTES

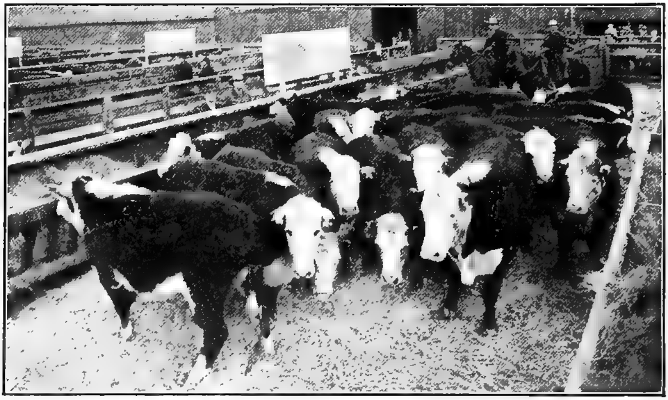
7. Selling exchange.—Were there not reasonable organization of the unloading and distributing end of this stock traffic, disorder and trouble would certainly result. This is provided against by the closest sort of attention to detail and regulation. An organization, known as a live stock exchange, and composed of live stock commission men, is an important feature of every stock yard. These men seek to promote square dealing and uniformity in buying and selling, settle disputes when such arise, and do whatever is necessary to facilitate the marketing end of the live stock traffic.

8. Cost of marketing.—In addition to the charges for freight, certain costs must be paid for the privilege of using the stock yards. Water is furnished free, but hay

IN THE PEN
Car of cattle waiting to be sold.

and grain must be purchased. The rates charged are usually considerably more than the market price of these feeds. A fee for "yardage," as it is called, or for weighing, varies from 10 to 25 cents for cattle and from 5 to 10 cents for hogs, sheep and calves.

9. Buyers and sellers.—The greater part of the buying and selling in the stock yards is done by commission men, who make this work their business. In such transactions, a commission man acts as the agent of the man who makes the shipment. It is his duty and business to obtain the best possible price that the stock will bring. The shipment may be sold during the day of arrival, or it may be held until the market would seem to advance. It is the custom to pay these commission men, for cattle, 50 cents a head or $12 a load; for hogs and sheep, 15 cents a head in small lots, $10 a "double decker" load and $6 for a single deck. The charge for calves is 25 cents each.



LOAD OF FAT CATTLE IN A SELLING PEN
These cattle were consigned to a commission firm and held in their care until sold.

10. Grading.—When live stock is marketed it is graded in accordance with its quality and kind. The price obtained depends naturally upon the grade to which the shipment belongs. Cattle, for instance, are graded as (*a*) beef cattle, (*b*) butcher stock, (*c*) cutters and canners, (*d*) stockers and feeders, and (*e*) veal calves. Each of these classes is further graded as prime, choice, good, medium, common and inferior. Other grades of a special nature are also made, such as Texas and western range cattle, baby beef, export cattle and stags. Sheep, hogs and horses are given a different classification. Look over your agricultural paper for the different classes of live stock at the leading market centers.

11. Weighing when sold.—When a pen of stock is sold, the weighing usually follows at once. At each scales is a weighmaster, whose business it is to see that the weighing is accurately made. Weigh tickets, made in duplicate, are given to both the buyer and the seller, and the weights with the necessary data are entered in the record book.

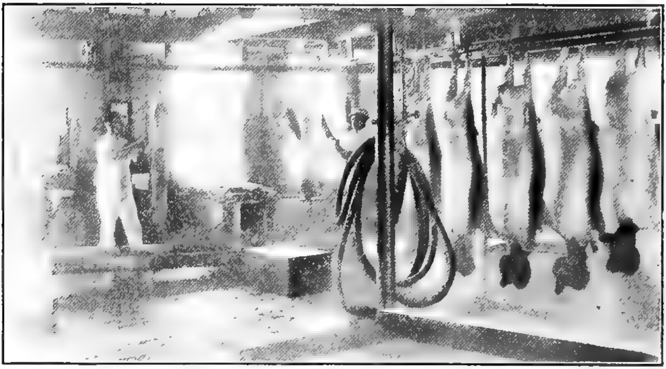
PRIME BEEF STEER

MEDIUM CANNERS

12. Inspection. — The federal government, in the interest of the public health, maintains a large inspection force to inspect both live and slaughtered animals. This inspection work is done by trained veterinarians who make their examination in stock yards, packing houses and ports of entry. At each packing establishment every carcass is inspected and tagged with the government label of inspection. Diseased meat is condemned and not allowed to be sold for human food.

13. Quarantine.—In order to prevent spread of contagious diseases, quarantine regulations are prescribed by federal and state laws. Thus when an outbreak occurs in any state or section, quarantine regulations prevent shipments from the affected districts to other parts of the state or country. Such quarantine is kept in force until not only the disease is under control, but in many instances until every evidence of its existence has been completely stamped out. In some states laws have been enacted that prevent the shipment of cattle into that state unless accompanied by a certificate of health.

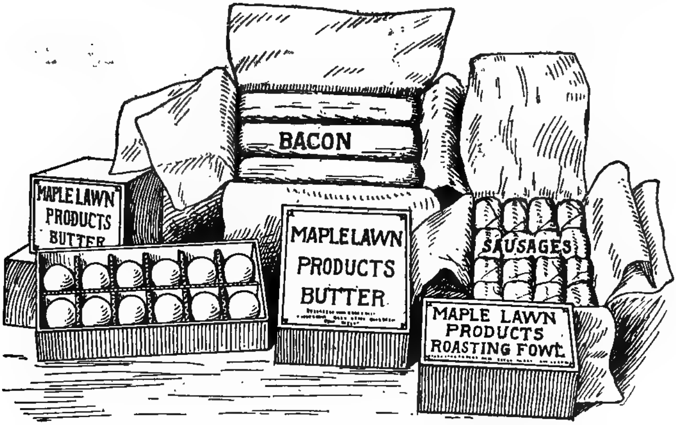
14. Live stock products.—In marketing live stock products a fundamental factor is cleanliness and purity. This is much more than mere neatness of package or mere tidiness in manner of delivery. Consumers have been taught much about food, and they will not be satis-



GOVERNMENT RETAINING ROOM FOR SUSPECTED ANIMALS IN LARGE PACKING HOUSE

fied unless they know that it is pure as well as clean. The farmer who makes it his business to prepare the products he offers for sale in accordance with the simple laws of sanitation will not only secure a better price for them, but will be able to extend his trade out to the full limits of what he is able to handle. There is a constant demand for clean milk, pure farm butter, fresh eggs, fresh poultry, farm sausage, cured pork and other animal products. While all farmers will not be able to dispose of their products to consumers direct, a large number, because of location, ingenuity, initiative and enterprise, will be able to do this and to their own financial advantage.

15. Selling by retail.—In the retail market better prices are paid than in the wholesale market. If one can do so he usually can sell at higher prices if he caters to an individual home trade than by selling through middlemen. An advertisement in the home or a nearby news-



NEAT PACKAGES FOR FARM ANIMAL PRODUCTS

paper will assist in building up a trade. A customer well pleased will remain a customer and in one way or another will cause other people to try the same method of purchase. With the enlargement in scope of the parcel post, it will be possible to market many kinds of animal products by that system. The secret of success in reaching consumers direct is square dealing, clean products and true weights and measures.

PRACTICUMS

1. Plan of Cattle Barn.—Draw a floor plan of a cow stable with room for 10 to 50 cows, the plan being worked out accordingly. The drawing should show inside and outside dimensions of stable, arrangement of stalls, feed room and milk room. The plan may be for a simple stable or for a cow barn of greater completeness.

2. Plan of Horse Barn.—Make a similar plan for horses.

3. Plan of Hog Barn.—Make a plan for hogs, including outside runs and sleeping quarters.

4. Plan of Poultry House.—Draw a plan for a simple poultry house, showing interior arrangements, such as nest boxes, roosts, feed hoppers, scratching pens or accommodations, etc. In this plan indicate windows and their kind, height of building, doors and size of rooms if more than one room is planned.

5. In many localities farm butchering is practiced. Teacher would find it desirable to arrange with neighboring farmer to have class present. Study not only the process of butchering, but the various internal organs so as to become acquainted with normal conditions. If arrangements cannot be made to assist in farm butchering visit where possible the local slaughterhouse. See the butcher in advance and explain the purpose of your visit. Ask the butcher to demonstrate to your pupils the methods of cutting up animals.

APPENDIX

TABLE I. FEEDING STANDARDS FOR FARM ANIMALS.

The Wolff-Lehman Standards for feeding farm animals are shown in the table below. They indicate the amount of food required daily per 1,000 pounds live weight.

Animal	Digestible nutrients					
	Dry matter	Crude protein	Carbohydrates	Fat	Sum of nutrients	Nutritive ratio
1. Oxen	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	1:
At rest in stall........	18.0	0.7	8.0	0.1	7.5	11.8
At light work..........	22.0	1.4	10.0	0.3	9.7	7.7
At medium work.......	25.0	2.0	11.5	0.5	12.0	6.5
At heavy work.........	28.0	2.8	13.0	0.8	15.0	5.3
2. Fattening cattle						
First period...........	30.0	2.5	15.0	0.5	15.6	6.5
Second period..........	30.0	3.0	14.5	0.7	17.0	5.4
Third period...........	26.0	2.7	15.0	0.7	17.2	6.2
3. Milch cows						
When yielding daily:						
11.0 pounds of milk..	25.0	1.6	10.0	0.3	10.2	6.7
16.6 pounds of milk..	27.0	2.0	11.0	0.4	12.2	6.0
22.0 pounds of milk..	29.0	2.5	13.0	0.5	14.4	5.7
27.5 pounds of milk..	32.0	3.3	13.0	0.8	16.0	4.5
4. Sheep						
Coarse wool...........	20.0	1.2	10.5	0.2	9.1	9.1
Fine wool.............	23.0	1.5	12.0	0.3	10.5	8.5
5. Breeding ewes						
With lambs............	25.0	2.9	15.0	0.5	16.3	5.6
6. Fattening sheep						
First period...........	30.0	3.0	15.0	0.5	16.5	5.4
Second period..........	28.0	3.5	14.5	0.6	16.9	4.5
7. Horses						
Light work............	20.0	1.5	9.5	0.4	10.0	7.0
Medium work..........	24.0	2.0	11.0	0.6	12.8	6.2
Heavy work...........	26.0	2.5	13.3	0.8	15.5	6.0
8. Brood sows	22.0	2.5	15.5	0.4	19.0	6.6
9. Fattening swine						
First period...........	36.0	4.5	25.0	0.7	31.2	5.9
Second period..........	32.0	4.0	24.0	0.5	29.2	6.3
Third period...........	25.0	2.7	18.0	0.4	22.0	7.0

TABLE I. FEEDING STANDARDS FOR GROWING ANIMALS—*Continued.*

Animal	Per day per 1,000 lbs. live weight					
	Digestible nutrients					
	Dry matter	Crude protein	Carbohydrates	Fat	Sum of nutrients	Nutritive ratio
10. Growing cattle Dairy breeds						
Age in months — Average live weight per head, lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	1:
2- 3 .... 150	23.0	4.0	13.0	2.0	21.0	4.5
3- 6 .... 300	24.0	3.0	12.8	1.0	17.0	5.1
6-12 .... 500	27.0	2.0	12.5	0.5	13.7	6.8
12-18 .... 700	26.0	1.8	12.5	0.4	12.8	7.5
18-24 .... 900	26.0	1.5	12.0	0.3	11.8	8.5
11. Growing cattle Beef breeds						
2- 3 .... 160	23.0	4.2	13.0	2.0	21.5	4.2
3- 6 .... 330	24.0	3.5	12.8	1.5	19.0	4.7
6-12 .... 550	25.0	2.5	13.2	0.7	15.8	6.0
12-18 .... 750	24.0	2.0	12.5	0.5	13.9	6.8
18-24 .... 950	24.0	1.8	12.0	0.4	13.2	7.2
12. Growing sheep Wool breeds						
4- 6 .... 60	25.0	3.4	15.4	0.7	18.4	5.0
6- 8 .... 75	25.0	2.8	13.8	0.6	15.8	5.4
8-11 .... 80	23.0	2.1	11.5	0.5	12.8	6.0
11-15 .... 90	22.0	1.8	11.2	0.4	12.0	7.0
15-20 .... 100	22.0	1.5	10.8	0.3	11.0	7.7
13. Growing sheep Mutton breeds						
4- 6 .... 60	26.0	4.4	15.5	0.9	20.9	4.0
6- 8 .... 80	26.0	3.5	15.0	0.7	17.8	4.8
8-11 .... 100	24.0	3.0	14.3	0.5	16.3	5.2
11-15 .... 120	23.0	2.2	12.6	0.5	13.8	6.3
15-20 .... 150	22.0	2.0	12.0	0.4	12.8	6.5
14. Growing swine Breeding stock						
2- 3 .... 50	44.0	7.6	28.0	1.0	38.0	4.0
3- 5 .... 100	35.0	4.8	22.5	0.7	29.0	5.0
5- 6 .... 120	32.0	3.7	21.3	0.4	26.0	6.0
6- 8 .... 200	28.0	2.8	18.7	0.3	22.2	7.0
8-12 .... 250	25.0	2.1	15.3	0.2	17.9	7.5
15. Growing, fattening swine						
2- 3 .... 50	44.0	7.6	28.0	1.0	38.0	4.0
3- 5 .... 100	35.0	5.0	23.1	0.8	30.0	5.0
5- 6 .... 150	33.0	4.3	22.3	0.6	28.0	5.5
6- 8 .... 200	30.0	3.6	20.5	0.4	25.1	6.0
9-12 .... 300	26.0	3.0	18.3	0.3	22.0	6.4

TABLE II. NUTRIENTS AND FERTILIZER CONSTITUENTS OF COMMON FEEDING STUFFS.

The tables giving the average digestible nutrients and the fertilizing constituents in the following American feeding stuffs have been adapted from Henry's "Feeds and Feeding."

Name of feed	Total dry matter in 100 lbs.	Digestible nutrients in 100 pounds			Fertilizing constituents in 1,000 pounds		
		Crude Protein	Carbo-hydrates	Fat	Nitrogen	Phosphoric acid	Potash
Grains, seeds and their parts	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Dent corn	89.4	7.8	66.8	4.3	16.5	7.1	5.7
Flint corn	88.7	8.0	66.2	4.3	16.8	7.1	5.7
Sweet corn	91.2	8.8	63.7	7.0	18.6	7.1	5.7
Corn meal	85.0	6.1	64.3	3.5	14.7	6.3	4.7
Corn cob	89.3	0.5	44.8	—	3.9	0.6	6.0
Corn-and-cob meal	84.9	4.4	60.0	2.9	13.6	5.7	4.7
Gluten meal	90.5	29.7	42.5	6.1	54.8	3.3	0.5
Gluten feed	90.8	21.3	52.8	2.9	40.0	3.7	0.4
Feed chop	90.4	6.8	60.5	7.4	16.8	9.8	4.9
Germ oil meal	91.4	15.8	38.8	10.8	34.7	3.9	2.1
Corn bran	90.6	6.0	52.5	4.8	17.9	10.1	6.2
Wheat	89.5	8.8	67.5	1.5	19.0	5.5	8.7
High-grade flour	87.6	10.6	65.1	1.0	19.2	5.7	5.4
Red dog flour	90.1	16.2	57.0	3.4	29.4	—	—
Flour wheat middlings	90.0	16.9	53.6	4.1	30.7	12.2	9.6
Wheat middlings	88.8	13.0	45.7	4.5	27.0	26.3	15.3
Wheat bran (all analyses)	88.1	11.9	42.0	2.5	24.6	26.9	15.2
Wheat feed	89.1	12.7	47.1	4.0	26.1	20.4	5.4
Wheat screenings	88.4	9.6	48.2	1.9	20.0	11.7	8.4
Rye	91.3	9.5	69.4	1.2	18.1	8.6	5.8
Rye flour	86.9	5.6	72.2	0.5	10.7	8.2	6.5
Rye middlings	88.2	11.0	52.9	2.6	22.9	12.3	9.6
Rye bran	88.4	11.2	46.8	1.8	23.3	22.8	14.0
Rye feed	87.6	12.6	56.6	2.8	25.1	7.7	4.7
Barley	89.2	8.4	65.3	1.6	19.2	7.9	4.8
Emmer (speltz)	92.0	10.0	70.3	2.0	18.4	7.6	5.7
Oats	89.6	8.8	49.2	4.3	18.2	7.8	4.8
Ground oats	88.0	10.1	52.5	3.7	19.7	7.6	5.0
Oat middlings	91.2	13.1	57.7	6.5	25.9	22.5	15.3
Oat feed	93.0	5.2	30.1	2.6	12.8	6.1	7.2
Oat hulls	92.6	1.3	38.5	0.6	5.3	1.6	4.9
Buckwheat	86.6	8.1	48.2	2.4	17.3	6.9	3.0
Buckwheat flour	85.4	5.9	63.0	1.2	11.0	6.8	3.4
Buckwheat middlings	87.2	22.7	37.5	6.1	42.7	12.3	11.4
Buckwheat bran	91.8	5.9	34.0	2.0	20.2	4.2	12.7
Buckwheat feed	88.4	15.6	38.2	4.4	29.3	15.8	10.5
Buckwheat hulls	86.8	1.2	28.6	0.5	7.3	4.3	14.7
Rice	87.6	6.4	79.2	0.4	11.8	1.8	0.9
Rice polish	89.2	7.9	58.6	5.3	19.0	26.7	7.1
Rice bran	90.3	7.6	38.8	7.3	19.0	2.9	2.4
Rice hulls	91.2	0.3	19.9	0.7	5.1	1.7	1.4
Canada field pea	85.0	19.7	49.3	0.4	37.9	8.4	10.1

TABLE II. NUTRIENTS AND FERTILIZER CONSTITUENTS OF COMMON FEEDING STUFFS.—*Continued.*

Name of feed	Total dry matter in 100 lbs.	Digestible nutrients in 100 pounds			Fertilizing constituents in 1,000 pounds		
		Crude protein	Carbo-hydrates	Fat	Nitrogen	Phosphoric acid	Potash
Grains, seeds and their parts—Cont.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Canada field pea meal	89.5	16.8	51.7	0.7	32.3	8.2	9.9
Canada field pea bran	89.0	7.7	41.6	0.6	16.0	3.1	10.3
Bean meal	89.1	20.2	42.3	1.3	37.1	12.0	12.9
Cowpea	85.4	16.8	54.9	1.1	32.8	10.1	12.0
Soy bean	88.3	29.1	23.3	14.6	53.6	10.4	12.6
Horse bean	88.7	23.1	49.8	0.8	42.6	12.0	12.9
Kafir corn	90.1	5.2	44.3	1.4	17.9	—	—
Sorghum seed	87.2	4.5	61.1	2.8	14.6	8.4	3.4
Broom corn seed	87.2	4.6	42.2	1.5	15.8	7.2	5.2
Millet seed	87.9	7.1	48.5	2.5	17.4	6.5	3.3
Hungarian grass seed	90.5	6.4	48.8	3.3	15.8	4.7	3.8
Flaxseed	90.8	20.6	17.1	29.0	36.2	13.9	10.3
Linseed meal (old process)	90.2	30.2	32.0	6.9	54.2	16.6	13.7
Linseed meal (new process)	91.0	31.5	35.7	2.4	60.0	17.4	13.4
Cottonseed	89.7	12.5	30.0	17.3	29.4	10.5	10.9
Cottonseed meal	93.0	37.6	21.4	9.6	72.5	30.4	15.8
Cottonseed hulls	88.9	0.3	33.2	1.7	6.7	4.3	10.4
Palm-nut cake	89.6	16.0	52.6	9.0	26.9	11.0	5.0
Cocoanut cake	89.7	15.4	41.2	10.7	31.5	16.0	24.0
Sunflower seed	91.4	14.8	29.7	18.2	26.1	12.2	5.6
Sunflower seed cake	89.2	29.5	23.3	8.0	52.5	21.5	11.7
Peanut kernels (without hulls)	92.5	25.1	13.7	35.6	44.6	12.4	12.7
Peanut cake	89.3	42.8	20.4	7.2	76.2	20.0	15.0
Rapeseed cake	90.0	25.3	23.7	7.6	49.9	20.0	13.0
Factory by-products							
Dried brewers' grains	91.3	20.0	32.2	6.0	40.0	16.1	2.0
Wet brewers' grains	23.0	4.9	9.4	1.7	10.7	4.2	0.5
Malt sprouts	90.5	20.3	46.0	1.4	42.1	17.4	19.9
Dried distillers' grains	92.4	22.8	39.7	11.6	49.9	6.0	1.7
Apple pomace	17.0	0.6	13.1	0.5	1.6	0.1	0.3
Cassava starch refuse	88.0	0.4	74.0	0.6	1.2	0.6	2.8
Starch refuse	88.0	2.4	70.6	1.1	7.6	2.9	1.5
Wet starch feed	31.2	3.7	12.4	2.6	8.0	0.5	0.2
Potato pomace	7.3	0.4	6.8	0.1	0.9	0.2	0.9
Wet beet pulp	10.2	0.5	7.7	—	1.4	0.3	11.4
Dried beet pulp	91.6	4.1	64.9	—	12.9	2.2	3.1
Sugar beet molasses	79.2	4.7	54.1	—	14.5	0.5	56.3
Porto Rico molasses	74.1	1.4	59.2	—	4.3	1.2	36.8
Dried molasses beet pulp	92.0	6.1	68.7	—	15.4	1.5	18.1
Molasses grains	89.6	10.8	48.0	2.2	27.4	8.5	21.1
Cow's milk	12.8	3.4	4.8	3.7	5.8	1.9	1.7

TABLE II. NUTRIENTS AND FERTILIZER CONSTITUENTS OF COMMON FEEDING STUFFS.—*Continued.*

Name of feed	Total dry matter in 100 lbs.	Digestible nutrients in 100 pounds			Fertilizing constituents in 1,000 pounds		
		Crude protein	Carbo-hydrates	Fat	Nitrogen	Phosphoric acid	Potash
Factory by-products—Continued	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Cow's milk (colostrom)	25.4	17.6	2.7	3.6	28.2	6.6	1.1
Skim milk	9.4	2.9	5.3	0.3	5.0	2.1	2.0
Buttermilk	9.9	3.8	3.9	1.0	6.4	1.7	1.6
Whey	6.2	0.6	5.0	0.2	1.0	1.1	2.0
Meat scrap	89.3	66.2	—	13.4	114.0	81.1	—
Meat and bone meal	94.0	36.7	5.5	10.6	63.2	146.8	—
Dried blood	91.5	70.9	—	2.5	135.0	13.5	7.7
Tankage	93.0	50.1	—	11.6	86.2	139.0	3.0
Dried fish	89.2	45.0	—	11.4	77.4	140.0	3.0
Dried roughage							
Fodder corn (ears, if any, remaining)	57.8	2.5	34.6	1.2	7.2	5.4	8.9
Corn stover (ears removed)	59.5	1.4	31.2	0.7	6.1	3.8	10.9
English hay	86.0	4.5	44.0	1.2	12.6	3.2	16.1
Hay for mixed grasses	84.7	4.2	42.0	1.3	11.9	2.7	15.5
Timothy (all analyses)	86.8	2.8	42.4	1.3	9.4	3.3	14.2
Timothy (cut in full bloom)	85.0	3.4	43.3	1.4	9.6	5.0	14.1
Timothy (cut soon after bloom)	85.8	2.5	39.2	1.5	9.1	—	—
Timothy (cut nearly ripe)	85.9	2.1	40.1	1.1	8.0	—	—
Meadow foxtail	93.4	5.3	41.0	1.3	14.9	—	—
Orchard grass	90.1	4.9	42.4	1.4	12.9	3.7	16.9
Red top	91.1	4.8	46.9	1.0	12.6	3.6	10.2
White top	86.0	6.8	40.6	1.5	17.9	—	—
Meadow fescue	80.0	4.2	36.9	1.5	11.2	4.0	21.0
Kentucky blue grass	86.0	4.4	40.2	0.7	12.5	4.0	15.7
Tall oat	86.0	3.3	41.4	1.1	10.3	—	—
Italian rye grass	91.5	4.5	43.4	0.9	12.0	7.6	24.6
Perennial rye grass	86.0	6.1	37.8	1.2	16.2	7.4	24.1
Rowen hay	86.0	7.9	42.2	1.4	18.2	4.3	14.9
Bermuda grass	92.9	6.4	44.9	1.6	17.1	—	—
Johnson grass	89.8	2.9	45.6	0.8	11.5	—	—
Macaroni wheat	93.0	4.4	48.7	0.8	10.9	—	—
Barley	85.0	5.7	43.6	1.0	14.1	—	—
Oat	86.0	4.7	36.7	1.7	14.2	6.7	25.4
Emmer (speltz)	93.4	7.0	43.9	0.6	17.1	—	—
Barnyard millet	86.0	5.2	38.6	0.8	16.9	4.3	28.8
Hungarian grass	86.0	5.0	46.9	1.1	12.1	4.3	15.4
Wild oat grass	85.7	2.9	48.7	1.7	8.0	—	—
Prairie grass	90.8	3.0	42.9	1.6	9.9	—	—
Buffalo grass	85.0	3.0	42 0	1.6	7.1	—	—
Gama grass	85.7	4.2	39.9	0.9	11.8	—	—
Texas blue grass	85 7	5.1	36.3	1.4	14.6	—	—
Salt marsh grass	89 6	3.1	39.7	0.9	8.8	2.5	7.2
Ox-eye daisy	89 7	3.7	41.0	1.7	12.3	4.4	12.5
Australian salt bush	93.0	3.8	28.8	0.7	18.6	5.9	21.3

TABLE II. NUTRIENTS AND FERTILIZER CONSTITUENTS OF COMMON FEEDING STUFFS.—*Continued.*

Name of feed	Total dry matter in 100 lbs.	Digestible nutrients in 100 pounds			Fertilizing constituents in 1,000 pounds		
		Crude protein	Carbo-hydrates	Fat	Nitrogen	Phosphoric acid	Potash
Dried roughage—Continued	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Red clover	84.7	7.1	37.8	1.8	19.7	5.5	18.7
Red clover in bloom	79.2	7.7	34.0	2.8	19.9	—	—
Mammoth red clover	78.8	6.2	34.7	2.1	17.1	5.2	11.6
Alsike clover	90.3	8.4	39.7	1.1	20.5	5.0	13.9
White clover	90.3	11.5	42.2	1.5	25.1	7.8	13.2
Crimson clover	90.4	10.5	34.9	1.2	24.3	4.0	13.1
Japan clover	89.0	9.1	37.7	1.4	22.1	—	—
Sweet clover	92.1	11.9	36.7	0.5	28.8	5.6	18.3
Soy bean	88.2	10.6	40.9	1.2	23.8	—	—
Cowpea	89.5	9.2	39.3	1.3	14.3	5.2	14.7
Alfalfa	91.9	10.5	40.5	0.9	23.4	6.1	17.9
Alfalfa leaves	95.1	16.8	35.9	1.3	37.3	—	—
Bur clover	91.0	8.2	39.0	2.1	21.8	—	—
Hairy (winter) vetch	88.7	11.9	40.7	1.6	27.2	9.7	24.4
Peanut vine	92.4	6.7	42.2	3.0	17.1	3.2	11.6
Velvet bean	90.0	9.6	52.5	1.4	22.4	—	—
Beggar weed	90.8	6.8	42.8	1.6	18.9	—	—
Sanfoin	86.0	10.4	36.5	2.0	23.7	5.0	14.7
Wheat and vetch	85.0	10.6	36.8	1.2	23.2	—	—
Oat and pea	89.5	7.6	41.5	1.5	16.5	6.1	18.1
Oat and vetch	85.0	8.3	35.8	1.3	20.5	6.0	12.7
Mixed grasses and clover	87.1	5.8	41.8	1.3	16.2	—	—
Mixed rowen	83.4	8.0	40.1	1.5	18.6	—	—
Straw and chaff							
Wheat	90.4	0.8	35.2	0.4	5.0	2.2	6.3
Rye	92.9	0.7	39.6	0.4	5.0	2.5	8.6
Oat	90.8	1.3	39.5	0.8	5.8	3.0	17.7
Barley	85.8	0.9	40.1	0.6	7.0	2.0	10.6
Millet	85.0	0.9	34.3	0.6	6.5	1.8	17.3
Buckwheat	90.1	1.2	37.4	0.5	8.0	1.3	11.4
Field bean	95.0	3.6	39.7	—	—	—	—
Soy bean	89.9	2.3	40.1	1.0	6.8	2.5	10.4
Wheat chaff	85.7	1.2	25.4	0.6	7.2	3.8	8.2
Oat chaff	85.7	1.5	33.0	0.7	6.4	1.4	4.5
Fresh green roughage							
Fodder corn (all varieties)	20.7	1.0	11.9	0.4	2.9	1.1	3.9
Dent varieties	21.0	0.9	12.2	0.4	2.7	—	—
Dent (kernels glazed)	26.6	1.1	15.0	0.7	3.2	—	—
Flint varieties	20.2	1.1	11.4	0.5	3.2	1.3	3.1
Flint (kernels glazed)	22.9	1.5	13.2	0.6	4.3	—	—
Sweet varieties	20.9	1.2	12.6	0.4	3.4	1.4	3.8
Sweet corn without ears)	20.0	0.7	11.6	0.4	2.2	—	—
Ped kafir corn	18.4	0.8	9.7	0.4	2.9	1.3	4.5
White kafir corn	16.6	0.9	8.3	0.5	3.0	1.2	5.0
Teosinte	9.9	0.9	4.9	0.2	2.2	0.6	9.2
Yellow milo maize	16.8	1.1	9.3	0.3	2.7	1.1	5.7

TABLE II. NUTRIENTS AND FERTILIZER CONSTITUENTS OF COMMON FEEDING STUFFS.—*Continued.*

Name of feed	Total dry matter in 100 lbs.	Digestible nutrients in 100 pounds			Fertilizing constituents in 1,000 pounds		
		Crude protein	Carbo-hydrates	Fat	Nitrogen	Phosphoric acid	Potash
Fresh green roughage—Continued	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Sorghum fodder	20.6	0.6	11.6	0.3	2.1	0.7	3.4
Sugar cane	15.8	0.5	9.5	0.3	1.9	0.9	4.4
Fresh green hay							
Pasture grass	20.0	2.5	10.1	0.5	5.6	2.6	7.4
Kentucky blue grass	34.9	2.8	19.7	0.8	6.6	—	—
Timothy	38.4	1.5	19.9	0.6	5.0	2.6	7.6
Orchard grass	27.0	1.2	13.4	0.5	4.2	1.6	7.6
Red top (in bloom)	34.7	1.9	21.3	0.5	4.5	—	—
Wheat forage	22.7	1.7	12.0	0.4	3.8	1.6	6.0
Rye forage	23.4	2.1	14.1	0.4	4.2	2.5	7.1
Oat forage (in milk)	37.8	2.5	18.2	1.0	5.4	1.3	3.8
Oat forage (in bloom)	25.0	1.1	12.4	0.5	2.6	—	—
Barley forage	21.0	1.9	10.4	0.3	4.3	—	—
Meadow fescue	30.1	1.6	18.6	0.5	3.8	—	—
Italian rye grass	26.8	1.5	12.6	0.7	5.0	2.9	11.4
Tall oat grass	30.5	1.2	15.7	0.5	3.8	—	—
Johnson grass	25.0	0.6	13.7	0.2	1.9	—	—
Bermuda grass	28.3	1.3	13.4	0.4	3.5	—	—
Hungarian grass	28.9	2.0	15.9	0.4	5.0	1.2	4.2
Japanese millet	25.0	1.1	13.6	0.3	3.4	2.0	3.4
Barnyard millet	25.0	1.6	14.4	0.3	3.8	1.1	5.8
Pearl millet	18.5	0.6	10.0	0.2	1.9	1.5	7.1
Common millet	20.0	0.8	11.0	0.2	2.4	0.7	4.7
Red clover	29.2	2.9	13.6	0.7	7.0	1.5	4.8
Mammoth red clover	20.0	2.0	9.1	0.2	4.8	—	—
Alsike clover	25.2	2.6	11.4	0.5	6.2	1.1	2.0
Crimson clover	19.1	2.4	9.1	0.5	5.0	1.2	4.0
Sweet clover	20.0	2.5	8.4	0.4	6.1	2.4	6.7
Alfalfa	28.2	3.6	12.1	0.4	7.7	1.3	5.6
Spring vetch	15.0	1.9	6.6	0.2	4.3	1.0	4.5
Cowpea	16.4	1.8	8.7	0.2	3.8	1.3	4.6
Hairy vetch (winter)	15.0	2.8	6.4	0.3	5.8	1.4	5.2
Hairy vetch (in bloom)	18.0	3.5	7.7	0.3	6.7	—	—
Soy bean	24.9	3.1	11.0	0.5	6.4	1.4	5.6
Velvet bean	17.8	2.7	8.4	0.4	5.6	—	—
Canada field pea	15.3	1.8	6.9	0.3	4.5	1.6	5.0
Canada field pea (in bud)	15.0	2.6	6.8	0.3	5.0	1.1	4.4
Canada field pea (in bloom)	13.0	2.3	5.3	0.2	4.5	1.1	3.2
Canada field pea (in pod)	16.0	1.9	7.0	0.2	3.7	1.3	3.7
Barley and vetch	20.0	2.1	6.5	0.3	4.5	2.0	5.7
Barley and peas	20.0	2.1	9.1	0.4	4.5	—	—
Oats and peas	20.3	1.8	10.2	0.4	3.8	1.5	5 0

TABLE II. NUTRIENTS AND FERTILIZER CONSTITUENTS OF COMMON FEEDING STUFFS.—*Continued.*

Name of feed	Total dry matter in 100 lbs.	Digestible nutrients in 100 pounds			Fertilizing constituents in 1,000 pounds		
		Crude protein	Carbo-hydrates	Fat	Nitrogen	Phosphoric acid	Potash
Fresh green hay—Continued	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Oats and vetch	20.0	2.3	10.0	0.2	4.8	1.4	3.0
Wheat and vetch	20.0	2.6	10.3	0.3	5.4	—	—
Mixed grasses and clover	25.0	2.3	14.6	0.5	4.6	—	—
Roots and tubers							
Potato	20.9	1.1	15.7	0.1	3.4	1.6	5.8
Common beet	11.5	1.2	7.9	0.1	2.4	0.8	4.8
Mangel	9.1	1.0	5.5	0.2	2.2	0.9	3.8
Sugar beet	13.5	1.3	9.8	0.1	2.9	0.9	3.7
Flat turnip	9.9	0.9	6.4	0.1	2.1	0.9	3.4
Carrot	11.4	0.8	7.7	0.3	1.8	0.9	2.6
Rutabaga	11.4	1.0	8.1	0.2	1.9	1.2	4.9
Parsnip	11.7	1.1	10.1	0.2	2.6	2.0	4.4
Artichoke	20.5	1.3	14.7	0.2	4.2	1.4	4.7
Sweet potato	28.9	0.8	22.9	0.3	2.4	0.8	3.7
Chufa	20.5	0.6	9.1	5.6	—	—	—
Cassava	34.0	0.8	28.9	0.2	2.0	1.0	4.0
Miscellaneous							
Apples	22.2	0.8	16.5	0.2	1.2	0.1	1.7
Dwarf Essex rape	14.3	2.0	8.2	0.2	3.5	1.2	3.5
Cabbage	10.0	2.3	5.9	0.1	4.2	1.1	4.3
Sugar beet leaves	12.0	1.9	5.0	0.2	4.2	1.5	6.2
Field pumpkin	9.1	1.0	5.8	0.2	2.1	—	—
Garden pumpkin	19.2	1.4	8.3	0.4	2.9	1.6	0.9
Silage							
Corn (early analyses)	20.9	0.9	11.4	0.6	2.7	1.1	3.7
Corn (recent analyses)	26.4	1.4	14.2	0.7	4.3	1.1	3.7
Corn (ears removed)	26.3	1.1	14.9	0.7	3.5	—	—
Sorghum	23.9	0.1	13.5	0.2	1.3	1.5	1.9
Millet	26.0	0.2	13.1	0.6	2.7	1.4	6.2
Rye	19.2	0.7	9.0	0.2	3.8	—	—
Red clover	28.0	1.5	9.2	0.5	6.7	—	—
Canada field pea	49.9	3.4	25.5	1.0	9.4	—	—
Soy bean	25.8	2.7	9.6	1 3	6.6	1.6	7.5
Cowpea vine	20.7	1.5	8.6	0.9	4.3	1.5	4.6
Brewers' grains	29.7	4.6	11.5	1.8	10.1	4.2	0.5
Apple pomace	15.0	0.7	9.6	0.5	1.9	1.5	4.0
Corn cannery refuse (husk)	16.2	0.4	10.1	0.4	2.2	—	—
Corn cannery refuse (cobs)	25.9	0.3	13.7	0.9	2.4	—	—
Pea cannery refuse	23.2	2.1	13.1	0.8	4.5	—	—
Cowpea and soy bean	30.2	2.2	12.9	0.8	6.1	—	—
Corn and soy bean	24.0	1.6	13.2	0.7	4.0	1.5	3.6
Barnyard millet and soy bean	21.0	1.6	9.2	0.7	4.5	1.1	4.4

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