The Farmer's Handbook

A CONVENIENT REFERENCE BOOK
For All Persons Interested In

General Farming, Fruit Culture, Truck Farming, Market Gardening, Livestock Production, Bee Keeping, Dairying, Etc.

BY

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PREFACE

This handbook is intended as a book of reference for general farmers, fruit growers, truck farmers, market gardeners, livestock raisers, dairymen, and in fact all persons interested in the principles and best modern practices of agriculture. Students and teachers of agriculture in colleges and public schools will find it of great value to them in their work, and suburbanites and city and town dwellers who have gardens or raise livestock will receive much help from a study of its pages. While not a treatise covering the entire subject of agriculture; it presents facts, data, and information in language that is clear, concise, and easily-understood, and with the matter arranged in a manner that makes the work especially valuable for ready reference.

Among the subjects treated are: Soil improvement, general farm crops, fruit and vegetable culture, dairying, bee keeping, farm implements and machinery, as well as a section on farm livestock; this last includes descriptions of the approved types and breeds of livestock and the best method for the feeding and caring of animals in both health and disease. Although the treatment of some of the subjects is necessarily brief, the information given is of the same high order as that contained in the Instruction Papers of the Agricultural Courses of the International Correspondence Schools and is in strict accord with the latest agricultural methods.

This handbook was prepared under the supervision of H. O. Sampson, Principal of our School of Agriculture, assisted by the following Agricultural Editors, all members of our staff of textbook writers: J. E. McClintock, S. W. Shoemaker, W. W. Otto, H. J. Stevens, and E. D. Stivers.

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The Farmer's Handbook

PROPERTIES OF SOIL

Soil and Subsoil.—*Soil* is that part of the earth's surface in which plants, by means of their roots, may or do find nourishment and a place in which to grow. To distinguish the different parts of the soil, the terms surface soil and subsoil are employed. *Surface soil*, as the name implies, is soil at or near the surface of the ground—that portion usually subjected to tillage; *subsoil* is soil that lies beneath the surface soil. Surface soil is usually darker in color than subsoil, due to the presence of humus.

Inorganic Soil Ingredients.—The inorganic ingredients, or rock particles, of soil are classified according to size into three divisions known as sand, clay, and silt. *Sand* is made up of larger soil particles than clay or silt. In nearly all soils a certain amount of sand is present. The quantity in an area of soil influences its character to a marked degree. For example, a soil containing relatively few sand particles is harder to work with tillage implements than one containing a larger number of sand particles.

The smallest particles of soil are known as *clay*. They are so small that when rubbed between the fingers no gritty feeling is noticeable. A mass of clay particles is usually gray in color. A familiar example of clay is the material used for the making of brick and tile.

The particles of soil that are finer than the finest sand but larger than those that make up clay are known as *silt*. Particles of silt are darker in color and less angular in shape than particles of sand.

Organic Soil Ingredients.—The animal and vegetable matter of soil forms what is termed *humus*, which is partly decomposed organic matter. The proportion of humus in soil greatly influences its crop-producing power. Other conditions being favorable, a soil rich in humus is fertile, and one poor in humus is not fertile. Soils rich in humus are, as a rule, dark in color, and those poor in humus are light in color. Humus is retentive of water, and for this reason soils rich in this material are usually moist. If an area of soil is treated with a liberal quantity of humus-forming material, stable manure for example, the soil will become more compact, more retentive of moisture, darker in color, and more fertile, all of which are desirable soil qualities.

Types of Soil.—Soils are designated according to the proportion of rock particles of certain size that they contain; or, if they are nearly deficient in rock particles, according to the proportion of vegetable matter they contain. For example, a soil made up largely of sand is known as a *sandy soil;* one in which the particles are nearly all silt is a *silty soil*, and one largely of clay is a *clay soil.* Soils that are largely organic matter are known as *peat soils* or as *muck soils.* The term *loam* is used to designate soils that are made up of at least three of the four ingredients—sand, silt, clay, and humus. Loams are named in accordance with their predominating-sized mineral particles. For example, a loam largely of sand is a sandy loam; one made up practically of clay is a clay loam; and one rich in silt is a silty loam.

Sandy soils are easy to work but are poor in plant-food, and are not retentive of water. However, they are what are known as quick soils, that is, they produce crops quickly after seed is planted or young plants are set out.

Sandy loams and light sandy loams allow water and plant-food to pass through them quickly, but, as a rule, they are lacking in humus and also in fertility. They are, however, easy to work, become warm quickly, and will produce early crops of good quality, provided they are kept supplied with large quantities of organic matter. Still, they are not particularly desirable for cropping on account of the expense necessary to keep them in a desirable state of fertility.

Regular sandy loams are light in color and contain a comparatively small proportion of humus, but they are easy to work, become warm early in spring, and are quick soils when vegetable matter is added in liberal quantities. They are very acceptable soils for vegetable growing, but on account of the expense of keeping them fertile, they are not profitable for general farming.

Medium sandy loams are often termed medium loams. Compared with regular sandy loams, medium loams are more compact, darker in color, more retentive of water, and a little more productive, but they do not produce crops so quickly. They are excellent soils for regular farm crops, such as wheat, corn, etc., but, on account of their lack for quickness, they are not so much desired for vegetable growing as are the regular sandy loams.

Clay soils are hard to work, sticky when wet, exceedingly retentive of water, and slow in producing crops, but they are usually fairly rich in plant-food. They are better adapted to the growing of regular farm crops than to vegetable production.

Clay loams are generally designated as medium clay loams and heavy clay loams. Medium clay loams are usually dark in color, fairly compact in texture, and retentive of water. They are rather difficult to work, and, in addition, are cool and late, which qualities make them unsuitable for vegetable growing. However, they are acceptable for many of the regular farm crops.

Heavy clay loams are more compact, more retentive of water, and more tenacious than the medium clay loams. Considering these facts, they are not suitable for vegetable growing, but if liberally supplied with humus they are desirable for some forms of general farming.

Peat is formed by the partial decay of vegetation under water. It is nearly all vegetable matter, containing, as a rule, not more than 25% of rock particles. If drained of surplus water and the vegetation allowed to rot for a long time, peaty soils can be used for cropping.

Muck soils differ from peaty soils in the method of formation. They are formed where vegetable matter is under water for a time and is then successively exposed to air and to water. They usually contain a larger percentage of rock particles than is found in peat soils and are usually swampy, but after being drained often become exceedingly productive. Muck soils are excellent for celery and onions, but for general cropping they are not desirable.

Soils containing a large proportion of stone, varying in diameter from ¼ in. to 6 in., are termed gravelly soils. Of these there are several kinds, to which such terms as gravelly sandy soil, gravelly loamy soil, or gravelly clay soil are applied. Gravelly sandy soils contain large quantities of coarse sand and are of little use for crop production. Gravelly loam soils are suitable for general farming, but on account of the presence of gravel, which interferes with the working of land for vegetable crops, they are not particularly suitable for gardening. Gravelly clay soils are made up largely of clay in addition to the gravel. They have about the same characteristics as clay soils, and are more suitable for general farming than for vegetable growing.

Stony soils are similar to gravelly soils, except that they contain many large stones. They are not well adapted for vegetable growing, largely on account of the difficulty of the tillage operations, but for general farming and for tree fruit culture they are often very acceptable.

Soil Weight.—The weight of soil varies considerably; it is influenced by the size of the particles and by the proportion of humus and of water the soil contains. A soil composed largely of coarse particles is heavier than one made up principally of small particles. This is because in a fine-grained soil there is more combined air space than in a coarse-grained soil, air, of course, being lighter than soil particles.

The proportion of humus in a soil influences the weight to a marked degree. The humus is lighter than the soil particles; therefore, the larger the proportion of humus, the less is the weight of the soil, and vice versa. Peat or muck soils are about one-half the weight of sandy soils. Surface soils that have been treated liberally with stable manure are, on account of the large proportion of humus they contain, lighter in weight than the same types of soil that have not been treated with manure.

An increase in the moisture content of a soil increases its weight. Both water and air occupy the spaces around the soil particles; if water is added to soil, it displaces some of the air, which is lighter than water, and the result is an increase in the weight of the given quantity of soil.

Color of Soil.—The color of soil is influenced by its composition. For example, soil that is made up largely of white sand particles is light in color; soil of yellow clay particles is yellow in color. Humus, also, influences the color of a soil. Since humus is dark in color, if it is present in a soil in large quantities, the soil is likely to be dark in color. The proportion of water in a soil generally has an influence on the color. Most soils are darker in color when wet than when dry, but sandy soils change color but little when they become wet.

Need of Water in Soil.—Water in soil is absolutely necessary for proper plant growth. In fact, a soil without sufficient water for the needs of plants is a desert. The quantity of water taken up from the soil by plants is exceedingly large. Over 90% of cabbage and lettuce is water; green corn plants are nearly 80% water; clover and potatoes are also about 80% water. As all the water in a plant comes directly from the soil, it is easy to see that a soil to produce large crops must be liberally supplied with water.

Classes of Water in Soil.—The water in soil is grouped into three classes known as *hydrostatic water, capillary water,* and *hygroscopic water.* Below the surface of the soil, water that maintains a given level is encountered at a distance that depends on the quantity of water in the soil at the place where the observation is made. This standing water is the so-called hydrostatic water. It is known also as drainage water and as ground water.

Capillary water is that which soaks through the soil in the same manner that oil is carried through a lamp wick. This water passes in any direction—upwards, sideways, or downwards. The soaking of water through soil is caused by what is known as capillary attraction; hence, the season for the term capillary water.

Hygroscopic water is that absorbed by the soil particles and which can be driven out of the soil only by excessive heat. It does not move from place to place in soil like drainage water, and the only way it can be removed is by heating a quantity of soil to a temperature sufficient to drive the moisture away in the form of vapor.

Movement of Soil Water.—Water in soil moves about from place to place as a result of two forces; one, the attraction of gravity that draws water downwards, and the other, capillary attraction, that causes water to pass in any direction from one part of soil to another. The movement of water downwards is known as *percolation.* Water in percolating through soil carries with it to depths below the reach of plant roots many of the soluble plant-foods with which it comes in contact. The removal of plant-food from soil by the percolation of water is known as *leaching,* and any soil from which plant-food leaches rapidly is known as *leachy soil.*

The movement of water through soil by capillary attraction is necessary for crop production. Plant roots absorb capillary water and use it for the development of plants. In fact, no plant can thrive unless a plentiful supply of capillary water is available for use by its roots. The size of soil particles influences the rate at which capillary water travels. The coarser the particles, the more rapidly will water travel by capillary attraction, but, in a coarse soil it will travel a shorter distance than in fine-grained soil.

Air in Soil.—In a soil in which plants grow, air is as needful as water and plant-food. In fact, unless air is present in soil, seeds cannot germinate and there can be no plant growth. When drainage water fills all the spaces of a soil at or within a few inches of the surface of the ground, plants fail to grow simply because there is no air around the roots. The death of plants in a low, wet part of the field often results from a lack of air in the soil. The removal of surplus water by drainage is the remedy for such a condition.

Air in soil is necessary also for the decay of organic matter in the formation of humus. A grass sod or a quantity of stable manure plowed under and left in a water-filled soil will not decay for years, but, if plowed under and left in a soil where air is present, it will decay in a few months.

The presence of air in soil is necessary also to make possible chemical changes that liberate otherwise unavailable plant-food. If such changes did not occur, the supply of available plant-food might soon become deficient.

Soil Temperature.—Below a certain temperature seeds will not germinate nor plants make satisfactory growth. As soil is the medium in which seeds germinate and in which the roots of plants are imbedded, the proper degree of soil temperature is necessary for crop production. Different crops differ as to the best temperature for the sprouting of seeds and the growth of the plants, but from 75° to 100° F. is a good average temperature for most seeds.

The rapidity of the growth of a crop depends to a large extent on the temperature of the soil. With other conditions the same, crops will mature more quickly in a warm soil than in a cool soil. Soils that warm quickly and easily and retain their heat well, are, as a rule, more suitable for vegetable growing than those having less favorable temperature conditions. But, for grain growing, cooler soils are suitable.

The lay of the land influences the amount of heat received by an area of soil. The more direct the rays of the sun strike the land's surface, the greater is the amount of heat received by the soil. A warm slope is preferable for vegetables and other early crops on account of the warming effect of the direct rays of the sun. For fruit growing, however, a cool slope is preferred. This is because the fruit buds will be retarded, and thus they may escape injury from late spring frosts that are likely to occur.

Minerals in Soil.—The most abundant rock material in soil is a hard compound known as silica, or quartz. It is abundant in rocks, and on account of its hardness it resists weathering longer than most other minerals. For this reason it is found so largely in soils. Nearly all sand grains are silica. In addition to silica, soils contain quantities of compounds known as alumina, lime, magnesia, potash, soda, phosphoric acid, numerous salts, and humus. Alumina and soda are present in relatively large quantities in clay. Lime and magnesia are found more abundantly in soils of limestone origin than in those derived from other sources. The quantities of other compounds in soil vary, but are small in comparison with silica.

Chemical Changes in Soil.—Chemical changes are going on constantly in soil. Complex compounds are being broken up into simpler ones or into elements, and simple ones are uniting to form those more complex. These changes are brought about largely by the action of oxygen, which produces decay, or what may be termed slow combustion. Acids and alkalies in the soil also cause changes, and water in bringing materials into solution is responsible for many chemical changes. Bacteria, some forms of which live in the soil, are also responsible for many of the chemical changes that take place therein. The beneficial result of chemical changes is the liberation of plant-food. Much of the plant-food in soil is not soluble in water and is therefore unavailable for use by the plants, but the constant changes that take place break up these unavailable plant-food compounds and convert the food they contain into a form that can be used by plants.

Plant-Food in Soil.—The use made by plants of the chemical constituents of soil is for food. Research has shown that out of the eighty or more elements of the universe, only fourteen are taken up from the soil by plants for food, and, further, that the soil is never deficient in any of the plant-foods except four. This being the case, the farmer, gardener, and fertilizer manufacturer concern themselves only with these four foods, which are the elements nitrogen, phosphorous, potassium, and calcium. The last three of these are often spoken of as the mineral plant-food elements, on account of their being minerals.

Nitrogen is a colorless gas that is abundant in the atmosphere. As a gas, however, plants cannot absorb it. To be available it must be in the form of a compound that is soluble in water. Nitrogen combines to form a variety of compounds, only a few of which are available as plant-food, and these compounds are easily leached from the soil. The terms nitrates, nitrites, and ammonia are the most common compounds containing nitrogen.

Phosphorous is a solid; it forms the chief ingredient of match tips, and gives off a faint glow in the dark. To be available as a plant-food it must be part of a compound that is soluble in water. The term phosphoric acid is used to designate compounds containing phosphorous in the form usable by a plant.

Potassium is an element similar in appearance and character to phosphorous. It burns easily and united with oxygen it forms a compound called potash. In the form of potash it is added to soil for use as plant-food.

Calcium is one of the ingredients of lime. It is a yellow, solid element. In soil it is generally in the form of lime or limestone. As a plant-food, lime is not often deficient, but it is often applied to soil to correct an acid condition, to liberate unavailable plant-food, or for other beneficial effects.

The quantity of plant-food in an area of soil depends somewhat on the size of the particles, on the origin and method of formation, on the proportion of humus therein, and on the manner in which the soil has been cropped. The larger the particles of a soil, the less likely is a large proportion of food to be present. This is because a light soil does not retain plant-food well. This deficiency of plant-food in sandy soils applies more to the nitrogen compounds than to the others, simply because the nitrogen compounds leach away more rapidly. In a clay or a loamy soil there is likely to be more plant-food present, because the soil texture is better fitted to prevent its loss.

The origin of a soil has more of an influence on the mineral plant-foods than on the nitrogen compounds, simply because the former are minerals and are contained in the rocks that have formed the soil. For example, in a soil formed from limestone, there is likely to be a plentiful supply of lime present, or in one formed from rocks rich in potassic or phosphatic compounds, there is likely to be plenty of potassium and phosphorous.

The quantity of humus in a soil is of vast importance in regard to the quality of plant-food; humus not only contains plant-food but the decaying of animal and vegetable matter in the soil is instrumental in liberating much of the plant-food that would otherwise be unavailable.

By chemical analysis the quantity of plant-food of the different kinds can be told for a given quantity of soil. It would seem, therefore, that a chemical analysis would be of considerable benefit to a farmer. Such is not the case, however, for, although the chemist can tell how much plant-food is in a quantity of soil, he cannot tell about its availability, and it is the availability that the cultivator desires to know. Then, too, it is difficult to secure a sample of soil for analysis that is representative of a field or other given area. Thus, a chemical analysis tells about the quantity of plant-food in the sample analyzed, but it may or may not tell about the quantity of available plant-food of a large area of the soil.

Bacteria in Soil.—The presence of bacteria in soil is very necessary. In fact, were it not for soil bacteria there could be no crop production. One of the important effects of bacterial action in soil is the decay of organic matter. The result of this decay is the formation of humus, and without humus there can be no plant growth. The rate at which bacteria change organic matter into humus depends largely on the condition of the soil and the climate. The climatic condition cannot be influenced by man, but the soil condition can be influenced by the way the soil is farmed. By following the proper methods of cultivation, by rotating crops grown on the soil, and by manuring in the right way the organisms can be made more efficient than otherwise, and as a result the soil through the agency of humus becomes richer.

The bacteria in the soil have much to do with the available nitrogen supply. As stated previously, nitrogen is one of the plant-foods that may be deficient in soil. A large part of the nitrogen used by plants comes from the organic matter in the soil, in other words, from the humus. Nitrogen in the organic form, as it is called, is in compounds that are very complex, and in this condition it is not available for the plants. Certain forms of bacteria act on these complex compounds and break them up into simpler ones. In this process of change at least three forms of bacteria are necessary. Each form has its own special work to do. The first changes the organic matter in a way that what is known as ammonia is formed; the second changes the ammonia into what are known as nitrites; and the third one changes nitrites into nitrates. Nitrates are soluble and are therefore available as plant-food. This whole process of change from the organic to the nitrate, or soluble, form is known as *nitrification*. This process is indeed of vast importance to agriculture. In fact, were it not for nitrification there would be no plant growth, for there would be practically no available nitrogen, and without nitrogen no plant can grow.

Bacteria that live on the roots of legumes—clover, alfalfa, peas, beans, etc.—are of much importance in the enrichment of soil. On the roots of legumes that are growing under favorable conditions there are found knots of various sizes that are known as nodules, or tubercules. In these nodules live bacteria that are an aid to the plants. They are not parasites, for although they derive nourishment in the form of sugar and dissolved salts from the plants, they benefit the plant by supplying nitrogen to it in an available form. These bacteria, unlike higher plants, have the power to use the nitrogen of the air and make it available for use by higher plants. After the plants have been removed the roots and the tubercules decay and as a result some of the nitrogen that has been taken from the air is left for subsequent crops. This is why a crop of clover or other lĕgume acts as an enricher of the soil.

If none of the bacteria peculiar to the legume that is planted on an area of soil is present in the soil, the legume will make a poor growth and no nodules will form. A few bacteria, however, will serve to inoculate a large area of soil. The bacteria multiply rapidly, and they are carried about by water and on dust particles by the wind. In a region where a given kind of legume, Red clover, for example, is grown abundantly, there are likely to be plenty of Red-clover bacteria in any area of soil to be planted. When a legume new to a region is to be planted, however, bacteria often need to be supplied. The most practical way of accomplishing this is to obtain soil from a field where the kind of legume it is desired to grow has been grown successfully, and scatter it on the field that is to be planted. The bacteria will in this way be carried to the field, and when the legume plants become of sufficient size the bacteria will gain access to the roots, form nodules, and commence to be a benefit to the plants. This process of supplying certain kinds of bacteria to soil is known as *soil inoculation*.

SOIL IMPROVEMENT

SOIL DRAINAGE

Beneficial Effects of Drainage.—The beneficial effects that result from artificial drainage of farm lands are many and varied. The mechanical condition of wet ground is soon corrected when the land is drained, the soil assumes the light color characteristic of dry earth, and the air, the sun, the rain, tillage implements, soil bacteria, and plant-food are effective in a way that is impossible in wet soil.

One of the principal benefits of drainage is that it lowers the water-table below the zone of plant roots. When the water-table is at or just below the surface of the soil so that roots of plants are submerged, plant life cannot long exist because of want of air. Also, under such a condition, many of the plant-food compounds that are dependent on air for their dissolution and consequent availability to plants are rendered of no value to crops. As soon as water-logged soil is drained aeration takes place, with the result that plant roots are enabled to obtain the necessary air and many of the plant-food compounds are rendered available to plants.

Another important effect of drainage is the warming of the soil. All wet soils are cold, and crops planted on them will not thrive. When the surplus free water is removed from land by drainage the soil invariably becomes warmer.

A valuable effect of drainage is the mellowing of the soil. When a soil is properly drained, the change in its mechanical condition is most marked. The heavy character of the soil disappears, and the soil becomes light, pliable, and loose. On a well-drained and hence mellow soil, all tillage operations, including plowing, rolling, and harrowing, are carried on more easily than on a wet soil. and the planting and cultivating of crops is therefore accomplished more cheaply. Farm machinery also suffers less from wear and tear when it is used on a light, dry soil than when it is used on a heavy, wet soil.

An important benefit of soil drainage is the promotion of bacterial action. Most kinds of bacteria cannot live in a water-logged soil. Owing to the fact that the supply of available plant-food in soil is largely dependent on the action of bacteria, it will readily be seen that it is highly important to provide conditions that will facilitate their action.

A saving of plant-food is effected by drainage. If land is not well drained, and the fields, particularly those that are tilled, become surface-washed, much of the soil is carried away and with it the plant-food it contained.

One of the benefits of drainage is the increase in the quality of crops. Grass, wheat, corn, and many other kinds of crops are, when other conditions are favorable, of better quality if grown in drained soil than if grown in wet soil.

The reclaiming of waste land is, perhaps, one of the most beneficial results of drainage. Ground that would otherwise be useless is made fit for cultivation by ridding it of free water; in other words, the acreage of available land on a farm is increased by drainage. Wet soil that has never been farmed is, as a rule, rich in plant-food, and when reclaimed makes valuable farm land.

Cost of Drainage.—Some experts on drainage consider $35 an acre as being the average cost of draining farm land. Others claim that land can be drained for from $12 to $15 an acre. There is, undoubtedly, a wide variation in the cost of drainage.

OPEN DITCHES

Where large quantities of surplus water from surrounding highlands collect in ravines and overflow lowlands, open ditches should be constructed to carry away this surplus water. Gullies, which become larger at every rain, are likely to be formed when this is not done. These gullies interfere greatly with farm operations and occupy space that might otherwise be profitably cultivated.

Open ditches are also useful in draining large areas in regions where there is but little fall to the natural waterways. In such regions open ditches are provided to convey the water to natural water courses or to large open ditches that in many districts serve as outlets to drains from several farms.

Locating of Open Ditches.—In locating an open ditch care must be taken to place it where it will receive the most of the surface water in times when there is much rain or snow. As far as possible, however, open ditches should be placed where they will not be in the way of farm operations, and where they will receive little or no damage from livestock.

Construction of Open Ditches.—A ditch should have such an amount of fall, or grade, that a slow, steady flow will be maintained throughout its length. There will then be but little danger that the sides and banks of the ditch will be washed away. When a ditch is particularly steep at any point, the speed of the water may be checked by a series of waterfalls.

The depth and width of a ditch should naturally largely depend on the maximum quantity of water to be carried by it, that is, the water it must carry in times of freshets. The width should be a little greater at the outlet than at the beginning, as the quantity of water carried becomes greater as the outlet is approached.

Under most conditions the best kind of an open ditch for farm lands is a wide ditch whose bank and sides, and where possible its bottom, are kept grassed continually. Such drains can usually be maintained with less labor, expense, and inconvenience than any other type of open ditch. Open ditches are generally made with sloping sides, the best slope being about 45°. The banks can thus be grassed over so that the roots of the grass protect the soil by holding it in place, and with such a slope the grass can be easily mowed.

Furrow Drains.—Comparatively level stretches of stiff clay soil are often met with that can be properly drained neither by the ordinary surface ditch nor the underdrain. One of the best methods of removing surplus water from such areas is to plow the fields in narrow lands, or divisions, leaving open, or dead, furrows at the sides of each land. The water will collect in these open furrows and will, if there is an incline to the surface of the field, drain to some outlet. Even if the field is so level that water will not drain from the furrows, the drainage conditions of the field are better than if no open furrows were made, for the surplus water is removed from around the roots of many of the plants in the field.

The distance apart and the depth of the furrows will, of course, depend on various conditions. If the field is level or nearly so, the practice is to make the furrows shallow and from 9 to 15 ft. apart; if there is enough inclination to the surface of the field to cause the water in the furrows to pass to an outlet, the furrows are made deep, and from 40 to 50 ft. apart.

UNDERDRAINS

Arrangement of Underdrains.—All the lines of tile, with the silt wells whenever these are employed, that are used in draining surplus water from a field, make up what is known as an *underdrainage system.* The principal line or conduit of such a system is called a *main;* sometimes a main constitutes the entire system. When a large area is to be drained it is generally necessary for an underdrainage system to be made up of many branches. The number and size of these branches naturally depend on the area to be drained and the quantity of water to be removed.

A *submain* is a line of tile that has one or more drains branching from it but is itself subsidiary to a main. The lines that extend from either a main or a submain and that have no other lines branching from them are known as *laterals.* As more water is carried in the main of a drainage system than in the submains or the laterals, the main is generally made of tile of a larger bore than those used in building any of the other lines. More water is carried in submains than in their own laterals, and usually more than is carried in the laterals of the main, and so submains are generally made of tile with a larger bore than the tile used in laterals. The laterals should join the main or the submains at oblique angles and the submains should join the mains at like angles.

Determining Size of Tile to Use.—In determining the size of tile to use in an underdrain, careful study should be made of the quantity of water to be carried, the slope of the land in the area to be drained, and the size of this area. The quantity of water to be carried is naturally a very important consideration. Other things being equal, larger-sized tile should be used in regions where the rainfall is heavy than in those where it is light. It should be borne in mind that drainage has to deal with the extreme rather than the average rainfall. Suppose, for example, that there is often as much as 2 in. of rainfall in 24 hr. in a locality. If a drain is constructed in such a region provision should be made for getting rid of a large quantity of water quickly, as a rainfall of 2 in. gives 54,308 gal. of water to the acre. Of this, say one-fourth, is lost through evaporation and one-fourth is absorbed by the crops; there still remains one-half the water, or 27,154 gal., to be carried off through the drains. Of course this water is carried away slowly, but if the tile in the drains are too small it may remain in the soil long enough to injure the crops.

The extent of the area to be drained should likewise be considered when the size of tile to use is being determined. The following rules for determining in a general way the acreage that mains will drain will be helpful, but when considering them, the fact that many other conditions enter into the problem should not be overlooked. If the fall is about 3 in. in 100 ft., the rule for finding the acreage that can be drained by a tile of any diameter is to square the diameter and divide by 4. Hence, if a 3-in. tile is used, the area it will drain is $3 \times 3 \div 4 = 2\frac{1}{4}$ A. If a 4-in. tile is used the area that will be drained is $4 \times 4 \div 4 = 4$ A. If the fall is about 4 in. in 100 ft., the diameter is squared and the result divided by 3 instead of 4. Under this condition, a 3-in. main will carry the water from 3 A., and a 4-in. main from $5\frac{1}{3}$ A.

Distance Between Laterals.—Before deciding on the distance from each other at which to lay laterals in an area to be drained, full consideration should be taken of the inclination of the land, the kind of soil, and the quantity of water in the area. When there is a sharp incline, the water is more readily removed than when it has a gradual slope or is level, and consequently the laterals should be placed farther apart in the first case than in the other. The kind of soil and the quantity of water are, naturally, important points.

Water will reach a drain more quickly in a coarse-grained soil than in a fine-grained soil; therefore, the laterals should be placed farther apart in a sandy soil than in a clay soil. The following are the usual distances at which laterals should be placed apart from each other in various kinds of soil: In stiff clay soils, from 30 to 40 ft.; in loamy soils, from 40 to 50 ft.; in silty soils, from 50 to 60 ft.; in sandy soils, from 75 to 100 ft. In addition to considering these general rules, a farmer might do well to ascertain the experience other farmers in the locality may have had with drains on land similar to his.

Depth of Underdrains—When deciding the depth at which to lay a drain, careful consideration should be made of the climate of the region, the soil of the area to be drained, and the crops that are to be raised.

As the freezing of the water in drain tile will burst or displace them, they should be laid below the depth at which the ground freezes. In most parts of the United States a depth of from 3 to 4 ft. will be below frost, and consequently this is a good average depth for drains on tilled land.

The kind of soil is an important factor in determining the depth of an underdrain. When a field has a loose gravelly or sandy subsoil 3 or 4 ft. below the surface, care should be taken not to lay the tile so deep as to cause the water-table to be located in the subsoil. As water percolates easily through such subsoils, they would, unless the drain were placed above the subsoil, act as a filter through which the water would be carried out of the reach of plant roots.

In a field that has a stiff clay subsoil, the drain should also be placed above the subsoil, but for a different reason. Water percolates so slowly through a stiff clay that sufficient surplus water will not be removed to benefit the crops growing on the field. Drains in such a field should be as shallow as climatic conditions will allow.

Peaty soils or others of like class, which contain considerable humus, often settle to a depth of 2 ft. or more after being drained. In such areas the drains should be placed deep enough to allow for the sinking of the soil.

The natural wetness of a soil should influence the consideration of the depth of a drain. If a soil is wet only in the early spring and the late fall, and the farmer desires to work the land at both these seasons, he will probably be able to get rid of sufficient surplus water by building a drain, say from 3 to 3½ ft. in depth. On the other hand, if land is wet in the late spring and the early fall, and but partly dry in the summer, a drain from 3½ to 4½ ft. deep may be necessary.

The kinds of crops to be grown in drained land should have considerable influence on deciding the depth of drains. In a tilled field the ground freezes much deeper than in a field protected by a sod, and for this reason drains laid in permanent meadows or pastures may be more shallow than those laid in tilled fields.

Excavating for Underdrains.—After the ditch for a tile drain has been laid out and the grade has been properly marked on grade stakes, the excavating of the ditch is next in order. As with surface ditches, the work is done with hand tools or by means of a plow. The depth of the ditch at all points should correspond with the figures on the grade stakes, and the earth removed should be thrown near the ditch, as it has to be replaced after the tile are laid. Special care should also be taken to remove all loose dirt from the ditch, as its presence is likely to interfere with the laying of the tile.

Laying Tile in Underdrains.—Tile are laid end to end on the bottom of the ditch, generally in a single row. A whole tile should be placed at the outlet. When two rows are laid parallel in the same ditch it is a good plan, after two whole tile have been laid at the outlet, to have the joints of one row alternate with the joints of the other by starting the remainder of one row with a whole tile, and the remainder of the other row with a half tile. When this plan is employed each joint is opposite the center of a tile in the other row. The two rows can be laid at the same time.

The ends of the tile in an underdrain should be placed very close together, as a tight joint tends to prevent the entrance of silt and roots. There is no danger of getting joints so tight that water will not enter them. The tile if properly laid below where frost can reach them are practically indestructible, and hence the only way in which a tile drain is likely to become useless is by being clogged.

Obtaining a Uniform Grade.—There are many methods in vogue for obtaining a uniform grade in tile drains. A method that is commonly used is to test the grade by means of a spirit level as the tile are laid. If the grade of the line of tile is to be, say, 5 in. in 100 ft., there should be a grade of 2½ in. in 50 ft., 1¼ in. in 25 ft., ⅝ in. in 12½ ft., or ⅛ in. in 2½ ft. For practical purposes, the amount of fall, or grade, in such a case may be regarded as ⅛ in. for each 2 ft. Since a tile is 1 ft. long, the distance from the center of the first tile to the same position on the third tile is 2 ft. Therefore, if the grade is correct, the spirit level when raised ⅛ in. at the end toward the outlet should have the horizontal bubble in the center.

To verify the calculation of the grade after laying twelve or thirteen tile, it is a good plan to place a leveling board or other straightedge on these tile and set the spirit level on top of it, calculating the grade as just explained.

STABLE MANURE

Horse Manure.—The dung of the horse, if the animal is in normal health, is very dry, owing to the large quantity of crude, woody, fiber which is undigested. This coarse fiber in horse dung gives it a loose texture, which renders it liable to ferment easily. As soon as fermentation occurs, the manure readily loses much of its nitrogen in the form of ammonia. Horse dung is uniform in its character, being less variable in quality than any other animal manure.

Horses that are in the stable at night and at feeding times during the day, drop about two-thirds of their dung in the stable.

The ordinary work horse of 1,200 lb. will make from 50 to 60 lb. of manure a day, one-half of which is urine. At this rate, one horse will make in the neighborhood of 10 T. of manure a year, about 6 T. of which are dropped in the stable.

The liquid manure of solid-hoofed animals like the horse and mule is very rich in nitrogen and potash. Most of the nitrogen exists in the form of urates. On these compounds the bacteria act so soon after the manure is voided that the smell of hartshorn, or ammonia, is very perceptible in a horse stable. Such a condition always means loss of nitrogen.

Cattle Manure.—Steers and cows make a large quantity of both solid and liquid manure. The average quantity from a mature animal is 70 lb. a day, 30 lb. of which is solid and 40 lb. liquid. No other class of animals surpasses cattle in the quantity of the liquid voided, taking into consideration, of course, the weight of the animals. In estimating the value of the manure from either steers or cows, it is a serious mistake not to take into consideration the liquid manure along with the solid. As a rule, these animals, in summer time, are on a pasture range, and in the winter, if stabled at all, they are in the stable only at night, having the run of a barnyard during the day. By such practice, much of their manure is lost on the pasture, roads, and lanes, or is dropped in the barnyard. Cattle differ from horses and mules in that they will urinate as frequently out of as in the stable. Cattle manure, owing to its watery condition, decomposes much more slowly than does horse manure; it is also less inclined to ferment and fire-fang.

Sheep Manure.—The dung from sheep tests very high in nitrogen, phosphoric acid, and potash, being richer than that of any of the other farm animals, except, perhaps, poultry. Sheep dung is highly concentrated and ferments readily, which means a loss of ammonia. It is a quick-acting manure in the soil, soon becoming available as plant-food.

A full-grown sheep will produce from 1 to 1½ T. of manure a year. Sheep manure is liable to the same losses that attend horse manure, and these losses come about in a similar way.

Swine Manure.—The size and age of the animal has much to do with the quantity of hog manure that is made by one animal in a year. As nearly as experiments can be made to ascertain the facts, a hog makes, both of solid and liquid manure, from 8 to 10 lb. a day. Hogs drink considerable swill and water; consequently, their manure contains a large percentage of liquid. This being the case, it is not inclined to heat as quickly as either horse or sheep voidings. But, owing to the large quantity of water contained, it is in danger of losing some of its value by leaching. Hog manure decomposes slowly and in this respect it is like that of cattle.

Poultry Manure.—Poultry manure compares very favorably with that of sheep. It is rich in all the plant-food elements, because the solid and liquid voidings are made at the same time. As a fertilizer it acts promptly, but as it belongs to the hot manures, fermentation starts readily and the ammonia in it is likely to be lost in the air. To prevent this loss, plenty of powdered absorbents, like gypsum, road dust, fine loam, or other similar material, should be applied to the droppings when they are fresh.

Influence of Feed on Value of Manure.—The real value of manure, both in quantity and quality, depends not only on the animal producing it, but still more on the kind of feed fed to the animal. It has been proved both by experience and by chemical analyses that rich feed makes rich manure. Animals give off in solid and liquid excreta only that which they have eaten. If they eat feed rich in protein, the manure will be rich in nitrogen, because it is in the protein that nitrogen is found; whereas, if their feed is poor in protein, the manure is poor in nitrogen. Then, again, if they eat feed rich in carbohydrates, the manure, being of the same character as the feed, will not be nearly so valuable as if the animals had been fed protein feed.

Horses, cattle, and sheep, fed principally on hay and other fodders, make manure rich in potash but poor in phosphoric acid and nitrogen. This condition is due to the fact that most of the potash of plants is found in the leaves and stems. Cottonseed meal stands at the head of the list of all feeds for making rich manure. Linseed meal is another mill feed that makes a manure rich in value. Gluten meal stands next to linseed meal in its manure-making power, although it is a product that is very likely to vary in protein content. Distillers' grains, such as Ajax flakes, are high in protein, hence a manure rich in nitrogen can be expected when they are liberally included in a ration for livestock. Wheat bran is another feed that is excellent for its manurial value. Although worth only about one-third as much as cottonseed meal, or one-half as much as linseed or gluten meal for nitrogen, it contains a large quantity of ash, which makes it valuable as a manure producer, Corn meal is very low in manure-making value, however, a fact that often surprises farmers when they are thus informed. Yet, it is only too true that corn meal has only about one-half the manurial value of wheat bran, one-third that of linseed meal, and one-fourth that of cottonseed meal. There are many other mill feeds, such as wheat middlings, buckwheat middlings, rice feed, etc., that are very useful both for their feed value to animals and for their manure-making value.

The grasses like timothy, red top, orchard grass, and other similar plants, when fed to livestock, do not yield nearly so rich a manure as the legumes, such as clover, alfalfa, etc. The difference is not due to their digestibility, for grasses, like timothy, are more easily digested by the animal than legumes like clover, but it is due to the difference in nitrogen content inherent in the plant itself. There is also a difference in the manurial value of the varieties of each plant class. Corn fodder, a grass, yields a richer manure than timothy, while alfalfa, a legume, makes richer manure than Red clover.

Care of Horse Manure.—To save both the liquid and solid manure of horses, the water-tight floor of their stalls should be inclined slightly from the front to a point just behind the animals. At this point the floor should be a flat gutter having just enough of a depression to it to keep the liquid from flowing back over the main floor of the stable. The dung, urine, litter, and absorbents can be mixed in the gutter and all loss of liquid prevented.

Care of Cattle Manure.—If cattle or steers are stalled in a stable, there is no better way devised to save all their manure than to construct a water-tight gutter behind them. To hold a day's voidings, this gutter should be 24 in. wide and 7 in. deep, with the sides perpendicular and the bottom perfectly level. All the litter, absorbents, dung, and urine of the manure should be collected in this gutter, enough of litter and absorbents being used to soak up all the liquid. The manure from a gutter of this size should be removed daily and be spread on the fields as desired.

Care of Hog Manure.—The solid and liquid manure of hogs requires the same care and precaution against waste as that of other animals. Hogs usually drop most of their voidings in the outside pen. To prevent loss of the liquid manure, the floor of this pen should be water-tight and should slope toward either one side or the other.

A water-tight gutter of sufficient depth and width to hold the manure for whatever length of time the farmer sees fit to have it there, should be built along the sloping side. Hog manure, being cold, is not likely to heat quickly. If, however, heating occurs, the manure should be removed at once and applied to the soil; otherwise, it will waste. The gutter for hog manure should have a roof over it to protect the manure from the weather. Litter and absorbents are as necessary for use with hog manure as with any other kind.

Care of Sheep Manure.—Sheep are not stalled but are allowed to run loose in stables, yet their manure needs to be cared for quite as much as that of any other class of livestock. Owing to the dryness of their dung and the small quantity of water voided, there is no need of gutters as for the animals previously named. A tight floor over the whole sheep barn is of importance if the greatest quantity of manure is to be saved. Litter will not take the place of a tight floor, but when used on a floor that will not allow the manure to escape it is a most excellent material to retain all the rich manure of the sheep. As a rule, there is more litter used for sheep than for other animals, the idea being to have the flock tramp a large quantity of it into shreds to be used as fine manure. It is customary to allow manure to remain in the sheep stable and add bedding from time to time, only removing it when a large quantity has accumulated.

Care of Poultry Manure.—The coarse litters are not so well suited for saving poultry manure as are the powdered mineral absorbents. In a poultry house, a tight floor or dropping-board sprinkled with road dust, loam, gypsum, or some other absorbent is very necessary to retain the richness of the poultry manure. Poultry manure should be gathered frequently so that it may not be wasted by being knocked about over the house by the moving fowls.

GREEN MANURE

Weeds as Green Manure.—Weeds are often very rich in plant-food, and although it is not recommended to have them grow on farms, they may be made use of by plowing them under for green manure. The best time to put them under the soil is while they are in bloom, as they are thus prevented from going to seed.

Clovers as Green Manure.—Red clover is one of the plants sometimes used for green manuring. If the whole plant is turned under, it will supply a large quantity of vegetable matter to form humus. However, the tops are so valuable for animal feed that, as a rule, the entire plant is seldom used for green manure.

Alsike clover is useful as a green manure. One advantage of this variety is that the plants will often grow on ground too wet for Red clover. Besides this, Alsike lasts in the soil longer than does Red clover.

Crimson clover, like Red clover, has a long tap root and numerous branching roots. It is particularly useful as a catch crop, and if plowed under will make very good green manure. A crop of Crimson clover in a region where it is indigenous is easily grown, and is one that yields a heavier tonnage per acre than any of the other clovers.

Canada Field Peas as Green Manure.—The Canada field pea, which is grown to a great extent in the northern part of the United States, makes a very good green-manure crop. It is a quick-growing crop, the plants blooming about 7 or 8 weeks after the seed is planted. The physical condition of a soil on which pea vines have been grown is very much improved; so much so, in fact, that it is often surprising to see how the soil crumbles when being plowed. The matting of the pea vines on the surface of the ground may be largely prevented if the crop is grown with a strong-growing, tall-stemmed variety of oats, as the oat plants will act as a support for the pea vines. Better results are insured by planting the seed of peas and oats separately, the peas being placed from 2½ to 3 in. in the soil and the oats 1 in. The combination planting, or even the peas grown alone, makes an excellent green-manure crop.

Cowpeas as Green Manure.—Cowpeas grow with heavy foliage and consequently make a large quantity of green manure. However, the mass of foliage is so great at times that, when it is all plowed under, the heat caused by the decaying vegetable matter will make the top layer of soil too dry. When used as green manure, cowpeas should not be plowed under too deeply. For the northern part of the United States, the varieties known as New Era and Whippoorwill are probably the best. They are quick-growing and will generally develop sufficiently during the growing season to furnish a large quantity of green manure.

Soybeans as Green Manure.—The soybean, like the cowpea, makes a large quantity of valuable green manure. It grows very well in the southern part of the United States, and has an advantage over the cowpea in that it is able to stand more drought. The soybean plants, too, grow more upright and with less matting of stems.

Vetch as Green Manure.—Two kinds of vetch are used for green manuring, namely, Hairy vetch and Common vetch.

Hairy vetch, although it grows best on a rich, moist soil, will often make satisfactory growth on soils that are somewhat dry and sandy, and for this reason is sometimes called sand vetch. As sand vetch will mat on the ground, the crop is often sown with some other crop, a cereal like wheat, rye, or oats usually being chosen.

The Common vetch, or tare, is a legume similar in habits of growth to the field or garden pea. The vetch plant, however, is more slender, and has more tendrils and leaves than the pea plant. Common vetch makes a good catch crop if sown with either rye or wheat, as these crops will hold the vines off the ground. When plowed under, this mixed crop makes excellent green manure.

Alfalfa as Green Manure.—Alfalfa is seldom used as a green manure, as the tops are of great value as animal feed. It makes excellent green manure, however, when it is desired to use it as such.

Effects of Green Manuring.—One of the principal benefits of green manuring is that it adds humus to the soil, thus making the soil more porous, more retentive of film water, and lighter in weight, the latter being particularly true of heavy soils, like clay. Owing to the fact that soils treated by green manuring are made physically better, they are easier to work with the implements of tillage than soils not so treated.

Another benefit of green manuring is the addition to the soil of such plant-foods as nitrogen, phosphoric acid, potash, and lime, these fertilizing elements being contained in varying quantities in the crop turned under.

The decomposing of the vegetable matter of green manure adds much heat to the soil. The quantity of heat liberated when vegetable matter decays is as great as if the same quantity of matter were burned, the only difference being in the time taken to complete the process. In fact, decomposition is really slow burning. This heating caused by the decay of green manure is often of much benefit to the crop that follows.

Soil depth can be increased by green manuring, provided the vegetable matter is placed somewhat deeper than the usual plow depth. The plowing must not be so deep, however, as to shut off the supply of air from the surface, because air is necessary for the decay of vegetable matter.

Supplying of Green Manure.—Two or even three green-manure crops may be grown and turned under within a year, provided, of course, that the income crop is given up. The advantage of turning under several crops is that much more humus and nitrogen can be added to the soil than when only one crop is used. The work may be begun either in the spring or the fall, as desired.

The stage of a crop's growth greatly influences its value for green manure. If the plants have mature, woody stems, the vegetable matter will be slow to decay when placed underneath the plow furrow. Besides this, when a layer of dry, woody plant material is placed a few inches below the soil surface, the normal supply of capillary water from the lower soil depths is partly prevented from reaching the roots of the plants growing in the soil. Then, too, mature plants during their growth have used large quantities of water, and the soil on which they are grown is therefore likely to be deficient in water. Thus, it is easy to conclude that plants should not be too mature when they are plowed under for green manure. During their blossoming period, plants are in the best condition to be plowed under. At this stage of growth, the stems are soft and succulent, will decay rapidly, and will not cause the surface soil to become dry for the succeeding crop.

The deeper green manure is placed in the soil, the longer it will take the vegetable matter to decay. This is because air, which is necessary for decay, is present in smaller quantities as the soil depth increases. In wet weather 4 in. and in dry weather 5 in. are good average plow depths for green manuring.

COMMERCIAL FERTILIZERS

Nitrate of Soda.—Chile saltpeter, or nitrate of soda, is a natural product that is mined with common salt in the rainless regions of South America. Before the fertilizer is sent to the farmer, it is purified. It then contains from about 95 to 97% of practically pure nitrate of soda. This purified salt contains from 15½ to 16% of nitrogen, which means, of course, from 15½ to 16 lb. to the hundredweight. The price of nitrate of soda varies from $50 to $70 a ton, thus making the nitrogen it contains cost from 15 to 20c. or more a pound.

Sulphate of Ammonia.—At gasworks where gas is manufactured for light and fuel, a by-product called sulphate of ammonia is formed. This material is sold as a fertilizer. In 100 lb. of the sulphate there are 25 lb. of ammonia, which is equal to 20½ lb. of actual nitrogen. Since the sulphate, like the nitrate, is readily soluble, it should be applied after the crop is started. Sulphate of ammonia is a good fertilizer to use when growing wheat, corn, rye, oats, grass, or potatoes.

Dried Blood.—Among the important nitrogenous animal fertilizers is dried blood. This material is rich in nitrogen and decays readily in the soil. At packing houses, the blood from the animals that are killed is carefully saved and dried, and then ground into meal. Two grades of the meal are on the market; one is bright red and the other is somewhat darker and almost black. The red meal contains from 13 to 15% of nitrogen, with little or no phosphoric acid, while the dark, or black, meal has from 6 to 12% of nitrogen and usually a small percentage of phosphoric acid. This lower grade of dried blood is more generally used in the manufacture of fertilizers, chiefly on account of its being cheaper in price. The red meal is extensively used as a stock food.

Tankage.—A fertilizer known as tankage is put on the market as a by-product of the large slaughter houses. Tankage is composed of the animal parts that cannot be used for other purposes. Two grades of tankage fertilizer, known as concentrated and crushed, are offered for sale.

Concentrated tankage is made by evaporating some of the animal fluids that are rich in fat. This leaves a fairly uniform product, yielding on analysis from 10 to 12% of nitrogen and a small per cent. of phosphoric acid.

Crushed tankage is made by boiling and steaming the otherwise waste materials, removing the fat, and drying and grinding the residue. It contains on the average from 5 to 10% of nitrogen and from 3 to 12% of phosphoric acid.

Fish Fertilizer.—Fish and fish scrap in various forms are utilized in making commercial fertilizer. At packing houses and fish canneries, all the waste fish products are saved and sold for fertilizer. At fish-oil works, the residue left after removing the oil is the part used as fertilizer. Fertilizer made of such material is more uniform in quality than that from the packing houses and canneries, and contains, as a rule, from 7 to 8% of nitrogen and the same amount of phosphoric acid.

Garbage Tankage.—The garbage of cities is often utilized for making commercial fertilizer. The value of such fertilizer, on account of the great variety of material of which the tankage is composed, varies widely. As a rule, this kind of fertilizer contains small quantities of nitrogen, phosphoric acid, and potash.

Wool and Hair Waste.—At slaughter houses, the refuse hair and wool is saved and sold as a fertilizer. Its nitrogen content is relatively high, reaching, especially if the refuse is mixed with blood and other forms of animal matter, as high as 12%. However, as wool and hair decay slowly, the fertilizer is classed as a low-grade product.

The waste wool from both carpet and woolen-goods factories is often used as a top dressing for grass lands. On an average, such waste contains from 1 to 5% of soluble potash and from 4 to 7% of nitrogen.

Hoof and Horn Meal.—From the waste of hoofs and horns, where these products are manufactured into combs, buttons, etc., fertilizers known as either hoof or horn meal are made. Although these meals contain as high as 12% of nitrogen they are very slow acting and of little use unless very finely ground. Hoof meal has been found by experience to decay more quickly in a soil than horn meal. These slow-acting fertilizers are largely used in the manufacture of mixed fertilizers.

Street Sweepings.—The sweepings from city streets are composed of manure mixed with dust or mud, chips of wood, scraps of paper, nails, tin cans, bits of glass, etc. The value of street sweepings as fertilizer depends on the proportion of manure contained.

Leather Meal.—At factories where leather is worked up into shoes, harnesses, etc. there are many waste scraps. As leather contains considerable nitrogen, these scraps are ground into meal and sold as fertilizer. Leather itself decays very slowly; therefore, the meal makes a slow-acting fertilizer. In fact, it is regarded as the slowest acting of all nitrogen fertilizers.

Cottonseed and Linseed Meals.—The vegetable products known as cottonseed and linseed meals are rich in nitrogen. Although they make very good fertilizer, their use for this purpose, on account of price, is nearly always limited to the regions in which cotton or flax is grown. So valuable are they as fertilizer, that whenever the price for which they can be purchased justifies their use, fertilizer men incorporate them in mixed goods.

Castor Pomace.—The residue left after the oil has been extracted from the castor bean, known as castor pomace, is a vegetable product that is high in nitrogen. The pomace differs from cottonseed and linseed meals in that it is not used for feeding livestock. This makes its use as a fertilizer more general. Castor pomace, when analyzed, shows about 6% of nitrogen.

Raw Bone.—When bones in their natural condition —that is, without any treatment of steaming, cooking, burning, or the use of acid—are ground into a fine powder, the product is known as raw bone. There is a strong tendency to adulterate raw bone with such cheap materials as coal ashes, lime, and ground oyster shells. Bone in its raw state shows by analysis from 3 to 5% of nitrogen, from 20 to 25% of phosphoric acid, and from 50 to 60% of lime.

Steamed Bone.—If bones are steamed or boiled before grinding, the resulting product is known as steamed bone. The object of cooking raw bones is to get rid of the fat and meat particles. The steaming puts the bone into a condition that will permit it to be more easily crumbled. The advantage, then, that steamed bone has over raw bone is not due to a difference in composition, but to the fact that the steamed bone is more readily reduced to a fine powder than is raw bone; the finer the bone, the better it is fitted for use either as a single fertilizer or in mixed goods.

Bone Black.—Charred, or partly burned, bone, called bone black, is extensively used in the refining of sugar. After being used several times, it is no longer valuable to the sugar manufacturer, and is then sold as fertilizer. This product contains about 30% of phosphoric acid, but like all other charcoal resists decay for a long time.

Dissolved Bone.—When bones are treated with sulphuric acid, the phosphoric acid contained in them is made available, and the product is called dissolved bone, or acidulated bone. Dissolved bone contains from 2 to 3% of nitrogen and from 15 to 17% of total phosphoric acid, of which from 12 to 14% is available.

Rock Phosphates.—In North Carolina, South Carolina, Tennessee, Florida, and one or two more states are found rock phosphates deposited in beds, veins, and pockets. As regards consistency, there are two classes of the phosphate rock. One is very hard and the other is comparatively soft. The soft rock is easily crushed, but powerful stone crushers are needed to render the hard rock fine enough for fertilizer. Raw phosphate rock usually contains from 18 to 30% of phosphoric acid, and owing to its variation in quality, it is sold at the crushers for from $1.75 to $4 a ton.

Acid Phosphate, or Superphosphate.—By treating finely ground rock phosphate with sulphuric acid, the resulting material is commercial acid phosphate, which usually contains about 14% of phosphoric acid. Both dissolved bone and acid phosphate are sometimes known as superphosphate.

Basic Slag.—A basic slag formed as a by-product at iron furnaces where steel is manufactured is sold as fertilizer. This slag is known also as Thomas slag and odorless phosphate. To make it of use as a fertilizer, it must be ground very fine, and then in this form it is not soluble in water. The soil acids, however, will in time dissolve the phosphate and make it available as plant-food. The phosphoric acid content of basic slag ranges from 12 to 20%.

Wood Ashes.—There are two kinds of wood ashes: those from hard-wood trees, such as hickory, oak, beech, walnut, and elm; and those from soft-wood trees, such as pine, cedar, spruce, poplar, etc. The ashes from hard woods are richer in potash than those from soft woods. Besides supplying potash to a soil, wood ashes, because they contain lime, correct acidity. They are good fertilizers for soils rich in humus and make a good top dressing for grass; but not more than 300 lb. per acre should be applied at one time.

Kainite.—The only Stassfurt salt that in its crude condition is imported into the United States is kainite. It is a compound of magnesia, common salt, and potash, about 12 to 13% of the material last named being present. Kainite is used either alone as a fertilizer or in mixtures to form commercial brands. On account of its tendency to absorb water when kept for a long time, it gets lumpy, and when in this condition it is difficult to apply to the soil. One reason for the frequent use of kainite as a fertilizer is that it is cheaper per ton than the higher grades of potash. Kainite sells on the market for from $11 to $16 a ton.

Muriate of Potash.—From the crude potash salts the muriate of potash is manufactured. It is perhaps the cheapest form of potash, as it contains 50% of actual potash on an average and sells for from $40 to $50 a ton, which, as just explained, brings the cost per pound from 4 to 5c. However, it does not seem to be the best, for after continued use the muriate affects the soil in such a way that lime is required to bring it back to fertility.

Muriate of potash can be used for all legumes and fruit trees, but on account of the chlorine it contains, it should not be used for potatoes, tobacco, sugar beets, onions, or mangels. For these, the sulphate of potash is a better form.

Sulphate of Potash.—Another fertilizer made by refining crude Stassfurt salts, is sulphate of potash. It contains from 48 to as high as 53% of actual potash. It is a very valuable fertilizer, because it can be safely used on any and all crops. Sulphate of potash does not cause the loss of lime in soil as does the muriate, nor does it attract moisture, become lumpy, or pack into the soil. Perhaps the main reason that the sulphate form is not used more as a fertilizer is its cost. The actual potash in the sulphate costs ½c. more per pound than it does in the muriate.

For clay soils, the sulphate is a better form to use than the muriate. On account of not becoming lumpy, the sulphate of potash mixes very easily with other ingredients in manufacturing commercial fertilizer.

Vegetable Potash Fertilizers.—Sometimes, ground tobacco stems are used as a potash fertilizer. On the average, they show by analysis from 7 to 8% of potash, from 2½ to 3½ of nitrogen, and from 3 to 5% of lime.

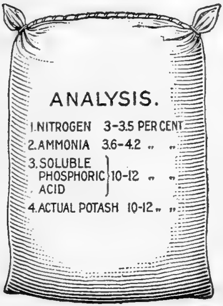
Another vegetable product useful for commercial fertilizer is cottonseed hulls. Both raw hulls and the ashes obtained from burning the hulls are used. The ashes are the quicker acting, and, bulk for bulk, they are richer in potash and phosphoric acid.

State Fertilizer Laws.—In states where fertilizers are used, there are state laws that require the manufacturer to attach to his goods a prescribed label. The form of this label is fixed by the state; as a rule, it must bear the name and address of the manufacturer, the weight of the package to which it is attached, and the chemical analysis of the fertilizer. In addition, the state fertilizer laws provide for the inspection and analysis of all brands offered for sale within the state. Were it not for these laws, the farmer when purchasing mixed or unmixed commercial fertilizer would be almost entirely at the mercy of the manufacturer. The reason for this is that no one can tell from the appearance, odor, weight, or handling qualities of a fertilizer whether it contains plant-food in such form and quantity that the fertilizer can profitably be applied to the soil. Chemical analysis is the only way in which the quantity of plant-food in a fertilizer can be determined.

As a rule, mixed fertilizers are put up in bags, on the outside of which is printed the analysis. In some states the manufacturer is required to purchase from the state printed tags that bear the analysis of the brand to which they are to be attached and the signature of the state chemist or person in charge of fertilizer control. No matter what form of label is used, the analysis must be legible and the fertilizer must conform to the analysis. In most states the state guarantees to the public that each package of fertilizer bearing the approved label contains as much of the fertilizing ingredients as the manufacturers state; if the fertilizer falls short of the guarantee, the manufacturer is liable to arrest and fine. From these statements it will be seen that every farmer who purchases fertilizer should become informed regarding the fertilizer control law in his particular state.

Misleading Methods of Stating Analyses.—Notwithstanding this effort on the part of the state to protect the public, it is not difficult for fertilizer manufacturers to practice misleading methods of stating the analyses of their products. Some of these dubious practices can scarcely be said to be dishonest, yet they certainly give a wrong impression concerning goods.

For example, in the guaranteed analysis printed on a fertilizer bag or tag, the manufacturer often uses two numbers which represent, respectively, the minimum and the maximum percentage of each plant-food ingredient. This method of stating an analysis is shown in the accompanying illustration. Although it is not dishonest, it is, in a way, misleading, for unless a person is familiar with the interpreting of an anlysis, he is likely, on account of seeing many figures, to be misled into thinking that he is getting considerable more plant-food than is actually present in the fertilizer.



As required by law, the manufacturer guarantees the smallest quantity of each ingredient shown in the analysis. The second number showing the maximum quantity of each ingredient that might be present, then, really has no meaning to the farmer. Thus, in the analysis shown in the illustration, nitrogen 3 to 3.5% means that there is at least 3% of nitrogen in the bag and that there *may* be 3.5% present. In the second line of the analysis, the nitrogen is given in terms of ammonia, 3% of nitrogen being equal to 3.6% of ammonia. As shown in the third line, the soluble phosphoric acid is guaranteed to be 10% with a *possibility* that 12% may be found. The actual potash, as indicated in the line, is given as 10 to 12%, showing that 10% is there, but that as high as 12% *may* be present.

As actual nitrogen, soluble phosphoric acid, and actual potash are the forms that a farmer should consider when buying a fertilizer, he should always bear in mind that the smallest quantities of these forms expressed on the bags show the true commercial value of the fertilizer. Therefore, in the analysis just given, the purchase should be made on the basis of 3% of nitrogen, 10% of phosphoric acid, and 10% of potash. If slightly more than these quantities are present, the farmer will be a gainer, but he should not figure on more than the stated quantities being present. Neither should he be deceived by lengthy analyses that have as their purpose nothing but deception.

Facts About Fertilizers.—On the market, both mixed and unmixed fertilizers are sold by the ton, with the quantity of plant-food ingredients expressed in percentages. Thus, if a ton—2,000 lb.—of fertilizer is said to contain 3% of nitrogen, 10% of phosphoric acid, and 10% of potash, the quantities, in pounds, of these ingredients are:

Nitrogen	$2{,}000 \times .03 = 60$
Phosphoric acid	$2{,}000 \times .10 = 200$
Potash	$2{,}000 \times .10 = 200$

In stating the percentages of ingredients in a fertilizer, that of nitrogen is generally given first, that of phosphoric acid second, and that of potash last. In fact, it is so much a universal custom to use this order that the names of the ingredients are often omitted. Thus, the fertilizer just considered is often spoken of as a *3-10-10 fertilizer*. A *1-12-8 fertilizer* would be one that contained 1% of nitrogen, 12% of phosphoric acid, and 8% of potash.

How to Find Fertilizer Equivalents.—It is often necessary for a farmer to find fertilizer equivalents. This is because manufacturers do not confine their statements of analyses to the percentages of nitrogen, phosphoric acid, and potash actually contained in a fertilizer. The following table will be found helpful in making the calculations necessary to express the quantity of one ingredient in terms of some other ingredient.

By using this table a complex analysis of a fertilizer is made clear. For example, consider the following analysis: Ammonia, 2%; available phosphoric acid, 8%; insoluble phosphoric acid, 2%; total phosphoric acid, 10%; bone phosphate, 21.8%; actual potash, 4%; sulphate of potash, 7.4%.

DATA FOR COMPUTING FERTILIZER EQUIVALENTS

To Convert Guarantee of	Into Terms of	Multiply by
Nitrogen	Ammonia	1.215
Ammonia	Nitrogen	.823
Sodium nitrate	Nitrogen	.165
Nitrogen	Sodium nitrate	6.061
Bone phosphate	Phosphoric acid	.458
Phosphoric acid	Bone phosphate	2.183
Potash	Sulphate of potash	1.850
Sulphate of potash	Potash	.541
Potash	Muriate of potash	1.583
Muriate of potash	Potash	.632

Referring to the table, the percentage of ammonia can be easily converted into terms of nitrogen by multiplying the quantity of ammonia by .823. Thus, 2% of ammonia is equal to $2 \times .823 = 1.65\%$ of nitrogen. The available phosphoric acid given as 8% in the analysis is really the only quantity representing phosphoric acid that should be considered by the farmer. The 2% insoluble added to the 8% soluble equals 10% total phosphoric acid, as given. The quantity of bone phosphate, 21.8%, is found by multiplying the 10% of total phosphate acid by 2.183. There is really no reason why the quantity of phosphoric acid in the analysis need be given in terms of bone phosphate. The actual potash given as 4% is, as in the case of the available phosphoric acid, the only quantity representing potash that it is necessary to give in the analysis. This amount, however, when expressed in terms of sulphate of potash, found by multiplying 4 by 1.85, as shown in the table, equals 7.4%. It will readily be seen that the analysis under consideration could be written as follows: Nitrogen, 1.65%; available phosphoric acid, 8%; actual potash, 4%.

LIMING OF SOILS

Lime is a soil constituent that is necessary for normal plant growth. This is proved by the fact that plants will not grow properly in soils deficient in lime. An additional proof is that when plants are analyzed, lime is found. But, as a rule, enough lime is present in the soil for the use of crops; if it were not for the fact that lime is needed in soil for other purposes than as a plant-food, it would seldom be necessary to apply it. For this reason, lime is usually considered an indirect fertilizer; that is, it indirectly renders soil more fertile.

The beneficial effects that result from the liming of soil are, of course, dependent on the condition of the soil. Aside from the value of lime as a plant-food, there are three ways in which it may benefit soil, namely: (1) by correcting soil acidity; (2) by making otherwise unavailable plant-food available; (3) by improving the mechanical condition.

Effects of Lime.—Soils that are sour, or acid, produce very poor crops. The acid in soil comes largely from plant roots, where it is needed to dissolve a part of the plant-food. Soils on which crops have been raised for a number of years without the application of lime are very likely to become sour from the surplus of this plant acid that remains in them. The use of commercial fertilizers that are acid also tends to make soil acid. The same is true of soils in which free water is allowed to stand for a long time; insufficient drainage is a very common cause of soil acidity. On account of these conditions, many of the farm soils of the United States and other countries are acid; and if these soils are to produce good crops, the acidity must be corrected. This can best be done by the application of lime.

In some soils nitrogen, phosphoric acid, and potash are often present in such a form that they are unavailable to plants. This is often the case in soils of a vegetable origin, such as reclaimed swamp soils and heavy black loams containing long, deep roots. When such a condition exists, lime is an effective agent in rendering the plant-food available. In fact, the good effects obtained by applying lime to soil are often due to the action of the lime in releasing plant-food.

Some soils, particularly those of a heavy clay nature, are vastly improved mechanically by lime. In heavy soils the particles composing them are very fine and have a tendency to pack together, thus causing the soil to retain a large quantity of free water and to become very unfriable. Lime causes the fine soil particles to flocculate, that is, join together in small lumps. This makes the soil more friable, lighter, and easier to work with the implements of tillage. In other words, the structure is greatly improved.

Methods of Determining Whether Soil Needs Lime. Although it is very profitable to apply lime where it is needed, it is a waste of labor and money to apply it where it is not needed. For this reason, soil should be tested to determine whether it is in need of lime before an application is made. There are three common tests for determining this point; the beet test, the litmus-paper test, and the ammonia test. These tests can easily be made by any one.

The beet test consists merely of growing a crop of beets in the soil to be tested. Owing to the fact that all kinds of beets grow very poorly in soils deficient in lime, a beet crop is a good indicator of the condition of a soil with respect to this constituent. To make the test the ground may be prepared and the beets planted as follows:

Lay off in the field a piece of ground 36 ft. by 90 ft. Next, plow this ground as deeply as the soil will allow without subsoil being brought to the surface; the usual depth of plowing in the locality will be the best for the test. Roll the ground immediately after it is plowed, and then put on, at the rate of 500 to 600 lb. per acre, a good complete fertilizer—one containing available nitrogen, phosphoric acid and potash—that is rich in nitrogen. Harrow the ground well after applying the fertilizer. Then divide the piece into three plats of equal size and spread lime as evenly as possible on two of them, using 100 lb. on one plat and 50 lb. on the other, which is at the approximate rate of 1 T. and 2 T. per acre.

On the third plat use no lime at all, as this is to be a check plat. The lime used in the test should be very fine and free from lumps, and should be brushed into the soil with a weeder or a light harrow. When applied in this way it does not come in direct contact with the ammonia of the fertilizer. Next, beet seed of a quantity sufficient, if they all grow, to produce a good stand should be drilled into the soil. The beets should be permitted to come to maturity, when the yields of the different plats will show whether or not lime is needed on the soil.

The litmus-paper test is used to determine whether a soil is acid. If a soil is found to be acid it follows that it is in need of lime. Litmus paper is a paper covered with a preparation called litmus. It has the property of turning red when it comes in contact with an acid and blue when it comes in contact with an alkali. In making soil tests, the blue litmus paper used by chemists should be used, as it is better than the common grade generally sold by druggists. To test a soil, puddle a small quantity with water in a cup and then place a small strip of blue litmus paper in the wet soil. If the paper turns red soon after being placed in contact with the soil, it is a good indication that the soil is acid and, consequently, that it needs lime. Before making the test, however, it is a good plan to determine whether the water used for puddling is free from acid.

The ammonia test is used, like the litmus-paper test, to determine whether soil is acid. To make the ammonia test, half fill a 2-oz. bottle with the soil to be tested and pour boiled rainwater into the bottle until the water is about ½ in. above the soil. Next add a teaspoonful of strong ammonia. If the water in the bottle is turned slightly yellow, it indicates that the soil is slightly acid; if the water is made almost brown in color, it indicates that the soil is decidedly acid. Owing to the fact that the ammonia test is somewhat less convenient of application than the litmus-paper test, it is not so commonly used as the latter.

Application of Lime to Soils.—Two forms of lime are now used for soil improvement. These are limestone in powdered form and stone lime, or quicklime, made by burning limestone. Both forms can be purchased on the market, or, if limestone exists in a community, the farmer can burn it himself and thus obtain stone lime. Powdered limestone is in condition to be applied to the soil when it is purchased. Stone lime, or quicklime, as it comes from the kilns must be either ground or slaked before it is of use in a soil. By slaking is meant the absorbing of water. This produces a chemical change, making the lime caustic. In this condition the lime is a powder and can easily be applied to the soil. Lime may be slaked either by applying water to it directly or by exposing it to the air, from which it absorbs the moisture necessary for slaking it.

There are several ways in which lime can be spread on the soil. It may be applied with a manure spreader, a lime spreader, or a fertilizer distributor, be spread from a wagon or be placed in piles on the ground and distributed by means of shovels. If a manure spreader is used and the wind is blowing, it is practically necessary to use a wooden or a canvas hood over the spreader drum, to prevent the loss of considerable lime. Spreading lime from a wagon by means of shovels is an unsatisfactory method, as the lime, being caustic, will burn the hands and faces of the workmen, and, besides, is likely to injure the harness. If lime is to be distributed from piles on the ground, the size and distance apart of these will, of course, depend on the quantity of lime that is to be used per acre. If it is desired to use 1 T. per acre, 50-lb. heaps should be placed 33 ft. apart. Two tons per acre can be distributed by placing 100-lb. heaps 33 ft. apart.

It is often desired to apply a certain number of bushels per acre. The weight of a bushel of stone lime in most states is 80 lb.; after this quantity is slaked, it will weigh from 150 to 160 lb., according to the quantity of water absorbed. In order to put on a given number of bushels per acre, the following figures showing the quantities and distances apart for the piles will be found useful: For an application of 20 bu. per acre, put ½ bu. heaps 11 steps apart each way, one step to be considered 3 ft.; for 25 bu. per acre, put the heaps 10 steps apart; for 30 bu., 9 steps; for 40 bu., 8 steps; for 50 bu., 7 steps; and for 60 bu., 6 steps.

The quantity of lime to use per acre varies. Heavy soils usually require more lime than light soils, very acid soils require more than only slightly acid soils, and some crops use more lime than others. Then, too, twice as much ground limestone should be used per acre as slaked lime. Lime containing impurities, or air-slaked lime that is not fresh, will not go as far as good water-slaked lime. As a rule, from 1 to 2 T. of water-slaked lime per acre are used and from 2 to 4 T. per acre of ground limestone. An application of 1 T. of slaked lime or 2 T. of limestone should give good results in soils not exceedingly heavy or acid. Supplying the soil with too much lime at one time is injurious, small and frequent applications being better than large ones.

When to Apply Lime to Soil.—As a top dressing for sod land, lime may be applied either in the spring or in the fall. The latter season is preferable, because the lime will have more time to work down into the soil than if applied in the spring. When sod land that is to be placed to corn is limed in the spring, it is a good plan to plow and roll the land before putting on the lime. After the lime has been applied it should be harrowed well into the soil. Although lime is not as beneficial to corn as it is to some other crops, it is helpful to the crop that follows corn.

Lime should never be applied just before planting sugar beets or potatoes, as it will decrease the quantity of sugar in the beets and the percentage of starch in the potatoes. Neither should lime be applied at the same time that manure or commercial fertilizer is put on the soil, as it acts chemically with these substances and sets the nitrogen free. This danger may be avoided by applying the lime a few months before using the manure or fertilizer.

TILLAGE

BENEFITS OF TILLAGE

Pulverization of the Soil.—One of the prime objects of tillage is to break the soil into fine particles. Soil, from lying dormant for months or perhaps years, becomes packed and hard; it is first turned up by the plow and is then still further broken up by other instruments of tillage until it is divided into very minute particles, in which condition it is suitable for a seed-bed. Much of the plant-food present in a soil is liberated by this pulverization and made available for plants, and the fine soil grains are thoroughly mixed with manure, plant roots, and humus. Many of the living plant roots are shredded, torn, and broken by tillage so that they will not sprout again, but these broken roots are left in a condition to enrich the soil.

Effects of Sunshine on Plowed Soil.—As soon as the plow or any of the lighter implements of tillage disturb the top layer of soil, the effects of sunshine on it can be noticed. The heat from the sun's rays soon dries out the upturned furrow slices and makes it possible for the air to enter. By this action, the soil begins to weather and change structure. In addition to the facts just mentioned, the soil is also sweetened, that is, made less acid, by the action of the sunshine. Then, too, many insects, and other vermin are destroyed by the excessive heat. There is a danger, however, of exposing the furrow to too much sunsine. For instance, if the furrow slices are left upturned for too long a time before the rolling and harrowing processes take place, the soil will be injured by drying out too much.

Soil Aeration.—The drying of soil by sunshine makes more space for air to enter among the soil particles. This better aeration, as it is called, is very important for crop production. Without sufficient air in the soil, seeds cannot sprout or plants grow. Besides these uses, were it not for the air in the soil, there would be no decay of vegetable and animal matter. The presence of air also makes possible chemical changes, without which much of the plant-food of the soil would be kept in an unavailable condition. The air, too, is absolutely necessary for the use of soil bacteria. The sunshine can do the best work when the soil is prepared to receive the sun's heat.

Increase of Water-Holding Capacity.—As tillage breaks up the soil into fine particles, it increases the amount of the soil surface exposed to the air. This being the case, the quantity of film water that a soil can hold is increased. The great importance of an increase in the film water held in a soil is obvious when it is remembered that it is from film water that plant roots absorb the moisture for plant growth.

There is always more or less loss of film water by evaporation from the surface. The damage done to crops by such loss of moisture, especially during dry spells, is often considerable. There is a remedy, however, by which the farmer can at least prevent excessive loss of moisture by evaporation. It has been found that if 2 or 3 in. of fine, loose soil is kept on the top of a cultivated field, that the quantity of moisture lost by evaporation is reduced to a minimum. Such a layer of loose soil, or dust mulch, as it is frequently called, can be secured by frequently stirring the surface soil with the implements of tillage.

Lessening of Denitrification.—A certain kind of bacteria called denitrifying bacteria exists in soil and causes available nitrogen compounds to become unavailable. The denitrifying bacteria work actively only where air is absent. In well-tilled soil, therefore, which contains plenty of air, denitrification practically ceases.

These injurious bacteria live in manures and straws as well as in the soil, and if any of this vegetable material containing active denitrifying bacteria is plowed under a soil, and thorough tillage to supply air is not practiced, the bacteria will continue to do their destructive work of changing the available nitrates into unavailable forms of nitrogen.

Mellowing of Soil.—A well-tilled soil is more mellow and friable than one not well tilled, the mellowness being due to the combined effects of tillage. Other things being equal, a mellow soil is a good crop-producing soil.

All kinds of soil are more or less dependent on tillage operations to turn their characteristics into use. Rich soil, for example, will not respond with profitable crops without good tillage. Deep soil, too, is made better for crops by careful tillage. A hard soil—that is, one containing little or no plant-food—can be benefited by tillage, but only after plant-food in the shape of manure has been thoroughly mixed with the mineral matter of the soil. A soil that is thin, due to the lack of plant-food and humus, can be made deeper and more mellow, provided plant-food and humus are well worked into it by deep tillage operations. A soil that is thin by reason of the nearness of the water-table can be made deeper and more mellow by first removing the surplus water by drainage and then practicing deep tillage. Heavy soils that do not pulverize easily are benefited by plowing them in the fall, and allowing the upturned furrows to remain exposed to the weather during the winter.

There are soils, however, that are not benefited by tillage, and these are wet soils. The use of tillage implements on soils of this class will greatly injure their texture and make their surfaces lumpy and hard.

Destruction of Weeds.—One of the important benefits of tillage is the destruction of weeds. Weeds are expensive boarders; they are greedy eaters, excessive drinkers, and poor payers. They live on precisely the same kind of food that crops do, and, what is more, they take their food in the very same manner. Every weed acts as a pump; its roots bring water to the stalk from whence it is carried to the leaves, and is finally lost to the plant by escaping into the atmosphere. Such a drain of water and also of plant-food is very hard on the crops that are growing on the soil. Tillage comes to the aid of the farmer in the matter of weed destruction, and if the operations are carried on at the right time there need be but little loss of crop caused by weeds growing in the soil.

TILLAGE OPERATIONS

Plowing.—Plowing is the first important work necessary to prepare a suitable seed-bed for crops. It is the basis for all other mechanical operations connected with tillage. There is no other work done on a field that can be substituted for good plowing. Not one of the other operations of tillage, nor even all the rest combined, can make amends for poor plowing, so essential is the turning of the furrow slice to successful crop production. So important is plowing, that experienced farmers consider that, even in the most favorable season, the best soil and seed amount to but little unless the plowing is well done.

Although the plowing of a field is done to prepare the seed-bed for the immediate crop, it influences future plowings and crops to a greater extent than is generally supposed. Often one bad plowing so injures a soil that a good seed-bed cannot be prepared until the soil has had several good plowings. Hence, the plowing of a field should always be done in the best manner possible.

The depth to plow can, to a large extent, be regulated by the natural depth of the surface soil. A good rule to follow in this respect is to plow a little shallower than the soil depth. For instance, if the surface soil is 6 in. in depth, the rule is to plow 5 in. deep; and, if the soil is 5 in. in depth, to plow 4 or 4½ in. deep. But, if the soil is 10 in. deep, plow 7 or 8 in.; if 12 in. deep, plow 9 or 10 in.

The width of plowing is largely regulated by the depth. It is impossible to plow a wide furrow and at the same time make it of shallow depth. An old rule in plowing is to make the furrow from 2 to 3 in. wider than it is deep. According to this rule, then, if the furrows are 4 in. deep, they should be 6 or 7 in. wide; or if 5 in. deep, they should be 7 or 8 in. wide. More modern practice, however, is to make the furrows as wide as is possible for the power in use to make them and still have the furrow slice well turned. Plowing is the most expensive part of tillage work, and it should be done as cheaply as possible; the wider the furrow, the less the cost of plowing a given area.

Rolling.—The rolling of ground is often one of the most important of the tillage operations. In cases where it is desired to pack down a seed-bed, to crush clods, and to secure a fine dust mulch on ground, the roller is invaluable. However, no more injurious effect can proceed from the use of any implement of tillage than that from a farm roller used when the soil is too wet.

Soil in this condition is compressed into cakes that adhere to the roller and are removed with difficulty.

Dragging.—The drag is used for leveling the uneven edges of the furrows after plowing, and also for compacting the ground. The drag is especially useful if the plowed ground has been left very rough. The action of the drag is to grind off and smooth the surface, not to roll it as is done with a roller. For smoothing dry, cloddy fields, the plank drag is much more effective than the roller, as the drag breaks the clods instead of pressing them deeper into the ground as is done when a roller is used. The plank drag is also employed to pulverize fields after they have been harrowed. In this connection it is especially useful if the harrows have failed to pulverize thoroughly the soil on the surface of the field.

Harrowing.—After a field has been plowed and either rolled or dragged, it must be pulverized to make it light, fluffy, and smooth at the surface. This work is done by harrowing, which is for the purpose of putting the field in a smooth and well-finished condition for seeding. If a field is wet it is in no condition to be harrowed. The disturbing of the soil particles at such a time causes the soil to puddle rather than to crumble. A soil can, however, be too dry for harrowing; this is especially true if there are many clods on the field. Under such adverse conditions it is a saving of labor and a reduction of expense to wait for rain. Ground when frozen is also unfit for harrowing, as it will be chopped into lumps instead of being crumbled.

The depth of harrowing is determined by the depth of plowing, the condition of the soil, the crop, and the season. The best average depth for harrowing is 3 in.; soil should never be harrowed to the depth it was plowed. If a soil is plowed to a depth of 5 in., for instance, it would not be wise to harrow it to a depth greater than 3½ or 4 in., since the harrow teeth would come too close to the turned-under sod.

GENERAL FARM CROPS

WHEAT

Wheat, according to the time of the year it is planted, is known as winter wheat or as spring wheat. The seed of winter wheat is planted in the fall; the seed of spring wheat is planted in the spring.

Following is a brief description of the chief varieties of wheat:

Fultz wheat is a beardless soft winter wheat. It is extensively grown in the eastern part of the United States and Canada, and is noted for producing large yields. It is probably the most widely grown variety of wheat in the United States.

Blue Stem wheat is a beardless hard spring wheat. It is extensively grown in Minnesota, where it has been found to give large yields of good quality.

Mammoth Red wheat is a bearded soft winter wheat. It is grown in the eastern part of the United States and Canada.

Purple Straw wheat is a beardless soft winter wheat. It is grown in the eastern and the southern part of the United States, particularly in the states south and west of North Carolina.

Fife wheat is a beardless hard spring wheat. It is extensively grown in Minnesota, and, like Blue Stem wheat, has been found to produce large yields of good quality.

Galgalos wheat is a beardless semihard wheat, grown as a spring wheat in the South, particularly in Oklahoma and New Mexico.

Kharkov wheat is a bearded hard winter wheat. It is extensively grown in Kansas, Nebraska, and Oklahoma.

Club wheat has a short, compact head, and is the wheat most widely grown in California, Oregon, Washington, and Idaho. The grain is white and exceedingly soft.

Spelt, of which there are both spring and winter varieties, is a very ancient form of wheat that has been cultivated for centuries in Europe and Africa. In thrashing most other kinds of wheat all the chaff is removed, but in thrashing spelt a part of it remains on the grain.

Emmer is similar to spelt in that the chaff adheres to the grain after thrashing.

Einkorn is supposed to resemble the original wild form of wheat from which all cultivated forms originated. The head in einkorn is much flattened and is heavily bearded, and the grains are somewhat angular in form.

Seven-headed wheat is a species that is distinguished from the others by the branched head. It is known also by the names Egyptian, Mummy, Hundredfold, and Alaska. Agriculturally it is unimportant.

Durum wheat is a species that has been grown in the United States since 1901. It is well adapted for regions where the summers are hot and the atmosphere is dry, and is practically free from rust. Experience has shown that it is particularly adapted to the Dakotas, although it is now grown rather extensively in many of the other Western states.

In the table on page 54 is given the date of the first sowing and harvesting, the date of the most general sowing and harvesting, and the date of the latest sowing and harvesting of wheat in several states of the United States.

Loose smut on wheat is combated by placing the seed wheat in sacks, soaking it for 4 hr. in cold water, and allowing it to stand for 4 hr. or more in the wet sacks; it is then immersed for 5 min. in water having a temperature of 133° F., after which it is ready to be dried and sown.

Stinking smut is combated by: (1) Placing the seed wheat in sacks and immersing it in water at 133° F. for

FIRST, GENERAL, AND LAST PLANTING AND HARVESTING OF WHEAT

State	Planting			Harvesting		
	First	General	Last	First	General	Last
Ala.	Oct. 4	Oct. 27	Nov. 22	June 4	June 13	June 23
Ark.	Sept. 22	Oct. 11	Nov. 6	June 6	June 14	June 24
Del.	Oct. 3	Oct. 10	Oct. 26	June 22	June 24	June 30
Ga.	Oct. 14	Nov. 5	Nov. 28	June 1	June 9	June 21
Ill.	Sept. 12	Sept. 24	Oct. 8	June 24	June 30	July 7
Ind.	Sept. 8	Sept. 21	Oct. 7	June 26	July 3	July 10
Iowa	Sept. 4	Sept. 15	Sept. 27	July 3	July 11	July 15
Kans	Sept. 11	Sept. 26	Oct. 24	June 26	July 4	July 14
Ky.	Sept. 19	Oct. 5	Oct. 25	June 17	June 24	July 3
Md.	Sept. 18	Oct. 1	Oct. 20	June 23	June 28	July 7
Mich.	Sept. 3	Sept. 14	Sept. 26	July 15	July 23	July 31
Minn.	Sept. 3	Sept. 13	Sept. 21	July 15	July 23	July 29
Mo.	Sept. 9	Sept. 23	Oct. 10	June 20	June 27	July 6
Nebr.	Sept. 5	Sept. 17	Oct. 6	July 6	July 13	July 21
N. C.	Oct. 14	Oct. 26	Nov. 15	June 11	June 19	June 26
N. J.	Sept. 12	Sept. 24	Oct. 8	July 3	July 7	July 16
N. Y.	Sept. 4	Sept. 18	Oct. 2	July 10	July 19	July 28
Ohio	Sept. 11	Sept. 24	Oct. 10	June 29	July 6	July 13
Okla.	Sept. 13	Sept. 30	Oct. 29	June 12	June 23	July 7
Pa.	Sept. 2	Sept. 15	Oct. 4	July 4	July 10	July 18
S. C.	Oct. 13	Nov. 5	Dec. 8	June 3	June 13	June 24
S. Dak.	Aug. 31	Sept. 16	Oct. 10	July 14	July 22	July 31
Tenn.	Sept. 22	Oct. 10	Nov. 14	June 10	June 20	June 30
Tex.	Sept. 30	Oct. 20	Nov. 18	May 29	June 9	June 22
Va.	Sept. 20	Oct. 3	Oct. 21	June 20	June 26	July 3
Vt.	Aug. 7	Aug. 27	Sept. 8	July 22	Aug. 2	Aug. 18
W. Va.	Sept. 15	Sept. 28	Oct. 15	June 25	July 2	July 10
Wis.	Sept. 5	Sept. 14	Sept. 25	July 16	July 22	July 28

10 min. and then cooling it by placing in cold water or by stirring the seed while drying. (2) Placing the seed in a solution of copper sulphate, made by dissolving 1 lb. of the sulphate in 10 gal. of water; the seed is immersed in the solution for 10 min. and then drained for 10 min., after which it is spread out and dried. (3) Immersing the seed for 30 min. in a solution made by mixing 1 lb. of formalin with 50 gal. of water.

One of the best methods of combating the *chinch bug*, which attacks wheat crops, is to plant some crop, such as millet, as a barrier between the wheat and the corn fields, and when the bugs are in this crop to spray it with kerosene and then plow the plants under. Another type of barrier is made by throwing two furrow slices together and forming a ridge, along the top of which there will be a slight depression; this depression is filled with coal tar, which the bugs are unable to pass. Holes are dug at intervals along the furrow next to the wheat field and the bugs, in passing to and fro in trying to find a way around the barrier, drop into these holes. Kerosene is poured into the holes occasionally, and as a result many of the bugs are killed.

A practice often adopted by farmers to prevent ravages of the *Hessian fly* in the wheat crop is to delay the sowing of the wheat until after the flies are killed by early frosts. Another is to avoid the continuous cropping of wheat on the same land. Perhaps one of the best methods is to plant a strip of wheat along the edge of the regular wheat field somewhat earlier than the usual time of planting. The flies will then congregate in this strip, and as a result the regular field will not be ravaged. The burning of the wheat stubble is also an effective preventive.

OATS

The average yield of the oat crop in the United States for several decades past has been a little over 27.5 bu. per acre. The Northern states produce larger crops per acre than do the Southern states. A few states report yields as high as 50 or more bu. per acre. Yields of

FIG. 1

FIG. 2

60 to 70 bu. are considered to be high, although yields of 100 bu. per acre have been reported.

The average yield in the United States would be produced by three plants on each square foot of an acre, provided each plant produced three or four stalks and each stalk produced 40 grains of fair size. An oat crop is said to be well filled when each stalk bears from 30 to 150 grains.

There are two distinct types of oats: (1) The *spreading oats*, as shown in Fig. 1, in which the branches bearing the grains spread in all directions from the main stalk, or straw; and (2) the *side*, or *mane*, oats, as shown in Fig. 2, on which all the branches bearing the grains hang on one side of the main stem. These two distinct types of oats may be subdivided as to time of planting into spring and winter oats; as to color, into white, black, gray, and red oats, and many variations of these colors; and as to shape of the grain, into short and plump oats, and long and slender oats.

There are also a few varieties of oats, the hulls of which are so loose that they are separated from the kernels in thrashing. Such varieties are called naked oats. They are, however, poor yielders and are therefore not extensively grown.

The winter varieties of oats are those which are sown in the fall. They have been grown almost wholly in the South, but seem to be gaining favor in Northern sections.

The spring varieties are those which are usually planted in the spring. They are grown almost entirely in the North. For Southern growers, the Red Rust Proof and Virginia Gray varieties are recommended. For planting in Northern United States, the varieties known as American Banner, Improved American, Badger Queen, Wide Awake, Colonel, Lincoln, Swedish Select, and Siberian have met with much success. In Canada, the Siberian variety is considered to be the best yielder.

Oats thrive best in a cool, moist climate and in a soil that is not especially fertile, but in all instances the soil should be moist.

Oats are inclined to grow too rank to produce a large quantity of straw and a comparatively small quantity of grain, and have a tendency to break over, or lodge, if they are grown on soils in a high state of fertility.

The most severe damage to the oat crop is caused by *oat smut*. This disease causes a loss of from 5 to 50% in fields sown with untreated seed. The best way to combat the disease is to treat all seed oats with a fungicide and thus kill the spores of the smut. The treatments that are recommended for the stinking smut on wheat are recommended for oat smut. The formalin treatment, which is most commonly used, is as follows: A solution made up of 1 lb. of formalin to 50 gal. of water is sprinkled over the oats at the rate of 1 gal. of solution to 4 bu. of grain. The grain is then mixed thoroughly by shoveling the oats into a conical pile, and is covered with blankets. After being covered for 2 hr. the oats must either be sown or be spread out and dried.

BARLEY

The barley plant is similar to wheat in its general appearance and its habits of growth; barley grain resembles the oat grain, in that it consists of a kernel and a hull, except in the case of a few varieties known as hull-less barleys.

Two distinct varieties of barley exist, namely, the *two-rowed* and *six-rowed varieties*. There are, however, other so-called varieties, known as four-rowed, hull-less, and beardless.

Barley may be grown under more varied climatic conditions than any other grain crop; also, it requires less water for its production than any other grain crop, though an abundance of water does not materially retard its growth. It may be raised in nearly all parts of the United States and in some sections of Canada, and its cultivation is carried on successfully even in Alaska. But the soil, to grow barley successfully, should be well drained and fertile.

The only insect that proves injurious to barley is the chinch bug. Smut attacks barley and as a preventative the seed barley should be treated as follows: Place the seed in sacks and soak it in cold water for 4 hr.; then let it stand in the sacks for 4 hr. After this immerse the sacks with the grain in hot water at a temperature of 130° F. for 5 min. The grain should then be dried in the manner described for wheat.

RYE

Rye grows much taller than either wheat or barley, frequently attaining a height of 6 or 7 ft. The heads that bear the grain are longer and more slender than those of wheat, and are covered with beards, as are most of the barleys. Although rye kernels closely resemble those of wheat, they are longer, more slender, and more pointed at the end nearest the stem of the head.

The annual yield of rye in the United States is about 14 bu. per acre. Yields of 20 to 25 bu. are considered to be fair, and those of 30 to 35 bu. are said to be good.

Rye is naturally adapted to a cool climate and will thrive in climates that are too cold for wheat. However, it is successfully grown in the warmer sections of the United States. It may be successfully grown in soils that are too poor in fertility to produce average yields of other grain crops.

BUCKWHEAT

Buckwheat is classed with grain crops, although it is a member of a family of plants that includes sorrel, smartweed, and bindweed.

Buckwheat leaves the soil in which it is grown in a peculiarly mellow, crumbly condition, and for this reason, together with the fact that it will grow in almost any kind of soil, it is considered to be a soil improver.

CORN

Four general classes of corn are grown on a commercial scale. These are pop corn, flint corn, dent corn, and sweet corn.

There are two general varieties of *pop corn*—Rice and Pearl. The grains of Rice pop corn are pointed at the top, and the ears are somewhat cone-shaped. The grains of Pearl pop corn are rounded at the top and the ears are cylindrical.

The kernels of *flint corn* are hard and smooth. In shape they are nearly round. The width of grains varies in different varieties from 3/8 to 1/2 in. The average depth in all varieties is about 3/8 in., and the thickness is about 1/6 in. In color, flint kernels are usually yellow, white, or red, although brown and purple varieties are known.

The ears of flint corn vary in length from 4 to 18 in., the average length being from 7 to 10 in., and in diameter they vary from 1 1/4 to 2 in. In most varieties of flint corn there are but eight rows of kernels on a cob, although ten, twelve, and even sixteen rows are found on some varieties.

Among the leading varieties of flint corn may be mentioned Rhode Island White Flint, King Philip, 90-Day Yellow Flint, Pennsylvania Yellow Flint, Longfellow Flint, and Hall's Golden Nugget.

The most widely distributed class of corn is *dent corn*, which gets its name from the fact that the kernels, when matured, are indented at the top. In color, dent kernels are generally yellow or white, although red and mixed yellow and red kernels are sometimes found.

The ears of dent corn vary in different varieties from 5 to 12 in. in length and from 1 1/2 to 2 1/2 in. in diameter. A medium sized ear weighs 1/2 lb. and a rather large-sized ear weighs 3/4 lb. The average number of rows of kernels on dent ears is from sixteen to twenty, although as few as eight and as many as forty-eight are sometimes found. The size and shape of grains vary with the variety and with the position on the ear.

Among the important varieties of dent corn are: Boon County White, Clarage, Funk's Yellow Dent, Hickory King, Hildreth, Hogue's Yellow Dent, Johnson County White, Kansas Sunflower, Leaming, Minnesota No. 13, Pride of the North, Reid's Yellow Dent, Silver King, and Silver Mine.

The corn most widely cultivated for household use is *sweet corn*. Part of the starch of sweet corn turns to sugar during the growth of the plant. The corn is, therefore, sweeter to the taste than other kinds of corn. The grains of sweet corn, when matured, are wrinkled at the surface, rather broad, and rounded at the top. In most varieties a typical grain is about ½ in. long, ⅛ in. thick, and about ⅜ in. wide.

Among the early varieties that are highly recommended are Early Golden Bantam, Marblehead, Crosby, Chicago Market, Early Landreth; among the medium varieties, Squantum, Maul's XX, Stabler's Early; and among the late varieties, Ne Plus Ultra, Stowell Evergreen, and Country Gentleman.

The number of quarts of seed corn used per acre will vary largely with the size of the kernels. When planted three kernels to the hill with the hills 3 ft. 6 in. apart, from 4 to 4½ qt. is the average quantity required to plant an acre; where four kernels are planted to the hill, the hills being 3 ft. 8 in. apart, about 5 to 5½ qt. are required to plant an acre.

Fig. 3 shows the United States divided into sections or corn zones, and in the table showing the varieties of corn grown for silage is given a list of some of the best-known varieties of corn for silage for each zone.

The table on pages 64 and 65 gives the date of the earliest planting and harvesting, also the date of the most general and latest planting and harvesting of corn in several states of the United States.

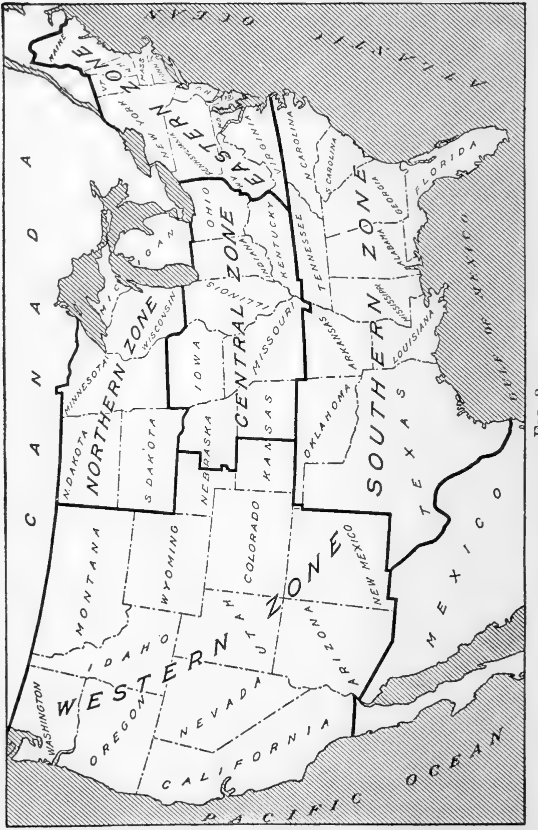

CANADA
ATLANTIC OCEAN
PACIFIC OCEAN
GULF OF MEXICO
MEXICO
NORTHERN ZONE
EASTERN ZONE
CENTRAL ZONE
SOUTHERN ZONE
WESTERN ZONE
MAINE
VT
MASS
CONN
NEW YORK
PENNSYLVANIA
VIRGINIA
N CAROLINA
S CAROLINA
GEORGIA
FLORIDA
OHIO
INDIANA
KENTUCKY
TENNESSEE
ALABAMA
MISSISSIPPI
LOUISIANA
MICHIGAN
WISCONSIN
MINNESOTA
ILLINOIS
IOWA
MISSOURI
ARKANSAS
N DAKOTA
S DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MONTANA
WYOMING
COLORADO
NEW MEXICO
IDAHO
UTAH
ARIZONA
WASHINGTON
OREGON
NEVADA
CALIFORNIA

FIG. 3

VARIETIES OF CORN GROWN FOR SILAGE IN DIFFERENT ZONES OF THE UNITED STATES

Variety	Color of Ear	Length of Ear Inches
Northern zone:		
Early Huron	Yellow	7 to 8
Longfellow Flint	Yellow	10 to 12
Pride of North	Yellow	7 to 8
Silver King	White	6 to 8
Central zone:		
Boone County White	White	9 to 11
Silver Mine	White	8 to 11
McAuley	White	10 to 11
Clarage	Yellow	7 to 9
Funk's Yellow Dent	Yellow	9 to 11
Golden Surprise	Yellow	9 to 10
Leaming	Yellow	9 to 10
Reid's Yellow Dent	Yellow	9 to 11
Riley's Favorite	Yellow	8 to 9
Hogue's Yellow Dent	Yellow	9 to 11
Hildreth	Yellow	10 to 11
Southern zone:		
Boone County White	White	10 to 12
Cocke Prolific	White	8 to 9
Hickory King	White	8 to 9
Red Cob Silage	White	10 to 12
Mosby Prolific	White	8 to 9
Virginia Silage	White	10 to 12
Eastern zone:		
Hickory King	White	7 to 9
Cocke Prolific	White	7 to 9
Clarage	Yellow	7 to 8
Leaming	Yellow	8 to 10
Longfellow Flint	Yellow	10 to 12
Sibley's Pride of the North	Yellow	7 to 8
Western zone:		
Minnesota King	Yellow	7 to 8
Dakota Dent	Yellow	7 to 8
Hickory King	White	8 to 9

DATE OF THE FIRST, GENERAL, AND LAST PLANTING AND HARVESTING OF CORN IN SEVERAL STATES OF THE UNITED STATES

State	Planting			Harvesting		
	First	General	Last	First	General	Last
Ala.	Mar. 12	Apr. 5	May 18	Sept. 16	Oct. 26	Dec. 1
Ark.	Mar. 18	Apr. 6	May 6	Sept. 23	Oct. 14	Nov. 4
Conn.	May 10	May 22	June 4	Sept. 10	Sept. 16	Sept. 28
Del.	Apr. 28	May 6	May 20	Aug. 28	Sept. 12	Sept. 28
Fla.	Feb. 21	Mar. 11	Apr. 2	Aug. 23	Sept. 23	Oct. 23
Ga.	Mar. 16	Apr. 4	May 7	Sept. 16	Oct. 20	Nov. 23
Ill.	Apr. 30	May 13	June 2	Sept. 26	Oct. 29	Dec. 10
Ind.	May 1	May 14	May 31	Sept. 21	Oct. 29	Dec. 8
Iowa	May 4	May 13	May 26	Oct. 19	Nov. 6	Dec. 6
Kans.	Apr. 14	Apr. 29	May 18	Oct. 11	Nov. 9	Dec. 16
Ky.	Apr. 15	May 5	May 26	Sept. 18	Oct. 21	Nov. 13
La.	Feb. 27	Mar. 22	Apr. 24	Sept. 1	Oct. 7	Nov. 4
Md.	Apr. 26	May 8	May 31	Sept. 4	Sept. 15	Sept. 25

Mass.	May 10	May 20	May 31	Sept. 16	Sept. 24	Oct. 10
Me.	May 17	May 26	June 6	Sept. 12	Sept. 20	Sept. 30
Mich.	May 15	May 22	June 2	Sept. 10	Sept. 20	Sept. 29
Minn.	May 13	May 19	May 30	Sept. 9	Sept. 17	Sept. 28
Miss.	Mar. 12	Apr. 1	May 10	Sept. 21	Oct. 16	Nov. 16
Mo.	Apr. 14	May 1	May 22	Sept. 23	Nov. 4	Dec. 16
Nebr.	May 3	May 13	May 29	Sept. 23	Oct. 24	Dec. 19
N. H.	May 14	May 24	June 4	Sept. 8	Sept. 14	Sept. 24
N. J.	May 6	May 14	May 31	Sept. 24	Oct. 9	Nov. 1
N. Y.	May 12	May 21	June 3	Sept. 7	Sept. 18	Sept. 29
N. C.	Mar. 30	Apr. 19	May 24	Sept. 25	Nov. 7	Nov. 25
N. Dak.	May 14	May 21	May 31	Sept. 8	Sept. 15	Sept. 23
Ohio	May 1	May 14	May 27	Sept. 12	Sept. 26	Oct. 9
Okla.	Mar. 24	Apr. 7	Apr. 30	Sept. 14	Oct. 24	Dec. 9
Pa.	May 4	May 15	May 29	Sept. 11	Sept. 22	Oct. 1
R. I.	May 10	May 19	June 11	Sept. 13	Sept. 20	Oct. 8
S. C.	Mar. 18	Apr. 5	May 15	Sept. 18	Oct. 21	Nov. 19
S. Dak.	May 9	May 20	June 1	Oct. 12	Nov. 2	Nov. 29
Tenn.	Mar. 31	Apr. 21	May 25	Sept. 26	Nov. 1	Dec. 1
Tex.	Feb. 27	Mar. 13	Apr. 4	Sept. 6	Oct. 6	Nov. 18
Va.	Apr. 20	May 2	May 21	Sept. 16	Nov. 1	Nov. 28
Vt.	May 17	May 25	June 4	Sept. 7	Sept. 16	Sept. 26
W. Va.	Apr. 26	May 10	May 27	Sept. 9	Sept. 19	Oct. 3
Wis.	May 11	May 18	May 28	Sept. 9	Sept. 18	Sept. 28

The average yield per acre of corn in the United States is about 25 bu.; a fair yield is 50 bu.; a good yield, 75 bu.; an excellent yield, 100 bu.; and more than 125 bu. have been raised per acre. If corn is planted in hills 3 ft. 8 in. apart each way there will be approximately 3,250 hills per acre, and if only one plant, or stalk, in each hill produced one medium-sized ear weighing ½ lb. the yield per acre would be about 23 bu. If two stalks in each hill produced a ½-lb. ear the yield would be 47 bu. However, if three stalks grew in each hill and each stalk produced a large-sized or a ¾-lb. ear the yield per acre would be more than 100 bu.

The corn plant is injured by numerous insect pests among which are rootworms, root lice, cutworms, white grubs, earworms, stalk borers, chinch bugs, wireworms, and bill bugs. Corn smut appears in masses of black powdery spores on any part of the plant that is above ground, although the parts most likely to be affected are the ears and tassels.

The best way thus far discovered for ridding corn plants of smut is to gather the masses of spores two or three times during the season and either burn them or place them in boiling water. The heat will kill the spores, and germination will be prevented.

HAY AND PASTURE CROPS

GRASSES

Timothy.—Timothy in some localities is called herd's grass, but this name is confusing from the fact that the same name is sometimes used to designate red top. A seed-head of timothy is shown in Fig. 4.

In value, timothy leads all other hay grasses grown in the United States. It is, however, nearly always sown with Red or Alsike clover, sometimes with both. When sown alone for hay, the quantity is about 15 lb., or $\frac{1}{3}$ bu., per acre. If Red clover is included, the quantity of timothy seed is reduced. In this case, from 8 to 12 lb. of timothy is sown and about 8 lb. of clover.

Timothy is sown at almost any time during the growing season, but if sown alone, the sowing should be done in the fall, as the weather conditions at this time are the most favorable for successful seeding.

Meadow Foxtail.—The grass known as Meadow foxtail, a head of which is shown in Fig. 5, is a near relative of timothy and closely resembles it. Meadow foxtail, however, differs from timothy in that its habit of growth is slightly creeping. Meadow foxtail is not common in the United States.

Red Top.—Next to timothy, red top is doubtless the most important hay grass in North America. The plant is of a creeping habit, producing long underground stems. It grows rapidly from seed and quickly forms a dense, smooth sod. These latter characters make it particularly adapted for lawns and pastures, and it is consequently largely used for these purposes. The seed head is open and spreading, as will be seen in Fig. 6. Red top is sometimes mistaken for blue grass on account of the similarity of the heads of the two plants.

Fig. 4

Fig. 5

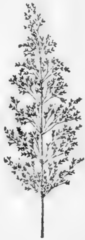


Fig. 6

Kentucky Blue Grass.—Probably the best-known pasture grass of the United States is Kentucky blue grass, also known in some sections as June grass. The first name doubtless had its origin in the fact that the plant grows luxuriantly in the limestone regions of Kentucky; the second name was given on account of the fact that the grass is at its best during the month of June. The plant is rather shallow rooted and strongly creeping in habit. When it becomes well established, it forms a fairly dense, even sod. The leaves are crowded near the base of the plant, and are light green in color. The end of the blade of blue grass is closed, giving the end of the leaf the appearance of the keel of a boat. A head of Kentucky blue grass is shown in Fig. 7.

Canada Blue Grass.—Canada blue grass very closely resembles Kentucky blue grass, but the stem of the former is more zigzag than that of the latter and the seed head of the Canada blue grass, which is illustrated in Fig. 8, is more flattened and is not so spreading as in the Kentucky blue grass.

FIG. 7

FIG. 8

Smooth Brome Grass.—Smooth brome grass is strongly creeping in habit and a coarse grower, under favorable conditions reaching a height of from 4 to 5 ft., and forming a dense sod from 6 to 8 in. thick. The leaves are coarse, being from $\frac{1}{4}$ to $\frac{1}{2}$ in. wide, and often reach a length of 1 ft. The seed head is in the form of a long, spreading panicle, as will be seen from Fig. 9. The seeds are among the largest of those of the cultivated grasses, often being $\frac{1}{2}$ in. in length.

Orchard Grass.—Orchard grass is a common grass in some sections of the United States. The grass probably derives its name from its ability to thrive under the shade of trees, although it does not appear to grow better in the shade than in the open. It is not creeping in habit like blue grass, but has a habit of growth similar to that of timothy. The plant does not form an even sod like many other grasses, but grows in raised clumps, making a very uneven and bunchy sod.

The coarse, light-green leaves are mostly produced near the ground. It will be seen from Fig. 10 that the panicle is somewhat spreading, with the flowers clustered in what are known as tufts.

Meadow Fescue.—Meadow fescue somewhat resembles brome grass when in blossom. Its habit of growth, however, is not at all similar to that of brome grass, as it is not a creeping plant. Meadow fescue can be distinguished from most other grasses by its shiny,

FIG. 9

FIG. 10

bright-green leaves. A seed head of Meadow fescue is shown in Fig. 11.

Tall Oat Grass.—Tall oat grass is related to the common cultivated oat plant. A seed head of tall oat grass is illustrated in Fig. 12. The grass is known also as Meadow oat grass, and in some localities as Evergreen. This last name is used in the southern part of the United States, where this grass remains green throughout the year. Tall oat grass grows to a height of from 3 to 5 ft., and forms clumps like orchard grass.

Bermuda Grass.—In the southern part of the United States, Bermuda grass is a favorite. The plant reproduces from seed and from creeping stems on or just below the surface of the ground. The main prostrate stem may extend 4 or 5 ft. during the season and send out several lateral branches a foot or two in length. At intervals of an inch or two, the stems take root. A flowering stem is shown in Fig. 13. The stems grow from a few inches to 2 ft. in height, depending on the soil and the climate. The habit of the grass is to form a dense sod, which bears trampling by cattle. It does not produce seed in the United States except in the extreme South.

FIG. 11

FIG. 12

Italian Rye Grass.—Italian rye grass, a head of which is shown in Fig. 14, reaches at maturity a height of from 2 to 3 ft. It is a short-lived grass, lasting but 1 yr., or, at best, 2 yr.

Perennial Rye Grass.—Perennial rye grass, often known as English rye grass, is said to have been the first of the true grasses domesticated for hay and pasture purposes. This grass grows from 1 to 2 ft. in height, and is adapted to both pastures and meadows.

FIG. 13

Johnson Grass.—In the southern part of the United States, Johnson grass is grown to some extent for hay and pasture, although it is probably more often looked on as an undesirable weed than as a useful plant.

Johnson grass often grows from 4 to 7 ft. high and produces seed on a spreading head, as shown in Fig. 15.

Velvet Grass.—Velvet grass is a low-growing variety that reaches a height of about 2 ft. It derives its name from the downy character of the leaves and other parts. This character makes it distasteful to horses and cattle. It is said that these animals will nearly starve before acquiring a liking for velvet grass, but when once accustomed to it they thrive remarkably well on it.

Quack Grass.—Quack grass is usually regarded as a weed wherever it is common. It spreads by underground stems in much the same manner as Johnson grass. In spite of its weedy character, it is often utilized as a hay and pasture grass.

FIG. 14

FIG. 15

Texas Blue Grass.—Texas blue grass is a close relative of Kentucky blue grass and has similar habits. It is a grass of southern origin and adapted to southern conditions, although it is grown as far north as Tennessee. It is used for both meadows and pasture and in some cases it is used successfully for lawns.

The Millets.—The millets grown in North America are generally classed in four groups, only two of which are of importance in the United States as hay. These two groups are the foxtail millets and the broom-corn millets, specimens of which are illustrated in Fig. 16. The three important varieties of the foxtail millets are Common millet, shown in (*a*); German millet, shown in (*c*); and Hungarian grass, shown in (*d*).

Sorghum.—Although sorghum is generally used for another purpose, namely, that of producing sirup, it has


Common Millet
(a)
German Millet
(c)
Broom-Corn Millet
(b)
Hungarian Grass
(d)

FIG. 16

great value as a hay crop in many parts of the country.

Kafir Corn.—Kafir corn is a variety of sorghum, although it does not have the sugar-producing qualities of the latter. It is most commonly grown for the grain, but is sometimes planted for hay in the same manner as sorghum. It is especially adapted to the semiarid sections, as it is able to endure extreme heat and drought.

Teosinte.—Teosinte is an annual grass that much resembles Indian corn in habit of growth; it is of tropical origin, and consequently not adapted to northern conditions. It is grown rather extensively in the southern part of the United States.

LEGUMES

Nearly all leguminous plants have certain common characteristics. The leaves are arranged around the stem in regular order—not two-rowed as in grasses. The leaf consists of a stalk and leaflets. All legumes have a common form of blossom, examples being sweet peas, garden peas, and beans. The root system of legumes comprises a large central root, called a tap root, from which numerous branches are sent out at varying distances. The roots of all legumes under favorable conditions bear tubercules, or nodules, which are caused by certain forms of bacteria that live in the soil. They have the power of assimilating the free nitrogen of the soil atmosphere and of transferring it to the root tubercules.

FIG. 17

Red Clover.—Red clover is the most important leguminous crop in the United States and is especially valuable as feed for milch cows, sheep, and in fact almost all classes of growing animals. It is not so suitable for horses because it is liable to contain too much dust. In purchasing Red-clover seed, care should be taken to secure seed free from such adulterants as Yellow trefoil, dodder, Curled dock, Sheep sorrel, Lamb's quarters, and Green foxtail.

FIG. 18

Experiments have proved that a crop of Red clover yielding 4,900 lb. of dry matter per acre will leave in the soil from roots and stubble 44 lb. of nitrogen, 32 lb. of potash, and 13 lb. of phosphoric acid.

The stem, leaves, and blossoms of a Red clover plant are shown in Fig. 17.

Perhaps the worst enemy of clover is the dodder plant, which is a tawny yellow plant that twines about the clover plant, as shown in Fig. 18, and on which it lives.

Mammoth Red Clover.—Mammoth Red clover, also called Mammoth clover, Perennial Red clover, and Pea vine clover, is a variety of ordinary Red clover, differing from it in a few respects only. It is larger and coarser than Red clover, is a longer-lived plant, and matures 3 or 4 wk. later.

Alsike Clover.—Alsike clover, a plant of which is shown in Fig. 19, has not attained the wide reputation that Red clover has, and is seldom a competitor with it where the latter can be grown successfully. But it is especially well adapted to land too wet for Red clover.

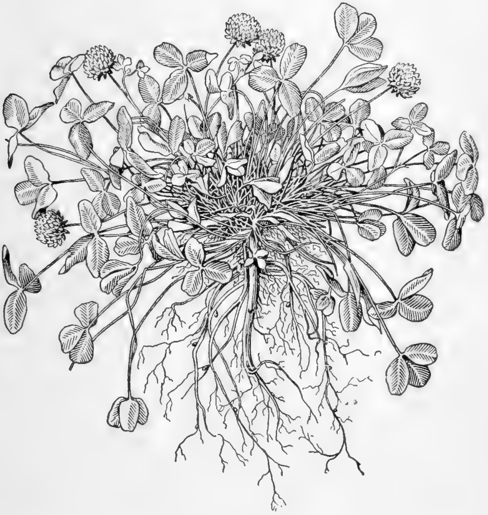


FIG. 19

Alsike clover may be used for the same purpose as Red clover, and matures at about the same time. It is often used in a mixture with Red clover to make certain that there will be at least a partial crop in case the latter fails.

Crimson Clover.—Crimson clover, a plant of which is shown in Fig. 20, differs from the other clovers in that it runs its life history in less than a year from seeding. This variety of clover is not likely to be hardy in northern latitudes; hence, it is not planted extensively north of the 40th parallel. It is grown most extensively in the South Atlantic States.

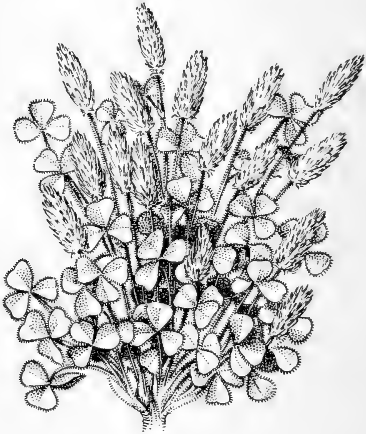


FIG. 20

White Clover.—White clover, also called Dutch clover, is a small plant of creeping habit. It is very common in pastures and lawns. The stems of the plant are prostrate, but at intervals, blossoms and leaves are produced that assume an upright habit of growth, as is well illustrated in Fig. 21. The root system of White clover is much shallower than the root system of other clovers; also, there is not so deep a tap root as is produced by either Red or Alsike clover.

White clover is less affected by climatic conditions than Red clover and is better adapted to moist, rich soils than to soils that are too dry. For this reason, it makes better growth during wet seasons than during dry seasons. It is one of the best plants for pasture and lawn purposes, for which it is most largely used.

Fig. 21

Alfalfa.—Among the leguminous plants used as hay and pasture crops, alfalfa is probably second in importance. It is a strongly growing branching perennial, which, at full maturity, may have a height of 3 or 4 ft. As shown in Fig. 22, which illustrates an old root that is starting a new growth, alfalfa has a large tap root, which grows directly downwards. Under favorable conditions the tap roots often reach a depth of from 12 to

14 ft., depending on the character of the soil and the depth of the permanent water-table.

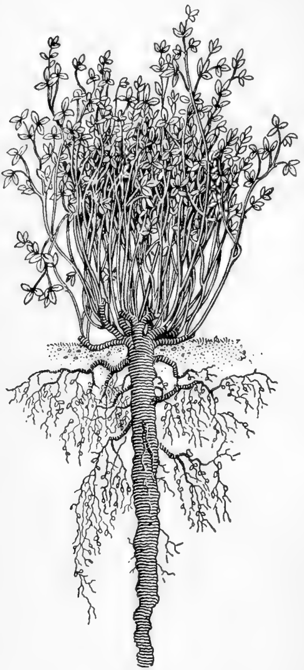


Fig. 22

Alfalfa is used as a feed for cattle, horses, sheep, swine, and poultry. It is used as pasture, as hay, as silage, and as a soiling crop. About four-fifths of the alfalfa grown in the United States is made into hay. Sometimes the hay is ground into meal and sold as alfalfa meal.

Alfalfa is a particularly desirable feed for young stock, because it contains a large percentage of protein, which is essential for growth of young animals. It is also a good roughage for beef cattle. It has been determined that 1 acre of alfalfa will produce from 562 lb. to 706 lb. of beef annually.

In the eastern half of the United States it is usually necessary, for the successful growing of alfalfa, to inoculate the soil with the proper nodule-forming bacteria.

Cowpeas.—The cowpea is an annual leguminous plant that is grown extensively in the South and is used largely to take the place of forage crops and of grain as feed for all kinds of farm animals. The feeding value of cowpeas is very high, as they are rich in protein.

Above ground there may be considerable variation in this plant, but there are only two general forms. One form is decidedly bushy in habit of growth; the other is of a trailing form. The bushy forms may grow to only 1 ft. or so in height; the trailing forms may extend only a few feet along the ground or they may extend 15 or 20 ft.

In Fig. 23 is shown a young cowpea plant with two seed pods.

Fig. 23

Soybeans.—The soybean, also known as soja bean, is an erectly growing plant of from 2 to 4 ft. in height. As shown in Fig. 24, the leaves are composed of three large leaflets borne at the end of a stem. This stem is often from 10 to 12 in. in length. The leaves, stems, and pods are covered with stiff, reddish hairs. As with alfalfa and cowpeas, the leaflets are the most valuable part of the plant when it is used as forage. The seeds are nearly globular, usually more or less compressed, and in color range from whitish to brown and black. In some varieties they are yellowish; in others green. The plant is prolific and will produce as many as 200 pods containing about 450 seeds. Root nodules, which are often as large as small peas, are borne in great profusion. The amount of nitrogen added to the soil by a crop of soybeans is large. It is believed that the proper nodule-forming bacteria are often wanting in the soils of the United States, unless provided artificially.

Vetches.—The vetches commonly grown in the United

FIG. 24

States are of two kinds: the Hairy vetch, also known as the Sand vetch; and the Common vetch. The leaf of these plants is composed of about eight pairs of leaflets arranged in pairs along the sides of the midrib. The stems of the plants trail on the ground unless they are supported by an upright plant. Both kinds of vetches make excellent green-manure crops.

Field Peas.—Field peas are an important crop in Canada. Although they are not grown so extensively in the United States, they are doubtless well adapted to various portions of the country.

Miscellaneous Legumes.—Other leguminous plants that are occasionally grown are: Japan clover, Florida beggar weed, Sweet clover, Yellow trefoil or Black medic, Bur clover, and Velvet bean.

POTATOES

The common potato is the enlarged, fleshy, underground stem, known as the tuber, of the potato plant. Although the tubers are widely known as Irish potatoes, the plant is a native of America. Aside from its universal culture in home gardens, the potato constitutes an important field crop, ranking next to rice as a food product for the human race. It is also extensively used for feeding to domestic animals. In those sections of America where potatoes are most largely grown, the small and the badly diseased potatoes, that is, the unmarketable portion of the crop, are used for the manufacture of starch, and in certain sections of Europe large yields of comparatively small tubers are grown especially for the manufacture of starch and of alcohol.

The average yield of potatoes in the United States for several decades past has been 83 bu. per acre. It takes about 15 bu. of seed potatoes cut into 1 oz. pieces to plant 1 acre, provided the rows are spaced 3 ft. apart and there is a space of 12 in. between the hills in the rows. If each seed piece grew and produced two 4-oz. potatoes, which are only medium-sized potatoes, 1 acre would yield 121 bu. of marketable potatoes. If each hill should produce eight 4-oz. potatoes, or 2 lb., as every grower should endeavor to have the crop yield, 1 acre would yield 484 bu. of marketable potatoes.

Among the thousands of varieties of potatoes that have been developed the following may be considered as standard: Bliss, Triumph, Bovee, Burpee, Extra Early, Crown Jewel, Early Ohio, Early Rose, Early Thoroughbred, Eureka, Norton Beauty, Reliance, Six-Weeks' Market, Beauty of Hebron, Irish Cobbler, Polaris, White Elephant, Burbank, Carman Number 3, Freeman, Green Mountain, Peachblow, Pearl, Rural New Yorker Number 2, Sir Walter Raleigh, State of Maine, Snowflake, and Vermont Gold Coin. In a general way, the varieties are mentioned in the order of their earliness of maturity. Some varieties, however, mature much earlier in one section of the country than in another.

The principal diseases of potatoes are *early blight*, *late blight*, and *scab*. The blights destroy the foliage of the plants and thus materially reduce the yield, and the scab attacks the tubers. The blights are prevented by spraying with Bordeaux mixture. There is no standard formula for this mixture; however, a good Bordeaux may be made up of the following: 5 lb. of copper sulphate, 5 lb. of fresh quicklime, and 50 gal. of water. If to this mixture 1 lb. of Paris green or 3 lb. of arsenate of lead are added the mixture will be effective in killing the potato bug, the most common insect pest of the potato.

The percentage of scabby potatoes in the crop produced can be materially decreased by disinfecting the seed potatoes by soaking them, before cutting, for 2 hr. in a solution consisting of ½ pt. of formalin and 15 gal. of water, or for 1½ hr. in 2 oz. of corrosive sublimate dissolved in 15 gal. of water.

ROOT CROPS

The principal plants that are grown as farm crops for their fleshy roots are mangel wurzels, beets, turnips, rutabagas kohlrabi, carrots, parsnips, and artichokes.

Mangel Wurzels.—Among the best known varieties of mangel wurzels, or cattle beets, or field beets, are the Norbiton Giant, Gate Post, Golden Tankard, and Yellow

Globe. These are grown almost entirely as feed for livestock.

Sugar Beets.—Sugar beets are grown both for the manufacture of sugar and as feed for livestock. The leading variety grown for sugar production is the Kleinwenzlebener. The leading varieties grown for stock feed are Lane's Imperial, Danish Red Top, and Danish Improved.

Turnips.—Three members of the turnip family are commonly grown as farm crops, namely, the common turnip, the rutabaga, and the hybrid turnip, which is a cross of the common turnip and the rutabaga. Some of the most-used varieties of common turnips are: Purple Top, White Globe, Golden Ball, Snow Ball, Strap Leaf, and Cow Horn.

In general appearance and habits of growth rutabagas are much the same as common turnips. They are used both as vegetables for human food and as a feed for stock. Two common varieties of rutabagas are the Purple Top and the Green Top.

Rutabagas are larger than common turnips and will yield twice as much bulk per acre, for which reasons they are grown more extensively as a root crop for stock feeding. One of the most apparent differences between the turnip and rutabaga is that the latter has a greater development at the crown, producing a distinct neck which the turnip does not have.

Kohlrabi.—Kohlrabi is a plant that is frequently referred to as the turnip-headed cabbage, for the only part used is the enlarged fleshy stem that grows above ground.

The two most common varieties are the White Vienna and the Purple Vienna.

Carrots.—The carrot is grown for human food and as a feed for livestock, particularly for horses. The juices of some varieties are used for coloring butter and the seed is employed in the manufacture of some kinds of liquor.

Parsnips.—The parsnip is a hardy plant that is widely grown in the United States for human food, and to some extent as a feed for horses. In European countries, it is valued highly as a cattle feed. Since the roots grow entirely under the soil, harvesting is more difficult than with most other root crops, and as the roots are comparatively small it is not likely that it will ever become popular in the United States as a crop for livestock.

Jerusalem Artichokes.—The Jerusalem artichoke is a native of the United States. In its habit of growth it resembles a small sunflower and belongs to the same botanical family. It has a coarse foliage and grows very rank. The artichoke is seldom planted with the expectation that it will be grown but 1 yr. Usually a field is devoted to it for several years, in some cases as many as 7 years.

TOBACCO

The tobaccos grown most widely in the United States are the White Burley, grown in Kentucky and small areas in neighboring states; Export, or heavy, tobacco, grown in the Middle West and in Maryland; Bright Yellow tobacco, grown chiefly in Virginia and the Carolinas; Sun-Cured tobacco, raised to a very limited extent in Virginia; Perique, which has a wide reputation, but is raised only in a small area in Louisiana; and cigar tobaccos.

All of the tobaccos named, except cigar tobaccos, are used in the manufacture of chewing, cigarette, and pipe tobaccos and are known as manufacturing tobaccos. However, a portion of the Export tobacco is used in foreign countries for the manufacture of cigars.

The cigar tobaccos are classed according to their use as cigar-filler, cigar-binder, and cigar-wrapper tobaccos.

Cigar tobaccos are raised in two distinct zones in the United States. The northern zone includes a large portion of the Connecticut River valley in the states of Connecticut and Massachusetts; two districts in New York, embracing Chemung and Onondaga and portions of adjoining counties in one, and Tioga and portions of adjoining counties in the other; Lancaster and adjoining counties in Pennsylvania; Montgomery and Miami and portions of adjoining counties in Ohio; and small areas in Southern and Western Wisconsin. The southern zone includes Gadsden County, Florida, with the adjacent county of Decatur in Georgia and small portions of adjoining counties; and small areas in Southern Alabama, and Anderson and Nacogdoches counties, Texas.

SOILING CROPS

Crops that are cut and fed green to livestock, either in the stable or the feed lot, are called soiling crops. The practice of feeding such crops is known as soiling. Soiling may be either partial or complete, depending on whether the feeding is practiced simply to supplement pastures or to supply all of the green feed used by the animals. Often several soiling crops are grown on the same land in a single season and each soiling crop produces a large quantity of feed per acre.

In the accompanying table is given a suggested list of crops and the acreage required in a partial soiling system for soiling 20 cows during the usual dry period

PARTIAL SOILING SYSTEM FOR 20 COWS

Kind of Crop	Area to be Seeded Acres	Time of Feeding
Oats and peas	1½	July 4 to Aug. 1
Clover	3	Aug. 1 to 20
Millet	1	Aug. 10 to 20
Corn	2	Aug. 20 to Sept. 5
Rape	1	Aug. 15 to Oct. 15
Clover (second crop)	3	Sept. 1 to Oct. 1

NEW ENGLAND COMPLETE SOILING SYSTEM FOR 20 COWS

	Kind of Crop	Area Sown Acres	Seed per Acre	Time of Seeding	Time of Feeding
1.	Winter rye	1	2 bushels	Sept. 1 to 10	May 20 to 30
2.	Winter wheat Winter vetch	1	2 bushels $\frac{3}{4}$ bushel	Sept. 10 to 15	June 1 to 10
3.	Red clover	$1\frac{1}{2}$	15 pounds	May 1 to 5	June 10 to 20
4.	Timothy Red top Red clover	2	8 pounds 4 pounds 6 pounds	May 1 to 10	June 20 to July 4
5.	Oats Peas	$\frac{3}{4}$	$1\frac{1}{2}$ bushels 1 bushel	May 1 to 5	July 4 to 15
6.	Oats Peas	$\frac{3}{4}$	$1\frac{1}{2}$ bushels 1 bushel	May 10 to 15	July 15 to 31
7.	Millet	1	$\frac{3}{4}$ bushel	June 1	Aug. 1 to 15
8.	Red clover	$1\frac{1}{2}$	Second crop from No. 3		Aug. 1 to 15
9.	Corn	$1\frac{1}{2}$	$\frac{1}{2}$ bushel	May 20 to 30	Aug. 15 to Sept. 5
10.	Medium green soybean	1	20 qt., in drills	June 10	Sept. 5 to 15
11.	Aftermath from grass	2			Sept. 15 to Oct. 15
12.	Rape	1	4 pounds	May 20 to 30	Aug. 15 to Oct. 15

NOTE.—The total area sown was 15 A., but the total area of land used was $9\frac{1}{2}$ A., the millet being sown on the rye ground and the soybeans on the wheat ground.

WISCONSIN COMPLETE SOILING SYSTEM FOR 20 COWS

	Kind of Crop	Area Sown Acres	Seed per Acre	Time of Seeding	Time of Feeding
1.	Rye	1	2 bushels	Sept. 10 to 15	May 20 to 30
2.	Wheat	1	2 bushels	Sept. 10 to 15	June 1 to 15
3.	Red clover	1	12 pounds	July 15 to Aug. 1 or with previous grain crop	June 15 to 25
4.	Timothy Red top Red clover	1	11 pounds 7 pounds 10 pounds	Aug. 1 to Sept. 1	June 15 to 30
5.	Oats Vetch	1	$1\frac{1}{2}$ bushels 1 bushel	April 20	June 25 to 30
6.	Canada peas Oats	1	$1\frac{1}{2}$ bushels $1\frac{1}{2}$ bushels	Mar. 30 to Apr. 12	June 1 to 20
7.	Canada peas Oats	1	$1\frac{1}{2}$ bushels $1\frac{1}{2}$ bushels	Apr. 10 to 25	June 15 to July 5
8.	Canada peas Oats	1	$1\frac{1}{2}$ bushels $1\frac{1}{2}$ bushels	Apr. 20 to May 15	June 1 to July 25
9.	Millet	$\frac{2}{3}$	$\frac{3}{4}$ bushel	May 10	July 25 to Aug. 10
10.	Millet	$\frac{2}{3}$	$\frac{3}{4}$ bushel	May 25	Aug. 10 to 20
11.	Soybeans (medium green)	$\frac{2}{3}$	18 quarts	May 20	Aug. 20 to Sept. 15
12.	Corn	$\frac{2}{3}$	18 quarts	May 20	Aug. 25 to Sept. 10
13.	Corn	$\frac{2}{3}$	10 quarts	May 30	Sept. 10 to 30
14.	Hungarian grass	$\frac{2}{3}$	1 bushel	July 15	Sept. 20 to 30
15.	Peas Barley	2	$1\frac{1}{2}$ bushels $1\frac{1}{2}$ bushels	July 15 to 30	Oct. 1 to 15

NEW JERSEY COMPLETE SOILING SYSTEM FOR 20 COWS

	Kind of Crop	Area Sown Acres	Seed per Acre	Time of Seeding	Period of Feeding
1.	Rye	$\frac{4}{5}$	2 bushels	Sept. 27	May 1 to 7
2.	Rye	$\frac{4}{5}$	2 bushels	Oct. 3	May 7 to 10
3.	Alfalfa (first cutting)	$\frac{2}{5}$	$\frac{3}{5}$ bushel	May 14	May 19 to 25
4.	Wheat	$\frac{4}{5}$	2 bushels	Sept. 26	May 25 to June 1
5.	Crimson clover	$2\frac{2}{5}$	$\frac{1}{5}$ bushel	July 16	June 1 to 21
6.	Mixed grasses	$\frac{2}{5}$			June 21 to 26
7.	Oats Peas	$\frac{4}{5}$	2 bushels $1\frac{1}{2}$ bushels	April 2	June 26 to July 4
8.	Oats Peas	$\frac{4}{5}$	2 bushels $1\frac{1}{2}$ bushels	April 11	July 4 to 9
9.	Alfalfa (second cutting)	$\frac{2}{5}$			July 9 to 11
10.	Oats Peas	2	2 bushels $1\frac{1}{2}$ bushels	April 19	July 11 to 22
11.	Southern white corn	$\frac{4}{5}$	$\frac{1}{4}$ bushel	May 2	July 22 to Aug. 3
12.	Barnyard millet	$\frac{4}{5}$	$\frac{3}{4}$ bushel	June 19	Aug. 3 to 19
13.	Soybeans	$\frac{2}{5}$	2 bushels	June 1	Aug. 19 to 25
14.	Cowpeas	$\frac{2}{5}$	2 bushels	June 10	Aug. 25 to Sept. 1
15.	Cowpeas Kafir corn	$\frac{4}{5}$	1 bushel $\frac{1}{2}$ bushel	July 10	Sept. 1 to 16
16.	Pearl millet	$\frac{4}{5}$	$\frac{1}{8}$ bushel	July 11	Sept. 16 to Oct. 1
17.	Cowpeas	$\frac{4}{5}$	$1\frac{1}{2}$ bushels	July 24	Oct. 1 to 5
18.	Mixed grasses (partly dried)	2			Oct. 5 to 27
19.	Barley	$\frac{4}{5}$	$1\frac{3}{4}$ bushels	Sept. 2	Oct. 27 to Nov. 1

from Aug. 1 to Oct. 15, in a region where blue-grass pastures prevail. In this plan, the soiling crops are depended on to supplement the pasture until corn silage is available, silage being used through the winter.

In the table on page 86 is given a complete succession of soiling crops, together with the rate and time of seeding, and the feeding period. The system given in this table is used in the New England states for the complete soiling of a herd of 20 cows from May to Oct.

In the table on page 87 is given a system used in Wisconsin, for a herd of 20 cows; the table on page 88 is a system applying to conditions in New Jersey and near-by territory and furnishes green feed for 20 cows for a period of 6 mo.

These tables are not intended as absolute guides, but are for the purpose of giving a correct idea of the essentials of a soiling system and to emphasize the importance of a complete and orderly succession of crops.

FRUIT CULTURE

SPRAYS FOR FRUIT PLANTS

INSECTICIDES

Arsenate of Lead.—Arsenate of lead is a much-used poisonous insecticide that contains very little soluble arsenic; it stays in suspension well, is not easily washed from plant foliage by rain, and has some value as a fungicide. It is sold as a paste and as a powder. The paste form is used at the rate of 2, 3, or 4 lb. to 50 gal. of water, the exact quantity depending on the pest to be combated. Half as much of the powdered form as of the paste form is required.

Paris Green.—Paris green is an arsenical poison easily recognized by its green color. It contains a higher percentage of soluble arsenic than arsenate of lead. It should not be used on peaches, cherries, or plums. Often used as a potato spray. Generally used in the form of a spray consisting of 1 lb. to from 75 to 150 gal. of water.

Arsenite of Lime.—Arsenite of lime is an arsenical spray that is cheaper than arsenate of lead or Paris green, but its use is likely to be attended with spray injury. Made by boiling 1 lb. of white arsenic and 2 lb. of good lime in 2 gal. of water for 40 min. Water to make 300 gal. of spray is added.

London Purple.—London purple is a by-product in the manufacture of aniline dyes. Varies greatly in composition, and for this reason is not often used in orchard work. Used in the same proportion and in the same way as Paris green.

Hellebore.—Hellebore is a poison made from the powdered roots of hellebore. Recommended as a substitute for arsenical poisons where insects must be combated on nearly ripe fruit. May be applied dry mixed with from 5 to 10 parts of flour or lime, or as a spray consisting of 1 oz. of hellebore to 1 gal. of water.

Lime-Sulphur.—Lime-sulphur is a contact insecticide made by boiling stone lime and powdered sulphur. Used as a spray on dormant trees at 1.03 sp. gr. for scale insects, especially the San José scale. Also used as a fungicide at 1.007 to 1.01 sp. gr. Concentrated lime-sulphur may be purchased or may be made at home by using the proportion of 1 lb. of lime, 1 lb. powdered sulphur to 1 gal. of water and boiling for 1 hr. The concentrated mixture should be tested with a hydrometer and water added to give the specific gravity required for the spray.

Miscible Oil.—Oil that has been chemically treated so that it will combine with water to make a uniform mixture is called miscible oil. Such oils are used successfully as contact insecticides. Many brands of miscible oils are on the market. Miscible oil is often used as a spray for the San José scale.

Kerosene Emulsion.—Kerosene emulsion is a contact insecticide, similar in nature to miscible oil. Made from kerosene with soap as an emulsifier. Much used for combating plant lice. It is made by dissolving 1 lb. of soap in 1 gal. of water and adding 2 gal. of kerosene and churning with a force pump until a butter-like mass is formed. To this is added water in different proportions for spraying.

Distillate Oils.—Distillates are made from oil taken from wells in the western part of the United States. Used either as an emulsion or in the form of a mechanical mixture. Used for combating scale insects.

Tobacco Extracts and Decoctions.—Tobacco extracts and decoctions are spray materials made from tobacco waste. Much used for plant lice and other sucking insects. Many proprietary tobacco decoctions are on the market, and these, when applied in accordance with the directions that accompany the packages, will generally prove satisfactory. May be made at home by steeping 1 lb. of tobacco in 1 gal. of water.

FUNGICIDES

Bordeaux Mixture.—Bordeaux mixture is a much-used fungicide made from copper sulphate and lime. Can be used successfully on most fruit and vegetable crops. Sometimes causes injury to fruit and foliage of apple and other fruit trees. The copper sulphate, lime, and water are combined in different proportions, depending on the plant to be sprayed and the fungus to be combated. The strength of Bordeaux mixture is designated by figures giving the proportions of the ingredients and followed by the name Bordeaux. For example, 6 : 6 : 50 Bordeaux means that the proportions of the mixture are 6 lb. of copper sulphate, 6 lb. of lime, and 50 gal. of water; 3 : 4 : 50 means that the proportions are 3 lb. of copper sulphate, 4 lb. of lime, and 50 gal. of water.

Ammoniacal Copper Carbonate.—Ammoniacal copper carbonate is a solution made from copper carbonate 6 oz., ammonia 3 pt. and water to make 50 gal. This solution does not cause injury to fruit as Bordeaux mixtures does, and for this reason its use on ripe fruit may sometimes be advisable, but it is more injurious to the tree than Bordeaux mixture and is not so effective.

Sulphur Dust.—Sulphur in the form of dust has considerable value as a fungicide. It is used principally to combat powdery mildew on certain kinds of fruit.

Potassium Sulphide.—A spray of some value as a fungicide is made by dissolving from 2 to 3 oz. of potassium sulphide, sometimes called liver of sulphur, in 10 gal. of water. It is of value principally for powdery mildew on berry plants.

Lime-Sulphur.—During recent years dilute lime-sulphur is being used as a summer fungicide to replace Bordeaux mixture for many classes of fruit plants. It is claimed that lime-sulphur does not cause injury to fruit as does Bordeaux mixture.

Self-Boiled Lime-Sulphur.—Self-boiled lime-sulphur is a mechanical mixture of lime and sulphur. A small quantity of the sulphur becomes dissolved in the mixture, and it is this sulphur that gives the preparation its fungicidal property. Much used as a summer spray for peaches. It is made by adding sufficient water to lime to start slaking and then sifting in sulphur. Water is added to keep up the slaking and the mixture is thoroughly stirred. When slaking is complete enough cold water must be added to cool the mixture at once. The proportion of 6 lb. of sulphur, 6 lb. of lime to 50 gal. of water is generally used in making the compound, but other proportions are sometimes recommended.

APPLES

VARIETIES OF APPLES

Summer Varieties.—Among the most important summer varieties of apples are the following:

Yellow Transparent: Summer apple; good variety for the home orchard. Tree is rather a slow grower, but bears at an early age; often 2- or 3-year-old trees will set considerable fruit. Fruit, above medium in size, beautiful clear yellowish white in color; flesh, white, juicy, with a pleasant flavor. Skin somewhat tender; fruit should be picked often in order to be marketed in good condition.

Early Harvest: One of the oldest and most widely disseminated varieties of summer apples in America. Tree, vigorous and healthy; comes into bearing rather young. Fruit, medium size; pale yellow; pleasant; of very good quality.

Red Astrachan: Widely known variety of summer apple. Tree, medium size, fairly vigorous, although in some sections it is not very productive. Fruit, medium to large size; red splashes over greenish or greenish yellow; a little too sour for dessert, but excellent for cooking. Apples mature unevenly; are very perishable; and are not well suited for long shipment.

Oldenburg: Adapted to a cool climate, but widely disseminated; considered one of the most important of summer apples. Tree, rather a slow grower; medium in size; bears when young; prolific in most localities. Fruit, medium to large; roundish to oblate; yellowish, almost completely covered with irregular splashes and stripes of red; stands shipment fairly well; generally in demand on the market.

Gravenstein: Summer variety that is fairly well known in most sections. Tree, strong, vigorous, spreading. Fruit, medium to large; roundish oblate; red and yellow striped. Flesh, yellowish; firm; quality very good.

Fall and Winter Varieties.—Several of the important varieties of apples suitable for fall and winter use are:

Fall Pippin: Tree, large; moderately vigorous; long lived. Fruit, large; yellowish-green; of good quality, but ripens unevenly, the first often being ready in September and the last not ripening until a few weeks later. A desirable variety for home and commercial orchards.

Alexander: Fall, or in some places a late summer apple, grown especially in the eastern apple-growing regions. Tree, a strong grower; bears at an early age. Fruit, round, conic, or oblate conic; very large; coarse in texture; of fair quality; greenish yellow almost covered with red stripes; ripens early in July in Virginia and continues until Sept. or Nov. in New York.

Wolf River: Similar to the Alexander. Tree, fairly vigorous; large; spreading; comes into bearing rather late. Fruit, large; broad; flat at the base; round; slightly conic; bright red and yellowish stripes blushed with deep red. Flesh yellowish; somewhat coarse; juicy; of only fair to good quality. On account of their high color and good size the apples are in good demand on the market. Fruit may be kept until Dec. in a cool cellar or until Jan. in cold storage.

Wealthy: An important fall apple extensively grown in the Central States and to some extent in the Eastern States. Tree, hardy and thrifty when young, but with maturity it becomes a rather slow grower. Fruit, medium to large; roundish oblate; of good quality; heavily striped with red over light yellow or green. Flesh, white, sometimes tinged with red.

Fameuse: An old variety decidedly adapted to Northern regions. Tree, of medium size; a moderate grower; healthy and long lived. Fruit, above medium in size; roundish and somewhat conic; bright red, deepening to purplish black in the best colored specimens. Flesh, white, often streaked or tinged with red; quality, good.

McIntosh: Similar to the Fameuse, but adapted to a wider range of localities. Tree, in some localities a slow grower and not very productive; in other places, a strong grower, hardy, and productive; bears fairly early; yields good crops. Fruit, medium to large; roundish to somewhat oblate; red with a slight amount of whitish yellow or green; quality, very good to best; prized for dessert, but lacks sufficient firmness to stand long shipment. Flesh, white or slightly yellowish; often tinged with red; firm; fine; crisp; tender; juicy; aromatic.

Hubbardston: An early winter variety. Tree, vigorous and generally of good size. Fruit, medium to large; roundish ovate; red mingled with yellow or green. Flesh, whitish; slightly tinged with yellow; quality, very good to best.

Tompkins King: One of the highest quality apples produced. Tree, rather vigorous; lateral branches, slender and somewhat drooping. Fruit, large to very large; roundish; sometimes inclined to conic; red with a small amount of yellow. Flesh, rich yellow; tender; aromatic; juicy; quality very good to best. In ordinary storage the King keeps until Dec. or Jan., and in cold storage until about Feb. King apples are probably at their best about Christmas.

Yellow Belleflower: Tree, large; vigorous; good grower; fairly hardy; not a satisfactory bearer. Fruit, roundish oblong, narrowing toward the base; pale lemon yellow, often with brownish yellow cheek; quality good; excellent for dessert and for cooking. Flesh, white, showing slightly yellowish. The season same as King.

Winter Banana: Tree, medium; vigorous; a fair grower; bears young; yields moderate crops; in most cases is an annual bearer. Fruit, large; roundish conic; bright pale yellow with a dark pinkish blush; quality, good to very good. Flesh, whitish tinged with yellow; moderately firm; tender; juicy. The apples are better for dessert than for cooking, being too mild in flavor for the latter purpose. They will keep in cold storage until about March.

Smokehouse: Tree, vigorous; healthy; hardy; bears rather young; a good yielder, usually producing crops annually; has a tendency to form a dense head. Fruit, medium large to large; oblate; yellow; deeply mottled red; flesh, slightly tinged with yellow; rather firm; crisp; juicy. Quality is good. Season is from Oct. to Feb. in storage.

Black Gilliflower: Tree, medium in size; a vigorous grower; generally a reliable bearer. Fruit, medium in size; long ovate to oblong conic; dark red to dull purple. Flesh, whitish or yellowish; becomes mellow and mealy on standing. The season is from Oct. to Jan. or Feb.

Rambo: Tree, of medium size; moderately vigorous. Fruit, medium in size; roundish or somewhat oblate in form; greenish yellow, mottled with red; quality, good to very good. Flesh, white, tinged with yellow or green; juicy; rather fine grained. In ordinary storage the apples keep until Nov.; in cold storage until Feb.

Tolman Sweet: Tree, moderately vigorous; a good grower; long lived; very hardy. Fruit, medium; oblate; pale yellow, sometimes slightly blushed; sweet; quality fair to very good. Flesh, white; firm; rather tough. In ordinary storage the apples will keep until about Jan. 1 and in cold storage to about March or April.

York Imperial: Tree, vigorous; a thrifty grower; a good bearer, bearing biennially, or in some cases annually. Fruit, medium to large, roundish oblate, and distinctly lopsided; pinkish red over green or yellow. Flesh, yellowish; firm; fairly juicy; quality, generally good. In cellar storage it will keep from Jan. to April; in cold storage it seems to scald badly, and may last only through Feb.

Smith Cider: Tree, moderately vigorous; has long, stout, straggling branches. Fruit, medium; round; striped pinkish red. Flesh, whitish; juicy; of good flavor. Desirable for cooking purposes; will keep in cellar storage until Feb.; in cold storage until March.

Baldwin: The most important commercial winter apple grown in America, a standard fruit in both American and export markets, and one of the principal varieties handled in cold storage. Tree, strong grower; long lived; vigorous; slow to come into bearing, but bears very abundantly, generally biennially. Fruit, medium in size; roundish to conic; red over light yellow or green. Flesh, yellowish; moderately coarse; quality good to very good. Fruit is suitable both for dessert and cooking purposes. Its season in ordinary storage is from Nov. to March, in cold storage until May or June.

Esopus Spitzenberg: Better known, perhaps, as Spitzenberg. Is of the Baldwin type, but of better quality and more highly prized as a fancy dessert fruit. It is also a good quality cooking apple. Tree, rather slow grower and generally rated as a moderate cropper. Fruit, medium to large; oblong; bright red over yellow. Flesh, yellowish; crisp; tender; quality very good to best. Its season extends from Nov. to Feb. or March in ordinary storage and to May or June in cold storage.

Delicious: Tree, a strong grower and a heavy bloomer. Fruit, large to very large; oblong conic, with 5 points projecting from the basin; red splashed and striped over pale yellow. Flesh, pale yellow; tender; moderately juicy. The quality is of the best, especially for dessert.

Rhode Island Greening: As a type of green apple, the Rhode Island Greening is the best known in America. Tree, large and spreading; a reliable cropper; yields fruit annually. Fruit medium to large; grass green in autumn, to yellowish green when fully matured; roundish oblate; a good shipper. Flesh, yellowish; firm; fine grained; juicy; quality very good. It is highly prized for cooking and by many is thought to be an excellent dessert fruit. Its season is about the same as that of Baldwin.

Yellow Newtown: Also known as the Albemarle Pippin. Tree, vigorous and erect. Fruit, yellow, often with a pink blush spread over a part of the surface. Flesh, yellowish with a mild and highly aromatic flavor. Its season extends from Jan. until April and sometimes until May.

Northern Spy: Tree, large and vigorous; upright; a slow grower and late coming into bearing, but when mature a good yielder. Fruit, large to very large; roundish conic; pale yellow nearly concealed by pinkish red and splashed with carmine. The flavor is very good and the fruit is well liked for dessert and for cooking. In ordinary storage the apples cannot be kept much later than Feb. or March, and even in cold storage they are likely to deteriorate if left longer than March.

Jonathan: Tree, medium; fairly reliable cropper; bears rather early. Fruit, small to medium; roundish conic; bright red over yellow, which is sometimes visible where a twig or leaf has shaded the fruit. Flesh, white often marked with red; juicy; spicy; quality, very good to best. Its season is from Oct. to some time in Jan. in ordinary storage, and to Feb. or March in cold storage.

Ben Davis: Tree, medium; rather a rank grower when young; has coarse, strong wood that will stand under heavy crops. The form of tree tends to be upright and roundish, becoming rather spreading in old trees. Fruit, medium to large; conic; deep red or red striped. Flesh, whitish slightly tinged with yellow; firm; moderately coarse; slightly tough. The quality is fair to poor. Its season extends as late as June or July if the fruit is kept in cold storage.

Gano: Similar to the Ben Davis, although better in quality. Tree, generally vigorous and of the same upright spreading habit as the Ben Davis. Fruit, medium; roundish conic; light yellow, overlaid almost completely with red. Flesh, whitish, slightly tinged with yellow; firm, but coarse in texture. Its season is about the same as that of Ben Davis.

Black Ben Davis: Is of the Ben Davis type, but resembles the Gano more nearly than the Ben Davis.

Tree, upright when young but spreading and dense when mature. Fruit, medium to large; roundish conic; a clear pale yellow covered with a brilliant red that becomes a dark purple on the side exposed to the sun. It lasts until April and May when kept in cold storage.

Winesap: Tree, of medium size; rather vigorous; bears early; usually an annual cropper. Fruit, small to medium; roundish; slightly conical; deep red. Flesh, yellowish, with an occasional red streak running through it; juicy; crisp; quality, good to very good. The ordinary limit in cold storage is April.

Staymen Winesap: Tree, fairly vigorous; spreading; rather open. Fruit, medium to very large; roundish conic to globular; a dull red that is rather indistinctly striped with carmine. Flesh, yellowish or greenish; crisp; juicy; quality good to very good. The fruit will keep in storage until April or May.

Wagener: Tree, small; vigorous when young, but short lived. Fruit, medium to large; roundish oblate; bright, light-red stripes over pale yellow. Flesh, whitish, slightly tinged with yellow; juicy; tender. Quality, very good to best, being similar to the Northern Spy in this respect. Its season extends from Oct. to Feb.

Grimes: A variety adapted to middle latitudes and one of the best quality apples produced. Tree, moderately vigorous; branches, short, curved, and crooked; good cropper. Fruit, medium to large; roundish oblong. Flesh, yellow; firm; tender. Can be kept until Jan. or Feb. in cold storage.

Rome, or Rome Beauty: Does well in the latitude of New Jersey and Southern Ohio. Tree, not particularly vigorous, but attains medium size and bears early. Fruit, medium to very large; roundish; red mixed with yellow. Skin, thick; tough; smooth. Flesh, nearly white, with a slight tinge of yellow or green; juicy; crisp; of an agreeable taste; good quality. The fruit is used both for dessert and for cooking purposes. The season extends to about April or May.

Stark: Tree, vigorous; large; a reliable cropper, and very productive. Fruit, medium to large; red mixed with dull green or yellow. Flesh, yellowish and firm; quality, fair to good. The apples can often be kept in storage until May. A variety widely grown in the central part of the United States.

PRUNING OF APPLES

When the young apple tree from the nursery is planted it should be cut back and the head started about 2½ to 3 ft. from the ground. If the branches are properly placed, the three or four best ones should be cut back to stubs 10 to 15 in. in length; these branches should be strong and be spaced about 6 in. apart on the trunk. If the branches on the tree are not properly placed so that a good head can be started, cut off all the branches, leaving the trunk merely a whip, and form the head from the new shoots that are sent out.

There is much difference of opinion in regard to the subsequent pruning of the apple tree. Some authorities give detailed instructions as to just how and when an apple tree should be pruned, and the approximate distances the tree should be cut back at different ages. Taking the average experience of a large number of growers, however, it seems that the best results have not been obtained by heavy pruning, but rather by moderate pruning, and that the least cutting possible should be done, consistent with training the tree into such form that each individual fruit will receive as much light as possible, and with keeping the tree in such form that spraying and harvesting can be done to the best advantage. The most economical way of pruning is to pinch out, and train the growth of the branches during the summer so that only the limbs that are desirable are permitted to grow. This will save cutting out a large quantity of wood later on, and the branches permitted to grow in this way usually grow larger than those pruned during the dormant season.

From year to year after the tree has once been properly started, it should be developed according to some definite system. Each of the original three or four main branches should be headed back some the second spring and two branches allowed to develop on each of them, the branches coming off at different points and growing in such directions that the top of the tree will be balanced and open. That year, during the summer, the growth on these laterals should be limited to two or three branches, chosen with the same end in view, as in the case of the first laterals. This system of selecting branches should be continued for 3 or 4 yrs. until the main framework of the tree has been built up.

After the framework of the tree has been built up, the quantity of wood cut from the tree should be gradually reduced, until only the removal of misplaced and diseased branches will be needed. When the trees approach bearing age care should be taken to leave the fruit spurs on the tree and to keep the bearing wood low and well distributed in all parts of the tree so that the load of fruit may be well carried and easy of access.

Future injury to the tree is prevented if the pruning is well and neatly done. No stubs should be left, the cuts being made flush with the limb from which a branch is pruned. All large cuts that will not heal over in a short time should be painted with a good white lead and linseed-oil paint. This painting of the wounds is very important and should never be neglected.

SPRAYING OF APPLES

The principal insects attacking the apple are the bud moth, canker worm, coddling moth, apple maggot, cigar-case bearers, San José scale, oyster-shell scale, scurfy scale, leaf-blister mite, round-headed borer, and apple-tent caterpillar. The principal diseases of the apple are scab, fire blight, black rot, sometimes called New York apple-tree canker, and bitter rot.

In order to control the insects and diseases of the apple that can be controlled by spraying the following system of spraying will be found effective:

1. During the season when the trees are dormant and just as the leaf buds are swelling but before they are open, spray with lime-sulphur solution (sp. gr. 1.03—that is, concentrated lime-sulphur of 33° Baumé diluted 1 to 8 with water) to which has been added 2 lb. of arsenate of lead to each 50 gal. of solution. This spraying is for the control of the San José scale, leaf-blister mite, bud moth, and cigar-case bearer. It is generally known as the dormant spray.

2. After the leaf buds are open, but just before the fruit blossoms open, or about the time when the fruit blossoms are beginning to look pink at the tips, spray with a dilute lime-sulphur solution (sp. gr. 1.007, that is, concentrated lime-sulphur of 33° Baumé diluted 1 to 40 with water). Bordeaux mixture (8 lb. copper sulphate, 4 lb. lime, water-slaked, 50 gal. water), may be used instead of the dilute lime-sulphur, but it is likely to cause some damage to the foliage or fruit or to both. Whichever of these solutions is used, arsenate of lead should be added (2 to 3 lb. arsenate of lead to 50 gal. of the other spray solution). This combined fungicide-insecticide spray is for the control of the apple scab, bud moth, cigar-case bearer, and canker worm.

3. After the petals have begun to fall from the apple blossoms, starting when about two-thirds of them have fallen, spray with the solution given in paragraph 2, preferably with the lime-sulphur-arsenate-of-lead solution. This spraying is for the control of the apple scab, leaf spot, coddling moth, canker worm, and bud moth, and is the most important of all the applications.

4. From 10 to 14 da. later another application of the solution given in paragraph 2 should be made for the control of apple scab, leaf spot, coddling moth, and canker worm.

5. From 8 to 9 wk. after the blossoms fall the spraying described in paragraph 2 should again be repeated for any late infections of the apple scab that may occur, and also for any of the later brood of the coddling moth. Though in most seasons this application will not be found necessary, the work is not so expensive but that it generally pays to apply it.

6. In case the green aphis attacks the foliage, spray thoroughly, before the leaves begin to curl, with a whale-oil soap solution (1 lb. whale-oil soap to 6 gal. of water), or with a tobacco preparation guaranteed to contain 2.7 per cent. of nicotine diluted with 65 to 100 parts of water, or with kerosene emulsion diluted in the proportion of 1 part of emulsion to 6 parts of water.

The importance of applying all of these sprays thoroughly and at the right time cannot be too greatly emphasized.

PEACHES

VARIETIES OF PEACHES

Early Varieties.—The following are the principal early varieties of peaches that are used in commercial plantings:

Greensboro: Very early. Fruit, white fleshed; medium to large; oblong to oval, often somewhat flattened; clingstone; fair flavor, rather soft for distance shipment. Tree, hardy and productive. Best market peach of its season and profitable where an early peach is in demand. Inferior to Carman in flavor and shipping quality, but ripens 2 wk. earlier.

Waddell: Early. Fruit, white fleshed; medium size; oblong conic; semi-clingstone; flavor better than Greensboro; better for shipment than Greensboro. Tree, hardy and productive. Fruit needs to be thinned severely to reach good size; ripens only a few days in advance of Carman. Can be used to start the Carman season, especially in local markets.

Carman: Ripens a few days after Waddell. Fruit, white fleshed; large; round to oval; semi-clingstone; flavor, medium to good; shipping quality, fair to good. Tree, hardy and productive. Regarded as the first important early shipping variety. More hardy and productive than Elberta in most sections, but not high enough in flavor for a good canning peach.

St. John: Earliest yellow-fleshed market variety. Fruit, yellow-fleshed; medium size; round, blunt at apex; freestone; flavor, high; rather soft for distance shipment. Tree, fairly hardy and productive in some localities.

Mountain Rose: Medium early; ripens about 7 to 9 da. after Carman. Fruit, white fleshed; medium size; nearly round, blunt at apex; freestone; high prominent flavor; shipping quality, fair. Tree, fairly hardy and in favorable seasons, productive; less hardy than Greensboro, Carman, and Hiley.

Hiley, or Early Belle: Medium early fruit, white fleshed; large; oblong conic, apex pointed; freestone; high quality and flavor. This variety has taken the place of Mountain Rose in some localities, as it is hardier, of better shipping quality, and ripens at the same season.

Brigg's Red May: Early-ripening variety in California. Fruit, medium to large; skin white, with rich red cheek; round; semi-clingstone. Standard early variety.

Alexander: Widely grown early variety in California. Fruit, greenish white, nearly covered with deep red; medium to large; semi-clingstone; flesh, firm, juicy, and sweet; bears transportation well.

Mid-Season Varieties.—The following are the principal mid-season varieties of peaches used in commercial plantings:

Champion: Ripens about 5 to 8 da. after Mountain Rose or Hiley. Fruit, white fleshed; large; round, blunt at apex; freestone; flavor regarded as the highest; rather tender for distance shipment, otherwise a good market variety. Tree, hardy and productive.

Belle of Georgia: Ripens a few days before Elberta, and a few days after Champion begins. Fruit, white fleshed; large; oblong conic, apex pointed; freestone; high flavor; especially desirable for distance shipments; very firm. Tree, hardy and productive. Good variety both for market and for the home garden.

Reeve's Favorite: Ripens about the same time as Belle of Georgia. Fruit, yellow fleshed; very large; round, with blunt apex; freestone; high flavor; good shipping quality. Tree, less hardy than Early Crawford; lacks productiveness as generally grown.

Foster: Widely grown in California where it ripens just before or about the time of Early Crawford. Fruit, yellow fleshed; uniformly large; slightly flattened, with slight suture; freestone; flavor, good, rich, and juicy. Tree, hardy and productive.

Oldmixon: Ripens about with Early Crawford. Fruit, white fleshed; large; roundish, or slightly oval in shape; flavor, excellent; flesh, juicy.

Early Crawford: Ripens about 7 to 9 da. before Elberta. Fruit, yellow fleshed; medium sized; requires severe thinning to be of best size; round oval, blunt at apex; freestone; high quality; rather tender for shipping. Tree, rather tender in bud; fairly productive.

Elberta: Ripens a few days later than Belle of Georgia. Fruit, yellow fleshed; very large; oblong oval, often somewhat flattened; freestone; medium to good quality according to locality; firm; excellent for shipping. Tree, hardy and productive. Most popular market peach grown.

Ede: Ripens about with Elberta. Fruit, yellow fleshed; large; round oval conic; freestone; higher in flavor than Elberta; shipping quality good. Tree, hardy and productive.

Frances: Ripens a few days after Elberta. Fruit, yellow fleshed; large; round to oval; freestone; high flavor; good shipping quality. Tree, hardy and productive.

Late Varieties.—The following are the main late varieties of peaches used in commercial plantings:

Fox Seedling: Ripens about 10 to 14 da. after Elberta. Fruit, white fleshed; large; oval to conic; freestone; flavor good; shipping quality, good. Tree, medium hardy and productive. Best commercial variety of its season.

Muir: California variety. Ripens a few days before Late Crawford. Fruit, large to very large; freestone; flesh, yellow; flavor, excellent; fruit good both for shipment and canning, and also particularly adapted for drying. Tree, good bearer and strong grower.

Newhall: Grown largely in California. Ripens with or sometimes a few days before Late Crawford. Fruit, yellow fleshed; very large; freestone; flavor rich, somewhat vinous. Tree, hardy, healthy, and vigorous.

Late Crawford: Ripens from 10 to 14 da. later than Elberta. Fruit, yellow fleshed; large, round to oval, blunt at apex; freestone; flavor, good, but rather acid; shipping quality, fair to good. Tree, rather tender in bud, and, therefore, variable in productivity.

Smock: Ripens from 10 to 14 da. later than Elberta. Fruit, yellow fleshed; medium to large; oblong to oval; freestone; flavor, fair; flesh, rather dry; shipping quality good. Tree, hardy and productive. Old variety, grown commercially in some districts.

Edgemont Beauty: Ripens about 10 to 14 da. later than Elberta. Fruit, yellow fleshed; large; round to oval, pointed at apex; freestone; shipping quality good. Tree of the Crawford type, but appears to be slightly more hardy and productive.

Iron Mountain: Ripens 5 to 6 da. later than Edgemont or Late Crawford. Fruit, white fleshed; skin, greenish white; large; oblong to oval; freestone; high quality; firm. Tree, vigorous, hardy, and productive.

Krummel October: Ripens 7 to 10 da. after Late Crawford. Fruit, yellow fleshed; large; freestone; round, blunt at apex; quality, high; good shipper. Tree, medium hardy and productive.

Salway: Ripens 2 wk. after Late Crawford. Fruit, yellow fleshed; medium to large; round to oval; freestone; flavor good where season permits of thorough ripening; shipping quality good. Tree, requires long season and good soil to be medium hardy and productive.

Yellow Tuscany: Late variety, grown extensively in southern California. Ripens about 2 wk. later than Late Crawford; fruit, yellow fleshed; large; clingstone; especially desirable for canning. Tree, productive and a strong grower.

Bilyeu: Ripens about a month later than Late Crawford. Fruit, white fleshed; medium to large; round to oval; freestone; quality fair; very firm. Tree, hardy and productive where season is long and soil rich.

Staley: Late variety grown extensively in California; ripens about 3 wk. after Salway. Fruit, white fleshed; very large; somewhat elongated and flattened laterally; freestone; flavor, delicious; flesh, very juicy and tender.

PRUNING OF PEACHES

Before a young peach tree from the nursery is planted, the top should be cut back to about 2 ft. above the bud. If the side branches that are left are large they should be pruned back to stubs 2 to 3 in. long; if they are slender, the tree should be cut back to a cane. All injured roots should be cut back smoothly, and all of the roots should be cut back to not exceed 6 in. in length.

The pruning the second spring should be with the object of retaining the strongest two, three, or four main branches that will tend to form the strongest and best balanced tree; all other branches should be pruned off close to the trunk.

The pruning the third spring consists in thinning out the secondary branches that, when the tree becomes larger, would exclude the light. Where two branches take up much the same space, the weaker or more irregular branch should be removed. The branches left should be cut back from a third to a half of the previous season's growth, and if a tree possesses some branches that have made an excessive or irregular growth, these branches should be cut back even more severely in order to maintain a well-balanced top.

Beginning with the fourth spring, when the form of the tree has become well established, and continuing throughout the life of the tree, the pruning consists in cutting back the annual growth about a third to a half on the leading branches, and in keeping the top well thinned. The cutting back of the tips of the branches will tend to cause a thickening of the top, thus making the thinning of the top a necessity. In cutting back any leading branch, the cut should be made just above or beyond a side branch, or if no such side branch exists, the cutting should be made to a bud on the outside of the branch. Any broken branches should be cut off smoothly where they join another branch.

The annual cutting back of bearing peach trees reduces the bearing surface and may considerably reduce the crop, because the peach bears its fruit principally on the previous season's wood or twig growth, although some of the fruit is produced on spurs and short twigs that develop on portions of branches that are 2 and in some cases even 3 yr. old. Most commercial varieties of peaches, however, set such an abundance of fruit buds that some annual cutting back is necessary to keep them from overbearing and to retain the vigor of the tree.

Unpruned peach trees frequently produce a somewhat larger crop the first season than trees that have been regularly pruned, but after the first or second crop the pruned trees generally produce the larger crop, as they are likely to be more vigorous and to have a greater annual growth. Peach trees that are regularly pruned are much longer lived than unpruned trees, and the buds are less likely to be injured in winter.

SPRAYING OF PEACHES

The principal insects attacking the peach are the peach borer, plum curculio, and San José scale. The principal diseases of the peach are brown rot, black spot, or scab, leaf curl, and yellows. Spraying is not effective for yellows, the only known means of control being to take out and burn diseased trees as soon as they are discovered.

The following method of spraying should be followed for peaches:

1. Spray, before the buds open, with lime-sulphur mixture (at sp. gr. 1.03 to sp. gr. 1.035—that is, concentrated lime-sulphur of 33° to 34° Baumé diluted 1 to 8 or 1 to 9 with water) for the control of scale and peach-leaf curl.

2. Spray just after petals fall from blooms with a mixture of 2 to 3 lb. arsenate-of-lead paste to 50 gal. of water to control the curculio.

3. Spray when calyx is being shed from the fruit with self-boiled lime-sulphur (about 8 lb. sulphur, 8 lb. lime, 50 gal. water) to which has been added 2 to 3 lb. arsenate of lead for each 50 gal. of solution, for the control of curculio, scab, and brown rot.

4. Spray with self-boiled lime-sulphur (same formula as given in paragraph 3) about 3 wk. after the third spraying for the control of scab and brown rot.

5. For mid-season and late varieties, such as Champion, Elberta, Fox Seedling, Salway, and Bilyeau, spray with self-boiled lime-sulphur (same formula as given in paragraph 3) about 2 wk. after the fourth spraying, for the control of scab and brown rot.

PEARS

VARIETIES OF PEARS

Of the many thousand varieties of pears the following are the most important commercially; they are named approximately in the order in which they mature, the summer, fall, winter, varieties being given in the order named:

Bloodgood: Of considerable importance throughout California. Tree, generally hardy, close grower, having deep reddish-brown wood; short jointed; comes into bearing early and bears an abundance of fruit. Fruit, yellowish-white flesh; though fairly good in flavor is not very attractive in appearance.

Clapp's Favorite: Tree, very strong grower; young wood, reddish, dark brown; tree tends to rather upright growth, but when fruiting will spread considerably; bears its fruit evenly and is very productive. Flesh very fine and very juicy, being sweet and vinous in flavor.

Bartlett: European variety and known in Europe as the Williams Bonchretien. It is the king of pears commercially, has a very good market, and is one of the most profitable varieties. Tree comes into bearing early; generally healthy and vigorous, making a strong growth but varying somewhat in fruitfulness. Fruit, large, varying somewhat in form; when ripe is of a yellowish color, often with an attractive blush on one side; flesh, white and juicy; has a musky and perfumed flavor.

Beurre Hardy: In different localities may be a summer pear, an early autumn pear, and in some localities it becomes a late autumn pear. Tree, a strong, erect grower, with an abundance of foliage. Fruit, somewhat sub-acid but of rich, delicious flavor, and is well received in some markets.

Flemish Beauty: Popular variety, being known by more than twenty names. Tree, vigorous and hardy; tends to come into bearing early; heavy bearer. Fruit, generally large, yellow, often marbled and covered with patches of light russet; flesh, white, juicy, sweet, and often slightly musky in flavor. On the Pacific coast it must be picked early and ripened in the house to be of the best quality.

Seckel: Very small pear, but what it lacks in size is made up in quality. Fruit, very sweet and juicy, making a delightful pear for eating, pickling, or spicing. Because of small size, does not meet with much demand in many markets, but those markets that do know it appreciate it highly and will pay good prices when it is well grown. Tree, generally small, with a rather rounded head; likely to be a rather slow grower, but is fairly hardy and generally healthy.

Howell: Increasing in popularity on the Pacific coast, due largely to its handsome appearance and tendency to be an annual bearer. Fruit, light yellow, often with a red cheek; flesh, white and melting, generally juicy. Tree, generally vigorous grower of upright habit; comes into bearing early and bears annually.

Sheldon: Very popular pear in parts of the East; often troubled with core rot, due no doubt to its hanging on the tree too long. Tree, upright grower, vigorous, and early, generally producing a round-headed tree and tending to be a good bearer. Fruit, of medium size and roundish; greenish yellow; often has a light russet color, and at times becomes a bright red where exposed to the sun; sweet, aromatic, juicy.

Duchesse d'Angoulême: Grown extensively along Atlantic seaboard. When well grown it is an attractive pear of good quality, but must be well grown to be profitable. Fruit, varies in size, from large to very large; greenish yellow, with more or less streaks and spots of russet; flesh, white, juicy, and fine in flavor. Tree, generally vigorous and does very well grafted on the quince; is often used in double working for other varieties.

Beurre Bosc: Unfortunately, not as well known in America as it should be. When well grown, is one of the most delicious varieties to be found anywhere; its unattractive appearance has been against it, but as people come to know it better, the demand is constantly increasing. Fruit, large size and generally tapering; color varying from dark yellow to green, often covered with a cinnamon russet; there may also be streaks or dots of red on the fruit; in some regions fruit becomes almost entirely russet; flavor very delicious; has a melting buttery, very rich flesh. Holds in storage well.

Beurre Clairgeau: Fruit, very large and of pyriform shape; apt to vary in size; color, very yellow; often contains some cinnamon streaks covered with russet dots; varies extremely in quality; because of its attractiveness, often brings high prices and at times one of the most profitable varieties. Tree, an erect grower, and very vigorous, has handsome foliage, is a heavy bearer, and comes into bearing early.

Beurre d'Anjou: Becoming one of most popular pears on Pacific coast, also popular in many of the Eastern States. Fruit, very good quality and in good modern storage house can be held until Jan. or even Feb.; generally large and has a pyriform shape; stem short; color, generally greenish yellow—may have trace of russet and at times a shade of crimson on the sunny side; flesh, fine grained, very juicy; flavor rich, generally perfumed. Tree, in some parts of the country is a fair grower, and in other regions a rank grower.

Doyenne du Comice: French variety and has practically brought top prices for American pears, having sold as high as $10 per box in the Rogue River Valley; one of the favorite English Christmas pears and holds up very well in cold storage. Tree, fairly vigorous, upright grower, although with age becoming rather broad and spreading; unfortunately, comes into bearing late and is not very productive. Fruit, generally large, of pyriform type; color, greenish yellow and often russeted;

on the sunny side becomes shaded with crimson; quality, highest; flesh, white, melting, and has an abundance of sweet, rich juice.

Glout Morceau: An old pear, formerly grown quite extensively in the East, but on account of susceptibility to scab and blight is not grown as much as formerly, should, however, receive more attention. Tree, has a dark wood; generally of a spreading habit, usually hardy, and although it does not come into bearing early, when matured produces good crops and tends to bear regularly. Good variety to use as a dwarf. Fruit, highly prized by English trade, being on a par with Comice; varies somewhat in form; generally large; of a short pyriform type, at times approaching an oval; color, pale greenish yellow; flesh is very fine grained, white, melting, sugary, and extremely delicious.

Kieffer: Hybrid, supposed to be a cross between Chinese sand pear and Bartlett or some similar variety; has become the most popular variety in the South and parts of the Middle West; increasing in popularity, especially as a cooking pear; has been one of the most resistant to the blight. Fruit, ships and keeps well; probably stands rougher handling than most European and American varieties; quality, poor for eating but good for cooking; grows from a medium to a large size, generally oval pyriform shape; often sprinkled with small dots and has a tinge of red on the sunny side; flesh, coarse and juicy.

Le Conte: Le Conte is a variety that is grown rather extensively, especially in the South. It is supposed to be a hybrid between the Chinese pear and some other cultivated variety. Tree, generally vigorous, prolific, and hardy. Fruit, like the Kieffer in quality, is poor and is not grown in regions where the Bosc, Comice, etc., succeed; skin is generally yellow; large, pyriform.

Eastern Beurre: Grown quite extensively on the Pacific coast, especially in California; very late winter variety, often keeping until April. Fruit, color is generally yellow, may contain some russet, often has a brown cheek, and occasionally has patches of russet; when well grown, flesh is fine, white, sweet, and juicy. Tree, makes a moderate growth, has a round head and under favorite conditions is a good bearer; must be grown on good, rich soil.

Columbia: Being grown to some extent in California and is valued in parts of the South. Tree, good bearer and handsome grower. Fruit, yellow and when fully matured often is deep orange.

Lawrence: One of hardy winter varieties valued in the East. Tree, generally a good bearer and a fair grower. Fruit, in markets where it is known brings a good price; color, light yellow with some russet; flavor, generally melting, sweet, and aromatic; juicy; medium in size.

Winter Nelis: King of the winter pears. When well grown, reaches superb quality. Tree, however, often comes into bearing late and the fruit often tends to become rather small. Must be planted on deep, rich soil and thinned well if it is to succeed. Fruit, generally yellow in color, but may have patches of russet; when well grown, flesh is very fine grained and buttery, sweet, juicy, and of very good quality; generally a yellow white. Can be kept well by proper handling.

Patrick Barry: Receives more diversity of comment than almost any other variety, being condemned by some and praised by others. It is one of the few pears that can be shipped through the tropics. On the Pacific coast it is displacing the Winter Nelis in certain regions. Fruit, an elongated pyriform, fairly large; color, will vary from almost a complete russet to a rich golden russet or a deep yellow. Flesh, generally white, juicy, and melting; may vary extremely from very poor to fair. Tree, comes into bearing early and tends to bear regularly.

PRUNING OF PEARS

The same general principles of pruning that were given in the discussion of the apple apply equally well to the pear. The first 3 yr. the pruning should be practically the same as for the apple, the laterals being chosen and the framework being built up in the same way.

After a pear tree comes into bearing, however, close attention must be given to pruning, and pruning in such a way as to produce a growth of soft, sappy twigs or branches should be avoided, as such a growth is easily injured by fire blight. The pruning should be done regularly, and long, rangy branches that in time will have to be headed in severely should not be allowed to develop, for such heading in stimulates a rank growth of soft wood.

Summer pruning, when properly and not too severely done, is very effective on the pear, because it does not tend to stimulate a growth of soft wood and tends to throw the tree into heavy bearing. Terminal growth of branches checked in the summer will avoid the necessity later of heading in long, rambling branches, and will also force the formation of twigs further down, on the branch that in turn will bear fruit buds and thus better distribute the crop over the tree. As many pears have a tendency to produce a large percentage of their buds near the tips of the branches, summer pruning on such varieties is particularly desirable.

SPRAYING OF PEARS

The most serious insect pests of the pear are the pear psylla, leaf-blister mite, San José scale, coddling moth, and pear slug. The most destructive diseases attacking the pear are fire blight, and pear scab.

For the control of the insects and diseases of the pear that can be controlled by spraying the following system of spraying will be found effective:

1. The first spraying of the pear should be the same as for the apple, the spray solution being the same and applied before the buds swell. This spraying is for the control of the San José scale and leaf-blister mite.

2. The second spraying of the pear is likewise given at the same time as the second spraying of the apple (before the blossoms open), but the fungicide used may be weaker and no arsenate of lead is needed. In this spraying a dilute lime-sulphur mixture (at sp. gr. 1.006—that is 33° Baumé lime-sulphur solution diluted 1 to 50 with water) should be used; if Bordeaux is preferred, the same Bordeaux as used for the second spraying of the apple may be used. This spray application is for the control of the pear scab.

3. While the petals of the blossoms are still falling and the calyx is still open, spray with arsenate of lead (2 to 3 lb. arsenate of lead, 50 gal. water) and the same lime-sulphur solution given in paragraph 2. This spraying is for the control of the coddling moth, pear scab, and any other fungus diseases present.

4. After the blossoms have fallen, spray with dilute kerosene-soap emulsion (1 part kerosene-soap emulsion stock solution, 6 parts water), or whale-oil soap (1 lb. whale-oil soap, 4 or 5 gal. water), or one of the tobacco extracts (a preparation guaranteed to contain at least 2.7 per cent. nicotine diluted with 65 to 100 parts of water). This spraying is for the control of the pear psylla and should be repeated at intervals of 3 to 7 da. until the insects are under control.

5. From 10 to 14 da. after the spraying described in paragraph 3, spray with the same lime-sulphur-arsenate-of-lead solution. This is principally for the control of the coddling moth and pear scab.

6. For the entire control of the coddling moth, an arsenate-of-lead spray (2 to 3 lb. arsenate of lead, 50 gal. water) may have to be applied in July, Aug., or even as late as Sept.

7. The green aphis is controlled in the same way as on the apple. This pest should be sprayed for as soon as it appears, before the leaves curl, and is easy to control if this rule is followed. The green aphis has a number of broods and can rarely be controlled with one spraying.

8. The fire blight of the pear cannot be controlled by spraying. Prune out all affected parts as soon as infection is detected, cutting from 6 to 10 in. below the lowest affected part. Disinfect all cut surfaces with corrosive-sublimate solution (1 part corrosive sublimate to 1,000 parts of water). Coat all large wounds with paint or gas tar.

GRAPES

VARIETIES OF GRAPES

Not less than 300 varieties of grapes are offered by nurserymen to the grape growers of the United States. The following list of varieties of grapes includes those of the various classes that are generally considered the most important commercially. The varieties are arranged under the botanical groups to which they belong, a list of varieties being given, and then the particularly important ones being described.

Vinifera Grapes.—Black Ferrara, Black Hamburg, Black Morocco, Cornichon, Emperor, Gros Colman, Malaga, Mission, Muscat, Palomino, Rose of Peru, Sultana, Thompson's Seedless, Tokay, Verdal.

Black Ferrara: In California, considered excellent both for local market and for shipping a long distance. Bunches and berries, large, and berries cling well to stem; berries, black; flavor, superior; skin, thick; and pulp, firm.

Cornichon: Also known as Purple Cornichon and Black Cornichon. Vine, very vigorous and bears large, loose, bunches of grapes on long peduncles; berries, large and long, more or less curved; skin, dark in color, spotted and thick; berries, borne on long pedicles; quality, not of the best, but variety is desirable because of its excellent shipping qualities, lateness, and curious shape of the grapes.

Malaga, or White Malaga: Is grown in southern California as a table grape and for raisins. Vine, vigorous; bunch, very large, loose, shouldered, long, borne on a long, flexible stem; berries, very large, oval, yellowish green, covered with white bloom; skin, thick; flesh firm; of very good quality.

Mission: Delicious table grape, grown more or less in all parts of California having vineyards, but not largely shipped out of the state. Vines, very vigorous and productive. Bunches, of medium size, slightly shouldered, loose; berries, of medium size, round, dark-purplish black, heavy bloom; skin, thin; pulp, juicy; very sweet.

Muscat, or White Muscat of Alexandria: Leading table grape of Pacific coast. Vines, although short and straggling, are vigorous and productive, bearing often two and sometimes three crops annually; bunch, long, loose, shouldered; berry, oblong, light yellow, nearly transparent, covered with bloom; skin, thick; pulp, firm; very sweet, rich, with a musky flavor.

Thompson's Seedless: Vines, very vigorous, having an especially long trunk and long canes; bunch, large, cylindrical, well filled; berries, below medium or small, oval; skin, rather thick, of fine golden-yellow color; flesh, firm, crisp, juicy; quality, very good; as name implies, this variety is seedless and is now the most popular seedless grape grown on the Pacific coast, being found in vineyards in all parts of Vinifera grape-growing regions.

Tokay, or Flame Tokay: Leading shipping grape of Pacific coast. Vines, very vigorous, all parts being large; bunches, very large, sometimes weighing 8 or 10 lb., compact shouldered; berries, very large, oblong, red or reddish, covered with heavy bloom; skin, thick; pulp, firm; season, late; quality, rather poor.

Labrusca Grapes.—Agawam, Brighton, Campbell Early, Catawba, Concord, Diamond, Eaton, Empire State, Gaertner, Herbert, Iona, Jefferson, Salem, Vergennes, Winchell, Worden, Niagara.

Agawam: Best known of the hybrids between Labrusca and Vinifera grapes. Qualities which commend it are large size of bunch and berry; beautiful purplish-red, oval grapes; rich, sweet, aromatic flavor; attractive appearance; excellent keeping qualities, vigor of vine, and capacity for self-fertilization.

Catawba: One of the four standard grapes of eastern America. Characters which give it prominence are: adaptability to many soils; splendid keeping qualities; rich, sweet delicious flavor when fully ripe; vigorous, hardy, productive vine; large handsome bunch, with attractive dull purple-red berries; skin, thick but not disagreeable; flesh, juicy, fine grained, sweet, and rich. The chief defects of the variety is that it is susceptible to fungi, and its lateness keeps it from being grown in very northern regions.

Concord: Ranks first among the grapes of eastern America. Probably 50% of the grapes grown in this eastern region are Concords and at least 75% of those put on the markets are that variety. Characters of Concord which have enabled it to take first place in eastern America viticulture are: elasticity of constitution whereby it adapts itself to many soils and climates; its great productiveness; hardiness; ability to withstand diseases and insects; certainty of maturity in northern regions; and attractiveness from size of bunch and berry, both of which are usually uniform, the latter of a beautiful blue-black color.

Diamond: One of leading green grapes of the Labrusca group, being surpassed in quality and beauty by few other grapes. Vine, early, hardy, productive, vigorous. Fruit, of splendid quality; rivals Niagara for first place among green grapes; ships and keeps fairly well, and makes a very good white wine.

Worden: Seedling of Concord and has most of the good qualities of its parent; differs chiefly from Concord in having larger berries and bunches, in being better in quality, and in being a week earlier; equally as hardy, healthy, vigorous, and productive. Its fault that keeps it from being as popular as the Concord is that it is more fastidious as to soils and the berries crack badly.

Niagara: Has been leading green grape, but plantings of it have so signally failed that it is now ranked below several other green grapes. In vigor and productiveness, nearly equals the Concord, but it falls far short of this variety, and of a number of green grapes, in hardiness. Fruit, although highly esteemed by many, has too much foxiness to be high in quality; shell badly and do not keep well; of no value for wine making; ripens about with Concord; clusters, of medium size or large, usually shouldered, compact; berries, large, oval, light green or pale yellow; skin, thin, tender, astringent; seeds, separate easily from the pulp, rather numerous, and of large size.

Aestivalis Grapes.—Cynthiana, Norton, Berckmans, Delaware, Herbemont, Lenoir, Moir, Walter.

Norton: Leading wine grape in eastern America, but the fruit has small value for any other purpose. Vine, hardy, but requires a long, warm season to mature its fruit; has great adaptability to different soils, but thrives particularly well in rich alluvial soils; vines are robust, very productive, as free or more so from diseases than any other native grape, and very resistant to insects. Bunches, of medium size. Berries small, almost black; pulp, firm, rich, and spicy; pure-flavored but acid; skin, thick; fruit keeps well.

Delaware: Standard grape in quality for eastern America. Vines, productive, hardy, and adapted to many soils and conditions; fairly immune to fungus diseases; next to the Concord, probably most popular grape for garden, commercial vineyard, and wine press now grown in eastern United States. Fruit, matures sufficiently early to make crop certain; its handsome red color makes it attractive; grapes keep and ship well. Faults are: Small size of vine, bunch and berry, and slowness of growth; suffers very seriously from the depredations of robins.

Riparia Grapes.—Bacchus, Canada, Clinton, Elvira, Janesville, Noah.

Bacchus: Wine grape grown from seed of Clinton, an older and better known grape, which it much resembles in vine characters, but surpasses in quality of fruit and in productiveness; little by little it is superseding its parent. Vines, vigorous, hardy, productive, free from mildew, and adapted to a great variety of soils. Bunches and berries, small, latter dark red; quality does not fit it for a dessert grape, being too sour, yet if left until after frosts it becomes very good.

Noah: Rather largely grown in Missouri, where it is much used for wine making. Vine, remarkable for health and productiveness. Fruit, green, one of the few good Riparia grapes of this color. Clusters, for one of its species, are large, as are also the berries. Fruit ripens with the Concord or a little later, and neither keeps nor ships well. Seeds separate with difficulty from the pulp and are numerous; pulp, tough, juicy, and rather acid. Used for making white wines.

Rotundifolia Grapes.—James, Thomas, Mish, Flowers, Memory, Scuppernong.

James: Probably best general-purpose Rotundifolia grape for the South. Ripens toward the end of Aug. and remain on vines 2 or 3 wk. longer. Vines, vigorous, productive, healthy; bunches bear from 4 to 12 large, blue-black grapes of large size; skin, thin; pulp, sweet and juicy; quality, very good.

Flowers: One of the very late Rotundifolias, ripening last of Sept. and remaining on the vine until last of Oct. Vines, vigorous, healthy, and exceedingly productive; bunches, bearing from 10 to 20 purplish-black, oblong, large berries; skin, thick and tough; acid, pulpy; quality, good only when very ripe.

Memory: Considered best Rotundifolia table grape. Vines, vigorous and productive; bunches, bearing from 4 to 12 large, round, brownish-black berries; skin, thick and tough; pulp, juicy, sweet, tender; of very best quality.

Scuppernong: Oldest of cultivated varieties of Rotundifolia grapes, and still largely cultivated; also lightest in color of the varieties commonly cultivated, being a brownish amber. Vines, very vigorous, very healthy, and very productive. Bunches bear from 6 to 10 large berries; skin, thin; pulp, sweet, juicy, vinous, and with a peculiar flavor characteristic of this variety; quality, very good.

PRUNING AND TRAINING THE GRAPE

In discussing the pruning of the grape, the following technical terms are often used:

Trunk—the body of the vine when 2 or more yr. old.

Arm—a branch from the trunk when 2 or more yr. old.

Cane—1-yr.-old branch of an arm or of the trunk.

Spur—a very short but annually lengthening arm, from which cane renewals are made.

Shoot—a growing, leafy branch of the current season.

When young grape vines are to be planted in permanent places in a vineyard, the roots should be rather severely cut back, usually leaving stubs from 6 to 10 in. in length, and all dead or injured roots cut out. The top almost always should be cut back to a single cane and to two or three buds.

The aim for the first two or three seasons should be to develop a good root system; to accomplish this the growth of the first summer is cut back, late in the winter or early in the spring, to two buds, leaving the vines in apparently the same condition as at setting. At the end of the first year all grapes to be grown on trellises should be tied up to keep them out of the way of the cultivator. Grapes to be grown on stakes are staked at this age also.

Any fruit set the second season should be removed before it has attained much size. Two years after setting, the vines should be ready to train permanently on the trellis or stakes, as the case may be. East of the Rocky Mouutains all species of grapes are grown commercially on trellises, or on wires stretched on posts. On the Pacific coast they are nearly always grown on stakes.

Whatever the method of pruning and training chosen, the grower must keep in mind the relationship of the wood to fruit bearing; that is, grapes are borne on the base of shoots of the same year's growth, which in their turn spring from the canes of the preceding year.

The average yield for a Concord grape vine is about 15 lb. In order to produce this quantity, from forty to sixty clusters of grapes are required. As each shoot bears from two to three clusters, usually two, twenty to thirty buds must be left on the previous year's growth, or sufficient spurs to furnish the required number of clusters. These buds might be left on a single cane; but usually two, three, or more canes are selected, variously distributed on one or two main stems in accordance with different systems of training and trimming. Good pruning, then, consists in removing all wood except canes or spurs sufficient to furnish the shoots necessary for the desired number of clusters.

The time for pruning grapes extends from the dropping of the leaves in the fall to a period just before the swelling of the buds in the spring. Some vineyardists prune after a vigorous flow of the sap has begun and claim that no serious injury results, but such bleeding must be devitalizing to the vines. In sections where winters are severe it is often necessary, in order to prevent freezing, to cover the vines in position or to lay them on the ground for covering. To lessen the area to be covered, it is best to prune some before covering. In such pruning it is advisable to leave more wood than is actually needed for the next year's crop, as there is danger of some of the buds being broken off or of the canes being otherwise injured by the covering and uncovering. It is seldom advisable to prune when vines are actually frozen, as frozen canes are brittle and easily broken during handling.

Where the vines are in a vigorous condition the system of training to be adopted becomes somewhat optional with the grower, although there is no doubt that certain varieties do best when trained to a certain type. For example, it is generally agreed that strong-growing varieties like the Concord, Niagara, and others do best when trained with the shoots drooping, and the weaker and slower-growing varieties like the Delaware can be best trained to some form in which the shoots are upright, other conditions being the same.

SPRAYING OF GRAPES

The most serious insect pests attacking the grape are phylloxera, grape-vine fidia or grape-root worm, grape-vine flea beetle or steely flea beetle, grape-leaf hopper, grape-berry moth, and the rose chafer. Some one or several of these pests must be reckoned with in most parts of the country.

The serious diseases of the grape are black rot, downy mildew, powdery mildew, anthracnose, and chlorosis, or yellow leaf.

The best method of spraying for the control of such insects and diseases of the grape that can be controlled by spraying will vary. The following, however, will serve as a guide:

1. For the control of the grape-vine flea beetle, spray thoroughly just before the buds begin to swell with arsenate-of-lead solution (4 lb. arsenate of lead to 50 gal. water). Later in the season, when the worms appear on the leaves, arsenate of lead should be added to one of

the Bordeaux sprayings (8 lb. arsenate of lead to 150 gal. Bordeaux mixture).

2. If anthracnose has to be combated, apply to the surface of the canes when the buds are swelling, but before they begin to open, a warm, saturated solution of copperas (iron sulphate), to which may be added if necessary to make it stronger, 1% of sulphuric acid. This solution is very caustic and should be handled with care. If the saturated solution of copperas is used alone the solution may be sprayed on, but if the sulphuric acid has been added, it is safer to apply it to the canes with a swab. Thoroughness is essential in this work, as all the surface of the canes must be covered if the solution is to be effective. Anthracnose is not satisfactorily controlled by Bordeaux alone.

3. For the control of the black rot, and incidentally for the control of downy mildew and powdery mildew, spray with Bordeaux mixture (4 lb. copper sulphate, 4 lb. lime, water slaked, and 50 gal. water) just as the pink tips of the first leaves appear.

4. From 10 to 14 da. after the spraying described in paragraph 3, spray again with the same strength Bordeaux for the same troubles.

5. Repeat the spraying just after blossoming.

6. Repeat the spraying in from 10 to 14 da. later.

7. Repeat the spraying in from 10 to 14 da. later.

8. For the control of the grape-vine fidia, or grape root worm, while the beetles are feeding on the foliage about the middle of June, spray with a molasses-arsenical mixture (1 gal. molasses, 6 lb. arsenate of lead, 100 gal. water).

9. For the control of the grape leaf hopper, when the hoppers appear, spray with a nicotine preparation guaranteed to contain at least 2.7% nicotine diluted with 65 to 100 parts of water.

10. For the control of the rose chafer, when the insects are present, spray with glucose-arsenate mixture (10 lb. arsenate of lead, 25 lb. glucose, 100 gal. water).

11. If the sprayings for black rot are not necessary, other means of control must be applied for the powdery mildew. In such cases in dry climates, dusting the vines with flowers of sulphur is effective.

12. If the vines are suffering from chlorosis, or yellow leaf, this trouble is thought by some to be overcome by applying a small quantity of iron sulphate to the soil about the vine. But as a number of the American varieties are known to be free from this trouble, planting them is probably the wiser course.

PLUMS

VARIETIES OF PLUMS

Plums grown in the United States and Canada may be divided into four groups: (1) Plums that have been introduced from Europe; (2) native plums; (3) plums introduced from Japan; and (4) hybrid plums.

Of the European plums, only two species are of special interest to American growers. These are the *Domestica*, to which most of the large European plums grown in America belong, and, second, the *Insititia*, which are smaller plums and include fewer species of value.

The native plums may be divided into the following prominent species: (1) *Americana*, known as the red plum, yellow horse, hog plum, and goose plum; this plum is grown over a large portion of America. (2) The second division, the *Hortulana*, which includes a number of variable plums that are adapted to a wide range of climate and especially adapted to growing in the Southern States and the Mississippi valley. The Hortulana make good stock upon which to graft varieties of the same and other native plums. (3) The third division of the native plums is *Prunus nigra*. This species of plum grows further north than any other native plum and is often called the Canadian plum. The fruit of the Prunus nigra ripens earlier than that of the Americana, or

Hortulana. It is more oblong in shape, darker in color, has less bloom and a finer skin that that of the Americana.

The plums introduced from Japan belong to the variety known as *Prunus triflora.* These plums are about as hardy as the Domestica, and some of them have proven of special worth. However, many varieties of Prunus triflora that have been introduced into America have proved worthless.

Hybrid plums are produced by crossing different species. Many valuable hybrid plums are grown in America.

The following are the most important varieties of plums grown in this country:

Abundance: Triflora. Variable; several distinct strains exist; has been much overplanted. Fruit, ships and keeps poorly; subject to brown rot and drops readily; must be picked before it is ripe; color, pinkish red to dark red.

Agen: Domestica. One of the best plums of Europe or America for prune making; rich in sugar and solids; very good preserving plum; its defect is lack of size; many strains of this variety. Tree, bears regularly and heavily. Fruit, hangs well on trees; excellent for home orchard and for commercial use.

Apple: Triflora. Fruit, large and has firm, compact, red flesh; excellent keeper; fruit has peculiar flavor; inferior for dessert or kitchen. Tree, robust grower.

Arch Duke: Domestica. Well known. Fruit, large, dark, rich purple; keeps and ships well; suitable for home and market use. Tree, medium grower. Season, late.

Arctic: Domestica. Tree, hardy and productive; small; medium grower. Fruit, medium size; blue. Mid-season.

Bavay: Domestica. One of the best of the green plums; a desecndant of Reine Claude. Fruit, excellent dessert plum; high flavor; good canner; keeps well and flavor not quite equal to Reine Claude. Tree, medium size, vigorous. Season, late.

Bradshaw: Domestica. Tree, regular bearer, productive, hardy, healthy. Fruit, ships well; not very high in flavor. Ripens in peach season, which is against it. Leads all other plums in number of trees in New York.

Burbank: Triflora. Second to Abundance in number of trees planted in New York. Fruit, handsome, red; keeps and ships better than Abundance. Ripens a week later than Abundance. Tree, vigorous, but wood is brittle.

Compass: Hybrid of American type. It is being advertised as of value commercially for the Northwest. Fruit, small and of no value unless for regions mentioned.

Damsons: Insititia. Name is from Wamascus. Fruit, usually oval, black; chiefly used for making preserves. Tree, scarcely surpassed in productiveness, vigor, and hardiness by any of the plums. The Damsons show great adaptability to various soils and climates. There are a number of improved varieties of Damson, among which are Crittenden, Shropshire, a standard, and French. Many of these improved varieties excel the Damson in quality.

Diamond: Domestica. Fruit, large, well formed; flesh, coarse; flavor, poor; ships well; otherwise it is disappointing for market fruit. Tree, vigorous, hardy, and productive.

German Prune: Domestica. One of the oldest plums under cultivation; of several strains. Tree, medium to large; purplish black; flesh, yellowish green. Distributed over the whole country. Season, late.

Golden Drop: Domestica. Largest and best of the yellow plums; fit for the home garden only.

Grand Duke: Domestica. Tree, rather late in coming into bearing; fruit, excellent market plum, hangs well, and ships well; flavor moderate; good canner; large sized. Season, late.

Gueii. Domestica. One of the standards. Tree, bears early and abundantly; large, vigorous, healthy, hardy. Fruit, of poor quality, but excellent shipper.

Italian Prune: Domestica. One of the most widely grown of all plums; leading plum in the Pacific Northwest. Fruit, fine flavor; purple; attractive when cooked; ships well. Tree, large; hardy, productive; regular bearer, but often capricious as to soil and climate.

Lombard: Domestica. One of the most easily grown of all plums. Tree, hardy, productive; regular bearer; much used as a stock on which to graft weaker growing varieties. Fruit, very poor in quality.

Middleburg: Domestica. A very good late plum for New York. Fruit, purple. Not enough planted.

Monarch: Domestica. One of the most popular of the recent introductions. Fruit, of moderate quality; color, purple.

October: Triflora. Late plum. Tree, vigorous, rather tardy in bearing in some places. Mid-season or later. Fruit, dark red.

Pond: Domestica. Fruit, one of the largest; poor quality; purple.

Pottawattamie: Native. Especially adapted to northern latitudes. Fruit, good quality for a native plum. Tree, dwarf, vigorous, productive.

Quackenboss: Domestica. Tree, large, vigorous, hardy. Fruit, purple, large, good quality. One of the best.

Reine Claude: Domestica. Fruit, unexcelled in quality. Tree, moderate; grows very poorly in the nursery; productive; is apt to sun scald.

Satsuma: Triflora. Fruit, red flesh; one of the best of its class in quality; keeps and ships well; is subject to brown rot in the Southern States. Tree, fairly good grower; hardy; productive.

Washington: One of the largest of the Reine Claude or green gage type. Fruit, fine flavor; suitable for home use.

Wayland: Hortulana. Suitable for Central Iowa and Nebraska. Fruit, sour and small; excellent for jelly.

Wood: Americana. Can be recommended for the cold parts of the country. Fruit, red.

Yellow Egg: Domestica. Fruit, largest and most handsome of the yellow plums; good for culinary use.

PRUNING OF PLUMS

As a rule, the plum should be pruned as little as possible. More growers overprune plum trees than underprune them; and this is a serious condition, because a plum tree will not recover from overpruning nearly so readily as will an apple tree.

Plum trees are grown in two types, or forms. The first type has a leader, or main stem, with four or five branches coming from it at different points. This type is often used in New York for the Domestica and Damson plums. The second type of pruning is more common on the Triflora group of plums; in this it is usual to start four or five branches at a head about 2 ft. from the ground, and remove the leader, making the tree into a vase shape, somewhat like an inverted umbrella; the branches should be spaced 4 to 6 in. apart on the trunk to prevent splitting.

Subsequent pruning of the plum consists of the removal of limbs which cross and in keeping the trees low. Until the trees begin to bear, as little pruning as possible should be given; if this policy is adhered to it will tend to make the trees bear early. One disadvantage attending excessive pruning is that such a practice once started must be continued.

The trees should be kept low to lessen the expense of picking. In some orchards, plum trees are shorn off at a certain height and are never allowed to make a growth of more than two or three buds above this each year. Some of the Americana varieties make such a crooked, dense growth that considerable pruning is necessary in order to allow sufficient room for the pickers to harvest the fruit.

SPRAYING OF PLUMS

The principal insect attacking the plum is the plum curculio. The principal diseases of the plum are the black knot, brown rot, plum pockets, and leaf spot, peach yellow and little peach.

The following method of spraying the plum has been recommended:

1. If San José scale is present, spray just before the buds open in the spring with lime-sulphur solution (sp. gr. 1.03—that is, concentrated lime-sulphur of 33° Baumé diluted 1 to 8 with water).

2. Just after the blossoms fall, spray with arsenate of lead (3 to 4 lb. arsenate of lead, 100 gal. water) for the control of the plum curculio.

3. About 10 da. after the blossoms have fallen, or about the time when the shucks, or calyces, are being shed from the fruit, spray with arsenate of lead (3 to 4 lb. arsenate of lead, 50 gal. water) combined with self-boiled lime-sulphur (8 lb. sulphur, 8 lb. lime, 50 gal. water), for the control of the plum curculio, leaf spot, and brown rot.

4. About 2 to 3 wk. after the spraying described in paragraph 3, spray with self-boiled lime-sulphur (8 lb. sulphur, 8 lb. lime, 50 gal. water) for the control of leaf spot and brown rot.

5. About 1 mo. before fruit ripens repeat spraying given in paragraph 4 for the control of the fruit spot and brown rot.

CHERRIES

VARIETIES OF CHERRIES

There are two main types of cherries, sour cherries and sweet cherries. The sour cherries most commonly grown are included in two general groups, the *Montmorency group*, and the *Morello group*. The most important of the sour cherries commercially are:

Baldwin: Morello type. Tree has a stout spreading top and is regarded as promising.

Brusseler Braune: Very late in ripening, July 15 to 25. Tree, medium to large, upright in type; long branches; slender; twigs, light gray and covered with numerous lenticels; leaves, medium in thickness and slightly rough; dark green on the upper surface, much lighter below; serrated on the edge. In some sections, a poor bearer.

Dye House: Montmorency group. Fruit, medium to small; smaller than Early Richmond and Montmorency; quality, very good; flavor, slightly acid.

Early Richmond: Montmorency group. Season, early, or moderately early, June 15. Tree, usually regarded as productive, but inclined to be short lived; hardy, vigorous, profuse, and regular bearer. Fruit, medium in size, light red; poor for shipping.

English Morello: Morello group. Classed as one of the best sorts, being very productive and hardy; a firm and excellent shipper. One of the oldest varieties and has been grown in this country for many years. Season, late, about July 15 to 20 in Central Iowa. Tree, medium and spreading; slender and hardy in growth.

Montmorency: Montmorency group. Much confusion exists in regard to the Montmorency variety. There are at least two strains, the long-stemmed, or Montmorency Ordinaire, and the sort-stemmed, which is the large Montmorency and considered to be of the best quality, but a poor bearer. The long-stemmed variety is the one most generally distributed and the one that is generally secured by the public even when named Montmorency or Montmorency Ordinaire or Montmorency Extraordinaire, the short-stemmed Montmorency being practically non-existent in this country. The Montmorency Ordinaire is the Standard variety, and fruits from June 20 to about July 1, or mid-season.

Ostheim: Morello group. Really consists of a number of types. Has been grown in the United States for nearly a century. Fruit, round, medium to dark red; juicy; skin, tough; quality, fair. Planted in large numbers in some sections.

Suda: Morello group. Hard to distinguish the fruit of this variety from Wragg or English Morello, the only essential difference being in the stem; but the tree is more upright and can thus be readily distinguished from these varieties. Tree, good, prolific bearer in some sections.

Wragg: Morello. Regarded by some as little more than a large English Morello, which is somewhat later; is being considerably planted in all parts of the Northwest; now considered a standard variety.

The two main groups of sweet cherries commercially are the *Bigarreaux* and the *Dukes.* The principal varieties of the Bigarreaux group are:

Ring: Fruit, very large, almost flat, with a sweet flavor; flesh, firm; ripens in mid-season; high in quality; and is regarded as promising.

Centennial: Said to be a seedling of Napoleon; flesh somewhat similar to Yellow Spanish. Considered promising, especially on the Pacific coast.

Elton: Tree, good grower, but lacks productiveness in some sections. Fruit, very large, heart shaped; skin, pale yellow, with red blush; flesh, medium light, firm, with a sweet flavor of the best quality. Desirable for some sections. Mid-season.

Lambert: Originated in Oregon. Fruit, large to very large; heart shaped; color, dark amber, turning a dark red magenta as fruit matures; flesh, dark, rich, firm, and juicy, with a good flavor; pit, small for so large a fruit.

Napoleon, or Royal Ann: One of the most popular varieties. Tree, strong; vigorous in growth; very productive. Fruit, large, good quality; flesh, light colored. Mid-season.

Rockport: Early to mid-season. Fruit, quality very good. Tree, moderate in vigor.

Black Tartarian: One of the oldest and most popular varieties; lacks in vigor and hardiness when compared with Windsor and Napoleon. Fruit, very large, dark red; flesh, of good quality.

Windsor: Origin, Ontario, Canada. One of the new varieties that has made a good reputation; should be included in almost all cherry orchards. Tree, hardy, vigorous, and very productive. Fruit, heart shaped, dark liver colored; flesh, dark red, firm, fine quality.

Wood, or Governor Wood: Recommended for all near-by markets and home use. Tree, strong, vigorous grower, and productive. Fruit, medium to large; pale yellow, with a reddish blush; flesh, tender and juicy; of good quality.

Yellow Spanish: Old and well-known variety and does well under many conditions. Tree, strong grower and productive. Fruit, large sized; good quality.

The Dukes have one very undesirable feature in that they tend to ripen their fruit over a considerable period of time. In growth of tree they vary from the upright to a round, spreading head. As stated before, these are classed with the sweet cherries, but in flavor the fruit is neither sweet nor sour, being rather half way. It is usually tender, juicy, excellent in flavor, and can be used both fresh and preserved. In so far as acreage is concerned, the Dukes do not occupy a very important position, for they are poor shippers and are subject to rot.

Eugenie: Tree, lacks vigor, grows upright, and is fairly productive; one of the earliest to ripen and lasts over a long season; flesh, and juice, dark red; and flavor fine.

Louis Philippe: Downing states that the tree is upright, spreading in growth; skin, rich; dark; flesh, dark red. Said to be productive. Medium to late.

Magnifique: One of the latest of all cherries to ripen and of value on this account. Tree, upright, spreading grower, productive; but the fruit is of too light a shade of red to take well on the market; flesh, pale yellow, firm, and juicy.

May Duke: One of the most popular of all varieties, being one of the earliest to ripen. Tree, vigorous grower, productive. Fruit, dark red.

Montreuil Belle De: Comparatively new; productive and profitable. Fruit, glossy red, almost black; flesh and juice, dark red. Medium late in season and ripens in good season for a Duke.

Clivet: Tree, strong, spreading grower, frequently reported as unproductive. Fruit, color, dark red. Season, medium late.

PRUNING OF CHERRIES

Compared with other fruits, the cherry receives little pruning, especially after the first 2 or 3 yr. If the head is started within 18 in. of the ground and opportunity is given for the tree to spread, a desirable spreading habit may be started. Some of the most successful growers of cherries prefer to train their trees with a leader from which from three to five main branches are allowed to develop.

During the first year, just sufficient wood should be removed to secure the spreading habit, and no more. When a low-headed tree of this sort is forced to spread its growth, most of the fruit may be readily picked, thus materially reducing the cost of picking, and the spreading branches shade the trunk and to some extent prevent the cracking and splitting seen on some trunks.

When the trees reach bearing age, comparatively little pruning is needed other than to take out wood that crosses, and wood showing disease.

SPRAYING OF CHERRIES

Among the principal insects attacking the cherry are the black cherry aphis, plum curculio, San José scale, and other scale insects. The principal fungus diseases of the cherry are the black knot, brown rot, shot-hole fungus, or leaf blight, and powdery mildew.

The following system of spraying will be found effective in controlling the insect and disease troubles of the cherry:

1. Just before the leaf buds break, or open, spray with a lime-sulphur solution (sp. gr. 1.03—that is, concentrated lime-sulphur of 33° Baumé diluted 1 to 8 with water). This spraying is for the control of the San José and other scales.

2. Just before the fruit buds burst open, spray with a lime-sulphur solution (sp. gr. 1.007 to 1.006—that is, concentrated lime-sulphur of 33° Baumé diluted either 1 to 40 or 1 to 50 with water), to which has been added arsenate of lead (1½ or 2 lb. arsenate of lead to 50 gal. lime-sulphur solution). This spraying is for the control of the plum curculio and the fungus diseases.

3. As soon as the fruit has set, spray again with the same lime-sulphur-arsenate-of-lead solution given in paragraph 2, for the control of both the insect and the fungus troubles. In some cases it may be advisable to make two or three later sprayings with the same material.

Bordeaux mixture is sometimes used in place of the dilute lime-sulphur solution given in paragraph 2, but on account of the liability of injuring the foliage, this is not to be recommended.

QUINCES

VARIETIES OF QUINCES

There are comparatively few varieties of quinces in cultivation. The following are brief descriptions of the important commercial varieties, including information that the prospective planter would find useful in selecting varieties for his orchard:

Orange, or Apple Quince: Probably most important commercially. Tree, moderately vigorous, with spreading habits. Fruit, variable in size and shape, and is modified somewhat by the treatment it receives; it may be pear shaped or flattened on the end something like an apple; color, pale orange, surface being moderately covered with down. Flesh, firm and of good flavor. Mid-season variety and when well grown can be kept until Feb. Best general-purpose variety.

Champion: Tree, upright grower, somewhat taller than Orange. Fruit, large, pear-shaped and furrowed about the top; color, generally greenish yellow; covered with a prominent fuzz; late in maturing and in some places does not ripen well; it is one of the best keepers.

Rae, or Rae's Mammoth: Tree, small, of two-thirds the size of Orange at the same age. Fruit, large to very large; somewhat pear shaped; color, orange; surface, smooth; flesh, of good quality; ripens early but does not keep as well as Orange.

Meech, Meech's Prolific: Tree, something like Orange, bears young; fairly good cropper. Fruit, handsome but inclined to be small and not as valuable for market as some other varieties.

Missouri Mammoth: Tree, one of the largest and most handsome; bears reasonably young; generally regarded as prolific. Fruit, rich and aromatic.

Bourgeat: Tree, strong grower; regarded as a good bearer. Fruit, bright golden yellow; large in size, with a small core; good keeper; can be held until spring.

Van Deman: Recent introduction of Luther Burbank; by some claimed to be one of the hardiest and surest bearers in existence. Fruit, ripens throughout a comparatively long season and is claimed to be a good keeper.

Chinese, or Hong Kong: Sometimes catalogued as a new, unique, and distinct fruit. Fruit, may be regarded as very large in size, somewhat oblong in shape. Tree, not unlike an ordinary quince tree in habit; it is generally regarded as hardy in New York. Of no particular value for commercial growing.

PRUNING OF QUINCES

When the quince is planted direct from the nursery row and already has a good head started within a few inches of the ground, all the pruning necessary is to remove any excess of limbs and plant as it is; cutting back the terminal is not even necessary. However, if the tree has become dried in shipment and the tips of the limbs are dead, all dead parts should be pruned off.

Some quince growers prune their trees severely, as much as one-half of the new growth each year, but such men are usually those who force their trees with manures and other nitrogenous fertilizers, and who must prune severely to keep the trees within bounds. The better practice seems to be to use nitrogenous fertilizers sparingly and to prune very little.

A good plan is to head the trees from 6 to 8 in. from the ground and to allow them to grow at will until they come into bearing, the amount of pruning necessary to keep the fire blight in subjection being adequate. At the end of 4 years or so the trees may need heading back, but this is a matter of judgment in each case. In such cases, winter pruning is the best.

After the tree comes into bearing and thinning of the fruit is desirable in order to improve the size and quality of the fruit borne, heading in may be practiced. This consists in cutting back the annual growth a certain amount each year. There is, however, danger in this pruning, because the quince, like the pear, is subject to fire blight, and as excessive pruning will cause an excessive growth of tender sprouts on which the fire blight is especially severe, the pruning should be done with care and judgment.

SPRAYING OF QUINCES

The principal insects attacking the quince are the round-headed apple-tree borer, quince curculio, codling moth, and San José scale, though the latter, very fortunately, seldom attacks the quince and when it does causes very little harm. The most serious diseases of the quince are fire blight, leaf and fruit spot, or black spot, and rust, or cedar rust.

The following system of spraying the quince is followed by some of the best commercial growers:

1. Just before the blossoms open, spray with Bordeaux mixture (6 lb. copper sulphate, 6 lb. lime, water slaked, 50 gal. water); Bordeaux mixture appears to be well adapted to the requirements of the quince. Arsenate of lead (2 or 3 lb. arsenate of lead to 50 gal. of fungicide solution) should also be used with the fungicide spray at this time. This spraying is for the control of leaf and fruit spot, or black spot, rust, and curculio.

2. Immediately after the blossoms have fallen, or even while the last of the petals are falling, spray with Bordeaux mixture (3 lb. copper sulphate, 4 lb. lime, water slaked, 50 gal. water) and arsenate of lead (2 or 3 lb. arsenate of lead to 50 gal. spray solution). This spraying is for the control of the same troubles mentioned in paragraph 1.

3. From three to four other sprayings at intervals of 10 days after the spraying described in paragraph 2 will be sufficient to keep the fruit and foliage in excellent condition.

STRAWBERRIES

VARIETIES OF STRAWBERRIES

The following varieties of strawberries have been recommended for commercial planting, the varieties being named in the order of their ripening and designated as *perfect* and *imperfect*. These terms refer to the sex of the flowers. Perfect flowers have both sets of sexual organs, and varieties having them are self-fertile; varieties having only the pistils, or female organs, cannot fertilize themselves and should be planted with perfect varieties.

Michel's Early: Perfect. Fruit, pointed, conical; medium to below in size; seeds, not prominent; dull, pale red; flesh, pale, juicy, acid, subacid when dead ripe; rather soft; quality medium. Season, extra early; plant, moderately vigorous. Foliage, moderately good; rusts slightly to considerably.

Virginia: Imperfect. Plants, few in number; of medium vigor; healthy; productive. Leaves, inclined to be large; rather dark green. Blooms early in mid-season; ripens slightly before mid-season; picks easily. Seeds, deeply depressed. Fruit, large to medium, those ripening late being small; roundish conic to wedge, bluntly pointed and often with depression at apex; color, light and dark glossy scarlet, resembling Hunn. Flesh, medium red; of average firmness; mild; not high in flavor or quality. Only a fairly desirable variety.

Beder Wood: Perfect. Fruit, round to conical; medium size; pale red; seeds, not prominent; flesh, pale, juicy, acid, moderately firm, medium quality. Season, early to extra early. Plant, vigorous; runners numerous; foliage moderately good; rusts considerably.

Clyde: Perfect. Fruit, round, large to very large, pale red; seeds not prominent; flesh, pale red, juicy, subacid, pleasant, firm, and above medium in quality. Season, early to medium. Plant, vigorous, with numerous runners. Foliage, poor to moderately good; rusts considerably.

Lovett: Perfect. Fruit, pointed to wedge conical; above medium size; bright red, glossy; flesh, bright red, juicy, acid, moderately firm, and above medium in quality. Season, early to medium. Plant, vigorous, with but few runners; poor to moderately good foliage; rusts considerably. Attractive berry.

Warfield: Imperfect. Fruit, pointed conical; medium to above medium size; deep red, glossy; seeds, rather prominent; flesh, deep red, juicy, acid, moderately firm; quality, medium. Season early to medium. Plants, vigorous, with large number of runners; foliage moderately good; rusts considerably. Handsome berry and a good cropper.

Glen Mary: Perfect. Fruit, irregular, roundish to wedge conical; very large to large; deep red at base, becoming pale toward tip; seeds not prominent; flesh, bright red, juicy, rather watery; subacid, firm, of medium quality. Season, medium. Plant, moderately vigorous, with numerous runners; foliage, moderately good to good; rusts considerably.

Senator Dunlap: Perfect. Fruit, handsome, pointed, wedge shaped; medium to large in size; deep, glossy red; seeds, not prominent; flesh, rich red, juicy, tender, subacid, moderately firm; above medium quality. Season, early. Plant, vigorous, with large number of runners; productive; foliage, moderately good; rusts considerably.

Sample: Imperfect. Fruit, handsome, pointed, regular in shape; above medium to large; bright or rather deep, glossy red; seeds fairly prominent; flesh, bright red, juicy, almost watery, subacid, moderately firm; quality, medium. Season, medium to late. Plant, vigorous, productive, with large number of runners; foliage, moderately good to good; rusts considerably.

President: Imperfect. Plant has numerous runners; vigorous; somewhat injured by blight; productive; leaves, large, dark green. Blooms and ripens in midseason; picks easily. Fruit, of largest size, slightly conic; seeds, slightly depressed; attractive bright scarlet; flesh, medium light color, firm, moderately juicy, mild; fair to good quality; good variety where size and color are prime requisites.

Brandywine: Perfect. Roundish to sugar loafed; medium to large; deep, dull red; appearance, unattractive; seeds, not prominent; flesh, bright red, juicy; subacid, good, firm, and of good quality. Season, late. Plant, vigorous grower, with medium number of runners; foliage, moderately good to good; rusts slightly to considerably. Good late variety.

Gandy: Perfect. Roundish; medium to large; pale, dull red; seeds, not specially prominent; flesh, bright red, juicy, subacid, pleasant, firm; above medium to good in quality. Season, late. Plant, moderately vigorous, with a moderate number of runners; foliage, good; rusts slightly.

Marshall: Perfect. Fruit, pointed conical; large to very large; deep red; seeds, not prominent; flesh, pale red, moderately juicy, mildly subacid, firm, of good quality. Season, medium to late. Plant, vigorous, with a large number of runners; foliage good; rusts considerably. Probably better for home use than for market.

Bubach: Imperfect. Fruit, irregular wedge shaped; very large; bright red; seeds, not prominent; flesh, bright red, juicy, subacid, moderately firm; of good quality. Season, medium to late. Plant, vigorous, with moderate number of runners; foliage, moderately good, but rusts considerably. One of most satisfactory in regard to size and appearance of fruit, productiveness, and good foliage.

Steven's Late Champion: Perfect or semiperfect. Plant, sets few plants; vigorous, healthy; unproductive; leaves, large; dark green. Blooms and ripens in mid-season; picks easily. Fruit, large; retains its size well through the season; seeds, depressed; irregular in shape, but averaging wedge shaped; flesh, attractive light scarlet, well colored, firm, agreeably acid; quality, good. Plants should be set closer than most varieties.

SPRAYING OF STRAWBERRIES

The principal insect enemy of the strawberry is the white grub, though the strawberry leaf roller often does considerable damage, and the most serious diseases are the leaf spot, leaf blight, or rust. When once in a strawberry bed, the white grub can be controlled only by digging it out from below the crown of the infested plant, and by cultivating the land about the plants early in the fall. Strawberries should not be set on old sod land which is likely to be infested with white grubs. If cultivated for a year in corn or other farm crops (not potatoes) upon which the grub does not feed, a field will be rid of most of them.

The following method of spraying for the control of leaf spot and the leaf roller has been recommended:

1. Soon after the growth of the newly set plants begins, spray with Bordeaux mixture (5 lb. copper sulphate, 5 lb. lime, water slaked, 50 gal. water).

2. Repeat this spraying in about 2 wk. and two or three times more during the first season, as may be needed.

3. The second spring, before the plants blossom, spray with the Bordeaux mixture of the formula given in paragraph 1. Whenever the strawberry leaf roller is present add from 2 to 3 lb. arsenate of lead to each 50 gal. of Bordeaux solution.

4. Two weeks later give another spraying with the Bordeaux mixture mentioned in paragraph 1.

RASPBERRIES

VARIETIES OF RASPBERRIES

Red Raspberries.—The varieties of red raspberries most usually planted are:

Cuthbert: Bush, strong grower but only moderately hardy; where hardy, it is productive and is the main crop variety. Fruit, large, dull red, moderately juicy, of good quality, and a good shipper. Mid-season.

Herbert: Bush, strong grower, hardy, and very productive. Fruit, bright red, sweet, juicy, and of good quality. Mid-season. Likely to replace Cuthbert in localities where that variety is not sufficiently hardy.

Loudon: Bush, only medium grower, hardy, but not productive in all localities. Fruit, large and of good flavor. Mid-season.

Marlboro: Bush, fairly strong grower, hardy, usually productive. Fruit, medium or a little larger; bright red, and of medium quality. Best early variety.

Black Raspberries.—The most commonly planted varieties of black raspberries are:

Cumberland: Bush, strong grower; one of the hardiest, productive. Fruit, large, black, sweet, and of good quality. Season, medium, early.

Gregg: Bush, very strong grower; not hardy in all localities, but productive where hardy. One of most widely planted black raspberries. Fruit, large to very large; black, with a gray bloom; moderately juicy, sweet, and of good quality. Season, late.

Kansas: Bush, moderately vigorous grower; productive; not hardy in all localities, but promising where hardy. Fruit, above average in size; glossy black, and of good quality. Mid-season.

Black Diamond: Bush, vigorous grower; resistant to disease; very productive. Fruit, large, black; good shipper. Mid-season, a few days later than Kansas.

Ohio: Bush, strong grower; productive. Fruit, of medium size, but very seedy and for this reason very desirable for drying, because it will yield a high percentage of dried fruit to the bushel.

Palmer: Bush, strong grower; not always hardy; moderately productive. Fruit, medium size; black, juicy, sweet, and of good quality. Season, early. Probably best of the early varieties in localities where it does not winter-kill.

Purple-Cane Raspberries.—The purple-cane varieties are not of much importance commercially. Two of the best are:

Shaffer: Bush, very strong grower; fairly hardy; very productive when canes are not winter-killed. Fruit, large, dark, purplish red; juicy; quality, fair. Season, medium to late.

Columbian: Bush, strong grower; very productive when canes are not injured during the winter. Fruit, large, dark purplish red, juicy, and of good quality. Season, late.

PRUNING OF RASPBERRIES

Red Raspberry.—The wood of the red raspberry is biennial—that is, it lives for 2 yr.; but the roots are perennial—that is, they live year after year. The young canes shoot up from the roots in the spring and should be allowed to grow at will during the first season. The second spring each 1-yr.-old cane should be cut back to a height of about 2 ft. to cause the development of laterals on which the fruit is to be borne. As soon as the fruit has been picked from these in the summer, the old canes should be cut out to allow room for the development of the new canes. Some growers summer prune the young canes of the red raspberry, but this is not generally recommended.

Black Raspberry.—The wood and roots of the black raspberry are similar in growth to that of the red raspberry, but the pruning is different. As soon as the young canes that start up from the crown of the plant reach a height of 2 to 2½ ft. their tender tips, or terminal buds, should be pinched off with the fingers. This will prevent the further elongation of the cane and force the growth of the lower buds into lateral branches. The second spring the laterals of these 1-yr.-old canes should be cut back so that the cane will somewhat resemble a small conical tree, the lower side branches being cut back to a length of about 18 in. and each branch above proportionately shorter. These laterals will in turn throw out side branches on which the fruit will be borne during the summer. As soon as the fruit has been picked the old canes that bore it should be cut off close to the ground, taken out of the plantation and burned. On soils where the growth of black raspberries is very vigorous, the canes are supported by wires stretched on posts.

Purple-Cane Raspberries.—The pruning of the purple-cane raspberry is similar to that of the black raspberry, except that as the growth is somewhat more vigorous the young canes should be allowed to grow to a height of 2½ to 3 ft. before being pinched off.

BLACKBERRIES AND DEWBERRIES

VARIETIES

Blackberries.—Blackberries are a popular bush fruit and a large number of varieties are planted. Those most extensively planted are:

Agawam: Bush, vigorous grower; hardy and productive. Fruit, medium to large; glossy black, firm, juicy, sweet, and of good quality. Mid-season or a little earlier.

Eldorado: Bush, strong grower; hardy, but only moderately productive. Fruit, black, sweet, juicy, and of good quality. Season, about same as Agawam.

Mersereau: Bush, good grower but not as hardy as Agawam. Fruit, above medium size; glossy black, sweet.

Rathbun: Bush, moderately strong grower, but lacks hardiness. Fruit, large, black, and of good quality.

Snyder: Bush, vigorous and very hardy. Fruit, medium size; usually black but sometimes with a reddish tinge; juicy, sweet, and of good quality. Mid-season or a little earlier.

Dewberries.—Two of the most prominent varieties of dewberries are:

Lucretia: Bush, good grower but not hardy in northern localities. Fruit, large, glossy black, sweet, juicy, and of good quality. Season, early.

Mayes: Bush, strong grower but lacks hardiness. Fruit, very large; glossy black, juicy, and of good quality. Season, very early—earlier than Lucretia.

PRUNING OF BLACKBERRIES AND DEWBERRIES

Blackberries.—The pruning of the blackberry is also similar to that of the black raspberry, the growth of the wood and of the roots being the same, except that the suckers, or young canes, spring up from the roots. When the young canes are 18 to 24 in. high their tips should be pinched off and all except three or four of the strongest canes should be cut out. The second spring the laterals forced into growth by the previous summer pruning should be pruned so that each cane will assume a conical appearance, with the lower laterals about 18 in. long, though the proper length varies considerably with different varieties. As soon as the old canes have borne fruit they should be cut out and burned. The second year from five to six of the young canes should be allowed to grow, and should likewise be pinched off at a height of 18 to 24 in. The young canes will not all reach the required height at the same time, and for this reason the patch must be gone over several times. Blackberries are frequently supported on wires or stakes.

Dewberries.—Though the canes of the dewberry are very similar in growth to those of the other brambles, they grow long and trail much more along the ground. The dewberry is not summer pruned like the blackberry, but the 1-yr.-old canes, if too long, are cut back in the spring to a length of 18 to 24 in., and are thinned out to four or five strong canes in a hill. On account of their drooping, or trailing, habit of growth, the dewberry canes that are to bear fruit should be tied up in the spring; this will prevent the fruit from becoming soiled and will make cultivation easier. The young canes are allowed to trail along the ground, where their tips take root and form new plants, which may be used for starting new plantations.

SPRAYING OF RASPBERRIES, BLACKBERRIES, AND DEWBERRIES

Spraying of Raspberries.—The principal insects that attack raspberries, blackberries, and dewberries are the saw fly and the cane borer.

The principal fungous diseases of these small fruits are the following: Anthracnose, which is very destructive to black raspberries but not often a serious problem on red raspberries; cane wilt, or cane blight, a destructive disease on both red and black raspberries; crown gall, or root knot, a destructive disease on red raspberries; and *red rust*, often a serious trouble on black raspberries and blackberries, but which does not affect red raspberries.

Spraying is not often practiced on raspberries, blackberries, or dewberries, because their disease and insect troubles are largely controlled by cutting out diseased canes. For the control of anthracnose on raspberries, it is sometimes desirable to spray with Bordeaux mixture (5 lb. copper sulphate, 5 lb. lime, water slaked, 50 gal. water), the first application being made when the young growth of canes is from 6 to 8 in. high, and the second and third applications being made at in- interval of about 2 wk. each. It is, however, often found that such spraying is not profitable.

In case the brambles are attacked by the saw fly, sprayings with arsenate of lead (2 to 3 lb. arsenate of lead, 50 gal. water) or with Paris green (1 lb. Paris green, 50 gal. water) should be given until the pest is under control. One thorough application of either of these poisons, especially of the first, will usually be sufficient. Care should be taken not to apply either of these poisons after the fruit has formed.

In some sections of the country, at rare intervals, the canes in blackberry plantations will suddenly be found to be covered with dark-brown soft scales. These may be so abundant as almost to cover the entire canes. These insects suck the sap from the plants and greatly weaken them. In case of such an attack, all of the unnecessary wood should be pruned out and in the spring before growth begins a thorough spraying given with lime-sulphur solution (at sp. gr. 1.03—that is, concentrated lime-sulphur solution of 33° Beaumé diluted

1 to 8 with water) or with a kerosene emulsion. In most cases, however, it will be found necessary to abandon a blackberry plantation so attacked and to set out another on good, rich soil.

CURRANTS

VARIETIES OF CURRANTS

Red Currants.—Of the fifty or more varieties of red currants the following are the more important commercially:

Cherry: Bush, strong grower and productive in most places. Fruit, large to very large in long, well-filled bunches; deep red, acid, and medium in quality. Tips of branches sometimes go blind. Origin, Italy. Mid-season.

Fay: Bush, medium, spreading grower; branches lop and fruit gets soiled; is slow in starting to bear in some localities, but is largely grown. Fruit, large to very large in well-filled bunches; red berries and of a milder acid flavor than Cherry. Mid-season.

London Market: Bush, erect in growth and is less injured by diseases and borers than others. Fruit resembles Fay but is more acid. Mid-season.

Prince Albert: Bush, upright grower, with strong canes; moderately productive. Fruit, medium in size in short bunches; pale scarlet; medium in quality. Very late.

Red Cross: Bush, strong grower and productive. Fruit, large in short, compact bunches; red; excellent flavor. Origin, New York. Mid-season.

Filler: Bush, productive. Fruit, red and of good quality.

Pomona: Bush, rather spreading grower and productive. Fruit, bright red, of good quality, and contains few seeds.

Red Dutch: Bush and fruit, small. Not recommended.

Versailles: Bush, good grower and productive; a seedling of Cherry and something like it. Mid-season.

Victoria: Bush, a good grower and little troubled by leaf diseases or borers; foliage very good, but susceptible to injury by hot weather; very productive. Fruit, small, red, acid, and of good flavor. Late mid-season.

Wilder: Bush, strong, upright grower; productive. Fruit, large, hangs well; red, and of a good, mild flavor. Mid-season.

Perfection: Bush, productive and foliage good. A good variety for table use when well grown. Fruit large, mild in flavor, and borne in long bunches. Origin, New York.

Diploma: Bush, a strong grower. Fruit, large and of good quality.

White Currants.—The following are the most commonly planted varieties of white currants:

White Imperial: Best white currant. Bush, productive. Fruit, pale yellow, sweet, rich, and used for the table.

White Grape: Bush, productive. Fruit, pale yellow, mild, and of good quality.

Black Currants.—The following are the most commonly planted varieties of black currants:

Lee's Prolific: An improvement on Black Naples, and similar to it.

Black Naples: Bush, a strong grower. Fruit, large and borne in small bunches.

Champion: Bush, a good grower. Fruit, large and of mild flavor. Mid-season.

PRUNING OF CURRANTS

Practically no pruning is needed at the time of planting, although some growers prune the nursery plant to a single cane and head that cane back to five or six buds. In the commercial currant plantation, little pruning is given until the plants are 4 or 5 yr. old.

The red and white currants and the black currants bear the largest proporton of their fruit on wood of different ages and therefore require different pruning. The red and white currants bear their fruit on wood 2 or more yr. old, the most and best of it being on wood from 3 to 5 yr. old; hence a plentiful supply of wood of these ages should be left on the bushes. The black currant bears most of its fruit on wood that developed the previous summer; therefore black currant bushes should always have a sufficient supply of 1-yr.-old wood to bear a large crop of berries. At the beginning of the second year the bushes should be thinned out to five or six strong canes, or even less if a bush is not vigorous. Pruning during the succeeding years should be devoted to keeping about five or six strong, healthy canes in each bush, keeping the bush open enough so that sunlight will be admitted to all the fruit, and maintaining the proper proportion of fruit-bearing wood.

Currants are sometimes pruned to grow in tree form, but such plants are of no commercial value, because the damage done by a single borer will ruin the bush.

SPRAYING OF CURRANTS

The currant is attacked by the San José scale, currant borer, currant worm, or currant saw fly, green leaf hopper, or currant leaf hopper, yellow leaf currant bug, or four-lined leaf bug, grape flea beetle, currant plant louse, currant miner, and by the currant leaf spots. A number of the insects do but little damage.

To control the above insects and diseases, the currant should be given the following spraying: (1) Before the buds open with a 1 to 9 lime-sulphur solution to control the San José scale (sp. gr. about 1.03—that is, 33° Baumé lime-sulphur diluted 1 to 9 with water); (2) as soon as the plants have gone out of bloom, with 4 : 5 : 50 Bordeaux mixture (4 lb. copper sulphate, 5 lb. lime, water slaked, 50 gal. water), and a 2 : 50 arsenate of lead

(2 lb. arsenate of lead to 50 gal. Bordeaux mixture) combined to control the leaf spots and currant worm; when arsenate of lead is used in this spraying there is often no necessity for applying it again; (3) as soon as the fruit is harvested with the same spray as that given in (2), or without the arsenate of lead if the currant worm has been controlled by the previous spraying.

In some cases an application of 4 : 5 : 50 Bordeaux mixture between the second and third regular sprayings is advisable to control the leaf spots, but this application should not be made so late that the spray will stain the fruit. No arsenate of lead should be applied within 4 wk. of harvest.

GOOSEBERRIES

VARIETIES OF GOOSEBERRIES

Gooseberries are of three general classes: American, European, and American-European hybrids.

American Gooseberries.—*Downing:* One of the best of the American class and most widely grown. Bush, strong grower, seldom troubled with mildew, and very productive. Fruit, large for its class, with a thin, smooth, pale green skin; pulp, soft, sweet, juicy, and of good quality. Mid-season.

Houghton: Parent of Downing. Bush, vigorous and hardy, but somewhat drooping grower, and is productive. Although fruit is small and dark red in color, with a whitish bloom, flavor is very good.

Pearl: Cross between Downing and Ashton's Seedling or Broom Girl, and closely resembles Downing. Bush, strong, fairly erect grower, seldom attacked by mildew, and productive. Fruit, medium, or about as large as Downing; pale green skin; pulp, juicy, and of good flavor. Mid-season.

Red Jacket, or Josselyn: Cross between Houghton and Warrington Red. Bush, strong grower; does not mildew;

productive. Fruit, good size; skin, reddish green to red and tender; pulp, rich, fragrant, and of good quality. Highly esteemed by some growers. Mid-season.

Purple Red: Bush, strong grower and productive.

European, or English, Gooseberries.—Among the European, or English, gooseberries, of which about a thousand are catalogued, the following appear to have been of some value in certain sections in the Northern States and Canada:

Industry: One of the best. Bush, heavy cropper where it succeeds, but often suffers from mildew. Fruit, medium to large; skin, smooth or nearly so; dark red; pulp, very good in flavor; excellent for marketing in unripe condition.

Crown Bob: Good variety for early market. Fruit resembles Industry in color but is smaller.

Wellington Glory: Has proven productive in some parts of the country. Fruit, an attractive pale yellow.

Warrington Red: Bush, strong grower; somewhat subject to mildew. Fruit, pale red, hairy; pulp, sweet and of good quality.

Whitesmith: Frequently recommended as a desirable variety, especially for the home garden. Fruit, medium to large; skin, smooth, and pale yellowish green; pulp, of good quality.

American-European Hybrid Gooseberries.—Two of the American-European hybrids, which resemble the European in type, are of value:

Columbus: Bush, strong grower, and comparatively free from mildew. Fruit, white or greenish yellow, and of good quality.

Chautauqua: Bush, vigorous, healthy grower. Fruit, large, smooth; pale green.

PRUNING OF GOOSEBERRIES

At the time of planting no pruning is needed except to take off injured roots or twigs, nor is any usually given for the first 2 or 3 years except to head in a branch that may be growing too rapidly. Gooseberries are trained to grow in two forms, the bush form and the tree form. The bush form is the only commercial form; four, five, or six canes are allowed to develop to make the bush in the same way as described for currants. The gooseberry bush should not be pruned out too much, as such pruning may expose the fruit to too much sunlight. After three or four seasons of growth the new wood should be pruned back in the spring one-half of the growth made the previous summer, in order to prevent the formation of a large quantity of blind wood. Canes 4 to 6 yr. old should be removed. The best and the largest proportion of fruit is borne on wood 3 to 5 yr. old.

SPRAYING OF GOOSEBERRIES

Gooseberries are subject to the same insects and diseases already mentioned for currants, with the addition of the gooseberry mildew, which is a serious problem with European varieties. To avoid this mildew as much as possible, gooseberries should be planted on an elevation where they will have a good circulation of air about them, and should be pruned and cultivated so as to allow the air to circulate as freely as possible.

The first two sprayings for the gooseberry should be the same as those for the currant. Then, as soon as the fruit is set the plants should be thoroughly sprayed with a 1 to 35 lime-sulphur solution (sp. gr. 1.008, that is concentrated lime-sulphur solution of 33° Baumé diluted 1 to 35 with water), or a solution of 1 oz. of potassium sulphide in 2 gal. of water, making sure that both the upper and under surfaces of the foliage are well covered. These sprayings should be repeated at intervals of 10 da. until the fruit is harvested. Even in spite of all that can be done, however, the mildew will sometimes destroy the crop. After the fruit is harvested the bushes should be sprayed as described under (3) for currants.

VEGETABLE CULTURE

ESSENTIALS OF VEGETABLE CULTURE

MARKET GARDENING

Location for Market Gardening.—Before locating a market garden in a particular locality, the vegetable grower should give careful consideration to all conditions existing in the region. Some of the conditions may be improved; others are fixed. The points of greatest importance to consider in choosing a location are: the kind of market that is available, the distance from market, the nature of the roads to market, the labor supply, the stable-manure supply, the climate, the seasons, and the social conditions.

Site for Market Gardening.—The choosing of the site that is to be used as a market garden is of prime importance. The factors that influence the desirability of a site are: the kind of soil, the drainage of the soil, the water supply, the exposure of the land, and the previous treatment that has been given to the soil.

Unless certain special crops are grown, the kind of soil best suited for a market garden is one of light to medium loam. A soil of this nature is easy to work, it does not retain water to a degree to make it sticky, and it can be worked early in the spring or soon after a rain. Owing to the fact that much hand working of the soil is necessary in gardening, it is advantageous to have a soil free from stones. To have a soil rich in vegetable matter and plant-food is also desirable, although if necessary, this can be supplied in manures. Other soils than light to medium loams can be used for vegetable growing, of course, but they are not so suitable because they do not have the properties just mentioned.

Soil in which surplus water stands at or within 1½ ft. of the surface is of little use for the production of vegetable crops until the surplus water has been removed. However, soils that need draining are often very rich in plant-food; all they require to make them productive is the removal of the surplus water.

In the selection of a site for a market garden the availability of a water supply for the house and barn, and the shed where the vegetables are washed, and for irrigation purposes, is an important factor, as market gardening cannot be conducted without an adequate supply of water.

The ideal exposure for a market garden in the North Temperate zone is one with a slight slope to the southeast and with a protection on the northwest from the full sweep of the winds from that direction. The next best exposure is a level one. Level land is very desirable for market gardens provided it is well drained. One trouble with level lands, however, is that they are often exposed to winds that may at certain seasons do considerable damage.

The treatment soil has received before being converted into a market garden needs but little attention. If a soil is of the right type it can be made suitable for a garden by the addition of vegetable matter and other plant-food and by working it with proper garden tools and implements. A soil that has been made fertile by previous treatment is, of course, a valuable asset to a market garden, but, as just stated, it is not a requisite.

In selecting a site, the local seasonal differences should be studied. For instance, if a market gardener has decided on a region in which to locate, he should ascertain before choosing a site, whether or not there are frost belts in the region.

Equipment for Market Gardening.—Equipment for market gardening includes capital to run the business, land used for gardening and as a site for the buildings, the buildings themselves, a water-supply system, livestock, barn equipment, tools, machinery, glass for hot beds and cold frames, seeds, plants, stable manure, commercial fertilizer, and labor. The equipment may be either comparatively simple or very extensive, depending on the size of the business, the capital of the gardener, the nature of the soil, the kind of crops to be grown, the cost of labor, and the ideas of the grower.

Following is given an approximate list of items needed on a ten-acre market garden that requires fixed and working capital, and the cost of each item. It may be possible, of course, under local conditions, to dispense with some of these items, and the prices given may vary in different localities. The items and figures given are taken from the books of a market gardener in the northern part of the United States.

ITEMS REQUIRING FIXED CAPITAL

Land (10 acres at $100 per acre)	$1,000.00
Buildings:	
House	1,000.00
Barn	600.00
Combination packing shed, tool room, and implement shed	500.00
Water-supply system, including 3½ H. P. gasoline engine and duplex pump	400.00
Livestock:	
1 team of work horses weighing about 2,600 lb.	400.00
1 express horse weighing about 1,200 lb.	200.00
1 cow	75.00
Barn equipment:	
1 two-horse manure wagon	200.00
1 one-horse market wagon	175.00
1 one-horse tip cart	50.00
1 carriage	125.00
1 second-hand express wagon	35.00
1 heavy double harness	45.00
1 medium express harness	40.00
1 tip-cart harness	18.00
1 driving harness	18.00
3 collars	9.00
2 heavy horse blankets	8.00

1 medium-weight blanket	3.50
3 stable blankets	4.50
2 carriage robes	6.00
2 sets of curry combs, brushes, etc.	3.00
Incidentals	5.00
Tools and machinery:	
1 two-horse plow	15.00
1 one-horse plow	8.50
1 double-action disk harrow	24.00
1 smoothing harrow	15.00
1 Meeker harrow	22.50
1 five-tooth shovel cultivator	8.50
1 twelve-tooth spike cultivator	8.50
1 seed sower	9.00
1 wheel hoe	5.00
2 slide hoes	3.00
5 common hoes	2.00
3 manure forks	2.70
3 fourteen-tooth iron garden rakes	1.80
3 shovels	3.60
2 spades	1.50
1 hammer	.60
1 rip saw	1.25
1 cross-cut saw	1.25
1 plane	1.00
1 level	.75
2 chisels	.50
1 bit stock and bits	2.00
Miscellaneous tools	5.00
Miscellaneous garden equipment:	
1 garden line and reel	1.00
50 ft. of hose	4.00
Small tools not listed	10.00
25 hotbed sash at $4.25 each	106.25
Lumber for frames	20.00
Total	$5,204.20

Items Requiring Working Capital

Seeds and plants	$100.00
Stable manure, 400 tons at $1 per ton	400.00
Commercial fertilizer	200.00
Labor:	
6 men at $1.50 per day, working 26 days per month for 8 months	1,248.00
2 men at $25 per month for 12 months per year	600.00
Total	$2,548.00

TOTAL CAPITAL REQUIRED

Fixed capital required	$5,204.20
Working capital required	2,548.00
	$7,752.20

Markets for Market-Garden Produce.—Markets for market-garden produce may be classified as four kinds: wholesale markets, wholesale-retail markets, retail markets, and special markets.

Wholesale markets are those where produce is bought in large quantities to be sold to dealers, who, in turn, sell it to consumers. The consumer, therefore, buys goods that have been handled by the grower, by transportation agents (if the goods have been shipped), by the wholesale dealer, and by the merchant to whom the wholesaler sells. He pays, therefore, at least two profits other than that of the grower.

Wholesale-retail markets are those where the produce is sold by the grower direct to the retailer and by the retailer to the consumer. To this class belong all market and grocery stores. The wholesale-retail market does not usually offer a very acceptable opportunity to the market gardener because of the accessibility of the wholesale market, in which sales can be generally made with less trouble than in the wholesale-retail market. In small cities where no wholesale market exists and in towns where there are a number of enterprising marketmen and hucksters, however, good wholesale-retail markets are often open to the market gardener. To supply such a market a large variety of produce should be grown.

Retail markets are those where the producer sells direct to the consumer. Such trade is largely monopolized in the large cities and their suburbs by peddlers. In towns and villages the opportunity for such business is probably greater than elsewhere.

Special markets may be classified as two kinds: markets developed by the ingenuity of the gardener, and markets for a special product. In the case of markets of the first kind a broad field is open to the grower, provided he is able to devise some successful scheme for packing and distributing his produce, either to the wholesale-retail market or to the consumer. In the case of markets of the second kind, the market may be a canning factory that uses large quantities of certain vegetables, or it may be a hotel that demands a high-grade product. Often private families are willing to pay a fancy price for some exceptionally desirable product, and thus a profitable special market can be developed.

Range of Crops for Market Gardening.—The range of crops that may be grown by a market gardener is so great that usually the grower can find some crop especially suited to his soil, climate, or market. There are about forty vegetable crops that are commonly found in the markets of the United States, and it is possible to produce the greater number of these crops in most sections of the country. Of each of these different vegetables there are many varieties. In addition to this wide range of vegetable crops there are a number of small fruit crops that fit in well with the cropping and the marketing of the market gardener.

TRUCK FARMING

Location for Truck Farms.—The factors influencing the location of a truck farm are similar to those influencing the location of a market garden, but are of a different relative importance. In the order of their importance they are: Transportation facilities, climate, soil, marketing organizations, labor, distance to shipping centers, roads to market, and social factors.

Transportation Facilities for Truck Farming.—The truck farmer is absolutely dependent on public carriers for the transportation of his produce. These carriers are, as a rule, railroads and boats. Before locating a truck farm, consideration should be given to whether the service of such carriers as are available is adequate for the purpose.

Climate for Truck Farming.—The great variations of climate in different sections of the United States have made truck farming possible. The range in climatic conditions along the Atlantic coast, for example, is such that a succession of tender crops grown in the field are available to the northern consumer from one year's end to the other. The climate influences the selection of crops, the time of year of shipment, and indirectly the cost of transportation to the markets where the produce will be sold.

Soils for Truck Farming.—The ideal soil for truck farms is a sandy loam that is free from stones. Such soil should be well drained and in a high state of fertility.

Marketing Organizations for Truck Farming.—When truck farms are located a long distance from market it is practically impossible for individual growers to market their crops satisfactorily. Such a condition compels the growers to organize associations and provide sales departments to sell their produce. Such organizations have satisfactorily solved the marketing problem for truck farmers. These associations are found in localities where a number of growers can conveniently act together. To locate where affiliation with such an organization is impossible would be unwise for the truck farmer at a considerable distance from market.

Labor for Truck Farming.—The labor problem of truck farmers is not usually so difficult to solve as that of market gardeners, on account of the slack demand for labor in remote regions as compared to that near large cities. However, the cost of labor for the truck farm is comparatively large. An investigation of labor conditions should precede the selection of a location for the business.

Distance to Shipping Centers.—The extreme distance from a shipping center to the truck farm should not be more than 10 miles, and each mile nearer than this distance deducts the annual constant expense to a large degree.

Roads to Shipping Centers.—The same problems in regard to roads confronts both the truck farmer and the market gardener. Locations admirably suited by natural conditions for the business of truck farming may be rendered entirely unsuitable by impassable roads.

Social Conditions.—The truck farmer is usually in a sparsely settled region, and for this reason his social problems are more difficult of satisfactory solution than are those of the market gardener located in more thickly settled communities. For this reason, a prospective truck farmer should study thoroughly all conditions pertaining to the social life and customs of a locality before establishing a business.

Equipment for Truck Farming.—The size of a truck farm varies between wide limits. Some truck farms have from 4 to 5 acres of ground; others often have as many as 600 to 800 acres under cultivation. This variation in size is due largely to the type of crops grown, the ideas of the farmer, the length of time he has spent in the business, the success he has attained, and the amount of capital invested.

The capital necessary to go into truck farming is small, but the amount that may be invested is almost unlimited. A lesser investment in land, glass, buildings, and labor, makes the amount needed by the truck farmer less than that required by the market gardener. The cost of selling produce is also less because of the opportunity to sell through organizations. To start a small truck farm $1,000 would be sufficient. Some persons could start on less and succeed and others would need more.

Markets for Truck-Farm Produce.—It is typical of the truck farmer to sell his produce in distant markets, through a selling organization. Occasionally a truck farmer operating a large farm is found who handles his own products, the bulk of his business enabling him to do this to advantage. It is also typical of the truck farmer to produce large quantities of single crops. Such crops are marketed in carload lots to wholesale distributors.

The marketing organization of the truck farm bears much the same relation to the grower as the commission house of the large city bears to the market gardener. There is, however, one distinct difference; as the marketing organizations exist to provide a market for truck farmers' products, they are controlled by the grower, while the commission man of the city is in business to amass wealth for himself. The truck farmer gets much more satisfaction from his method of marketing than does the average market gardener who depends on commission merchants to handle his crops. On the other hand, it is necessary for the truck farmer to market his produce through his association or not at all, while to the market gardener a number of ways of distribution are opened.

Truck-Farm Crops.—The crops of the truck farm are practically identical with those of the market garden, different crops being grown in different sections of the country. The development of methods of distribution and of packing have made possible the shipment of very perishable products for a long distance and have thus increased the range of crops that may be produced on sections far distant from market.

There are a number of distinct trucking sections along the Atlantic coast of the United States. The largest of these centers is at Norfolk, Va. The principal crops of this section in the order of their importance are: Irish potatoes, spinach, cabbage, kale, sweet potatoes, strawberries, radishes, peas, lettuce, cucumbers, cantaloups, egg plants, tomatoes, asparagus, beans, and beets. In the trucking centers of Texas, onions are the principal crop. Florida excels in the production of lettuce, cucumbers, celery, and tomatoes. Colorado is foremost in the production of cantaloups. Georgia leads in growing watermelons. Other sections, of course, produce the crops to which they are adapted.

HOME GARDENING

Site for Home Garden.—In selecting a site for a home garden the following factors need careful attention: (1) Convenience of access from the house; (2) extent of land available; (3) richness of the soil; (4) ease of working the plot; and (5) appearance of the garden.

A home garden not convenient of access to the housekeeper loses a large part of its value. The garden should be located so that when vegetables are wanted they can be quickly obtained, fresh from the soil.

The fact that a home garden must be located largely according to the land available often makes accessibility to the house out of the question. Nevertheless, it does not lose its importance on this account.

Size of Home Garden.—The extent of land needed for the home garden depends on the size of the family to be fed, and the amount of time and money that can be spent on the garden. A home garden 20 ft. long by 10 ft. wide can be made to produce a good supply of some of the smaller vegetable crops, such as lettuce, radishes, spinach, beets, carrots, turnips, and perhaps a few potatoes and tomatoes.

An area 50 ft. × 100 ft. will yield sufficient produce for a large family for both the summer and winter supply. In a home garden the plants can be grown close together and more than one crop can be taken from the same land the same season.

Soil for Home Garden.—The home garden, especially if it is in a city or town, must often be located with little opportunity for selection according to soil characteristics. The soil should preferably be sandy. Other types of soil can be made to produce crops, but always with more labor and expense.

Soil Improvement for Home Garden.—Soil improvement for a home garden should consist of the addition of as much stable manure as can be obtained conveniently. A quantity that covers the soil to the depth of from 3 to 8 in. is desirable, provided it is later worked into the soil. The plowing under of grass sod and the addition of all vegetable matter available, such as clipped lawn grass, garbage, etc., help to increase the capacity of the soil for crop production. The addition of wood ashes is also helpful. Except in limestone regions, the use of about 50 lb. of lime to every 100 sq. ft. of soil is good practice. Lime and manure should not, however, be added at the same time. If good tillage is coupled with the addition of the fertilizing material and lime, satisfactory crops can be produced from practically any type of soil. Drainage, if necessary, should be provided in a home garden.

Selection of Crops for Home Garden.—The selection of crops for the home garden is distinctly a family problem. The home gardener is practically unlimited in his choice of garden crops, and the greater the variety, within reasonable limits, the greater the interest in the garden, and the more benefits received from it.

The majority of garden crops are easily grown from seed, and the cost of seeds of the best kind and from the most reliable sources is very small. Plants of those crops that must be started in hotbeds or cold frames can usually be purchased ready for transplanting from dealers in towns and cities. The cost of such plants, too, is usually not high.

Glass for Home Garden.—Home gardening for the city and town worker is made much more interesting by the use of a few sash for the production of plants out of season. From 1 to 5 sash is the usual number in use on a home garden, depending on the amount of money it is desired to spend, the room available, and the time allowable for the work. The type of glass structure most used by home gardeners is the cold frame.

Arrangement of Home Garden.—A rectangular shape is the most desirable for the home garden, as the plan of cropping may then be such as to make necessary the least possible labor in the care of the garden. The gardener can, in addition, economize on space in a rectangular plot.

Every home garden, if of sufficient size, should have the following perennial crops: Asparagus, rhubarb, raspberries, blackberries, gooseberries, and currants. These should be located on one side of the garden where they will not interfere with the annual plowing and harrowing for other crops. A border of perennial crops makes a most desirable arrangement. In addition to the perennial crops, the following are desirable: Strawberries, lettuce, beets, carrots, cabbage, cauliflower, cucumbers, spinach, radishes, sweet corn, string beans, and tomatoes.

To be most successful with the garden a plan should be made before the gardening season opens. In making a plan the gardener should arrange the crops according to their planting time and degree of hardiness. The length of time usually needed from seed to maturity should also be considered, as it is often desirable to plant crops on ground that has already produced a crop earlier in the season.

General Rules for a Home Garden.—Some general rules in regard to cropping a home garden are given following: (1) Group the perennials; (2) plant the hardy crops together, so that no more land than is necessary need be cared for early in the season; (3) group the small crops and the large crops that need similar tillage; (4) as soon as one crop has been harvested, follow it by another; (5) interplant some of the slow-growing large crops with quick-growing small crops.

Tillage of a Home Garden.—The soil of a home garden should be plowed after the manure has been applied. The plowing then mixes the manure with the soil and upturns the soil particles to the air, thus making the soil fine in texture. Spading the ground will accomplish the same result as plowing, but it is more expensive and tiresome.

After the soil has been plowed a harrow should be used to make a finely pulverized seed-bed. On small areas a hand garden rake can be used in place of a harrow.

After the plants in the garden have commenced to grow, tillage between the rows is necessary. Thorough working of the soil should be done to keep the ground stirred to a depth of 1 or 2 in. during the whole growing season. This stirring of the soil conserves soil moisture and keeps the garden free from weeds, both of which are essential in gardening.

Planting and Harvesting of Home-Garden Crops.—The planting of the seeds, the setting out of the plants, and the harvesting of the crops take place in different parts of the garden throughout the entire season. There is no general planting and harvesting time for home-garden crops, as in most branches of agriculture.

Tools for a Home Garden.—For the average home garden the following implements and tools will be found useful. The average cost of the equipment is also given.

1 seed sower and wheel cultivator combined.	$9.00
1 common hoe	.40
1 fourteen-tooth iron garden rake	.50
1 spading fork	.70
1 shovel	1.00
1 garden hose and reel	1.00
1 wheelbarrow	4.50
Total	$17.10

For the man who plants an area of say 10 ft. × 20 ft., such an equipment is not necessary. The hoe, rake, and spading fork are all the tools that he need have.

VEGETABLE CROPS

Vegetable plants are of three degrees of hardiness: Hardy, half hardy, and tender. *Hardy plants* are those that can withstand frost without injury. *Half-hardy plants* are those that will grow in the cool moist season of the year, but will not withstand frost without injury. *Tender plants* are those that are killed by frost; they should not, therefore, be put in the ground until the season is far enough advanced that no long period of cool weather is likely to occur.

Following is given a list of the common vegetable crops classed as hardy, half hardy, and tender:

Hardy crops: Rhubarb, beets, cabbage, carrots, cauliflower, celery, lettuce, onions, peas, parsnips, radishes, turnips.

Half-hardy crops: Asparagus, beans (some varieties), sweet corn (some varieties).

Tender crops: Beans, sweet corn, cucumbers, potatoes, squashes, tomatoes.

HARDY VEGETABLE CROPS

Rhubarb.—The ideal soil for rhubarb is a deep, rich, sandy loam, but the plant can be grown successfully on all types of soil, provided they are put in proper condition. Rhubarb requires an enormous quantity of soil moisture, consequently irrigation is especially valuable.

Propagation of rhubarb is usually accomplished by root division. A piece of root that has a strong eye will, under favorable conditions, produce a good plant in one season. The best time to plant rhubarb is in the early spring. The roots are usually planted 3 ft. × 4 ft. or 4 ft. × 4 ft., being covered with several inches of soil. Linnaeus and Victoria are the most popular varieties.

Beets.—Beets thrive best on sandy loams that are deep and moist, but well drained. They will, however, grow in practically all American gardens. When grown in heavy soils they are likely to be too fibrous.

Beets are propagated from seed. The early varieties are sown as early in spring as the ground can be prepared. From about 6 to 8 weeks are required for the roots to reach a size sufficient for use. Succession plantings of oval and turnip-shaped beets may be made until the middle of August. In planting beets, the distance between plants in the row should be from 2 in. to 3 in. for small-topped varieties, and from 5 in. to 6 in. for the larger-rooted varieties. These distances are secured by thinning. If cultivating is to be done with a hand-wheel hoe, the rows should be about 12 in. apart; if cultivating is to be done with a horse cultivator, the distance between rows should be from 24 in. to 30 in.

Cabbage.—Cabbage will do well on any soil that is constantly moist, yet well drained, and that has abundant plant-food. Perhaps the largest crops of late cabbage have been grown on clay loams that have been well manured. The best climate for cabbage is one that is cool and moist, consequently the growing of cabbage is largely confined to northern districts.

For early cabbage, fall plowing is generally desirable; for late cabbage, it is the practice to break the ground early in the spring. When early cabbage is to be raised, it is now almost a universal practice in the North to sow the seed in hotbeds or greenhouses in Jan. or Feb. Late cabbage seed is sowed in the open sometime during May in northern latitudes. When the plants have reached a suitable size they are transplanted into rows. The proper distance to set the plants depends on the methods of cultivating, spraying, and harvesting. Early varieties, such as Jersey Wakefield, may be planted 14 in. × 26 in. or even closer; Charlestown Wakefield, 16 in. × 28 in.; Danish Ball Head, 18 in. × 30 in.; and Flat Dutch and the other late flat-headed varieties, 24 in. × 36 in.

Carrots.—The soil for carrots should be fine, mellow, fertile, moist, and not inclined to bake. The best roots are grown in distinctly sandy soils.

The carrot is propagated from seed sown in the open. If an early crop is desired, the seed should be sown as early in the spring as the ground can be prepared. A succession of roots is secured by planting at various times throughout the season. The early varieties mature in from 8 to 10 wk. and late varieties in from 4 to 5 mo.

Carrot seeds germinate slowly, consequently it is an advantage to sow enough radish seed with the carrot seed to mark the rows, so that cultivation may not be interfered with. The seed should be covered, as a rule, with about ½ in. of soil.

For the small early varieties, 10 in. to 12 in. between rows is sufficient space if a hand-wheel hoe is used. For later varieties, 15 in. between rows is about right. When a horse cultivator is to be used, all varieties should be planted in rows from 24 in. to 30 in. apart. Various spaces are recommended for the distance between plants in the row, from 4 in. to 5 in. being the usual space allowed. Thinning, of course, is necessary to space the plants properly.

Cauliflower.—Cauliflower thrives best in rich, heavy, loams, although large crops are obtained when the crop is grown in light soils. A constant supply of moisture is the most important factor.

Cauliflower, both late and early, is grown by practically the same methods as late and early cabbage. As cauliflower plants are more tender than cabbage plants, it is customary, however, to sow the former somewhat later than the latter, Mar. 1 being about right for northern districts. The planting distances are the same as for cabbage.

Celery.—Muck soils are specially adopted to celery growing, because they are very moist, fertile, loose, and mellow. It is a fact, however, that the flavor of celery is somewhat deficient when the crop is grown on muck soil. Many clay and silt soils produce good crops, especially when well manured and irrigated. Large quantities of celery are also raised on light sandy loams, but it is usually necessary to use considerable commercial fertilizer.

Celery seeds are very small and slow to germinate and must be provided with the best conditions in the seed-bed. The soil should be in fine condition and moist. It is seldom best to sow seed for the early crop before Mar. 1. In most Northern districts, the seed may be sown in flats, hotbeds, or greenhouses. When the rough leaves appear, the small seedlings are transplanted into flats or beds; 1½ in. each way is ample space. Seed for the late crop is usually sown in the open or in protected beds as early in the spring as the ground can be prepared. The rows are generally 1 ft. apart. This provides plenty of space for wheel-hoe cultivation until the plants are transplanted.

In most sections, planting for the early crop should not occur until from May 10 to 15. Vigorous plants, properly set at this time, should produce a marketable crop by Aug. 1. The late plants may be set the latter part of June and throughout the month of July. Planting distances are extremely variable. If planting is to be in blanching trenches, the distance between rows must not be less than 3½ ft.; 5 ft. is the more common spacing, especially for the tall, green varieties. When boards or other devices are used for blanching, the space between rows varies from 18 in. to 3 ft. The standard distance between the plants in the row is 6 in. Some of the best growers plant the early varieties only 4 in. apart and allow 24 in. between rows. At this distance, 65,000 plants are required for an acre.

Lettuce.—Rich, sandy soils, properly fertilized, are preferable for growing early crops of lettuce. For all classes of lettuce, however, sandy loams furnish the best conditions. The soil preparation for lettuce should be thorough. The seed is sown in the open from early spring until late fall, and all winter in the far South. It is customary to drill lettuce in rows about 1 ft. apart, and to thin to 1 ft. or less. In home gardens, the plants are often thinned out at first to about 4 in. and later to 1 ft.

Onions.—Perhaps the best soils for onions are those containing large quantities of organic matter. Such soils as muck and peat seem to be an ideal medium for the growing of this crop, as they warm up rapidly in the spring, and thus facilitate early planting, which is very important. Such soils also retain moisture, so that drouth seldom injures the crop to any great extent. Land used in growing onions should be practically level to prevent damage from washing. Onions are easily washed out on sloping lands.

Most of the onions grown in the United States are produced from seed sown in the open, where the crop matures. When wheel hoes are used, it is customary to plant the crop 12 in. to 14 in. between rows. When horse tools are used the rows are made from 24 in. to 30 in. apart. In fairly heavy soil, the seed should be covered with not more than ½ in. of soil. In very sandy soil, it is advisable to cover the seed a little deeper. It is customary to allow 8 to 12 plants to the lineal foot. The proper distance in a row is secured, of course, by thinning.

Peas.—A cool, moist, but well-drained soil is essential to the largest yields of peas. Sandy loams are preferred, although good results can be obtained on any loose, friable, and well-prepared soil.

For the earliest crop, the seed should be planted in Mar., or as soon as the ground can be prepared. For the first planting, a shallow covering of about 1 in. of soil should be given to the seed. As the season advances, the planting should be deeper. Planting distances depend on the height of the vines, whether the vines are to be supported or not, and the purpose of the crop. When sown in drills, the space between rows varies from 18 in. to 3 ft.

Parsnips.—Parsnips do best in deep, fertile, sandy loams. Clay soil has a tendency to produce crooked and branching roots.

Parsnip seeds germinate very slowly, consequently they should be sown as early as possible in the spring. A few radish seeds should be sown with the parsnips to mark the rows so that cultivation may be begun before the parsnips are up. The soil should be thoroughly prepared before sowing. From ½ in. to 1 in. of soil is sufficient covering. It is customary to use plenty of seed, and then thin the plants to 6 in. or 7 in. in strong soils, or 4 in. to 5 in. in poorer ones. There should be 15 in. to 18 in. between rows for wheel-hoe cultivation, and 2 ft. or more when horse implements are to be used.

Radishes.—The soil for radishes should be cool, moist, fertile, and friable. Sandy loams are preferable. In heavy soils, the roots are likely to be rough or ill shaped, with a large number of fibrous laterals.

Radishes are planted from early spring, as soon as the ground can be worked, until 6 wk. before frosting weather. By the selection of different varieties, and sowing at frequent intervals, a constant succession of radishes may be had throughout the season. The seeds are strong in germination, and should be sown thinly. The distance between plants in the row should vary from 1 in. to 5 in., depending on the size of roots and tops. As a rule, rows are about 1 ft. apart.

Spinach.—For spinach a very rich, moist soil is required. In soils of moderate fertility, the plants become spindling, and the production is light. The general practice is to make early sowings in low beds from 5 to 9 ft. wide. The rows, which should be 10 or 14 in. apart, are drilled lengthwise in the beds and the plants thinned to from 4 to 6 in. apart. It is important to sow in good time, so that the plants will become thoroughly established before winter. Sept. 25 is the favorite time for sowing in the latitude of Norfolk, Va.

Turnips.—Turnips, like other root crops, are best grown in sandy soils, and although the crop is produced in a wide range of soil types, to obtain large yields and high quality, the soil must be fertile and constantly moist.

For an early crop, the seed should be sown as soon as the ground can be prepared. For a late crop, the seed should be sown the latter part of July, or early in Aug., depending on the locality. If a wheel hoe is to be used in cultivating, the rows should be from 12 to 18 in. apart, and if a horse cultivator is to be employed, the rows should be from 26 to 30 in. apart. In the case of the early crop, the plants should be about 2½ to 3 in. apart in the row. For the larger late varieties, 4 or 5 in. between plants in a row is about right. The seed should be planted from ½ to ¾ in. deep.

HALF-HARDY CROPS

Asparagus.—Asparagus is grown successfully on a great variety of soils. The best soil is a deep, rich, moist, sandy loam. Sandy loams are especially important for the green or blanched asparagus, because it is very difficult to produce straight shoots in heavy clay soils.

Asparagus is propagated by seed and by dividing the crowns. The latter method, however, is not satisfactory and is seldom practiced by commercial growers. Owing to the fact that the asparagus plantation is to last 10 years or longer, too much thought or care cannot be given to the preparation of the soil. Planting distances vary considerably in different sections. In the growing of white stalks, the average spacing in New Jersey is 2 ft. × 5½ ft.; in New York, about 2 ft. × 5 ft.; in California, about 2 ft. × 9 ft. In the growing of green asparagus, the average spacing in New Jersey is 2 ft. × 5 ft.; in Massachusetts, 2 ft. × 4 ft.; in Pennsylvania, 2 ft. × 4½ ft. Spring planting is universally regarded as better than fall planting. In America, the asparagus plants are set from 6 in. to 1 ft. deep, but 8 in. is considered deep enough. An ordinary moldboard plow is used to make the trenches for planting. The furrow soil is thrown on each side of the furrow. It is often necessary to make two or three rows before the proper depth has been obtained. It is not best to set the plants in the bottom of a hard trench. The best practice is to spread the roots over a slight mound of fine soil and then cover the crown with 2 or 3 in. of fine, moist soil. The crown should be fully firmed over the fleshy roots.

Beans.—Beans are discussed here as a half-hardy crop, but in reality only certain varieties are half hardy, the others being tender varieties.

The soils for beans should be well drained and have a moderate quantity of organic matter. Some varieties of beans will grow and mature light crops on poor soils, but high fertility is necessary to larger yields. The light sandy loams are especially important for lima beans.

It is better to wait until the ground is thoroughly warm and there is little danger of damaging weather conditions before planting beans. Kidney beans may be planted early, followed by the marrows, and then the pea varieties. In New York, the kidney beans may be planted the latter part of May, and the pea varieties from June 5 to 20. The distances between rows range from 24 in. to 34 in., 28 in. being about the proper spacing. The usual distance of the beans apart in a row is from 2 to 4 in. In heavy soils, 1½ in. is ample depth for planting; in lighter soils, 2 in. to 3 in. is about right.

Sweet Corn.—Sod land is invariably the best for sweet corn. The crop may be grown successfully on practically all types of soils, but large yields are to be obtained, of course, only from very fertile soils. As in the case of beans, some varieties of sweet corn are half hardy and some are tender.

When grown for market, early planting of sweet corn is especially important. The crop is often grown in hills, but drills are preferred. Plants of a lighter growing variety, may stand 10 in. apart, and 1 ft. is not too much space for vigorous varieties. The space between rows varies from 30 in. to 4 ft. It is best to seed freely and then if necessary to reduce the number of plants.

TENDER CROPS

Cucumbers.—Light, sandy loams are best for early cucumbers, if earliness is the chief consideration, but yields are larger and the bearing period longer in heavier soils. Whatever the type of soil, it must be moist but not wet.

Planting should not occur until the ground is warm and there is practically no danger of frost. Many growers plant seed at two different depths. The early plants come on first, and if these are killed or damaged by frost, the later ones will be likely to escape. Planting in hills was the universal practice some years ago and is still preferred by many growers. In good soils, the distance between hills should be not less than 5 ft. × 5 ft. and some prefer to plant 6 ft. × 6 ft. In lighter and moderately fertile soils, 4 ft. × 5 ft. may be permissible.

Potatoes.—Soil for potatoes should be rather loamy in character and should have a liberal supply of potash, either naturally or supplied in the drill by the application of sulphate of potash.

Potatoes are cut into sections for planting, a section being a small piece containing one or more eyes. The pieces are planted 3 or 4 in. below the surface of the ground. It is the best practice to plant in drills, dropping two pieces every 12 to 18 in. If horse cultivation is used, the drills should be at least 3 ft. apart.

Squashes.—A rich, warm, but well-drained, moist soil is essential to quick maturity and high yields in squashes. The plants are often started under glass, like cucumbers and muskmelons, and planted in the open. It is customary to sow from 10 to 12 seeds in hills enriched with two or three forkfuls of rotten manure, and then to thin to two or three plants. Squashes are often planted in drills and thinned as may be desired. The dish types of pattypan and crookneck squashes are generally planted 4 ft. × 4 ft. apart. The winter, or running varieties, should be planted about 8 ft. × 8 ft., or 10 ft. × 12 ft., depending on the fertility of the soil and the vigor of the varieties.

Tomatoes.—A deep, fertile, sandy loam, or a well-drained clay sod soil undoubtedly provides the best conditions for the culture of tomatoes. The crop, however, is grown successfully on a great variety of soils. The tomato is propagated from seed sown in hotbeds, cold frames, or greenhouses. When the seedlings have attained sufficient size, they are transplanted to the open ground. The proper distances should be determined by the fertility of the soil, the vigor of the variety, and the method of culture. In fine soils, and with early varieties, 3 ft. × 3 ft. apart will be satisfactory. In many soils, 3 ft. × 4 ft. are good distances for early varieties; 4 ft. × 4 ft., and 4 ft. × 5 ft. are good planting distances for late varieties.

FARM LIVESTOCK

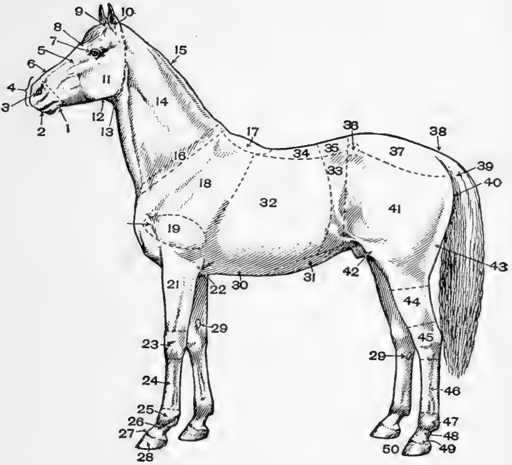
HORSES

For a proper understanding of the terms used by horsemen, a knowledge of the various parts and exterior regions of a horse is necessary. In the accompanying illustration is shown a profile view of a horse with the parts and exterior regions numbered. The names of the numbered parts and regions are given following the cut.

The common unit of measurement for the height of horses is the hand. A *hand* is 4 in. or the supposed width of the human palm. Thus, if a horse were 5 ft. 4 in. tall, its height would be expressed as 16 hands; if it were 5 ft. 6 in. tall, its height would be expressed as 16½ hands. The measurement of a horse's height is taken from the ground to the top of the shoulders.

THE ARAB HORSE

The native home of the Arab breed of horse is in Arabia, but it is probable that the breed is not indigenous to that country. Arab horses range from 14 to 15 hands in height, rarely exceeding 15¼ hands. The head is of splendid appearance, being broad and high, the muzzle short and fine, the face bony, the veins handsomely coursed, the nostrils large, the ears small and well set, the eyes large and prominent, and the jaw heavy and wide, giving an abundance of room for the windpipe. The neck is deep where it joins the shoulder, of good length, and nicely turned in the throatlatch. The shoulders are long and obliquely set, but the withers are often too thick and are inclined to



1, Chin groove
2, Lips
3, Nostril
4, Muzzle
5, Face
6, Nose
7, Eye
8, Forehead
9, Poll
10, Ear
11, Lower jaw
12, Angle of lower jaw
13, Throat latch
14, Neck
15, Crest
16, Juncture of neck and shoulder
17, Withers
18, Shoulder
19, Arm
20, Point of shoulder
21, Forearm
22, Elbow
23, Knee
24, Front cannon
25, Front fetlock
26, Front pastern
27, Front coronet
28, Front hoof
29, Chestnuts
30, Floor of chest
31, Belly
32, Ribs
33, Flank
34, Back
35, Loin
36, Hip
37, Croup
38, Dock
39, Tail
40, Point of buttock
41, Thigh
42, Stifle
43, Quarters
44, Gaskin
45, Hock
46, Hind cannon
47, Hind fetlock
48, Hind pastern
49, Hind coronet
50, Hind hoof

be rather low for saddle purposes. The body is rather short and usually deeply ribbed, the ribs springing out well from the spine with a symmetrical curve; the back is well sustained with heavy muscles; the loins are broad and muscular; the croup is rather long and level, and the tail is set high and usually carried with style; the quarters are long and deep, but the gaskins and hocks are not of the most approved shape. The legs and feet are of good size and shape for strength.

Contrary to popular opinion, the prevailing color of the Arab is not snow white, or coal black, or spotted. The best authorities state that about 50% of the animals are bays, about 20% are chestnuts, and about 30% are grays and white with dark skin; occasionally a brown specimen is found and very rarely a black.

As a saddle horse the Arab ranks high.

THE THOROUGHBRED HORSE

The Thoroughbred has a fine, lean head that has quality, eyes that are prominent and intelligent, ears of medium size, a broad forehead, a heavy jaw, and a refined muzzle. The neck is long and rather thin, the crest fairly straight from the withers to the poll, and the head carried somewhat low with the nose pointing forwards when the animal is running. In the best specimens of the breed, the shoulders are obliquely set and well covered with muscle, and the withers are high and thin. The chest of a Thoroughbred has a tendency to be narrow and deep; very narrow chests, however, are objectionable. It is desirable that the front legs, from the bottom, or floor, of the chest to the ground, should be little more than half the height of the horse. The back and loins are comparatively short and well muscled, the conformation of these parts indicating an ability of the animal to carry weight. The ribs are long and well sprung. The croup is of good length, rather level, and curved gracefully with the tail, which is attached at a medium height and is somewhat lightly haired. The Thoroughbred is heavily muscled in the thighs and quarters, which are long and deep, exhibiting great propelling power. The gaskins, or lower thighs, should be broad, and the feet and joints should show strength and quality. The cannons are broad and the pasterns are longer than those of any other breed and frequently too sloping. It is desirable that the hind legs should be a trifle straighter than in the case of harness horses.

In color, Thoroughbred horses are variable. Bay and brown are the most common and the most popular colors, although chestnut is by no means uncommon, and black, sorrel, gray, and roan occasionally occur.

THE AMERICAN SADDLE HORSE

Between 1830 and 1840 many horses were taken into Kentucky, principally from Virginia and other eastern states and from Canada. Most of the horses from Virginia were either Thoroughbreds or animals largely permeated with Thoroughbred blood. Many of those taken from New York and the New England states were pacers, and were descendants from crosses of the early French Canadian mares with the stallions of New York and New England. It is probable, also, that many of them were descendants of the Narrangansett Pacer, a well-known strain that existed in the eastern part of the country in colonial times. These pacing horses, when taken to Kentucky, were crossed with the Thoroughbreds that had been brought from Virginia. From the animals resulting from this cross the American Saddle horse has been developed.

The size most desired for animals of this breed is a height of from 15 hands 1½ in. to 15 hands 2½ in. and a weight of from 950 to 1,100 lb. The saddle horse exhibits much style in carriage of head and in arch of neck and tail. In the best animals of the breed, the back is very strong and hence capable of sustaining considerable weight. The shoulders and pasterns are usually long, obliquely set, and springy. The croup is long and level, and the tail is long, set high, and stylishly carried.

Gaits of the Saddle Horse.—The most distinguishing feature of the saddle horse is his variety of gaits. The three natural gaits of a horse are the walk, trot, and gallop. The gallop, in the case of the saddle horse, has been changed by training to the canter. The canter is performed by practically the same movement of the legs as the gallop but is slower and easier on the rider. Some saddle horses have only the three gaits, the walk, the trot, and the canter; and are known as walk-trot-canter horses, or merely as plain-gaited horses. Many saddle horses have acquired through training two additional gaits, the rack and a slow gait. The rack is a gait in which each foot strikes the ground separately and in a peculiar rhythm. The rack was formerly termed the single-foot gait, but the American Saddle Horse Breeders' Association has officially adopted the term rack. The slow gait may be either the running walk, the slow pace, or the fox trot, all of which are closely allied. The running walk is faster than the common walk but is performed with the same rhythm; that is, each foot strikes the ground independently of the others. The slow pace is a slow, modified form of the common pace. The fox trot is a slow trot or a jog trot. A horse that can show the walk, the trot, the canter, the rack, and the running walk or the slow pace or the fox trot is called a gaited horse.

THE MORGAN HORSE

The Morgan horse is small, standing from 14 to 15½ hands high, and weighing from 900 to 1,200 lb. The head is small and neat, the forehead being broad and high. The eyes are large and brown, and are neatly set in the head. The head and ears are smaller and more refined than those of the American Trotter, and the neck is longer, has a better crest, and is set better, being carried higher. The shoulders are long and obliquely set, and the chest is deep and capacious, indicating endurance and hardiness of constitution. The back is short and well muscled; the ribs spring well from the spine, giving a round barrel; the croup is long and the tail neatly set; and the limbs are clean and cordy, the bone being of the best quality. The prevailing colors are bay, chestnut, brown, and black. Although but few Morgans ever attained phenomenal speed, most of them have good action and are clean, open-gaited trotters. Many of them with a little schooling readily acquire saddle gaits.

THE AMERICAN TROTTER

The American Trotter breed, the animals of which are commonly known as standard-bred horses, includes both the trotter and the pacer. In fact, the trotting and the pacing gaits are somewhat interchangeable and many of the so-called trotting horses have both. In the early development of this type, breeders failed to recognize any standard toward which to breed, but simply bred for speed. The American Trotter horse is scattered widely throughout the United States, being found in almost every section. He is distinctly the product of America and has been developed because of the love of Americans for horse racing at the trotting and pacing gaits.

No breed of horses is characterized by such a great variation in size, conformation, and color, as the American Trotter. In fact, there is so little of breed type found among these light-harness horses that some persons refuse to recognize them as belonging to a breed. In the best of these animals there is great symmetry of form. The head is inclined to be a little large and coarse; the neck rather short, lean, and straight; the shoulders sloping and well laid; the back and loin longer than is desired; and the croup short and somewhat drooping. American Trotters usually have deep chests and, as a rule, short, clean, fine-boned legs, and strong feet of excellent quality. The action is quick and the stride long. Breeders desire a weight, in the case of stallions, of about 1,150 lb., and, in the case of mares, of about 1,050 lb. Bay and brown are the most common colors of these horses.

THE ORLOFF TROTTER

The Orloff Trotter has the characteristic conformation of light-harness horses and is used chiefly for driving purposes. The average height is about 16 hands, and the weight varies considerably, running from about 1,000 to 1,300 lb. Gray, white, and black are the most common colors of these horses, although chestnut and bay are not uncommon. It is said that Orloff Trotters are lacking in quality. The head is usually small and the face dished. In good animals of the breed, the neck is strong, well arched, and carried high. The back is short and strong, and the loin full and muscular. The croup is somewhat sloping, being commonly criticized in this respect, but is heavily muscled. The shoulders are sloping but lack heaviness of form. The legs are strongly muscled and the bone and feet are regarded as of superior quality.

THE HACKNEY HORSE

The most desirable height for the Hackney is from 15½ to 15¾ hands, but the breed shows a wide variation in this regard. Some animals are less than 14 hands and others range over 16 hands. In England, the horses of this breed under 14 hands are called Hackney ponies; those from 14 to 15 hands Hackney cobs; and those 15 hands and over, Hackney carriage horses. They have all been bred much alike with the exception of size, which represents a difference of the breeders' ideas as to what is most desired and useful. The largest Hackney rarely weighs over 1,250 lb. Animals of this breed are usually stoutly built, compact, strong boned, muscular, and of kindly disposition. The head is light, clean cut, and intelligent in appearance; the neck is strong, well arched and muscular, but free from coarseness; the shoulders are smooth and oblique; the body is rotund, short, and compact; the legs are short, strong boned, and flattish; the tendons are prominent; and the hoofs are symmetrical and of good quality. The action of the Hackney is high, quick, elastic, and regular, the hocks being well flexed. The common colors are bay, chestnut, and brown, although black, roan, gray, and buckskin occasionally occur.

THE FRENCH COACH HORSE

The French Coach breed of horses, as the name implies, originated in France. The name French Coach, however, is an American one, there being no breed of that name in France. The breed known in America as French Coach is termed in France the Demi-Sang, meaning half blood. The horses of this breed are, on an average, about 16 hands high. The average weight of the stallions is about 1,350 lb., and of the mares about 1,200 lb. There is, however, considerable variation in the size. French Coach horses have a good length of body; a refined, well-placed neck; and a neat head. The back is short, broad, and well muscled; the croup is level and of good length; and the tail is well carried. The limbs are well placed, of good shape, and have quality; and the feet and pasterns are of superior quality. The trot of the French Coach horse is not so snappy and high as that of the Hackney, but the stride is longer and more powerful. Bay and brown are the prevailing colors, but black and chestnut are not unusual, and sometimes other colors occur.

THE GERMAN COACH HORSE.

The German Coach breed of horses, as the name suggests, is a product of Germany. Horses of this breed range in height from 15½ to 17 hands, and weigh from 1,250 to 1,600 lb. The usual height is from 16 to 16½ hands, and the weight from 1,300 to 1,500 lb. The head of the German Coach is neat, the neck is long and arched; the shoulders are oblique and well placed; and the withers are prominent. The German Coach horse is larger than the French Coach horse, the body being longer and heavier. In color, the German Coach horses are bay, brown, and black, brown and bay being more prevalent than any other color.

THE CLEVELAND BAY HORSE

In height, the Cleveland Bay ranges from about 16 to 16¾ hands, and weighs from 1,200 to 1,550 lb. The body is of the large coach type. The neck is of moderate length and the head is neat. The shoulders are long and sloping; the back and loins short and broad; and the croup high. These animals have an abundance of bone of good quality, and their action is good, although by no means as high as that of the Hackney. The color of the Cleveland Bay horse is always some shade of bay, either light or dark, with black legs, mane, and tail.

THE YORKSHIRE COACH HORSE

The Yorkshire Coach breed is recognized as a distinct breed in England, but is registered in the same stud books as the Cleveland Bay in the United States. The Yorkshire Coach horse is not so heavy as the Cleveland Bay but is a little taller, often standing 17 hands high. He is finer in bone, with more quality and refinement about the limbs, head, and neck, and is also a little more snappy in his action. In the best animals, the color is bay or brown, with black eyes; and there is an abundance of mane and tail.

THE PERCHERON HORSE

Percherons range in height from about 16 to 17½ hands and weigh from about 1,600 to 2,200 lb. An average weight for a Percheron stallion in good condition is from 1,900 to 2,000 lb. The Percheron has a deep, thick, compact body on rather short legs, which are devoid of the long hair characteristic of the Clydesdale and the Shire. The head is neat and refined, of good width between the eyes and the jaws, and tapers to a refined muzzle; the forehead is broad and full; and the ears are small, pointed, and carried erect. The neck is of moderate length, rather arched, and is usually set well on the shoulders.

In action, the Percheron is quick and energetic, exhibiting considerable snap. Percherons are good walkers but have a shorter stride than either the Clydesdales or the Shires. The trot is performed with vim and energy, and the knees and hocks are usually flexed well when carried forwards. Gray and black are the predominating colors, although occasionally bay, brown, and chestnut occur. The Percheron has a sanguine temperament, and an amiable disposition, in these respects being the best of all the draft breeds.

THE CLYDESDALE HORSE

Clydesdales commonly range in height from 16 to 17 hands, and weigh from about 1,800 to 2,000 lb. In the best animals the head is of good shape; the shoulders are rather oblique; and the chest is somewhat narrower than in animals of the other draft breeds. The body of the Clydesdale is criticized by many competent judges, who assert that it is lacking in depth and circumference. The feet, bone, and action are cardinal points with Clydesdale breeders, and in these respects animals of the breed are superior. A prominent characteristic of Clydesdale horses is the long, fine, silky hair, commonly termed feather, which grows out from the backs of the cannons and from the coronets.

In the early days a few of the Clydesdales were black, a few were gray, and a few were chestnut, but the Highland Agricultural Society made it a rule that only bays and browns should be allowed to compete for prizes. This checked the production of blacks and grays, which were rather common in the country at that time. Gray Clydesdales are still unpopular, and some authorities think that a chestnut color indicates Shire blood.

THE SHIRE HORSE

Shire stallions range in height from 16 to 17½ hands and weigh from about 1,800 to 2,400 lb. The shoulders are massive and powerful. The back is of moderate length and the croup of fair length, although not so level as that of the Clydesdale. The Shire is inclined to be a little plain over the hips and a little too short and straight in the pasterns. The feet are inclined to be small and too flat, lacking height at the heel, and also brittle, especially feet of a white color. As a rule, animals of the breed have an abundance of bone. A deep chest and heavily muscled shoulders, thighs, and quarters are characteristic of the breed. Shire horses have a profuse growth of feather coming out from the cannons; often the feather is not as fine and silky as is desired.

Horses of the Shire breed are usually of a bay or brown color, although black, gray, and occasionally chestnut occurs. As a rule, they have white faces, the white extending from the forehead to the muzzle, and one or more white feet and legs, the white extending to the knee or hock, and occasionally higher.

THE BELGIAN HORSE

The Belgian is the heaviest of all draft horses. The stallions range in height from 16 to 17 hands and vary in weight from 1,800 to 2,500 lb. The mares, of course, are considerably lighter in weight than the stallions, but are heavy in comparison with mares of the other draft breeds.

The characters that distinguish the Belgian draft horse from the horses of other draft breeds are the deep, thick body and short legs, which are free from long hair. He lacks the levelness of top that is desired, many animals of the breed being low in the back, rising rather high on top of the hips, and being rather short and drooping in the croup. The neck of the Belgian is short and thick and has a heavy crest that extends to the poll. The pasterns, in many instances, are a little short and upright, and the feet are small, having much the shape of the feet of a mule.

The prevailing colors of the Belgians are chestnut, bay, brown, and red roan; occasionally black and infrequently gray occurs, the latter color, however, not being popular.

THE SUFFOLK HORSE

Suffolk horses range in height from 15½ to 16⅓ hands high and weigh from about 1,700 to 1,800 lb. The Suffolk is not claimed to be strictly a draft horse, but is suited for agricultural purposes.

The Suffolk differs from the Clydesdale and the Shire in that it is free from all long hair on the limbs. It has a neat head, which is wide in the forehead, and the jaw tapers to the muzzle. The neck is of good length and the crest exceptionally well developed, presenting an arched appearance. The shoulders are long but not extremely straight nor obliquely set. The legs, which are rather short, are free from feather, and appear to be a little light in bone; however, breeders disclaim this, stating that it is simply because they are free from feather. The pasterns are of moderate length and the feet are of good texture, although at one time they were criticized for being too flat.

In color, the Suffolk is always some shade of chestnut, either light or dark, the light being preferred. The color of horses of this breed is exceptionally uniform.

MARKET CLASSES OF HORSES

The market classification of horses is based on their size, conformation, height, weight, style, and action. A classification based on such widely variable characters as these must necessarily be somewhat flexible, that is, the lines of division between the classes must be more or less a matter of personal opinion and subject to change according to the market demands for and the supply of any particular class. Many animals go to market and help to supply the demand that are not altogether typical of the market class in which they are sold. In attempting to meet the market demands, if there are not enough horses of a particular type, dealers try to fill the demand as far as possible with animals that are only partly typical of the class.

In the table on page 191 are given the names of the market classes and subclasses of horses, and the height and weight requirements for each. It will be seen that in most cases the name of the class and subclass is suggestive of the use to which the horses belonging to it are put.

Draft-Horse Class.—The draft-horse class is composed of horses that are broad, massive, rugged, and compact, and have sufficient weight, strength, and endurance to pull heavy loads. The weight should come from size rather than an abundance of fat. Draft horses range in height from 15¾ to 17½ hands, and weigh from 1,600 to 2,200 lb. or more. The action should be energetic and spirited, and the stride at the walk should be long and rapid.

The draft-horse class has been divided into light draft horses, heavy draft horses, and loggers, but the distinction between the light and the heavy subclasses is rarely made on the market, pertaining almost exclusively to the show ring.

Light draft horses are from 15¾ to 16½ hands high and weigh from 1,600 to 1,750 lb. Although 15¾ hands is accepted as the minimum height, a horse of this height is less desirable that one that is taller, and it closely approaches the eastern chunk subclass.

Heavy draft horses are the heaviest type of horses; they weigh from 1,750 to 2,200 lb. or more, and are from 16 to 17½ hands high.

MARKET CLASSES AND SUBCLASSES OF HORSES AND HEIGHT AND WEIGHT REQUIREMENTS OF EACH

Classes	Subclasses	Height Hands	Weight Pounds
Draft horses	Light draft horses	$15\frac{3}{4}$ to $16\frac{1}{2}$	1,600 to 1,750
	Heavy draft horses	16 to $17\frac{1}{2}$	1,750 to 2,200
	Loggers	$16\frac{1}{4}$ to $17\frac{1}{2}$	1,700 to 2,200
Chunks	Eastern and export chunks	15 to 16	1,300 to 1,550
	Farm chunks	15 to $15\frac{3}{4}$	1,200 to 1,400
	Southern chunks	15 to $15\frac{3}{4}$	800 to 1,250
Wagon horses	Express horses	$15\frac{3}{4}$ to $16\frac{1}{2}$	1,350 to 1,500
	Delivery-wagon horses	15 to 16	1,100 to 1,400
	Artillery horses	$15\frac{1}{4}$ to 16	1,050 to 1,200
	Fire horses	15 to $17\frac{1}{2}$	1,200 to 1.700
Carriage horses	Coach horses	$15\frac{1}{4}$ to $16\frac{1}{4}$	1,100 to 1,250
	Cobs	$14\frac{1}{4}$ to $15\frac{1}{4}$	900 to 1,150
	Park horses	15 to $15\frac{3}{4}$	1,000 to 1,150
	Cab horses	$15\frac{1}{2}$ to $16\frac{1}{4}$	1,050 to 1,200
Road horses	Runabout horses	$14\frac{3}{4}$ to $15\frac{1}{2}$	900 to 1,050
	Roadsters	15 to 16	900 to 1.150
Saddle horses	Five-gaited saddlers	15 to 16	900 to 1,200
	Three-gaited saddlers	$14\frac{3}{4}$ to 16	900 to 1,200
	Hunters	$15\frac{1}{2}$ to $16\frac{1}{4}$	1,000 to 1,250
	Cavalry horses	15 to $15\frac{3}{4}$	950 to 1.100
	Polo ponies	14 to $14\frac{1}{2}$	850 to 1,000

Loggers are heavy draft horses that are used in the lumbering regions for drawing heavy loads of logs. They usually differ from the heavy draft horses in being plain, rough, or slightly unsound in some respect, such as being defective in wind, having sidebones, boggy hocks, etc. Occasionally, good horses are purchased for logging purposes, but as a rule the trade demands rather cheap animals.

Chunk Class.—Horses of the chunk class are short legged, broad, and heavy set. As a class, chunks are less uniform in type than the animals of any other class. They vary in height from 15 to 16 hands and weigh from about 800 to 1,550 lb. The subclasses of the chunk class are eastern and export chunks, farm chunks, and southern chunks.

Eastern and export chunks are of much the same type and conformation as draft horses, but are a little more blocky and compact. At one time a considerable number were exported, but in recent years the price has been too high to permit of a profit in such business. Eastern and export chunks are largely used in pairs and in threes for trucking purposes.

Farm chunks are an important item in the horse market, particularly during the spring months. At other seasons they are usually sold to supply demands other than for farming. Farm chunks are lighter in bone and not as uniform in type as eastern chunks.

Southern chunks, or southern horses, as they are more generally called, are lighter in bone and more rangy in conformation that farm chunks. They are somewhat of the road-horse type, and usually have considerable light-horse blood. Southern chunks are taken to the southern states, where they are largely used for agricultural purposes.

Wagon-Horse Class.—Animals of the wagon-horse class are used principally for the pulling of light wagons, such as delivery and express wagons, on city streets. Horses of good action are required for this purpose, as they are required to do their work at a fairly rapid gait. Horses of this class are from about 15 to 17½ hands high and weigh from about 1,050 to 1,700 lb. The subclasses of the wagon-horse class are express horses, delivery-wagon horses, artillery horses, and fire horses.

Express horses are used singly or in pairs by express companies in the collecting and delivering of packages. The size of the horses that are used is determined by the weight of the wagon, whether the horses are worked singly or doubly, and the extent of the territory from which collections and deliveries are made. The lightest grade of express horses, which are used for the delivering of valuable packages, such as money, etc., are known as money horses; such horses must be capable of doing fast work.

Delivery-wagon horses, or, as they are often termed, wagon horses, are similar to express horses, but are not quite so large and generally not as high grade, as most mercantile firms do not care to pay large prices for horses. However, there are exceptions, some large department stores buying nothing but choice animals.

Artillery horses should be from 5 to 8 yr. old. Only geldings are used for artillery purposes, and the demand is rather spasmodic.

Fire horses, as the term implies, are animals that are used for the drawing of fire-fighting apparatus. Because of the fact that such horses are required to pull comparatively heavy loads at fast speed, it is necessary that they be more rangy than express horses.

Carriage-Horse Class.—Horses of the carriage-horse class are used for drawing heavy vehicles and are frequently spoken of as heavy-harness horses. They range in height from 14¼ to 16¼ hands and weigh from 900 to 1,250 lb. The subclasses of the carriage-horse class are coach horses, cobs, park horses, and cab horses.

Coach horses must have high action and beauty of form. They must flex the hocks well under the body and carry the knees high toward the chin. They are a little larger than other horses of the carriage class, and may be said to be a little more stately in action than cobs or park horses.

Cobs are small, stocky coach horses. The cob is a popular English type, and in England a horse is never considered a cob that is over 15 hands high. The action of the cob is much the same as that of the coach horse, being, perhaps, a trifle higher at the knees and hocks. Cobs should be somewhat quicker on their feet than coach horses.

Park horses are used strictly for display purposes, such as for driving in parks or on boulevards, and are usually used by horse fanciers. An abundance of quality and extremely high action at both knees and hocks are essential in horses of this subclass.

Cab horses are usually either the lower grades of the coach class or worn-out and discarded coach horses. They are used chiefly in cities for the conveyance of vehicles for public service.

Road-Horse Class.—Road horses are more lithe in build and angular in form than those of the carriage class. They are frequently spoken of as drivers or as light-harness horses. Although performance is the principal quality sought, a good conformation is very desirable. This class is composed of runabout horses and roadsters.

Runabout horses occupy an intermediate place between typical roadsters and carriage horses. They wear harness much like that of carriage horses, but in action and conformation and in the use to which they are put they correspond more to the roadster. They are not so heavy and full as coach horses, and are not so light, thin, and angular as roadsters. They are used on runabouts, driving wagons, phaetons, etc.

Roadsters are less uniform and usually more lithe and angular than runabout horses. In general, a roadster may be described as having the greyhound form, often being a little higher at the hips than at the withers, and powerfully developed in the hind limbs. Speed, style, and stamina are the principal qualities sought for.

Saddle-Horse Class.—The most important requirement for an animal of the saddle-horse class is to be sure of foot, as no rider cares to mount a stumbler. A saddle horse should also be an easy rider, and be easily controlled. In selecting a saddle horse, it is a good plan to choose a conformation that will place the rider well back on the animal, thus lessening the weight on the fore end. The subclasses of the saddle-horse class are: five-gaited saddlers, three-gaited saddlers, hunters, cavalry horses, and polo ponies.

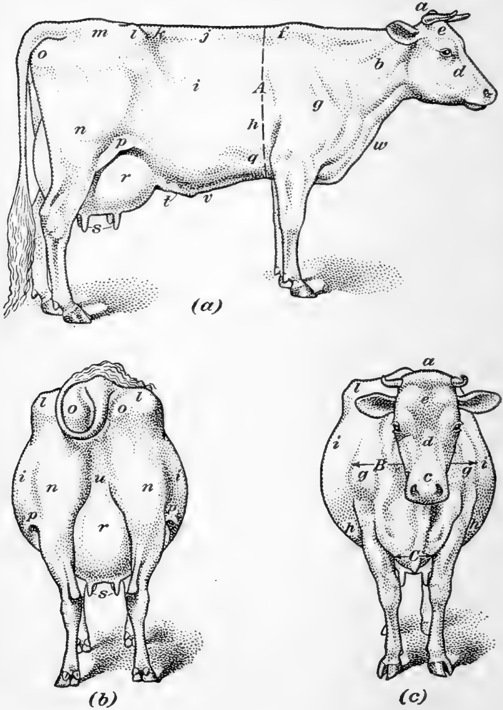
Five-gaited saddlers, often spoken of as gaited saddle horses or as American saddle horses, are the result of skilful selection and breeding for more than half a century. They have the five recognized distinct gaits under the saddle, namely, the walk, the trot, the canter, the single-foot, or rack, and a slow gait, which may be either the running walk, the fox trot, or the slow pace.

Three-gaited saddlers are much the same in general type and conformation as the five-gaited saddlers, but they are a little more compactly built, having shorter necks and bodies; the tails are usually docked and set; and they have only the three gaits: the walk, the trot, and the canter.

Hunters are horses used by sportsmen to ride after hounds. They are often required to take daring leaps over fences and gullies, and must be fearless and trained to jump. They should be strongly built and able to stand long, hard rides without becoming unduly jaded.

Cavalry horses, as the name implies, are horses used by the government for cavalry mounts. For this service, the government requires geldings of uniform and lasting color, that are from 4 to 8 yr. old.

Polo ponies are small saddlers that are used in playing polo. The four essentials which they must have are a specified size, weight-carrying ability, agility, and speed.



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DAIRY CATTLE

DESCRIPTION OF DAIRY TYPE

The majority of animals of all breeds of cattle that are noted for the secretion of large quantities of milk have a peculiar and distinct conformation, commonly termed the *dairy conformation*, and animals that have this conformation are said to be of the *dairy type*. The most distinguishing features of the dairy type are the triangular, or wedge, shape of the body and the

NAMES OF EXTERIOR REGIONS OF DAIRY CATTLE

a, Poll	*n*, Thigh
b, Neck	*o*, Pin bones, or thurls
c, Muzzle	*p*, Flank
d, Face	*q*, Fore flank
e, Forehead	*r*, Udder
f, Withers	*s*, Teats
g, Shoulders	*t*, Milk veins
h, Chest	*u*, Escutcheon
i, Barrel	*v*, Navel
j, Back, or chine	*w*, Dewlap
k, Loin	A, Heart girth
l, Hips	B, Width of Chest
m, Rump	

lean frame. This conformation is decidedly more marked in the females than in the males.

In addition to being wedge-shaped, the characteristic dairy form is angular, or lean; that is, it has a comparatively thin covering of muscular tissue. The shoulders are thin and the ridge of the shoulder blade is prominent. The ribs are thinly covered with muscle, particularly on the upper part close to the backbone. The loin is broad and flat but bony, and the thighs are thin, flat, and incurved at the rear as viewed from the side. That the angularity is due to a lack of muscular development rather than to a lack of fatty tissue is shown by the fact that cows of the dairy type frequently take on fat when far advanced in the period of lactation or when completely dry.

The characters of the dairy type of animal that have just been described are the most striking, but there are numerous minor characters that distinguish this type from the beef type. Among these are: leanness of head, breadth of muzzle, and thinness of neck. The dairy type of cow also has a distinctly feminine appearance.

The desired conformation of a dairy cow is shown in the accompanying illustration, (*a*), (*b*), and (*c*) showing, respectively, a profile view, a rear view, and a front view. The different exterior regions of the animal are marked with letters and in connection are given the corresponding letters with the names commonly applied to these regions.

JERSEY CATTLE

Jersey cattle are characterized by small to medium size. The official score card of the breed calls for from 800 to 1,000 lb. as the weight of a mature cow. The bulls weigh considerably more than this, their weight usually ranging from 1,200 to 1,800 lb. when they are mature.

A prominent characteristic of the Jersey form is the tendency of the bones to be short and curved. For instance, the face is short and usually dished; the hind legs are crooked; and in many cases there is more or less of a tendency for the back to depart from a straight line.

In color, the Jersey is variable. The typical color, however, is fawn or gray shading to black at the extremities, with a black muzzle, a black tongue, and a black switch at the end of the tail. As a rule, there is a ring of light-colored hair immediately about the muzzle. In some animals, particularly in bulls, the gray shades to black over the whole body, and in others the fawn color deepens to almost a red. A considerable proportion of Jerseys are marked with more or less white.

The Jerseys produce a moderate quantity of milk, which contains a high percentage of butter fat. Normal Jersey milk contains about 5% of butter fat; frequently the per cent. is less and frequently greater, in some cases rising as high as 7%. In quantity of butter fat produced in a year, the Jersey ranks as one of the leading dairy breeds.

GUERNSEY CATTLE

Guernseys are of a larger size than the Jerseys, although the animals, as a whole, cannot be characterized as large. Mature cows will seldom weigh more than 1,200 lb., and occasionally weigh less than 1,000 lb. The official score card of the breed calls for a weight of 1,050 lb. for a cow 4 yr. old or over, and 1,500 lb. for a bull of the same age.

In form, Guernseys have the characteristic wedge shape and the spareness and angularity of conformation of the dairy type, although in some animals there is a slight tendency to beefiness and to thick, heavy shoulders. This latter conformation is more frequently seen in bulls, although a number of the cows are thicker through the shoulders than is desirable.

The bones of the Guernsey are much straighter than those of the Jersey and are inclined to be somewhat longer.

The characteristic Guernsey color is fawn and white. Breeders of fancy stock prefer the colors to be about equally distributed and in rather large blocks or patches. Occasionally, Guernseys are seen with no white at all; and the number of animals of this breed in which the white color includes more than two-thirds of the whole surface is comparatively small. The shade of fawn varies from very light to very deep or dark, almost red, the shade most preferred being usually described as orange fawn. Whatever the shade of fawn, there should be no black hairs, especially in streaks or patches, forming a brindled appearance.

A characteristic of the Guernseys that has considerable influence in affecting their color is a profuse secretion of yellow coloring matter, which pertains to the whole skin, but may be seen especially on those parts where the skin is bare or only thinly covered with hair, such as in the ears, about the muzzle, in the fore flank, and about the vulva. In the best specimens, this secretion is of a deep golden-tan color shading into orange yellow. This color extends also to the hoofs and horns, giving these, especially in choice specimens, an amber appearance. The muzzle of the Guernsey should be of a clear flesh color tinged with orange.

Guernseys do not produce large quantities of milk, but their milk is ordinarily of about the same quality as that of the Jerseys, varying from 4½ to 6½% of butter fat. The milk, cream, and butter of the Guernseys are of a higher color than the similar products of any other breed.

HOLSTEIN-FRIESIAN CATTLE

Holstein cattle are characterized by large size. Mature cows of the breed seldom weigh less than 1,200 lb. and not infrequently reach a weight of 1,400 to 1,500 lb. The bulls, when mature, often exceed 2,000 lb. in weight. The characteristic wedge shape is usually strikingly developed in these cattle. In general, the form is inclined to be spare, although in many individuals there is considerable muscular development, even approaching what may be termed beefiness. The animals have long, straight faces, long backs, long ribs, and the legs, in some cases, are rather long. The back and legs are straight, although there is often a decided tendency for the back to droop from a point over the hip bones to the root of the tail.

A prominent character of Holstein cattle is their color, which is distinctly black and white, the two colors being entirely separate from each other. The proportion of the two colors is variable, running from almost all white to almost all black; during recent years the proportions most desired by the breeders have been rather more white than black, with the two colors in rather large patches. Although animals marked in this way are considered to be more desirable, little discrimination is made against those showing other proportions of color.

Holstein cows excel those of all other breeds in milk production. The percentage of butter fat in the milk, however, is small, in occasional instances so small as to interfere seriously with the sale of the milk as such. In addition, the butter fat in Holstein milk is soft and of rather light color, but with modern methods of butter manufacture these disadvantages are largely overcome, so that, taking into consideration the large quantity of milk produced, Holsteins are often as satisfactory as any breed from the standpoint of butter production.

AYRSHIRE CATTLE

Ayrshire cattle are of medium size. The American standard calls for a weight of about 1,000 lb. in the case of mature cows, and of 1,500 lb. for mature bulls. The Scotch standard calls for a weight of about 1,050 lb. for a mature cow.

The characteristic wedge shape of the dairy type is clearly defined in the Ayrshires. Their lines are straight and their bones fine and well knit together, which gives them a smooth appearance even when they do not carry much flesh. They are particularly round in the barrel, and the hindquarter is long, strong, and square. The cows commonly have large, symmetrical udders, with rather small teats placed wide apart and on the lines of a square.

In color, Ayrshires are the most variable of any of the dairy breeds, running from almost pure white to all admixtures, except roan, of white with yellow red, red, dark red, brown, and even black. The most common color at the present time is dark red and white, with a large preponderance of white in most cases.

Although definite statistics are lacking, it is commonly believed that Ayrshires are particularly economical users of feed, and that, in proportion to the feed consumed, their milk production is relatively high. Ayrshires give a large flow of milk, ranking next to Holsteins in this respect, although the milk is not particularly rich in butter fat, seldom exceeding 4%.

DUTCH BELTED CATTLE

Dutch Belted cattle are of medium size, being in this respect comparable to the Ayrshires. The cows average about 1,000 lb. when full grown, and the mature bulls about 1,500 lb. Animals of this breed have a distinct dairy form.

In color, the Dutch Belted cattle are black and white; the black is confined to the forequarters and hindquarters and the white extends in a broad belt about the middle. Much attention is given by breeders to the particular markings of the animals. In a perfectly marked specimen, the white belt should extend from the shoulders back to the hips in a regular band around the whole body. In the case of the cows, the band, or belt, includes the forward half of the udder; in the case of the bulls, the belt is similar, except that the sheath of the penis is usually black. A very narrow belt or a belt running onto the forequarters or the hindquarters is looked on with disfavor, as is any irregularity of the belt, such as a black spot in the white or broken patches of white in the black areas.

In milk production, the Dutch Belted cattle have considerable merit, and there are many animals of the breed that are listed high in this respect.

BROWN SWISS CATTLE

Brown Swiss cattle are of large size and rather heavy form. The bones of the head and legs are large and strong, giving the animals a sturdy appearance. Many specimens have considerable muscular development, enough to be described as beefy, although they do not approach the pronounced beef type as seen in beef breeds.

In color, the Brown Swiss are of a uniform dark grayish-brown or mouse color, running toward gray in the flanks and on the belly, and with a light ring about the muzzle. There is little variation in the color. Occasionally, an animal will shade a little darker toward black and occasionally one a little lighter toward light gray.

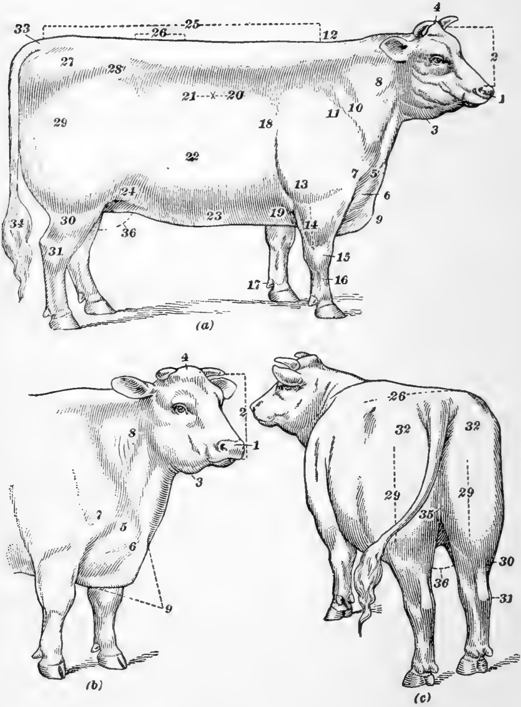
The Brown Swiss are hardy and vigorous and, as a rule, easy to keep in good condition. As milk producers, they vary considerably. Few individuals have made notable records.

SIMMENTHAL CATTLE

The Simmenthal breed of dairy cattle is closely related to the Brown Swiss breed. The animals of the Simmenthal breed are from the valley of the Simme in Switzerland, and are found in largest numbers in the vicinity of Berne, in that country. They are similar to the Brown Swiss in all respects save color. In color, they are a light fawn mixed with white. Only a few have been imported into America.

FRENCH CANADIAN CATTLE

French Canadian cattle are small, of a strictly dairy type, and somewhat resemble the Jersey in form. In color, they vary from a dark reddish brown to black, and almost never have any admixture of white. They are prized by their owners on account of their activity and vigor and their ability to thrive under adverse



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conditions as to feed and climate. They have not, as yet, become firmly established as a breed in any part of the United States.

BEEF CATTLE

DESCRIPTION OF BEEF TYPE

Beef cattle are cattle that are kept primarily for the production of beef, in contrast to dairy cattle, which are raised primarily for the production of milk.

NAMES OF EXTERIOR REGIONS OF BEEF CATTLE

1, Muzzle
2, Face
3, Tongue fat (feeder's wattle)
4, Poll
5, Breast
6, Brisket
7, Shoulder point
8, Neck
9, Dewlap
10, Shoulder vein
11, Shoulder
12, Withers
13, Elbow
14, Arm
15, Knee
16, Cannon
17, Dew claws
18, Crops
19, Fore flank
20, Fore ribs
21, Midribs
22, Barrel
23, Belly
24, Hind flank
25, Back
26, Loin
27, Rump
28, Hooks
29, Thighs
30, Gaskins
31, Hocks
32, Pin bones
33, Tail head
34, Switch
35, Twist
36, Udder in cows; cod in steers; scrotum in bulls.

An animal of the correct beef type has a compact form. It is short in the neck and legs, and has a broad, short head; well-sprung ribs; a deep, broad chest; well-laid-in shoulders and hips; a long, level rump; and well-fleshed thighs. The top line and bottom line are approximately straight and parallel. In general, a beef-type animal has a high percentage of meat to bone and offal.

Animals of the beef type invariably show marked indications of having a high percentage of the blood of one or more of the recognized improved breeds of beef cattle. The breeds that are classed as beef breeds are: the Shorthorn, the Polled Durham, the Hereford, the Aberdeen-Angus, the Galloway, and the Sussex.

In describing beef cattle, it is necessary to mention various parts and regions of the body. The location of all of the parts and exterior regions about which doubt might arise is shown in the accompanying illustration. In (*a*) is shown a profile view of an animal; in (*b*), a front view; and in (*c*) a rear view. These views also illustrate the ideal type of beef animal.

SHORTHORN CATTLE

The Shorthorn breed has wonderful adaptability, and this quality has led to wide distribution of the animals not only in this country under various conditions, but in nearly every country in which cattle are bred. Shorthorns were the first cattle used for improving the cattle on the ranges, but notwithstanding their value for this purpose, they are best adapted to a system of mixed farming, such as is carried on in the Central States. The Shorthorns are popular in localities where land is high in value, because many of the animals yield a profit in milk as well as in calves.

The Shorthorn may be red, white, red and white, or roan in color. Animals of the breed are the heaviest of the beef cattle, mature bulls often weighing as much as 2,400 lb. At present the tendency is to breed for early maturity, and as a result present-day Shorthorns are not as large and coarse as they were formerly. The Shorthorn is characterized by great scale and substance, together with symmetry and style. The Shorthorn is a good feeder and makes large gains for the feed consumed.

The breed is very popular in the United States, Canada, England, and other countries where beef is produced.

The "Prime Scots," so popular in the English markets, are crosses of the Shorthorn on the Aberdeen-Angus, and the "blue-gray" steers are crosses of light-colored Shorthorns on Galloways.

POLLED DURHAM CATTLE

Polled Durhams have been developed along two lines, the single standard and the double standard. The *single-standard* line of breeding had its origin in crosses of Shorthorn bulls on native muley, or hornless, cows. The term single standard is derived from the fact that animals of this line of breeding can be registered only in the American Polled Durham Herd Book. The *double-standard* line of breeding had its inception in what might be termed a freak of nature—the birth of hornless calves from pure-bred Shorthorn parents. The term double standard is derived from the fact that animals of this strain are eligible to registry in both the American Polled Durham Herd Book and the American Shorthorn Herd Book.

In size, color, and general appearance, the Polled Durhams are similar to the typical Shorthorn, save that the Polled Durhams are hornless. The preferred and prevailing color is red. The breed is so much like the Shorthorn that no additional description need be given.

The breed is not yet sufficiently strong in numbers and has not been handled enough for dairy purposes to furnish milk records of value. The animals have been from the first, and continue to be, bred primarily for the development of beef qualities as their dominant character, consequently their dairy qualities must be regarded as a secondary consideration.

HEREFORD CATTLE

In general conformation, the Hereford represents the beef type to an extreme, having a broad, deep, compactly built, thick-fleshed body set on short legs. The horns are white or waxy yellow, often coarser and considerably longer than those of the Shorthorn; in cows and steers they are often a little elevated, but in bulls they are usually drooping. The color of the Hereford is red with white markings. The most common markings are a white face, a white stripe on top of the neck and sometimes part of the way down the back, white on the legs from the hock down, and more or less white on the belly. White may occur to a greater or less extent on any part of the body. Herefords have proved to be especially well adapted to range conditions and are used more extensively for the improvement of the cattle on the ranges of the West and Southwest than are the animals of any other breed. In size, the Herford ranks a little below the Shorthorn. The bulls often weigh as much as 2,200 lb. and the cows 1,500 lb. or more.

ABERDEEN-ANGUS CATTLE

The striking features of the general outline of the Aberdeen-Angus are smoothness, compactness, and a cylindrical shape of the body. The Aberdeen-Angus are low-set; have great style, quality, and symmetry; and are evenly and smoothly covered with a wealth of firm flesh that retains its smoothness and firmness even if the animals are forced in fattening.

In the early history of the breed, browns, blacks, reds, and brindles were common, but now black is the prevailing color, although red calves are occasionally dropped, showing a tendency to revert back to the old colors. White is objectionable except on the bottom line behind the navel, and it is tolerated there only to a moderate extent. In size, the Aberdeen-Angus is somewhat smaller than the Shorthorn; mature cows usually weigh from about 1,200 to 1,600 lb. and mature bulls, from about 2,000 to 2,200 lb.

An important point in favor of the Aberdeen-Angus is their hornless character.

It is frequently claimed that the Aberdeen-Angus surpasses all other breeds in the production of beef. There is, of course, a considerable difference of opinion as to this, but it is safe to say that the Aberdeen-Angus is second to none as an all-round beef breed, and is, in some respects, superior to all others. This claim is substantiated by the position that the breed has taken at the leading fat-stock shows and by the high regard in which the meat is held in the market.

The milking qualities of the Aberdeen-Angus have been considerably neglected, more attention having been paid to beef production. However, there are some individuals and certain strains of the breed that make a creditable showing as milkers.

GALLOWAY CATTLE

Galloways are best adapted for a cold, damp climate, their special qualifications for these conditions being ruggedness and a thick coat of hair that protects them from cold and rain. They have been found very suitable for Dakota, Montana, and Idaho ranches, and for the Canadian Northwest. Being of a rather small frame and very muscular and active, they are well adapted to rugged pastures.

The Galloway is a thick, low-set, symmetrical, black, polled animal, resembling somewhat the Aberdeen-Angus. In good animals the head is short and broad, without any trace of horns or scurs, and is surmounted by a poll that is not quite as sharp as that of the Aberdeen-Angus. The ears are set a little farther back than those of the Aberdeen-Angus and point forwards and upwards, and have a fringe of long hair. The body is cylindrical but somewhat longer and flatter in the rib than that of the Aberdeen-Angus.

The color of the Galloway is black with a brownish tinge; white markings on the feet, legs, or any portion of the body above the bottom line are very objectionable. In size, the Galloway hardly equals the Shorthorn, Hereford, or Aberdeen-Angus. Galloway steers can usually be made to weigh from 1,000 to 1,200 lb. as yearlings past; from 1,200 to 1,400 lb. at 2 yr. old; and from 1,400 to 1,600 lb. at 3 yr. old. Mature bulls will weigh about 1,800 to 1,900 lb., and mature cows from about 1,200 to 1,500 lb.

The Galloway is distinctly a beef breed and lays no claim to milking qualities, although the animals produce enough milk to raise their calves, and the milk is of good quality.

SUSSEX CATTLE

The Sussex are best adapted to localities that are rich in crop production and temperate in climate. Their grazing qualities are nearly if not quite equal to those of the Herefords. They are very hardy, which is due largely to the manner in which they have been handled. The color of the Sussex is solid red, a moderately deep shade being preferred. The horns are inclined to be large and long, curving around in front and often inclining slightly downwards. The nose is of flesh color. The form is blocky, the ribs being well sprung and long, and the body capacious. The Sussex is comparatively large, ranking about on a par with the Hereford in size. The average weight of mature cows is about 1,400 lb. and of mature bulls about 2,000 lb.

The Sussex has long been held in high esteem as a beef breed, as might be assumed from the excellent showing it has made at fat-stock shows in England. In beef production it is comparable to the Shorthorn and the Hereford.

DUAL-PURPOSE CATTLE

DESCRIPTION OF DUAL-PURPOSE TYPE

Dual-purpose cattle are cattle that are kept for the production of both beef and milk. An appropriate term for them and one that is commonly applied is general-purpose cattle. They produce, when fattened, fairly satisfactory carcasses of beef, although they are not the equals of the special-purpose beef cattle in this respect, and the cows give a sufficient quantity of milk of fair butter-fat content to warrant milking them. If cattle of a dual-purpose breed or strain possess merit as beef animals but are without dairy qualities, they should be classed as beef cattle. If, on the other hand, they possess dairy qualities but neither they nor their offspring exhibit beef qualities, they should be classed as special-purpose dairy cattle.

The dual-purpose type of animal is not restricted to any particular breeds, but because a large number of animals of certain breeds are of this type, the breeds are spoken of as dual-purpose breeds. These breeds are: the Devon, the Red Polled, and the Brown Swiss; certain animals and strains of the Shorthorn breed are also classed as dual purpose.

DEVON CATTLE

In color, the Devon is a solid red, with the exception of deep orange-colored rings around the eyes and occasionally a small amount of white in front of the udder or the scrotum and in the switch. White is not permissible on any other part of the body. The red varies from dark to light; some breeders prefer one shade and some the other.

The Devon is smaller than the Shorthorn and the Hereford, the size varying greatly, however, with the breeding, feeding, and care. The lack of size of the Devons makes them less popular than they would otherwise be, but what they lack in size they make up in quality, fattening powers, compactness of flesh, perfection of form, splendid handling qualities, and beauty when finished. The average weight of mature cows is about 900 lb. and of mature bulls about 1,200 lb. The bulls seldom weigh more than 2,000 lb.

Combining fair flesh and milk-producing qualities, the Devons are very suitable animals for hilly regions where a system of mixed farming is followed.

RED POLLED CATTLE

The Red Polled breed is one of the best of the dual-purpose breeds. Red Polls produce an abundant quantity of milk and the steers fatten readily, producing carcasses that are very acceptable to the butcher. As the name implies, the animals are without horns, all indications of such being very objectionable. The color is red, varying from a light to a dark shade. A solid red is preferred, but a little white is permissible on the udder, on the belly, and on the switch of the tail. In size, the Red Poll ranks below most of the animals of the beef breeds. Typical mature bulls of the breed will weigh from about 1,800 to 2,000 lb. and mature cows from about 1,100 to 1,300 lb.

Although the dairy qualities of the Red Poll do not rank with those of special dairy cattle, the breed stands high in this respect among the dual-purpose cattle.

MARKET CLASSES OF CATTLE

Variations in the quality, condition, weight, and age of cattle reaching the great livestock markets make it necessary that different classes and grades be established. If it were not for these classes and grades it would be impossible properly to designate different kinds of cattle and intelligently to report market conditions through the public press. A list of the various market classes and grades of cattle is given in the accompanying table.

Market Classes and Grades of Cattle

Classes	*Grades*
Beef cattle	Prime steers Choice steers Good steers Medium steers Common steers
Butcher stock	Prime heifers Choice heifers Good heifers Medium heifers Prime cows Choice cows Good cows Medium cows Common rough steers Choice bulls Good bulls Medium bulls
Cutters and canners	Good cutters Medium cutters Common cutters and good canners Medium canners Inferior canners Bologna bulls
Stockers and feeders	Fancy selected feeders Choice feeders Good feeders Medium feeders Common feeders Inferior feeders Feeder bulls Fancy selected yearling stockers Choice yearling stockers Good yearling stockers Medium yearling stockers Common yearling stockers Inferior yearling stockers Good stock heifers Medium stock heifers
Veal calves	Choice Good Medium Common
Milkers and springers	

Beef Cattle.—In the beef-cattle class are included all grades of fat steers and occasionally the best grades of fat heifers and cows. Condition and quality rather than weight determine whether an animal shall be included in this class. Beef cattle are in demand in the Chicago market by three classes of buyers: exporters, packers, and shippers. Exporters desire fat cattle for export to the British markets; packers desire them for slaughter in Chicago as dressed beef; and shippers desire them for shipping to Boston, New York, Philadelphia, Pittsburg, Baltimore, Cleveland, Albany, Detroit, and many smaller eastern cities. The Chicago packing houses use from about 50 to 60% of the beef cattle sold on the Chicago market, and the exporters and shippers from about 20 to 25% each.

The beef cattle class is made up of the following grades: *Prime steers, choice steers, medium steers,* and *common rough steers.* Prime steers are those that are practically above criticism as to both condition and quality. The bulk of the prime steers sold at Chicago weigh from about 1,200 to 1,600 lb. Choice steers are not quite right as to either quality or condition but have to a marked degree desirable characteristics. Such steers usually weigh from about 1,150 to 1,600 lb. Steers that are of good quality, but noticeably lacking in condition or in finish, or those that are finished but are deficient in quality, or those lacking in both quality and condition but above the average are graded as good. They weigh from about 1,150 to 1,600 lb. Steers of about average quality and condition but lacking to a marked degree the finish and quality demanded in a prime steer are graded as medium steers. Steers of this grade are usually of light weight, weighing from about 1,100 to 1,400 lb. Common rough steers, as the term implies, are the roughest grade of beef cattle. Such steers weigh from about 900 to 1,200 lb.

Butcher Stock.—A large number of cattle of all grades as to weight and quality reach the market after having been merely *warmed up*—an expression used by cattlemen to designate the fact that cattle have been full fed but a short time. Then, no matter how carefully stockers and feeders are selected, there is almost sure to be a few animals that do not fatten satisfactorily. These, together with the better grades of heifers, cows, and bulls are classed as butcher stock. The butcher stock class is made up of the following grades: *prime heifers,* usually weighing from about 800 to 1,200 lb.; *choice heifers,* weighing from about 700 to 1,000 lb.; *good heifers,* weighing about the same as choice heifers; *medium heifers,* weighing from about 600 to 900 lb.; *prime cows; choice cows; good cows; medium cows; common rough steers*; *choice bulls*; *good bulls*; and *medium bulls.*

Cutters and Canners.—Thin cows, inferior steers, rough heifers, and the poorer grades of bulls, provided they carry sufficient flesh to allow of the loin or rib, or both, being used for cutting, or selling over the butcher's block, are classed as *cutters.* Cutters are a slightly better grade of cattle than *canners,* which are cattle of the same general class as cutters, but too inferior to allow of even a part of their carcasses being used for sale over the butcher's block. Canners are used largely for canning purposes. The class of canners and cutters and the grades within this class are more or less elastic and variable, as are all market classes and the grades within them.

The bulk of cattle classed as cutters and canners may be graded as follows: *Good cutters, medium cutters, common cutters,* and *good canners, medium canners, inferior canners.* and *Bologna bulls.* The impression prevails among persons unfamiliar with the cutter-and-canner trade that only old, thin cows are classed as canners. This is an erroneous impression, as wretchedly thin bulls, steers, and heifers are included as well.

Stockers and Feeders.—The class known as *stockers and feeders* includes calves, yearlings, 2-yr.-olds, and older cattle. When it is necessary to refer to steers or bulls 18 mo. old or older that are intended for immediate use in the feed lot, they are spoken of as *feeders*. Calves, heifers, and young steers, including yearlings, are referred to as *stockers*. Some difficulties are encountered, however, in attempting to draw a definite line between stockers and feeders. Cattle of the same grade, age, quality, and weight shipped to the country by two different feeders might not be handled at all alike; one feeder might use them as stockers while the other might place them in the feed lot for immediate use.

It is seldom that a steer weighing less than 800 lb. is placed in the feed lot; the common practice is to buy steers for feeders that weigh from 900 to 1,000 lb. or more. Such steers are usually 18 mo. of age or older. Steers spoken of in the market as feeders are, generally speaking, in better flesh than stockers. As a rule, therefore, feeders may be classified as steers weighing 900 lb. or more, that are 18 mo. old or older, and that are fleshy enough to render an extended period of low feeding unnecessary.

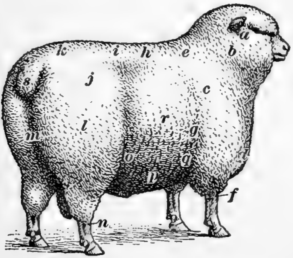
The stocker and feeder class of cattle is divided into the following grades: *Fancy selected feeders, choice feeders, good feeders, medium feeders, common feeders, inferior feeders, feeder bulls, fancy selected yearling stockers, choice yearling stockers, good yearling stockers, medium yearling stockers, common yearling stockers, inferior yearling stockers, good stock heifers, medium stock heifers,* and *common stock heifers.*

Veal Calves.—Calves of suitable age, condition, and weight to sell, when slaughtered, as veal are classed as *veal calves*. Veal calves are graded as follows: *Choice veals, good veals, medium veals,* and *common veals.* Weight is not as important in determining the grade of a veal calf as age and flesh, although desirable weight in the good and choice grades of veals is important. A veal either 25 lb. too light or too heavy may be sold at a reduced price when one of the same quality, age, and flesh, but of desirable weight, would sell as a choice veal. It is more difficult to distinguish breeding in young calves than in older cattle; it is fortunate, therefore, that the breeding of veals is of little importance and that the most important point is to get fine finish on a young calf—say a weight of from about 140 to 160 lb. with faultless finish on an 8-wk.-old calf.

Milkers and Springers.—A cow that is in milk when she goes to market or has a calf at her side is classed as a *milker*. One that shows unmistakable signs of pregnancy is classed as a *springer*. Milkers and springers may be either slaughtered or returned to the farm to serve as dairy cattle or as breeding stock.

SHEEP

In order that the description of the types and breeds of sheep may be more intelligible, the position of the different parts of a sheep is indicated on the animal shown in the accompanying illustration. The names



of the different parts are as follows: *a*, head; *b*, neck; *c*, shoulder; *d*, brisket; *e*, top of shoulder, or withers; *f*, fore leg; *g*, chest; *h*, back; *i*, loin; *j*, hip; *k*, rump; *l*, leg of mutton; *m*, twist; *n*, hind leg; *o*, flank; *p*, belly; *q*, fore flank; *r*, ribs, or sides; and *s*, tail, or dock.

WOOL TYPE OF SHEEP

From the sheep that centuries ago were raised in the southern part of Europe, especially in the hills of Spain, and fostered by the early Romans, there has been developed a type of sheep known as the *wool type*. The animals of this type are noted for the production of a large quantity and a fine quality of wool, from which the finest woolen cloth is made.

A typical wool-type animal is angular in shape; the skin lies in folds over the body, especially about the neck; and the head presents a strong and rather coarse appearance, particularly in the case of a ram that shows great vitality. The neck is long, rather thin, and often droops where it joins the body; the shoulders are close together, sharp, and prominent on top; the brisket is narrow; the fore legs are close together, with the fore feet often wider apart than the knees; and the fore flanks are low but thin. The ribs slope downwards sharply from the backbone, which appears to be too long for the length of the sheep; the back is narrow; the loin is thin and narrow; the rump is short and inclined to droop abruptly from the hips, which are also narrow; the thighs are thin and separated well up toward the tail, or dock; the flanks are thin; the bottom line is generally level; and the legs have a tendency to be long.

Some breeds of the wool type of sheep have been developed by feeding, selection, and breeding until they produce a fair quantity and quality of mutton as well as excellent fleeces of wool.

MUTTON TYPE OF SHEEP

In the British Isles, sheep raising has been carried on for several centuries, but in this region the chief aim of the breeder has been the production of a fine quality of mutton, wool production being a secondary consideration. The type of sheep that has been developed under these conditions is known as the *mutton type.* In form, a sheep of the mutton type is smooth, round, compact, symmetrical, and free from angularities, and the flesh is evently distributed over the carcass. The head is broad between the eyes, which are large and prominent; the neck is short and thick; the brisket is broad and full; the fore legs are short, straight, and set squarely under the body; the fore flanks are well filled so that there is but a slight depression just back of the shoulders, which are evenly and deeply covered with flesh and are smooth and round on top. The ribs are well covered with flesh and spring boldly out from the backbone, making the back broad and level and the body cylindrical. The loin is broad and thickly covered with flesh; the flanks are let well down but are thick, giving a straight bottom line that is parallel with the top line. The hindquarters are broad; the rump is long and level; and the twist extends well down to the hocks. The legs stand well apart; and the thighs, both on the outside and between the legs, are well covered with flesh, thus making a good leg of mutton.

Sheep of breeds of the mutton type produce heavy fleeces, but these are not of as fine a quality as those produced by sheep of the wool type.

AMERICAN MERINO SHEEP

In general appearance, a typical animal of the American Merino breed of sheep more nearly represents the ideal wool type than does an individual of any other breed in America. The American Merino is narrow and angular in conformation; has a rather long neck and long leg; and has many distinct folds in its skin, except on the back.

The head of the American Merino is small as compared with the heads of animals of other breeds, and usually the lips, nostrils, legs, and part of the face are covered with fine, white, silky hair. The ears are small, and, as a rule, are covered like the parts just mentioned, with fine, white hair, although occasionally tan-colord spots of hair are found on one or more of such parts. The head of the ewe is hornless, but the rams carry heavy, spiral horns, which are marked with transverse wrinkles.

In size, American Merinos vary greatly. It is generally accepted, however, that mature ewes should weigh about 100 lb. and mature rams about 150 lb.

The American Merino is an inferior animal for mutton production, because it does not make a rapid growth, lay on flesh rapidly, or produce a first-class carcass. The meat is lacking in quality, and there is always much waste in dressing, due to the extensive folds of the skin, the long legs, and the large proportion of bone to flesh.

In wool production, sheep of the American Merino breed surpass those of all other breeds in America. Sheep of no other breed produce as fine or as heavy fleeces.

DELAINE MERINO SHEEP

Sheep of the Delaine Merino breed differ from American Merino sheep in having a larger and better mutton carcass, fewer wrinkles and folds on the body, and longer wool that contains less yolk. The minimum weight for ewes of the various families of Delaine Merinos varies from 100 to 130 lb., and the minimum weight for the rams, from 150 to 180 lb.

The Delaine Merino breed is really a branch of the American Merino breed, and has been developed principally in the section including the western part of Pennsylvania, the Panhandle district of West Virginia, and a few counties in the eastern part of Ohio.

The Delaine Merino is superior to the American Merino for mutton production, and, as a rule, is inferior in wool production.

RAMBOUILLET SHEEP

In general appearance, a typical animal of the Rambouillet breed of sheep bears some resemblance to the American Merino, but the Rambouillet is larger and has more of a mutton carcass. The outline of the body is rounder and more plump; the back is broader; the ribs are better arched; and there is a better development of loin, hindquarters, and leg of mutton, and a deeper fleshing all over the body than in the American Merino. The females are hornless, but the rams usually bear large, spirally curved horns; occasionally, polled rams are found.

In size, the Rambouillet is considerably larger than the American Merino. Mature rams usually weigh from 175 to 250 lb., and occasionally one will weigh 300 lb. Mature ewes weigh from about 110 to 150 lb., and mature wethers from about 150 to 200 lb.

The Rambouillet is not one of the best breeds of sheep for mutton production, but it is better in this respect than the American Merino, although not so good as the Delaine Merino.

The Rambouillet is one of the best breeds for wool production. The wool covers the body evenly, is of good length on the belly, and grows well down on the nose and legs.

SOUTHDOWN SHEEP

The Southdown breed of sheep probably more nearly represents the ideal mutton type than does any other breed. In general appearance, the typical Southdown presents a compact, broad, deep, and smooth body evenly covered with flesh. The head is small and hornless in the case of both rams and ewes.

The Southdown is the smallest of the medium-wool breeds, and is often criticised on account of its lack of size. However, the carcass of a Southdown is so compact that mature rams of the breed will weigh, on an average, about 175 lb. and mature ewes about 135 lb.

For the production of mutton, the Southdown breed is one of the best. Animals of this breed are good feeders, make good gains for the feed consumed, mature quickly, and can be made ready for the market at almost any age.

In wool production, the Southdown does not rank high, although the wool is finer in quality than that of sheep of any other breed of the mutton type.

SHROPSHIRE SHEEP

The Shropshire breed of sheep is a medium-wool breed that is popular with sheep raisers. The sheep of this breed are larger and heavier than those of the Southdown breed, which they resemble in general conformation, although they are not so compact as the Southdowns. Both the ram and the ewe are hornless, and in the case of the best specimens of the breed, the head, with the exception of a small part of the nose, is covered with a dense cap of wool. The nose of the ram is slightly Roman, and the nostrils are strong and large; the head of the ewe is finer than that of the ram and the nose is straight. The ears of a Shropshire sheep are small, short, pointed, moderately thick, wide apart, and covered with short, fine wool.

In size, the Shropshire is about an average of the sheep of the medium-wool breeds. Mature rams should weigh about 225 lb. and mature ewes from 150 to 160 lb.

The Shropshire breed ranks next to the Southdown in the quality of mutton produced; in fact, the quality of Shropshire mutton is claimed by some to be equal to that of the Southdown. Shropshires fatten readily and there is comparatively little offal in dressing.

The wool of Shropshire sheep is of superior fineness and crimp for a medium-wool breed, is usually about 3½ in. in length, and often contains a considerable quantity of yolk. The fleeces from a flock of Shropshire sheep should average about 7 or 8 lb. in weight.

OXFORD DOWN SHEEP

Sheep of the Oxford Down breed are the largest of the animals of the medium-wool breeds. They resemble the Southdowns and Shropshires in general conformation, which is that of the mutton type. The head is hornless, the poll, or top of the head, is well covered with a tuft or a topknot of wool, and the cheeks are covered with wool, although the rest of the face is usually covered with dark hair. The ears are rather long, thin, set low and well back, and are free from wool. The face and legs are of a dark-brown color. The body is practically the same as that of the Shropshire. The rump is broad, level, and well covered with flesh.

When mature, Oxford Down rams should weigh not less than 275 lb., and some rams of the breed have attained a weight of 400 lb. Mature ewes should weigh about 200 lb. Lambs dropped in April should weigh from 100 to 120 lb. in the following September.

In the ability to produce mutton, Oxford Down sheep rank high on account of their large carcasses, the small proportion of waste in dressing, and the fine quality of the mutton. The lambs grow rapidly and attain a desirable killing size at 12 mo. of age, and when kept until older they continue to make good gains.

As wool producers, the Oxford Downs are much in favor on account of their heavy fleeces. The wool is of a quality known as combing wool, which is longer and coarser than that from sheep of any of the other medium-wool breeds. The fleeces from a flock of good Oxford Down sheep should average from 10 to 12 lb.

HAMPSHIRE SHEEP

The ears, nose, and legs of Hampshire sheep are of a uniformly dark-brown color that often shades to almost black. The ears, the back of which may be of a dark mouse color, are rather long and in the best specimens of the breed are inclined to fall slightly outwards. The head is well covered with wool between the ears and on the cheeks; the neck is rather long, thick, and well muscled, and the body is very much like that of an animal of the Oxford Down breed.

The Hampshires raised in America are lighter in weight than the Oxford Downs, but in England the Hampshires are often regarded as the heaviest sheep of the medium-wool breeds. Mature rams should weigh about 250 lb. and mature ewes about 190 lb. Occasionally, by careful breeding and good care, rams weighing 300 lb. are produced.

For production of mutton, Hampshire sheep have long ranked high. The wool of the Hampshire sheep is of medium length and not so fine as that of the Southdowns.

DORSET SHEEP

The Dorset breed of sheep, also known as the Dorset Horn breed, is a breed that is distinctly marked. Both the rams and the ewes have horns. The horns of the ram are spirally curved rather close to the head; those of the ewe are shorter, smaller, not so close to the head and are curved less than those of the ram. The sheep of the Dorset breed have white faces and legs. The face, muzzle, ears, and that part of the legs below the knees and hocks are covered with short, white hair. The nostrils are large and white. The body of the Dorset, although smooth and well covered with flesh, is longer in proportion to its depth and width than the body of a sheep of the other breeds of the mutton type.

In size, sheep of the Dorset breed rank somewhat above the average of those of the medium-wool breeds. Mature rams should weigh about 225 lb. and mature ewes about 165 lb.; an extra good 2-yr-old ram has been known to weigh 317 lb.; a yearling ram, 287 lb.; a 5-mo.-old ram lamb, 184 lb.; and yearling ewes, 250 lb.

In the production of mutton, sheep of the Dorset breed rank only fair among those of the medium-wool breeds.

Sheep of this breed dress with a larger percentage of waste than those of some other breeds, although the quality of the meat is fair. The principal value of Dorset sheep is in the production of early, or hothouse, lambs, for which they have long been highly valued.

The Dorset does not rank high in production of wool.

CHEVIOT SHEEP

Sheep of the Cheviot breed are white in color and have a graceful carriage. The head is usually hornless in the case of both the male and the female, although occasionally horns occur on the ram; according to an enactment of the American Cheviot Sheep Society, all male lambs dropped after January 1, 1905, are ineligible to registry unless they have a true polled head. The head, back to a line just back of the ears and around under the middle of the lower jaw, and the legs from the knees and hocks down, are usually covered with fine, white hair; sometimes small black spots, which are not considered objectionable, appear on the head and ears. Reddish or sandy hairs that occasionally occur on the face and legs are objectionable.

A mature Cheviot ram should weigh from 200 to 225 lb. and a mature ewe from 150 to 160 lb.

The quality of the meat of the Cheviot is good, although not so delicate as that of the Southdown, and there is comparatively little offal in dressing.

Cheviot sheep produce fleeces of a medium quality known in the market as half combing wool.

SUFFOLK SHEEP

Sheep of the Suffolk breed have a characteristic inky-black color in the region of the head, ears, and legs. The head, in the case of both the male and the female, is hornless. The face is long and narrow, and the ears long and rather large. The face and the ears are covered with jet-black hair; there is rarely any wool on any part of the head, although a small quantity of clean, white wool on the forehead is not regarded as objectionable.

In size, the Suffolk sheep rank somewhat above the average of those of the medium-wool breeds. Mature rams should weigh from about 225 to 240 lb., and mature ewes about 175 lb.

Sheep of this breed rank high for the quality and quantity of the mutton that they produce, but do not rank high as wool producers.

LINCOLN SHEEP

Sheep of the Lincoln breed are large, squarely built animals, and are nearly white in color. The head is large and hornless in the case of both the ram and the ewe; the face is rather long and usually is covered with fine, white hairs, but frequently has a grayish tinge over the nose; the poll is surmounted by a short tuft of wool; and the ears are large and often covered with brownish spots.

Lincoln sheep are the largest of any breed. Mature rams should weigh from about 275 to 300 lb., and mature ewes from about 225 to 250 lb.

Lincoln sheep are good feeders and mature quickly, but they do not rank high as mutton producers. The carcass is too large to suit the modern market demand, yields too much fat, and the quality of the meat is not first class.

Sheep of this breed produce longer wool and heavier fleeces than those of any other breed with the exception of sheep of the fine-wool breeds.

LEICESTER SHEEP

The Leicester breed is divided into two strains; the English, or Dishley, Leicester, and the Border Leicester. These names are derived from the sections of England where the two strains were developed. The sheep of the two strains are much the same in general appearance, and the same description will apply to both, except where differences are stated.

The heads of both the ram and the ewe are hornless and usually are white, although small black spots occasionally occur on the face and ears. The head of a Border Leicester is covered with fine, soft, white hair, but occasionally the poll of the head of a Dishley Leicester is covered with a tuft of short wool. The ears are thin, somewhat large, and stand rather erect. The nose is slightly Roman and the skin at the muzzle is black. The hindquarters are not so large as breeders desire, because the thighs are not sufficiently thick, especially near the hocks.

When mature and fitted for market, Leicester sheep carry too much fat to be popular. The lambs fatten readily and make desirable mutton if killed before they are 12 mo. old.

The wool of Leicester sheep is about 6 in. long and is a fine grade of coarse wool.

COTSWOLD SHEEP

Sheep of the Cotswold breed are large, long-wooled, and white in color, and somewhat resemble those of the Lincoln and the Leicester breeds. The head in the case of both the male and the female is hornless and carried high, and the poll is surmounted by curling locks of wool, which often almost cover the eyes and extend down as far as the nostrils. This forelock is one of the characteristic features of the breed and is not trimmed when the sheep are shorn or trimmed for show. The face is usually covered with white hair, but is sometimes spotted with gray or brown patches.

In size, Cotswold sheep are larger than those of the Leicester and almost and sometimes fully as large as those of the Lincoln breed. The weight of these sheep will average about 25 lb. lighter than that of the Lincolns. A mature ram should weigh from about 250 to 275 lb. and a mature ewe from about 200 to 250 lb.

Cotswold sheep make a desirable grade of mutton if killed at about 1 yr. of age. If they are allowed to grow to 2 yr. of age, the carcasses are too large, bear too much fat, and the flesh is not of as desirable quality as when the sheep are killed at a younger age.

Cotswold sheep produce a lustrous combing of wool that is rather coarse and hair-like, and hangs in spiral curls, or locks. The wool is coarser than that of either Leicester or Lincoln sheep.

MARKET CLASSES AND GRADES OF SHEEP

Almost the entire number of sheep and lambs received at the large livestock markets are classed as mutton sheep, feeder sheep, or breeding sheep.

All sheep and lambs that are shipped to a large market and sold for slaughter, no matter what their condition, age, or weight may be, are classed as *mutton sheep.* The largest part of the sheep received in the market consists of this class, which is divided into the following subclasses: Lambs, yearlings, wethers, ewes, bucks, and stags. *Lambs* are animals that are mostly under 12 to 14 mo. of age. *Yearlings* are the castrated lambs from about 12 to 14 mo. of age until they are about 2 yr. old, or mature, after which they are known as *wethers.* All female sheep received in the markets and that are older than lambs are known as *ewes.* Rams after they have passed out of the lamb subclass are designated in the market as *bucks.* Male lambs that are castrated after they are 12 to 14 mo. old are classed in the market as *stags.* Each of the subclasses described and the subclasses of the other market classes of sheep are further divided into market grades of sheep. The grades usually given in market reports are prime or fancy selected, choice, good, medium, and common, or culls. The grades rank in the order named in regard to the quality and the condition of the sheep.

The class known as *feeder sheep* consists of sheep that are received in the markets in poor condition and that are sold to be fattened. The recognized subclasses of feeder sheep are lambs, yearlings, wethers, and ewes.

MARKET CLASSES AND GRADES OF SHEEP

Classes	*Subclasses*	*Grades*
Mutton sheep	Lambs	Prime Choice Good Medium Common, or culls
	Yearlings	Prime Choice Good
	Wethers	Prime Choice Good Common
	Ewes	Prime Choice Good Medium Common, or culls
	Bucks and Stags	Choice Good Common
Feeder sheep	Lambs	Fancy selected Choice Good Medium Common
	Yearlings	Choice Good Common
	Wethers	Choice Good Medium Common
	Ewes	Choice Good Medium Common
Breeding sheep	Ewes Bucks	Fancy selected Choice Good Common Not graded

Miscellaneous classes: Hothouse lambs, export sheep, throw-outs, dead sheep.

The class known as *breeding sheep* consists of those sheep that are bought in the large markets for breeding purposes. By far the largest number of sheep of this class are ewes. The rams, or bucks, as they are known in the markets, are few in number and most of them show a form and a mixture of blood that make them undesirable for breeding purposes.

A miscellaneous class consists of hothouse lambs, export sheep, throw-outs or rejects, and dead sheep. *Hothouse lambs* are those dropped at a time of year that will permit of placing them, when 8 to 12 wk. old and weighing from 25 to 50 lb., on the market between Christmas and the first of May. The weight of the lambs will vary with their age. *Export sheep* are usually sheep in excellent condition and are of the prime and choice grades of any of the subclasses of the mutton class of sheep. *Throw-outs* are the sheep first placed in the feeder class on account of their poor condition and then rejected, or thrown out, by purchasers of feeder sheep, a privilege allowed by the market authorities. Such sheep are usually purchased by local butchers who cater to a cheap trade. *Dead sheep* are those that are killed in transit. They are sold for their wool and for fertilizing purposes.

The classes, subclasses, and grades of market sheep are shown in the accompanying diagram.

SWINE

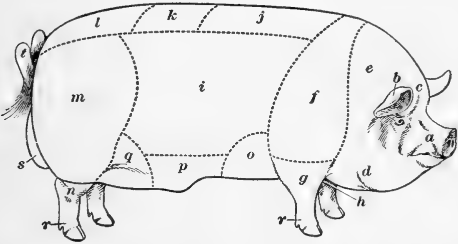
In describing the different breeds of swine, mention is made of certain parts of a hog, and in order that a clear understanding may be had of the location of these parts, they are designated by letters on the outline view of an animal shown in the accompanying illustration. In the illustration, *a* is the snout; *b*, the ear; *c*, the poll; *d*, the jowl; *e*, the neck; *f*, the shoulder; *g*, the front leg; *h*, the chest; *i*, the side; *j*, the back; *k*, the loin; *l*, the rump; *m*, the ham; *n*, the hind leg; *o*, the fore flank;

p, the belly; *q*, the hind flank; *r*, the pastern joint; *s*, the scrotum; and *t*, the tail.

LARD TYPE OF SWINE

Hogs of the lard type, as the term implies, produce large quantities of fat. The animals have, as a rule, well developed hams and shoulders, but they produce only a fair quantity of bacon.

The animals of the different lard-type breeds are of the same general character, but differ in minor respects. An animal of the lard type should show good width and fair length, and should be built low to the ground. The snout should be of medium length, the eyes full, mild, and bright, the face short, the cheeks full, the jowl



strong and broad, and the neck thick and of a medium length. The shoulders should be broad and compact on top, the chest broad, the sides deep, the back broad and thickly and evenly fleshed, the loins wide and thick, and the bottom line straight and even. The hams should be heavily fleshed, plump, full, deep, and wide.

BACON TYPE OF SWINE

Hogs of the bacon type, as the name indicates, produce relatively large quantities of bacon. Their bodies are long, deep, and narrow throughout. The shoulders and hams are not so well developed as in the lard type of hogs, but they should be smoothly covered with flesh and in line with the sides. The back should be of moderate but uniform width, and smoothly covered. The sides, as they are the parts from which the bacon is taken, should be long and deep, and have a good thickness of flesh. There should be no falling away at the flanks, and the flesh should be firm and free from wrinkles.

In general appearance, hogs of the bacon type are long and narrow, have long heads, and stand up rather high on their legs. There is really no use of the great length of the head and legs, so far as meat production is concerned, but it seems impossible to breed hogs without there being a certain correlation of parts, and it has been found that a hog with long legs and head will generally have a long and narrow body.

BREEDS OF THE LARD TYPE

Berkshire Swine.—The Berkshire breed of swine originated in the southern part of England, particularly in the counties of Berkshire and Wilts.

The animals of this breed are black in color and usually show six white points, namely, on the face, on the tail, and on the four feet. A splash of white on the jowl, under the neck, or on the fore legs is often found and is not regarded by the American Berkshire Association as a disqualification. White ears are sometimes found, but they are not objected to by breeders and judges. The black of the Berkshires differs somewhat from the black of some of the other breeds in that it is a sort of blue-black.

The conformation of the modern Berkshire is typical of the lard hog. An animal of this breed has a short face that is gracefully dished; the ears are short, pointed, and usually erect; the back is broad and level; the hams are full; and the legs are short, strong, and straight.

Berkshires are of medium to large size. The average mature boar in good breeding condition should weigh about 500 lb. and the sow about 400 lb. Frequently specimens are found that weigh considerably more than these weights. The pigs can be made ready for market at from 6 to 8 mo. of age, if desired.

Poland-China Swine.—The Poland-China breed of swine originated in the counties of Butler and Warren in Southwest Ohio, as a result of crossing the mongrel hogs of the early settlers with Berkshires and other old breeds from Europe and Asia. Associated with Butler and Warren counties in the early improvement of the breed were Hamilton County in Ohio, and Union and Wayne counties in Indiana, the five counties constituting a region known as the Miami Valley. The Poland-China swine are black with six white points —white in the face, on the tip of the tail, and on the four feet. Splashes of white are sometimes found on the jaw, legs, flanks, sides, or back, and are not objected to by judges and breeders. The black should be jet black and not blue-black, as in the Berkshires.

Like the Berkshires, the Poland-Chinas possess the characteristic conformation of the lard type. They have short heads, wide faces that are but slightly dished, full jowls, short and wide necks, broad shoulders, wide backs, well-sprung ribs, broad loins, full and broad hams, deep sides, and legs that are straight and of medium length. A distinguishing feature of the breed is the ears; these are rather small and on an ideal animal should stand up slightly at the base to within two-thirds of the tip, where a gentle break or drop should occur.

Poland-China swine are of medium to large size. A mature boar in breeding condition should weigh about 500 lb. and a mature sow about 400 lb. Poland-China pigs that are fed for market can usually be made to weigh 200 lb. at 6 mo. of age, and 250 lb. is by no means rare at this age.

Duroc-Jersey Swine.—The Duroc-Jersey breed of swine is an American breed that was originated by crossing the Durocs, a breed of red swine found in New York State, with the Jersey Red, a breed of red swine found in New Jersey. These original breeds constituting the foundation stock of the Duroc-Jerseys probably sprang from some of the red swine, such as the Guinea hogs, Portuguese hogs, red Spanish hogs, and Berkshires, that were imported into North America at an early date.

The Duroc-Jerseys are of a cherry-red color when purely bred. It often happens, however, especially in mature animals, that they become copper or reddish gray in color, and in some instances the tips of the hairs turn black. These variations from the established cherry-red color are undesirable. Black spots on the belly and legs are also undesirable, but are admissible.

The conformation of Duroc-Jersey swine is similar to that of the Berkshires and Poland-Chinas. The head is small, the face straight or slightly dished, the nose of medium length, the ears are of medium size and point forwards and downwards; the back is broad in comparison to its length, the sides are deep, and the hams and shoulders are heavily fleshed and extend well down on the legs.

In size, the Duroc-Jerseys are somewhat large. Mature boars in good breeding condition should weigh from about 500 to 550 lb. and mature sows in the same condition should weigh from about 400 to 450 lb. Duroc-Jersey pigs that are fed for market mature quickly and reach a good size.

Chester White Swine.—The Chester White breed of swine originated in Chester County, Pennsylvania, as a result of crossing the common white swine of that locality with white hogs brought from Europe.

In 1865, L. B. Silver, of Salem, Ohio, purchased some Chester White swine and began breeding with the purpose of securing a type of this breed of large size and superior quality. As a result of his breeding, a strain known as Ohio Improved Chester White, commonly spoken of as O. I. C., was originated. A separate herd book is maintained by breeders of this strain. Both the old type of Chester Whites and the O. I. C. strain have been developed to the extent that they are to be found in all parts of the United States and Canada where swine are kept.

The Chester White, as the name implies, is a white breed. Blue specks, known as freckles, are often found on the skin of these animals and are not objected to by judges, but black, sandy patches in the hair or on the hide are undesirable and will bar an animal from registration in the breed herd books.

In conformation, the Chester Whites are of the typical lard-hog shape. They have short, broad heads, and slightly dished faces. The ears are drooping but do not stand out so far from the head as in the case of animals of the Poland-China breed. In width and depth, Chester Whites are similar to the Poland-Chinas, but, as a rule, they have greater length.

In size, the Chester Whites are large. Mature boars in breeding condition should weigh about 600 lb. and mature sows in the same condition, about 450 lb. Young animals that are fattened for market should weigh from about 250 to 275 lb. at 6 mo. of age.

Mule-Foot Swine.—The origin of the Mule-Foot breed of swine is unknown. Certain breeders claim a knowledge of its origin, but their claims are discredited by the association fostering the interests of the breed. Doubtless this lack of information is due to the fact that the breed has only recently been brought to public attention.

The Mule-Foot hogs are characterized by a solid hoof, which resembles that of the mule, as the name indicates. This gives them great strength in the feet, a point widely exploited by their admirers. In color, they are black, although white points are admissible. It is claimed for the breed that no animal has ever been known to have hog cholera, but this claim has been proved erroneous. The Mule-Foots are known to have great vitality and to be good feeders.

Cheshire Swine.—The Cheshire breed of swine originated in Jefferson County, New York. Evidence indicates that the breed is the result of crossing Large Yorkshire and White Suffolk swine with the native white swine of Jefferson County.

Cheshires are white in color. Black spots sometimes occur on the skins of pure-breds and although objectionable do not disqualify them. The animals are smooth, compact, and of symmetrical proportions. As a rule, they mature early. They are of medium size, as a breed, but frequently specimens are found that are as large as the largest individuals of the lard-type breeds. The sows are good mothers and are very prolific. The feeding qualities of the animals of the breed have not been thoroughly investigated.

Small Yorkshire Swine.—The Small Yorkshire breed of swine originated in England. Little is known of the foundation stock, but it is believed they were Chinese swine.

Small Yorkshires are white, with occasional black spots on the skin. They are very small and compact. Animals of this breed are noted for quick-maturing qualities, and are well adapted for producing early market pork. Their meat is fine grained and tender, but inclined to be rather fat.

Victoria Swine.—The Victoria breed of swine originated in Lake County, Indiana, as a result of crossing Poland-Chinas, Berkshires, Chester Whites, and a breed of white hogs from England.

In color, Victoria swine are white, with occasional dark spots in the skin. The ears are erect or slightly drooping, and the animals have a good coat of fine, soft hair; the head is small and the face is medium dished; the bones are fine, and the back is straight, broad, and level. The Victorias are said to be prolific hogs, easy to keep in condition, and are readily fattened at any age. They are of medium size; mature sows should weigh about 450 lb. and mature boars about 600 lb.

Essex Swine.—The Essex breed of swine originated in the county of Essex, England, as a result of crossing Neapolitan swine with the native hogs of Essex. It is thought also that Berkshire and Suffolk blood was used in the crossing.

Essex swine are black; animals with white on them are not admitted to registry by the record association. They are small, compact animals, set on short legs. The face is dished, the snout short, and the shoulders and hams well developed. The animals are quick maturing, and easily fattened; the meat is fine grained, but carries an excessive quantity of fat. The breed does not stand very high in prolificacy.

BREEDS OF THE BACON TYPE

Large Yorkshire Swine.—The Large Yorkshire breed of swine originated in England. For many years large, awkward, white swine have existed in certain parts of that country, particularly in Yorkshire, Lincolnshire, and Norfolk, and it is from these animals that the Large Yorkshires were developed.

The hogs of this breed are white in color, with occasional blue spots on the skin. They are large in size, rangy, inclined to be long in the leg and coarse in bone, and are somewhat slow in coming to maturity. They have extreme length and depth of body, and their meat is well streaked with fat and lean, being especially desirable for bacon purposes. In fact, Yorkshire bacon is considered to be the best obtainable.

Tamworth Swine.—The Tamworth breed of swine originated in central England, notably in the county of Stafford. The breed is one of the oldest in existence and the ancestry is obscure.

The color of the Tamworths is somewhat variable, a golden-red hair on flesh-colored skin that is free from black being preferred. The snout is very long and straight, the ears are large and pointed, and the legs are long. The animals have long, deep bodies and the meat from their carcasses is well fitted for bacon purposes. As compared with Poland-Chinas, Berkshires, and other animals of the lard type, they seem long and narrow. In constitution, they take high rank, being especially strong and vigorous.

Hampshire Swine.—The Hampshire breed of swine, formerly known as the Thin Rind breed, is indigenous to England.

The Hampshire is a black animal with a broad white belt encircling the body and with white fore legs. The ears of Hampshires are erect, which, together with the peculiar marking of white, makes them easy to distinguish from animals of other breeds. They have a rather long snout and narrow face, and incline somewhat to smallness of bone.

The Hampshires can be fed to produce a good selling weight of hog at an early age, and by feeding to maturity they make good heavyweight hogs. As breeders, they are prolific and are said to have good constitutions.

LIVESTOCK FEEDING

COMPOSITION OF FEEDS

It is a matter of common observation on farms that certain feeds tend to produce growth—the formation of bone, muscles, etc.; that other feeds tend to produce fat; and that still other feeds tend to produce milk. The reason for this lies in the difference in their composition; therefore, a knowledge of the composition of a feed is a valuable guide in feeding livestock. Chemists have made five classes or groups into which all compounds that are found in feeds are placed. These classes are water, ash, protein, carbohydrates, and fat.

The following tabulation shows the elements that make up the compounds of each class:

Water	Hydrogen, Oxygen
Ash	Oxygen, Sodium, Potassium, Calcium, Magnesium, Iron, Manganese, Sulphur, Phosphorus, Silicon, Fluorine, Chlorine
Protein	Carbon, Hydrogen, Oxygen, Nitrogen, Sulphur, Phosphorus, Iron
Carbohydrates	Carbon, Hydrogen, Oxygen
Fat	Carbon, Hydrogen, Oxygen

Water in Feeds.—All feeds contain water, although the more water a feed contains the smaller is its nutritive value. In young and growing plants the presence of water is readily apparent; it constitutes from 70 to 90% of the total weight of such plants. Air-dried feeds, such as the grains, corn, wheat, and oats, and well-cured hays, contain on an average only from 8 to 15% of water.

Ash in Feeds.—The mineral matter, or ash, of a feed is the portion that is left after complete burning; it is, therefore, the incombustible part.

The common farm feeds contain but a small percentage of ash, although the percentage varies greatly in different feeds.

Potatoes contain .9% of ash; rutabagas, 1.2%; corn, 1.5%; oats, 3.2%; timothy hay, 4.4%; Red clover hay, cut when the clover is in bloom, 6.6%; and alfalfa hay, 8.6 to 10.6%.

Protein in Feeds.—All plant and animal compounds that contain the element nitrogen are grouped into a class to which the term protein is applied. This is a very general term, and the number of compounds included in this group is exceedingly large. In addition to nitrogen, there are always found in protein the elements carbon, hydrogen, and oxygen, and sometimes sulphur, phosphorus, and iron. Owing to the fact that nitrogen is found in all the compounds included in this class, they are often spoken of as nitrogenous compounds.

The percentage of protein in the common feeds is given in the table showing the dry matter and digestible nutrients in 100 pounds of feedstuffs, printed on a subsequent page. An examination of this table will show that the seeds of plants usually contain a higher percentage of protein than the other parts of the plants. It will be learned, further, that by-products from mills and slaughter houses are rich in protein.

Carbohydrates in Feeds.—Like protein, the term carbohydrate is a general one and is the name of a large group of compounds. All carbohydrates are alike, however, in that they contain only the three elements, carbon, hydrogen, and oxygen. There are two general classes of carbohydrates, namely, crude fiber and nitrogen-free extract. Crude fiber constitutes the framework, or skeleton, of plants, such as the hard, woody portions of corn stalks and of straws. The husks of grains, such as oat hulls and corn and wheat bran, contain large quantities of this material; wood also is an example of crude fiber. Carbohydrates of the nitrogen-free-extract class are much more valuable as sources of feed than are those of the crude-fiber class, because the former are more easily digested than the latter. Familiar examples of the nitrogen-free-extract compounds are corn starch and common sugar.

Fat in Feeds.—The term fat, as it is used in connection with feeds, applies to all true fats and oils, as well as to all other feed compounds that are soluble in ether, and because of this fact the terms ether extract and fat are used synonymously in tables showing the composition of feedstuffs. Although all feeds contain some fat, the percentage in feeds varies widely.

CLASSIFICATION OF FEEDS

Feedstuffs can be conveniently divided into two general classes; concentrates and roughages. Roughages are also of two classes: dry and succulent.

The *concentrates* include all grains, seeds, and by-products that are used as feeds. Feeds of this class yield a larger proportion of digestible nutrients than those of the other class. The proportion of concentrate feeds that should be supplied in a ration depends on the class of animal that is being fed and on whether or not the ration is merely one for maintenance or is a full ration.

Three general classes of dry roughage are used as livestock feed. These are hays, straws, and fodders. As compared with the concentrates, all roughage feeds are more bulky in nature, less digestible, and, therefore, are not so efficient as furnishers of materials for the production of energy, growth, fat, or milk. They usually are the stalks of the plants from which the seed has been removed. Their low digestibility is due to the large proportion of crude fiber, or woody matter, that they contain. Though ranking low in feed value, they constitute an essential and necessary part of every ration for all farm animals, except perhaps for pigs.

On account of the difference in the digestive capacity of the animals, less roughage is used for horses and pigs than for ruminants. The abundance and the comparative cheapness of roughage on most farms make it highly desirable that the feeder use all such feeds as completely as possible on the farm.

Hays.—The hays represent the most valuable roughage for feeding purposes. They are of two classes, namely, leguminous and non-leguminous. The leguminous hays have, on an average, a higher feed value, are more digestible and usually more palatable when properly cured, and contain a larger proportion of protein than the non-leguminous hays. As leguminous hays contain

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more protein and less carbohydrates than non-leguminous hays, the former are particularly valuable when fed with corn or other feeds that contain small percentages of protein. The quantity of protein that leguminous hays contain guarantees a high fertilizing value to the manure of the animals to which the hays are fed. There can be no well-directed or wise system of cropping established on farms that does not include some legume in the crop rotation, and experience and scientific investigation both indicate that leguminous hay should be fed on the farm where it is grown.

Straws.—The straws are the lowest of the roughages in feed value. Their high content of crude fiber makes them hard to digest and reduces their palatability. However, straws are of some use as livestock feed. Ruminants that are to be carried through the winter on merely a maintenance ration can make large use of straw. Idle horses can also be fed some of this material to advantage.

Fodders.—Most of the fodder available for livestock feed has its origin in the corn plant. Corn fodder, or fodder corn, is the entire corn plant after drying. Corn stover is corn fodder minus the ears. Shredded corn stover is corn stover that has been passed through a corn shredder.

Soiling Crops.—The crops most valuable for soiling purposes are field corn, sweet corn, sorghum, millets, rape, rye, oats, wheat, alfalfa, the clovers, cowpeas, soybeans, and vetch. It is desirable that these crops be fairly well matured before they are cut, as the immature plants are mostly water and often have an injurious effect on the digestive system of an animal.

Silage.—Silage may be defined as feed which has been stored in such a manner that its green or fresh condition is preserved. Green clover, alfalfa, cowpeas, sorghum, and other forage crops have been stored successfully in the silo. But the great American crop preeminently suited for the making of silage is the corn plant. Recent tests have shown that it is usually unprofitable to make silage out of a crop that can be successfully cured and stored in the mow without danger of excessive fermentation. The pithy stalk of the corn plant prevents it from drying and being handled in the same way as the hollow-stalked hays and straws.

Root Crops.—The roots ordinarily grown for feed are mangels, sugar beets, rutabagas, and carrots. Horses prefer carrots; sheep, common turnips and rutabagas; and for cattle, mangels are very appropriate. In England and Scotland, roots are largely depended on for all classes of livestock, especially for cattle and sheep. In fact, in those countries roots constitute the greatest part of the daily rations for livestock; but in America roots are not grown extensively for the feeding of livestock. This is due chiefly to the labor required to grow and harvest a root crop, and to the fact that corn is so extensively grown and made into silage.

BALANCED RATIONS

Feeding Standards.—A feeding standard shows the experimentally established quantities of dry matter, digestible protein, digestible carbohydrates, and digestible fat that are necessary to satisfy the physiological requirements per day per 1,000 lb. of live weight of animals under specified conditions.

Thus, the Wolff-Lehmann feeding standards given in the accompanying table show that a dairy cow weighing 1,000 lb. and giving 22 lb. of milk should receive 29 lb. of dry matter, 2½ lb. of digestible protein, 13 lb. of digestible carbohydrates, and ½ lb. of digestible fat for each 24 hr. This standard is the result of experiment and scientific investigation, which has shown that a daily ration supplying the above quantities and kinds of digestible nutrients to a 1,000-lb. cow will maintain on an average, a milk flow of 22 lb. a day. All the other standards in the table have been derived in the same manner.

Nutritive Ratio.—A nutritive ratio is the ratio of the digestible protein to the digestible carbohydrates and fat in any feed or ration. In computing the nutritive ratio of a ration, the amount of digestible fat is multiplied by 2.25 and the product added to the amount of digestible carbohydrates, and the sum divided by the amount of digestible protein. The ratio of one to the quotient is the nutritive ratio. To illustrate: What is the nutritive ratio of a ration furnishing 2.5 lb. of digestible protein, 15 lb. of digestible carbohydrates, and .5 lb. of digestible fat?

The calculation is usually made as follows: $.5 \times 2.25 = 1.125$; $1.125 + 15 = 16.125$; $16.125 \div 2.5 = 6.45$. The nutritive ratio is, therefore, 1 part of protein to 6.45 parts of carbohydrates and fat, or 1 : 6.45.

NOTE.—Some authorities on feeding multiply the quantity of fat by 2.4 in computing a nutritive ratio, but recent experiments and investigations show that 2.25 is a more nearly correct factor to use.

The nutritive ratio is wide or narrow according to the proportion of protein that the ration contains. If the relative amount of protein in a ration is large, it is said to have a narrow nutritive ratio, and if the relative amount of protein is small it is said to have a wide nutritive ratio. A ratio of 1 to 5.5 or less is considered narrow; a ratio of 1 to 8 and above is considered wide; between these two the nutritive ratio is medium. Young growing animals generally and cows giving milk need a large amount of protein, and should therefore receive a ration that has a narrow nutritive ratio. Fattening animals thrive well on wide rations, but pregnant animals and horses at work should receive rations of a medium nutritive ratio.

WOLFF-LEHMANN FEEDING STANDARDS

Animal	Requirements per Day per 1,000 Lb. Live Weight				
		Digestible Nutrients			
	Dry Matter Pounds	Crude Protein Pounds	Carbohydrates Pounds	Fat Pounds	Nutritive Ratio
Oxen:					
At rest in stall	18	.7	8.0	.1	1 to 11.8
At light work	22	1.4	10.0	.3	1 to 7.6
At medium work	25	2.0	11.5	.5	1 to 6.3
At heavy work	28	2.8	13.0	.8	1 to 5.3
Fattening cattle:					
First period	30	2.5	15.0	.5	1 to 6.5
Second period	30	3.0	14.5	.7	1 to 5.4
Third period	26	2.7	15.0	.7	1 to 6.1
Milk cows when yielding daily:					
11.0 lb. of milk	25	1.6	10.0	.3	1 to 6.7
16.6 lb. of milk	27	2.0	11.0	.4	1 to 6.0
22.0 lb. of milk	29	2.5	13.0	.5	1 to 5.7
27.5 lb. of milk	32	3.3	13.0	.8	1 to 4.5
Sheep:					
Coarse-wool	20	1.2	10.5	.2	1 to 9.1
Fine-wool	23	1.5	12.0	.3	1 to 8.5
Breeding ewes with lambs	25	2.9	15.0	.5	1 to 5.6
Fattening sheep:					
First period	30	3.0	15.0	.5	1 to 5.4
Second period	28	3.5	14.5	.6	1 to 4.2
Horses:					
At light work	20	1.5	9.5	.4	1 to 6.9
At medium work	24	2.0	11.0	.6	1 to 6.2
At heavy work	26	2.5	13.3	.8	1 to 6.0
Brood sows	22	2.5	15.5	.4	1 to 6.6
Fattening swine:					
First period	36	4.5	25.0	.7	1 to 5.9
Second period	32	4.0	24.0	.5	1 to 6.3
Third period	25	2.7	18.0	.4	1 to 7.0

TABLE—*(Continued)*

Animal	Requirements per Day per 1,000 Lb. Live Weight				
		Digestible Nutrients			
	Dry Matter Pounds	Crude Protein Pounds	Carbohydrates Pounds	Fat Pounds	Nutritive Ratio
Growing cattle—Dairy breeds:					
Age, 2 to 3 mo.; average live weight, 150 lb....	23	4.0	13.0	2.0	1 to 4.4
Age, 3 to 6 mo.; average live weight, 300 lb...	24	3.0	12.8	1.0	1 to 5.0
Age, 6 to 12 mo.; average live weight, 500 lb..................	27	2.0	12.5	.5	1 to 6.8
Age, 12 to 18 mo.; average live weight, 700 lb..................	26	1.8	12.5	.4	1 to 7.4
Age, 18 to 24 mo.; average live weight, 900 lb..................	26	1.5	12.0	.3	1 to 8.5
Growing cattle—Beef breeds:					
Age, 2 to 3 mo.; average live weight, 160 lb...	23	4.2	13.0	2.0	1 to 4.2
Age, 3 to 6 mo.; average live weight, 330 lb...	24	3.5	12.8	1.5	1 to 4.6
Age, 6 to 12 mo; average live weight, 550 lb..................	25	2.5	13.2	.7	1 to 5.9
Age, 12 to 18 mo.; average live weight, 750 lb..................	24	2.0	12.5	.5	1 to 6.8
Age, 18 to 24 mo.; average live weight, 950 lb..................	24	1.8	12.0	.4	1 to 7.2

TABLE—*(Continued)*

Animal	Requirements per Day per 1,000 Lb. Live Weight				
		Digestible Nutrients			
	Dry Matter Pounds	Crude Protein Pounds	Carbohydrates Pounds	Fat Pounds	Nutritive Ratio
Growing sheep—Wool breeds:					
Age, 4 to 6 mo.; average live weight, 60 lb....	25	3.4	15.4	.7	1 to 5.0
Age, 6 to 8 mo.; average live weight, 75 lb....	25	2.8	13.8	.6	1 to 5.4
Age, 8 to 11 mo.; average live weight, 80 lb.	23	2.1	11.5	.5	1 to 6.0
Age, 11 to 15 mo.; average live weight, 90 lb.	22	1.8	11.2	.4	1 to 6.7
Age, 15 to 20 mo.; average live weight, 100 lb..................	22	1.5	10.8	3	1 to 7.7
Growing sheep—Mutton breeds:					
Age, 4 to 6 mo.; average live weight, 60 lb. ...	26	4.4	15.5	.9	1 to 4.0
Age, 6 to 8 mo.; average live weight, 80 lb....	26	3.5	15.0	.7	1 to 4.7
Age, 8 to 11 mo.; average live weight, 100 lb..................	24	3.0	14.3	.5	1 to 5.1
Age, 11 to 15 mo.; average live weight, 120 lb..................	23	2.2	12.6	.5	1 to 6.2
Age 15 to 20 mo.; average live weight, 150 lb..................	22	2.0	12.0	.4	1 to 6.5

TABLE—(*Continued*)

Animal	Requriements per Day per 1,000 Lb. Live Weight				
	Dry Matter Pounds	Digestible Nutrients			
		Crude Protein Pounds	Carbohydrates Pounds	Fat Pounds	Nutritive Ratio
Growing swine—Breeding stock:					
Age, 2 to 3 mo.; average live weight, 50 lb....	44	7.6	28.0	1.0	1 to 4.0
Age, 3 to 5 mo.; average live weight, 100 lb...	35	4.8	22.5	.7	1 to 5.0
Age, 5 to 6 mo.; average live weight, 120 lb...	32	3.7	21.3	.4	1 to 6.0
Age, 6 to 8 mo.; average live weight, 200 lb...	28	2.8	18.7	.3	1 to 6.9
Age, 8 to 12 mo.; average live weight, 250 lb................	25	2.1	15.3	.2	1 to 7.5
Growing fattening swine:					
Age, 2 to 3 mo.; average live weight, 50 lb....	44	7.6	28.0	1.0	1 to 4.0
Age, 3 to 5 mo.; average live weight, 100 lb...	35	5.0	23.1	.8	1 to 5.0
Age, 5 to 6 mo.; average live weight, 150 lb...	33	4.3	22.3	.6	1 to 5.5
Age, 6 to 8 mo.; average live weight, 200 lb...	30	3.6	20.5	.4	1 to 5.9
Age, 9 to 12 mo.; average live weight, 300 lb................	26	3.0	18.3	.3	1 to 6.3

Making Up a Balanced Ration.—By the aid of the accompanying table giving the total dry matter and the digestible nutrients contained in 100 lb. of the different feedstuffs, and the number of pounds of each of the digestible nutrients, the nutritive ratio may be determined of almost any ration that may be fed. The value of such determinations to the feeder is not only to acquaint him with the wide variations in the demands and requirements of the different classes of livestock, but to increase his knowledge of the chemical composition of feeds. With a knowledge of feeding standards and of the composition of feeds a stockman is enabled to combine feeds so that they satisfy the needs of animals, or, in other words, to feed a balanced ration. This is the first and a most fundamental principle of feeding.

TOTAL DRY MATTER AND TOTAL DIGESTIBLE NUTRIENTS IN 100 LB. OF COMMON AMERICAN FEEDSTUFFS

Feedstuff	Total Dry Matter in 100 Lb.	Digestible Nutrients in 100 Lb.		
		Protein Pounds	Carbohydrates Pounds	Fat Pounds
Alfalfa hay	93.4	11.4	40.0	1.3
Alsike clover, green	25.2	2.6	11.4	.5
Alsike-clover hay	90.3	8.4	39.7	1.1
Artichokes	20.5	1.3	14.7	.2
Barley and peas, green	20.0	2.1	9.1	.4
Barley and vetch, green	20.0	2.1	6.5	.3
Barley forage	21.0	1.9	10.4	.3
Barley grain	89.2	8.4	65.3	1.6
Barley hay	85.0	5.7	43.6	1.0
Barley screenings	87.8	9.5	49.9	2.5
Barley straw	85.8	.9	40.1	.6

TABLE—*(Continued)*

Feedstuff	Total Dry Matter in 100 Lb.	Digestible Nutrients in 100 Lb.		
		Protein Pounds	Carbo-hydrates Pounds	Fat Pounds
Barnyard millet, green	25.0	1.6	14.4	.3
Barnyard millet hay	85.1	5.2	38.6	.8
Bean, horse, green	15.8	2.3	7.3	.2
Bean, horse, hay	90.8	4.3	39.5	.8
Bean, velvet, green	17.8	2.7	8.4	.4
Bean, velvet, hay	90.0	9.6	52.5	1.4
Beans, horse	88.7	23.1	49.8	.8
Beet pulp, dry	91.6	4.1	64.9	
Beet pulp, wet	10.2	.5	7.7	
Beets, common	11.5	1.2	7.9	.1
Beets, sugar	13.5	1.3	9.8	.1
Beggar-weed hay	90.8	6.8	42.8	1.6
Bermuda grass, green	28.3	1.3	13.4	.4
Bermuda-grass hay	93.1	6.4	44.9	1.6
Bone-and-meat meal	94.0	36.7	5.5	10.6
Bran, corn	90.6	6.0	52.5	4.8
Bran, wheat, all analyses	88.1	11.9	42.0	2.5
Brewers' grains, dry	91.3	20.0	32.2	6.0
Brewers' grains, wet	23.0	4.9	7.6	1.7
Broom-corn seed	87.2	4.6	42.2	1.5
Buckwheat bran	91.8	5.9	34.0	2.0
Buckwheat, grain	86.6	8.1	48.2	2.4
Buckwheat straw	90.1	1.2	37.4	.5
Buffalo-grass hay	85.0	3.0	42.0	1.6
Bur-clover hay	91.0	8.2	39.0	2.1
Buttermilk	9.9	3.8	3.9	1.0
Cabbage	10.0	2.3	5.9	.1
Canada field peas	85.0	19.7	49.3	.4
Canada field peas, green	15.3	1.8	6.9	.3
Carrots	11.4	.8	7.7	,3
Cassava	34.0	.8	28.9	.2
Cassava starch refuse	88.0	.4	74.0	.6
Cattail-millet hay	89.0	7.2	41.6	1.0
Clover and grass, mixed, hay	87.1	5.8	41.8	1.3
Colostrum	25.4	17.6	2.7	3.6
Common beets	11.5	1.2	7.9	.1
Common millet, green	20.0	.8	11.0	.2
Corn-and-cob meal	84.9	4.4	60.0	2.9

TABLE—*(Continued)*

Feedstuff	Total Dry Matter in 100 Lb.	Digestible Nutrients in 100 Lb.		
		Protein Pounds	Carbo-hydrates Pounds	Fat Pounds
Corn bran	90.6	6.0	52.5	4.8
Corn, dent, grain	89.4	7.8	66.8	4.3
Corn, flint, grain	88.7	8.0	66.2	4.3
Corn fodder, ears on	57.8	2.5	34.6	1.2
Corn leaves	70.0	2.8	37.8	.8
Corn meal	85.0	6.7	64.3	3.5
Corn stover, ears removed	59.5	1.4	31.2	.7
Cottonseed	89.7	12.5	30.0	17.3
Cottonseed hulls	88.9	.3	33.2	1.7
Cottonseed meal	93.0	37.6	21.4	9.6
Cowpeas, green	16.4	1.8	8.7	.2
Cowpea hay	89.5	5.8	9.3	1.3
Cowpea seeds	85.4	16.8	54.9	1.1
Crimson clover, green	19.1	2.4	9.1	.5
Crimson-clover hay	90.4	10.5	34.9	1.2
Distillers' grains, dry	92.4	22.8	39.7	11.6
Dried blood	91.5	60.8		2.5
Dwarf Essex rape	14.3	2.0	8.2	.2
Emmer, grain	91.6	10.0	70.3	2.0
Emmer hay	93.1	7.0	43.9	.6
English hay	86.0	4.5	44.0	1.2
Field-bean hay	95.0	3.6	39.7	
Field peas, Canada, green	15.3	1.8	6.9	.3
Flaxseed	90.8	20.6	17.1	29.0
Flax shives	90.0	1.2	34.4	1.0
Germ oil meal	91.4	15.8	38.8	10.8
Gluten feed	90.8	21.3	52.8	2.9
Hairy vetch, winter, hay	88.7	11.9	40.7	1.6
Hay from mixed grasses	84.7	4.2	42.0	1.3
Hog millet, green	20.0	.8	10.8	.3
Hominy chop	90.4	6.8	60.5	7.4
Hominy feed	90.4	6.8	60.5	7.4
Horse bean, green	15.8	2.3	7.3	.2
Horse-bean hay	90.8	4.3	39.5	.8
Horse-beans	88.7	23.1	49.8	.8
Hungarian-grass hay	86.0	5.0	46.9	1.1
Italian rye-grass hay	91.5	4.5	43.4	.9
Japan-clover hay	89.0	9.1	37.7	1.4
Japanese millet, green	25.0	1.1	13.6	.3

TABLE—(*Continued*)

Feedstuff	Total Dry Matter in 100 Lb.	Digestible Nutrients in 100 Lb.		
		Protein Pounds	Carbo-hydrates Pounds	Fat Pounds
Johnson grass, green	25.0	.6	13.7	.2
Johnson-grass hay	89.8	2.9	45.6	.8
Kafir corn, grain	90.1	5.2	44.3	1.4
Kafir corn, heads, ground	86.4	4.2	42.4	1.2
Kafir corn, Red, green	18.4	.8	9.7	.4
Kafir corn, White, green	16.6	.9	8.3	.5
Kentucky blue grass	34.9	2.8	19.7	.8
Kentucky blue-grass hay	86.0	4.4	40.2	.7
Linseed meal, new-process	90.3	31.5	35.7	2.4
Linseed meal, old-process	90.2	30.2	32.0	6.9
Malt sprouts	90.5	20.3	46.0	1.4
Mammoth-clover hay	78.8	6.2	34.7	2.1
Mangels	9.1	1.0	5.5	.2
Meadow fescue, green	30.1	1.6	18.6	.5
Meadow-fescue hay	80.8	4.2	36.9	1.5
Meadow-foxtail hay	93.4	5.3	41.0	1.3
Meat-and-bone meal	94.0	36.7	5.5	10.6
Meat scrap	89.3	66.2		13.4
Milk, cow's, whole	12.8	3.4	4.8	3.7
Milk, cow's, skim	9.4	2.9	5.3	.3
Millet seed	87.9	7.1	48.5	2.5
Millet straw	85.0	.9	34.3	.6
Milo maize, heads, ground	90.3	4.2	45.0	1.1
Milo maize, seed	91.0	4.9	44.8	1.3
Mixed grass and clover hay	87.1	5.8	41.8	1.3
Molasses, beet, pulp, dry	92.0	6.1	68.7	
Molasses grains	89.6	10.8	48.0	2.2
Molasses, Porto Rico	74.1	1.4	59.2	
Molasses, sugar-beet	79.2	4.7	54.1	
Oat and pea hay	89.5	7.6	41.5	1.5
Oat and vetch hay	85.0	8.3	35.8	1.3
Oat hay	86.0	4.7	36.7	1.7
Oat meal	92.1	11.9	65.1	6.7
Oat middlings	91.2	13.1	57.7	6.5
Oat straw	90.8	1.3	39.5	.8
Oats and peas, green	20.3	1.8	10.2	.4
Oats and vetch, green	20.0	2.3	10.0	.2
Oats, grain	89.6	10.7	50.3	3.8
Orchard-grass hay	90.1	4.9	42.4	1.4

TABLE—*(Continued)*

Feedstuff	Total Dry Matter in 100 Lb.	Digestible Nutrients in 100 Lb.		
		Protein Pounds	Carbo-hydrates Pounds	Fat Pounds
Oxeye-daisy hay	89.7	3.7	41.0	1.7
Palmnut cake	89.6	16.0	52.6	9.0
Parsnips	9.5	1.0	7.2	.2
Pea and oat hay	89.5	7.6	41.5	1.5
Peanut cake	89.3	42.8	20.4	7.2
Peanut kernels, without hulls	92.5	25.1	13.7	35.6
Peanut-vine hay	92.4	6.7	42.2	3.0
Perennial rye-grass hay	86.0	6.1	37.8	1.2
Potato	20.9	1.1	15.7	.1
Prairie hay	90.8	3.0	42.9	1.6
Pumpkin, field	9.1	1.0	5.8	.2
Pumpkin, garden	13.2	1.4	8.3	.4
Rape-seed cake	90.0	25.3	23.7	7.6
Red clover, green	29.2	2.9	14.9	.7
Red-clover hay	84.7	7.1	37.8	1.8
Red-dog flour	90.1	16.2	57.0	3.4
Red-top hay	91.1	4.8	46.9	1.0
Rice, grain	87.6	6.4	79.2	.4
Rowen hay	86.0	7.9	42.2	1.4
Rutabagas	11.4	1.0	8.1	.2
Rye bran	88.2	11.2	46.8	1.8
Rye forage	23.4	2.1	14.1	.4
Rye, grain	91.3	9.5	69.4	1.2
Rye-grass hay, Perennial	86.0	6.1	37.8	1.2
Rye-grass hay, Italian	91.5	4.5	43.4	.9
Rye straw	92.9	.7	39.6	.4
Sage, Common	50.4	1.2	14.1	3.8
Salt-marsh-grass hay	89.6	3.1	39.7	.9
Sanfoin hay	85.0	10.4	36.5	2.0
Serradella, green	20.5	2.1	8.9	.4
Serradella hay	90.8	11.4	38.6	1.7
Sesame oil cake	92.6	33.0	10.9	23.4
Shorts	88.8	13.0	45.7	4.5
Silage, corn	26.4	1.4	14.2	.7
Silage, corn, ears removed	26.3	1.1	14.9	.7
Sorghum seed	87.2	4.5	61.1	2.8
Soybean hay	88.2	10.6	40.9	1.2
Soybean seeds	88.3	29.1	23.3	14.6

TABLE—*(Continued)*

Feedstuff	Total Dry Matter in 100 Lb.	Digestible Nutrients in 100 Lb. Protein Pounds	Carbohydrates Pounds	Fat Pounds
Soybean straw	89.9	2.3	40.1	1.0
Spelt, grain	92.0	10.0	70.3	2.0
Spelt, hay	93.1	7.0	43.9	.6
Spring vetch, green	15.0	1.9	6.6	.2
Sugar beets	13.5	1.3	9.8	.1
Sugar-beet leaves	12.0	1.9	5.0	.2
Sugar-beet molasses	79.2	4.7	54.1	
Sugar cane; green	15.8	.5	9.5	.3
Sunflower seed	91.4	14.8	29.7	18.2
Sunflower-seed cake	89.2	29.5	23.3	8.0
Swamp-grass hay	88.4	4.0	38.9	.7
Sweet clover, green	20.0	2.5	8.4	.4
Sweet-clover hay	90.9	11.9	36.7	.5
Sweet corn, grain	91.2	8.8	63.7	7.0
Sweet potatoes	28.9	.8	22.9	.3
Tall-oat hay	86.0	3.3	41.4	1.1
Tankage	93.0	50.1		11.6
Teosinte, green	9.9	.9	4.9	.2
Texas blue-grass hay	85.7	5.1	36.3	1.4
Timothy grass	38.4	1.5	19.9	.6
Timothy hay, all analyses	86.8	2.8	42.4	1.3
Turnips, flat	9.9	.9	6.4	.1
Velvet-bean hay	90.0	9.6	52.5	1.4
Vetch and barley, green	20.0	2.1	6.5	.3
Vetch and oat hay	85.0	8.3	35.8	1.3
Vetch and oats, green	20.0	2.3	10.0	.2
Vetch and wheat, hay	85.0	10.6	36.8	1.2
Vetch, green	15.0	1.9	6.6	.2
Vetch, Hairy, winter, green	15.0	2.8	6.4	.3
Wheat and vetch, green	20.0	2.6	10.3	.3
Wheat and vetch hay	85.0	10.6	36.8	1.2
Wheat bran, all analyses	88.1	11.9	42.0	2.5
Wheat, grain	89.5	8.8	67.5	1.5
Wheat screenings	88.4	9.6	48.2	1.9
Wheat straw	90.4	.8	35.2	.4
Whey	6.2	.6	5.0	.2
White-clover hay	90.3	11.5	42.2	1.5
White-top hay	86.0	6.8	40.6	1.5
Wild-oat grass hay	85.9	2.9	48.7	1.7

RATIONS FOR DIFFERENT CLASSES OF LIVESTOCK

Ration for Draft Horses.—As an average for draft horses at moderate work, a good plan to follow is to feed 1 lb. of grain and 1¼ lb. of hay per day per 100 lb. of live weight of the horse. At this rate, a 1,600-lb. horse would receive 16 lb. of grain and 20 lb. of hay per day. If the work is severe, the quantity of grain should be increased to 1¼ lb. or more per 100 lb. of live weight of the horse, but should not exceed 1⅓ lb. When a heavy grain ration is fed it may be necessary to feed a slightly smaller quantity of hay, but this should not be less than 1 lb. per 100 lb. of live weight; the exact quantity must be determined largely by the individuality and appetite of each horse. When a heavy grain ration is being fed it should be slightly reduced as soon as the work slackens.

The grain ration should be divided into three equal feeds and given morning, noon, and night. The greater part of the hay should be fed to the horses in the evening, as they will then have all night in which to consume and digest it; about one-quarter should be fed in the morning and one-sixth or less at noon, the quantity for each feed depending on the time allowed for the horses to eat.

In selecting the kind of grain for the ration of a draft horse, the feeder should be guided by the kind of hay used and the cheapness of the ration; a larger quantity of corn can be economically and satisfactorily used in a ration with clover or alfalfa hay than with prairie or timothy hay. Also, the ration should contain enough digestible protein to meet the requirements of the horse. A ration consisting of ½ part of corn, ⅓ part of oats, and ⅙ part of bran, by weight, and a mixture of timothy and alfalfa or clover hay, or of prairie hay and alfalfa or clover, will give satisfactory results. For a 1,600-lb. horse at moderate work, a ration of this proportion would be as follows:

	Pounds
Corn	8
Oats	$5\frac{1}{3}$
Bran	$2\frac{2}{3}$
Timothy or prairie hay	10
Clover or alfalfa hay	10

Rations for Driving and Saddle Horses.—An ample ration for a driving or a saddle horse at severe work is 1 lb. of good hay and $1\frac{1}{3}$ lb. of grain per 100 lb. of live weight of the animal. At this rate a 1,200-lb. horse would receive 12 lb. of hay and 16 lb. of grain per day. Most of the hay should be fed at night and but little given in the morning before the horse is put at work. The grain should be divided into three equal parts and given morning, noon, and night.

For extremely severe work, such as racing, less hay should be given than for common road work; most of the nutrients should be supplied by grain, oats being best. About $\frac{4}{5}$ lb. of hay per 100 lb. of live weight of the animal should be given, most of it being fed at the evening feed.

Ration for Pregnant Mares.—A good grain ration for a mare that is just past the seventh month of pregnancy and is being worked is as follows: Ground oats, by weight, 4 parts; corn, 2 parts; wheat bran, 2 parts; alfalfa or clover hay, $1\frac{1}{4}$ lb. per 100 lb. of live weight.

Rations for Mares After Parturition.—For about 3 da. after foaling, mares should have a light grain feed of oats and bran, and good clean hay, preferably clover or alfalfa. The ration should be light, as a colt does not need a large supply of milk the first few days of its life. If, at the end of 3 to 4 da. the mare and foal are in good condition, the ration should be gradually increased in order to stimulate the flow of milk.

A mare that is working and suckling a foal requires a little heavier ration than is usually prescribed for work horses, owing to the fact that she is producing milk in addition to supplying energy for work. The ration should be a highly nutritious one that will produce a good flow of milk; for this purpose good alfalfa or clover hay fed in conjunction with corn and oats is desirable. If good alfalfa or clover hay is not available, some linseed meal or cottonseed meal should be added to the ration. Ordinarily, 1⅓ lb. of grain and 1¼ lb. of hay per 100 lb. of live weight will be sufficient, although it may be necessary to increase the grain to 1½ lb. per 100 lb. of live weight if the mare shows signs of getting in poor condition. When such a grain ration is fed it is a good plan to mix the grain with chopped hay in order to prevent any serious digestive disturbances.

Ration for Stallions.—The sexual tax on a stallion during the breeding season makes it necessary that he be fed a highly nitrogenous ration, as the principal part of the seminal fluid is composed of albuminous matter. During this time there is nothing better to feed than good clover or alfalfa hay, with oats and bran and a very little corn. A grain ration composed of 2 parts of oats, 1 part of corn, and 1 part of bran, by weight, combined with a roughage ration of 1 part of alfalfa hay and 1 part of timothy or prairie hay will give satisfactory results. Because of the low protein content of corn, a large quantity should not be fed. During the breeding season a stallion requires about the same quantity of feed as horses at hard work.

Rations for Dairy Cattle.—The efficiency of the dairy cow depends to a large extent on the feeding of a ration adapted to the production of milk and butter fat. The following rations are offered as suggestions to be modified to suit individual conditions. With these rations as a guide, a dairyman can easily make up from the feedstuffs he has available an economical and satisfactory ration for the cows of his herd.

Rations	*Pounds*
No. 1:	
Mixed hay	20
Dried distillers' grains	4
Hominy chop	2
Wheat bran	2
No. 2:	
Mixed hay	10
Corn silage	40
Gluten feed	4
Corn meal	2
Wheat bran	2
No. 3:	
Mixed hay	15
Mangels	40
Cottonseed meal	2
Hominy chop	4
Wheat bran	2
No. 4:	
Mixed hay	10
Dried beet pulp	5
Cottonseed meal	2
Hominy chop	4
Wheat bran	2
No. 5:	
Clover or alfalfa hay	15
Corn silage	25
Oats	3
Wheat bran	3
Buckwheat middlings	3
No. 6:	
Timothy hay	10
Corn silage	40
Dried distillers' grains	4
Cottonseed meal	2
Hominy chop or corn meal	2
No. 7:	
Timothy hay	10
Corn silage	40
Gluten feed	4
Linseed meal	3
Hominy chop or corn meal	1
No. 8:	
Alfalfa hay	20
Corn	3
Oats	3
Wheat bran	2

Rations for the Fattening of Cattle.—The following are samples of satisfactory daily rations for the fattening of cattle under corn-belt conditions:

Rations	*Pounds*
No. 1:	
Ear corn	20
Oil meal	3
Clover hay	8
No. 2:	
Shelled corn	18
Oil meal	3
Clover hay	9
No. 3:	
Ear corn	14
Oil meal	1.5
Shock corn	14
Clover hay	8
No. 4:	
Ear corn	18
Cottonseed meal	1
Alfalfa hay	10
No. 5:	
Ear corn	15
Corn silage	25
Alfalfa hay	5
No. 6:	
Ear corn	16
Cottonseed meal	3
Corn silage	32
No. 7:	
Alfalfa hay	5
Corn stover	5
Corn	18

Ration for Unweaned Pigs.—During the time pigs are running with their mothers they should have a rather narrow grain ration. The following materials mixed in the proportion given have been found by experience to be well suited for suckling pigs:

	Parts
Corn meal	2
Wheat middlings	7
Tankage	1
Skim-milk	30

These materials are mixed together to form a medium thick slop, and are fed soon after being mixed. Of this mixture the pigs are fed just what they will clean up with a relish. No feed should be left in the troughs to become sour. If skim-milk cannot be procured, pure, fresh water may be substituted.

Rations for Pigs After Weaning.—After weaning the pigs, the first ration given may be continued until they reach an age of about 4 mo. From the fourth to the sixth month, the following proportions may be used:

	Parts
Corn meal	5
Wheat middlings	4
Tankage	1
Skim-milk	30

From 6 mo. up to the time the pigs are marketed, the following proportions are used:

	Parts
Corn meal	4
Tankage	1

This mixture is either fed dry or made into a thick mush by the addition of skim-milk, whey, or water. If fed dry, an abundance of pure, fresh water should be placed where the pigs can get it at will.

Other mixtures that will give about the same proportion of nutrients may be substituted for the preceding rations. Hogs welcome a variety in food as well as do other animals.

Succulent Feed for Fattening Hogs.—In addition to rations given in the preceding paragraphs, young pigs need some kind of succulent feed. In summer this succulent feed can best be derived from pasture. Animals running on pasture require less attention from their caretakers than do animals that are being fed in a lot, for the reason that they gather a large part of their feed themselves. The exercise that the pigs get in searching for food in a pasture tends to give them a good appetite and to keep them healthy.

Rations for Bacon Hogs.—Rations for producing bacon hogs should be somewhat narrower than those required for fat hogs. In the corn belt, bacon hogs for the first month or two after birth should be fed about the same ration as that given for unweaned pigs of the lard type. The finishing ration, however, should be different from that for fat hogs. A mixture of corn, other grains, mill feed, tankage, skim-milk, and pasture crops makes a satisfactory ration for bacon pigs. Corn should not, however, form more than one-third of the concentrated part of the ration. Outside of the corn belt where barley, peas, and oats are grown, these grains mixed with shorts, middlings, tankage, and skim-milk give good results. For summer, alfalfa, clover, or some other pasture for the production of green forage is desirable. If the hogs are kept and fed during winter, mangel wurzels, sugar beets, or turnips may form the succulent part of the ration.

Rations for Herd Boars.—The boar or boars of a breeding herd of swine should be placed in pastures or lots by themselves, where they will have plenty of room in which to exercise, as this has a tendency to keep their appetite vigorous. They should be supplied with abundant water, and it is well to have a quantity of charcoal available. The feed for aged animals should consist of a slop composed of a mixture of different ground grains and mill feeds, enough only being fed to the animals to keep them in fair flesh. A ration that has been found satisfactory consists of the following:

	Parts
Ground oats	2
Corn meal	1
Wheat middlings	1

For each mess, a small quantity of salt and a handful of linseed meal may be added to this ration, and these should be mixed together with sweet skim-milk to form a slop. Only as much of this mixture as the boar will eat with a relish should be given at one time.

Young boars during their first half year should be given enough of a ration consisting of mixed mill feed and grain to keep them in rapid growth. This means that the quantity given at a meal should be all that they will eat with a relish.

Rations for Brood Sows.—The feed for a brood sow should be similar to that recommended for young pigs. The following combination for the concentrated part of the ration has been found to be satisfactory:

	Parts
Corn meal	5
Middlings or ground oats	5
Tankage	1

This ration may be fed either dry or mixed with water. If the sows are being fed during the winter, some bulky feed should be added to the above list. Well-cured alfalfa or clover hay will prove to be a good feed. If such hay cannot be procured, sugar beets or mangel wurzels may be used. In the absence of all these, sorghum cane that has been cut when ripe and placed where it is protected from frost will answer.

A brood sow carrying a litter during the summer should be placed on good alfalfa or clover pasture. She will then require no other bulky feed than that which she can gather. The preceding mixed ration may be fed to the sow if it is easily procurable, but if the pasture is an exceedingly good one, ear corn alone will answer as the grain part of the ration.

Rations for Pregnant Ewes.—Several rations for pregnant ewes weighing from 140 to 160 lb. that are not on pasture arc given in the accompanying list:

Rations	*Pounds*
No. 1:	
Shelled corn or oats	.4
Wheat bran	.1
Corn silage	2.0
or root crops	3.0
Clover hay	2.0
No. 2:	
Shelled corn or oats	.4
Wheat bran	.1
Corn silage	2.0
or root crops	3.0
Alfalfa hay	2.0
No. 3:	
Shelled corn or oats	.4
Corn silage	2.0
or root crops	3.0
Soybean hay	2.5
No. 4:	
Oats or shelled corn	.4
Wheat bran	.1
Corn silage	2.0
or root crops	3.0
Corn fodder	1.0
Clover or alfalfa hay	1.5
No. 5:	
Shelled corn	.4
Wheat bran	.1
Corn silage	2.0
or root crops	3.0
Oat or wheat straw	1.0
Clover or alfalfa hay	1.5
No. 6:	
Shelled corn	.3
Oats	.2
Wheat bran	.2
Clover, alfalfa, or soybean hay	2.2
No. 7:	
Shelled corn	.2
Oats	.2
Wheat bran	.2
Oil meal	.5
Corn fodder	1.0
Clover, alfalfa, or soybean hay	2.0
No. 8:	
Shelled corn	.2
Oats	.3
Wheat bran	.2
Oil meal	.1
Corn fodder	3.0
No. 9:	
Shelled corn	.3
Oats	.2
Wheat bran	.2
Oil meal	.1
Oat or wheat straw	1.5
No. 10:	
Shelled corn	.2
Oats	.2
Wheat bran	.1
Oil meal	.1
Corn silage	2.5
or root crops	3.8
Corn fodder	2.5
or oat straw	1.0

Rations for Ewes With Suckling Lambs.—In the accompanying table are given a number of rations for ewes with suckling lambs.

SUGGESTED DAILY RATIONS FOR EWES WITH SUCKLING LAMBS

Kind of Feed	No. of Ration					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
Mixture of: Shelled corn, 5 parts by weight; Whole oats, 5 parts by weight; Wheat bran, 2 parts by weight; Oil meal, 1 part by weight	1.33	1.33	1.33	1.60	1.33	1.40
Corn silage	3.00	4.00			2.50	2.50
Root crops	3.00		5.00		2.50	2.50
Clover, alfalfa, or soybean hay	2.00	2.50	2.50	3.00	1.50	1.50
Corn stover						2.00
Oat straw					2.00	

Rations for the Fattening of Lambs.—In the following list are given rations suitable for the fattening of lambs in the corn belt, in the western part of the United States, and in Canada or in the northeastern and eastern parts of the United States.

Daily Rations for Fattening One Lamb in the Corn Belt

Rations	*Pounds*
No. 1:	
Shelled corn	1.4
Clover hay	1.1
No. 2:	
Shelled corn	1.0
Clover hay	2.0
No. 3:	
Shelled corn	1.2
Linseed meal	.4
Oat straw or shredded corn, stover	1.0
No. 4:	
Shelled corn	1.0
Soybeans	.5
Soybean straw	.5
Oat straw	.5
No. 5:	
Shelled corn	1.0
Linseed meal	.3
Silage	1.5
Oat straw	.6

Daily Ration for Fattening One Lamb in the Western Portion of the United States

Rations	Pounds	Rations	Pounds
No. 1:		No. 4:	
Barley	1.5	Oats	.7
Alfalfa hay	1.5	Peas	.7
		Oat straw	.5
No. 2:		Pea straw	1.0
Barley	.8		
Alfalfa hay	2.8		
		No. 5:	
No. 3:		Barley	1.5
Barley	1.4	Sugar-beet pulp (wet)	6.0
Wheat bran	.3		
Prairie hay	1.0	Prairie hay	.5

Daily Rations for Fattening One Lamb in Canada or in the Northern and Eastern Portions of the United States

Rations	Pounds	Rations	Pounds
No. 1:		No. 3:	
Barley	1.3	Barley	.5
Linseed meal	.2	Peas	.5
Clover hay	1.2	Wheat bran	.2
		Mixed hay	1.0
No. 2:		Root crops	1.2
Oats	.4		
Barley	.4		
Peas	.4	No. 4:	
Wheat bran	.2	Barley	1.4
Root crops	1.4	Linseed meal	.1
Pea straw	.5	Silage	2.0
Oat straw	.5	Mixed hay	.5

DISEASES OF FARM LIVESTOCK

Any departure from a condition of health in an animal constitutes a diseased condition. In some cases the departure may be so slight and so unimportant as to be of no particular significance. On the other hand, the disturbance may be severe and the condition of the animal so serious that medical or surgical aid is necessary. Some of the more common of the derangements that may require medical aid are described herewith and such treatment suggested as it is practicable for one not skilled in veterinary science to undertake. The treatment of certain complex diseases and certain diseases that are likely to become epidemic and may spread to mankind are matters that should not be left to unskilled hands, for the situation is one that may involve even more than a heavy loss to the owner and to the community. In the case of some diseases lack of proper measures may even result in loss of human life. For these reasons it is always advisable, when there is reason to suspect that a dangerous transmissible disease has broken out, to call a qualified veterinarian. In many states, a state veterinarian is employed and, if notified, he will visit suspected premises or send a deputy to make an inspection, the expense being borne by the state. Every stock owner will do well to post himself as to the provisions made by his own state in this particular, and take steps to make use of any suggestions or assistance that may be available from the state veterinarian's office. Frequently leaflets or bulletins are issued by these offices, and these publications may afford timely warning on matters that are of the most absorbing interest to the owner and breeder of livestock.

TRANSMISSIBLE DISEASES

Infectious diseases and contagious diseases, as the terms are usually applied, are those that are transmissible from one animal to another of the same species, and sometimes to those of another species. A *contagious disease* is one that requires immediate contact of healthy animals with diseased animals, or with their excretions, before transmission can take place. This is due to the fact that the causal agent of the disease, usually a bacterium or an animal parasite, cannot exist for an appreciable time outside of or away from its host. Consequently, there is little danger of a healthy animal acquiring a contagious disease unless it comes close enough to one affected with the malady to permit the direct passage of the germs to the unaffected individual. An *infectious disease* is one that does not require close contact in order for transmission to take place, as the casual agents of infectious diseases are able to exist independently outside of the host. Hence, infection from such a disease, spread on the ground, on feed, in water, or in the air, may remain virulent for a considerable and in some cases an indefinite time, and animals coming in contact with it during this time may contract the disease. This, briefly, is the common distinction between infectious and contagious diseases, but it should be understood that there is no absolutely sharp line of demarcation between the two. Some diseases partake of the nature of both infectious and contagious disorders, hence, there is a tendency among pathologists to discontinue the use of these terms and refer to all the diseases included in the two groups as *transmissible diseases.*

Mange, or *scabies*, is an example of a contagious disease. It is caused by a minute animal parasite, which, although it may live for a short time away from the body of its host, is not capable of reproducing under such conditions and consequently cannot exist indefinitely. Healthy animals may contract mange by coming in contact with affected animals, by being confined in quarters or pastures but recently occupied by affected animals, by the use of blankets, harness, etc., recently used on affected animals, or in fact in any way that permits the living parasite to be transferred during its life cycle. If, however, sufficient time elapses between the use of these quarters, or articles, by infected animals and their occupation by or coming in contact with healthy animals the disease will not be transmitted, because the parasites will have been unable to maintain themselves during this time away from the host.

Blackleg may be cited as an example of an infectious disease. It is caused by a germ or bacterium capable of maintaining itself for an indefinite time outside of the body of the host. Hence, pastures, quarters, etc., when once infected with the germs of blackleg, are likely to harbor the infection for many years. From the above it is obvious that contagious diseases are much more easily controlled and exterminated than are infectious diseases.

NON-TRANSMISSIBLE DISEASES

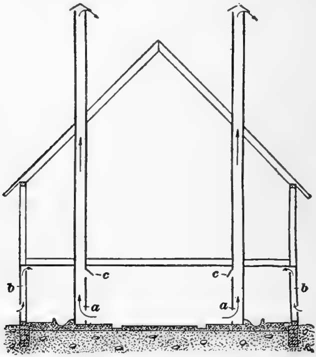
Under the heading of non-transmissible diseases may be grouped the numerous disorders that are not due to a specific organism. Certain forms of indigestion, for example, are due to errors of diet rather than to any specific germ or animal parasite; some skin diseases are not due to parasites, and some diseases of the heart and of the respiratory organs are not traceable to such causes.

SANITARY MEASURES

The maintenance of good sanitary conditions about livestock quarters is of the greatest importance not only in the treatment of animal diseases, but also in their prevention. Although it is not true, as some suppose, that dirt and filth generate disease, it is true that most disease-producing organisms find an ideal breeding ground under such conditions.

Light.—One of the most important steps in making buildings sanitary is a provision for an abundance of light. Direct sunlight is destructive to most disease germs, and buildings should be so placed and designed as to admit a maximum amount. Parts of livestock quarters that do not get direct sunlight should get an abundance of diffused light. Well-lighted interiors are conducive to the contentment of animals and greatly simplify the routine work of feeding, grooming, and cleaning the building, for accumulations of dirt and dust are quickly noticed and easily removed.

Ventilation.—Barns that are enclosed on all sides require some provision for ventilation. No domestic animal can be confined in an enclosed space that is not adequately ventilated without some bad effects from it. As a rule, quarters for hogs, sheep, beef cattle, and some other animals are somewhat loosely constructed, or consist of sheds rather than enclosed barns; in such cases it is not advisable or necessary to install an extensive system of ventilation, but if a building is of such a nature as not to admit of good natural ventilation, some means of supplying fresh air and of removing foul air should be provided. The King system



of ventilating barns is by far the most practical and satisfactory one in use. By this system, fresh air is admitted to the interior of the barn at a point near the ceiling and foul air passes out through flues that open near the floor. The accompanying illustration shows a diagram of a barn ventilated by the King system. Foul-air flues and the openings into them near the floor line are seen at *a*. Fresh air inlets are shown at *b*, and at *c* are auxiliary openings into the foul-air flues. The latter openings are to be kept closed except when the temperature of the barn becomes too high, at which time they may be opened to permit warm air near the ceiling to escape.

Disinfection.—Although the sanitary measures already described go a long way toward protecting animals from the ravages of disease-producing organisms, it is, nevertheless, advisable and often absolutely necessary to make use of chemical disinfectants as a means of destroying these organisms. Successful stock raisers commonly make it a rule to apply a disinfectant about animal quarters at fixed intervals regardless of whether or not disease is prevalent. Such a course is to be commended, for it tends to prevent the unrestricted multiplication of injurious organisms and may forestall a serious outbreak of disease.

Some of the most commonly-used disinfectants are carbolic acid, corrosive sublimate, formaldehyde, and the coal-tar dips. A brief description of these will be found under their respective names in the discussion of common medicines.

Disinfection, to be effective, must be thorough. In fact it is commonly accepted as true that the inefficient and haphazard use of disinfectants may be even worse than no application, because it is likely to give a false sense of security and also to have the effect of satisfying legal requirements with reference to disinfection, but in reality leaving the danger still present. In stables, sheds, barns, etc. that are to be disinfected, all movable fixtures should be taken out in order that the disinfectant may reach every accessible part of the structure. If wooden floors are in use and they are decaying and broken, it is advisable to remove them also, for beneath them there is sure to be an accumulation of dirt and filth that is favorable to the growth of disease germs. After the interior of the building has been exposed as far as possible by the removal of fixtures, etc., the disinfecting solution should be sprayed on all parts. If a suitable spray pump is not available, scrubbing with a broom, brush, or mop will accomplish practically the same results, and even if spraying is resorted to, the scrubbing process should be applied to walls, floors, etc., where there are accumulations of refuse material.

All fixtures should be treated with the disinfectant before being returned to the structure, or if they are old and racked a better plan is to install new ones. A concrete floor is one of the most valuable aids in maintaining sanitary conditions, and should be substituted for wooden floors whenever possible.

In rare cases, the use of a gaseous disinfectant such as formaldehyde gas or sulphur dioxide, may be practicable, but in most cases livestock quarters are not sufficiently close to permit of the use of these agents. Hence, liquid disinfectants are almost universally used for this purpose.

DIAGNOSIS OF DISEASES

The Pulse.—The pulse is one of the most important aids in the diagnosis of disease, because it serves to indicate the action of the heart and also is, to some extent, an indication of the condition of the nervous system. The pulse rate, or the number of beats per minute, is about as follows in different domestic animals: Horse, 30 to 40 beats per min.; cow, 40 to 50 beats per min.; sheep, 70 to 80 beats per min.; swine, 70 to 80 beats per min.

Owing to the fact that there is a considerable variation in domestic animals, even though they may be in perfect health, and the further fact that experience is necessary in order to make a correct interpretation of pulse, it is not likely that the man unskilled in veterinary science will be able to diagnose diseases by taking the pulse. Nevertheless, it will be of some assistance, when taken in connection with other diagnostic indications that are discussed in following paragraphs.

Temperature.—The following figures indicate the range of temperatures of various animals under normal conditions: Horses, 100° to 101°; cattle, 100° to 103°; sheep, 101° to 104°; swine, 102° to 104°.

Temperatures of domestic animals are best taken by means of the special thermometer known as a clinical thermometer, which may be purchased from any druggist. A considerable rise or fall of temperature, from the figures given, may be taken as an indication of a diseased condition. In general, veterinarians consider that a rise of 6° or more denotes a serious condition, and any considerable fall below normal almost always signifies approaching death. It must be understood, however, that local conditions may operate to bring about considerable variations in temperature, and all readings of the thermometer should be considered in connection with them. For example, excitement, heat, or œstrum, hot weather, and other factors may cause considerable rise of temperature. Cool weather, large quantities of cold water or cold feed taken into the body, and some other factors may cause a reduction of temperature; hence, if at any time the thermometer indicates a considerable departure from normal temperature, an investigation should be made to determine whether it is due to any of these causes.

Respiration.—The rate of breathing and the sounds heard during the process often afford aid in diagnosing disease. Rapid breathing may be due to disease and often constitutes a symptom of the disorders of the respiratory organs. However, it may also be occasioned by extreme heat, excitement, violent exercise, or other factors. Hence, as in preceding cases, it is important that the subject be considered in connection with the conditions that may have influenced it.

Mucous Membranes.—Ordinarily, mucous membranes, as seen in the mouth, nostrils, and other openings into the body have a characteristic pink color that is indicative of health. A diseased condition usually brings about more or less change in the appearance of these membranes. A flushed, congested condition indicates a general inflammation of the tissues, while a lack of proper color or paleness is taken as an indication of debility, anemia, or insufficient nutrition.

COMMON MEDICINES

The information presented here is offered merely as a suggestion of what may be done in certain cases and is not to be considered as specific directions for treatment nor is responsibility assumed by the publishers for cases in which favorable results are not forthcoming. The action of all medicines is relative, as is also the dosage of the same, and hence no attempt is made to lay down fixed rules.

Anesthetics.—The term anesthetic is applied to medicinal agents that are used for producing insensibility during periods of pain, or when an operation is being performed. Some of the anesthetics used in veterinary practice are cocaine, chloroform, and ether, but it is scarcely advisable for a layman to administer them. Carbolic acid has a distinct anesthetic action when applied to the skin, and is sometimes applied locally for this purpose.

Anodynes.—Remedies that are used to relieve pain are called anodynes. The following are medicines of this class: Cocaine, menthol, tar, carbolic acid, belladonna, etc. These are used for external applications. Internally, opium, choral hydrate, and turpentine are often given. Morphine is used by veterinarians for hypodermic injections.

Antispasmodics.—Antispasmodics are agents that relieve spasms or cramps. Hot and cold applications, friction, liniments, counter irritation, and bleeding are frequently resorted to. The agents enumerated under anodynes are frequently used internally as antispasmodics.

Astringents.—Astringents are used to check bleeding, to reduce secretions, and to cause tissues to contract and condense. Chalk, alum, turpentine, boric acid, common salt and iodoform are some common agents of this class.

Blisters.—Blisters are commonly spoken of as vesicants and counter-irritants. Some blisters merely cause redness and a slight irritation; others are so powerful that they actually burn the flesh with which they come in contact.

Mustard, and tincture of iodine are examples of mild blisters; butter of antimony, lunar caustic, and caustic potash are examples of severe blisters.

ADMINISTRATION OF MEDICINES

In most cases medicines are either administered to domestic animals through the mouth or are applied externally. Veterinarians occasionally resort to hypodermic injections, using for this purpose a syringe having a hollow needle. This procedure is often of value when immediate results are desired, or when on account of paralysis or other cause the animal is unable to swallow. It is also useful as a means of getting a drug into a specific locality in which it is required, as, for instance, the injecting of cocaine into the flesh previous to operations, or the injecting of vermicides into the windpipe to destroy worms. In addition to these methods of administration, some drugs are volatilized and animals permitted to inhale them.

Dosage.—The doses suggested in the following list of medicinal agents are those calculated to be given to adult animals. To small animals or to animals much weakened by disease or other causes reduced doses should be given. It should be noted that ruminants, that is, animals that chew the cud, such as cattle and sheep, will take larger doses than will horses or swine. This is due to the fact that ruminants have four stomachs, and consequently a more extensive digestive system.

The dosage of a solid medicament is usually given in apothecaries' weight. The tables of apothecaries' weight and fluid measures previously given will be of assistance in this connection.

LIST OF COMMON MEDICINES

Acetic acid: Occasionally applied externally for the removal of warts and abnormal growths.

Aconite, Tincture of: Frequently administered by veterinarians for fevers or inflammations. It is a powerful drug and should be avoided in case an animal is suffering from a weak heart or disturbance of the circulatory system. Dose, horses 10 to 20 drops; cattle 20 to 30 drops; sheep, 10 drops; swine, 1 to 5 drops. External applications of this drug are sometimes made to relieve pain, but should be used sparingly.

Aloes: Extensively used as a purgative for horses. Dose, 5 to 8 drams. Should be administered in a ball or bolus, which may be procured from a druggist.

Ammonia water: Frequently given as a drench in cases of acute indigestion, colic, bloating, and is also used as a stimulant. Dose, horses, ½ oz.; cattle, 1 oz.; sheep, 2 draws; swine, ½ to 1 dram. In all cases to be diluted with water.

Arnica, Tincture of: Is useful to promote sweating and reduce fever. Dose, horses, ½ to 1 oz.; cattle, 1 oz.; sheep, 2 drams; swine, ½ dram. Applied externally, tincture of arnica is useful in sprains, bruises, etc.

Arsenic, Fowler's solution of: Extensively used by veterinarians as a tonic for animals that are depleted in condition, also used in the treatment of heaves of horses. Dose, horses, 2 to 4 drams; cattle, 4 to 6 drams; sheep and pigs, 5 to 20 drops.

Belladonna, Fluid extract of: In cases of fever, colic, tetanus (lockjaw), it is believed to be a valuable agent. Dose, horses, ½ dram; cattle, 1 dram; sheep, 20 drops; swine, 3 drops.

Blue vitriol (copper sulphate): Used in the treatment of foot rot in sheep, also for application to wounds, on which it acts as an antiseptic and astringent. A solution of 1 oz. to 1 pt. of water is usually employed, but in severe cases a stronger solution may be applied.

Boric acid: A solution of 20 grains of boric acid to 1 oz. of water is useful in the treatment of sore or inflamed eyes, mouth, nostrils, etc. Such a solution is practically non-poisonous, yet it has considerable merit as a germicide and astringent.

Butter of antimony: A caustic used in the treatment of old sores, wire cuts, etc. in which proud flesh has formed. The material is applied undiluted by means of a swab. Must be handled with care and is never administered internally.

Carbolic acid: Crude carbolic acid in a 5% solution is a suitable disinfectant for use about barns, stables, pens, and for other purposes. May be applied with a sprayer or by scrubbing the surface with a broom or brush.

Pure carbolic acid (not crude), diluted with 30 parts of water is useful in the treatment of wounds, sores, scratches, etc., and is one of the most generally used disinfectants in veterinary medicine. The solution given is efficient for sterilizing instruments, which should be immersed in it for five minutes. Both the products mentioned are extremely poisonous, and their careless use or storage is frequently the cause of fatal accidents. It is, therefore, advisable to keep them in a compartment under lock and key, and take careful steps to prevent persons not familiar with their qualities from having access to them.

Calomel: An extensively used purgative and vermifuge. Dose, horses, ½ to 1 dram; cattle, 1 to 2 drams; sheep or swine, 5 to 20 grains.

Castor oil: Purgative. Dose, horses, 1 to 2 pt.; sheep, 4 oz.; swine, 2 oz.

Copperas (sulphate of iron): A valuable tonic and very often one of the constituents of condition powders. Useful for checking scours in pigs or calves. Dose, horses, 1 dram; cattle, 2 drams; sheep, 20 grains; swine, 10 grains.

Corrosive sublimate (bichloride of mercury): A powerful disinfectant and very poisonous. For external use only. Corrosive sublimate 1 part in 1,000 parts of water makes a solution that is suitable for use about livestock quarters, also for cleansing wounds and disinfecting prior to operations. It attacks metals, consequently should not be used on instruments or in any place where it will come in contact with metal surfaces.

Coal-tar dip: A general class of proprietary disinfectant and insecticidal solutions that are on the market under different trade names. They are extensively used as dipping and disinfecting solutions for sheep, swine, and cattle, and if they bear the label of reputable manufacturers may be depended on for destroying skin parasites, when used according to directions. They are also useful for dressing cuts, scratches, surgical wounds, etc. They have the advantage of being practically non-poisonous, hence are much safer to use than carbolic acid or corrosive sublimate, and if of good quality they are undoubtedly just as efficient as disinfectants.

Epsom salts: Purgative. Useful for cattle and sheep, but not much used for horses. Doses, cattle, 1 to 1½ lb.; sheep, 2 to 4 oz.

Gentian root: Powdered gentian root is one of the most common ingredients of condition powders, and it has considerable merit as a bitter tonic. Dose, horses, 2 drams; cattle, 4 drams; sheep, 1 dram.

Iodine, Tincture of: Used externally to paint surfaces where a counter-irritant is required, also in the treatment of skin diseases, such as ringworm. Application may be made once daily until the area becomes sore, when it should be discontinued for a time.

Jamaica ginger: Useful in many cases of intestinal disorders. Should be given in milk. Dose, horses, 1 oz.; cattle, 2 oz.; sheep, ½ oz.; calves and foals, ½ oz.

Kerosene and gasoline: Sometimes given internally for stomach worms. Lambs will take from 1 to 2 drams, larger animals a proportionate amount.

Laudanum: Given internally for the relief of acute pain such as is often present in colic; also useful in severe cases of intestinal disorders. Dose, horses, 1 oz.; cattle, 1 to 2 oz.; sheep, 2 drams; swine, 5 to 20 drops.

Lime water: Frequently given to young animals in cases of diarrhea. Should be diluted with milk, using about 2 parts of milk to 1 part of lime water.

Linseed oil, raw: Extensively used as a purgative, also as a diluent for mixing drugs that are too strong to be given undiluted. For purgative effects, 1 to 2 pt. may be given to horses; cattle, 2 to 3 pt.; sheep, ½ pt.

Quinine: A stimulant and bitter tonic. Dose, horses, ½ to 1 dram; cattle, 2 to 4 drams; sheep, ½ dram; swine, 10 grains.

Saltpeter (nitrate of potash): A favorite remedy for the treatment of kidney disorders, also useful in fevers. Dose, horses, 1 oz.; cattle, 1 to 1½ oz.; sheep, 2 drams.

Spirits of camphor: Will often afford relief from pain in colic. Useful in cases of dyspepsia and sometimes in respiratory troubles, coughs, and colds. Should be given in water. Dose, horses, 2 to 4 drams; cattle, 1 oz.; sheep, 2 drams; swine, 10 to 20 drops.

Sulphur: It is a common belief that feeding sulphur will tend to destroy skin parasites, but there is little evidence to support this belief. Dry sulphur dusted into the hair will often accomplish this result. Burning sulphur in a tight enclosure is useful in the treatment of hoose, or verminous bronchitis.

Turpentine: A standard remedy for colic. Useful in cases of bloating and for the destruction of intestinal parasites. Should be given in linseed oil or in milk. Dose, horses, ½ to 2 oz.; cattle, 2 to 3 oz.; sheep, 1 to 3 drams; swine, 1 dram. Turpentine is extensively used in compounding liniments.

Whiskey: A stimulant that is valuable in cases that require such treatment, as for example, sunstroke, chills, general depression, or collapse. Dose, horses and cattle, 2 to 4 oz.; sheep and swine, 1 to 2 oz.

COMMON DISEASES

Abortion.—Contagious abortion, due to a specific germ, is somewhat common in cows, ewes, and mares. Cases should be at once isolated from other animals and the fetus and fetal membranes burned, as they are likely to spread the disease. Disinfect quarters occupied by these animals and douche the womb with a 1% solution of coal-tar dip or a 2% solution of carbolic acid. Repeat douche daily and do not breed until all vaginal discharge ceases. A male may become infected by serving affected females, hence care must be used in selecting a sire.

If accidental abortion, due to injury, overwork, or undue excitement, is threatened, give the patient rest, quiet, and, if necessary, small doses of laudanum.

Abscesses.—For an abscess, as a rule, a hot poultice is advisable until the abscess softens and pus collects. The abscess should then be opened and thoroughly cleaned with an antiseptic solution such as carbolic acid. Repeat the cleansing daily or oftener if necessary. Apply lard or vaseline to the skin and hair about the abscess.

Actinomycosis.—Actinomycosis, or *lump jaw,* affects chiefly young cattle. It is due to a fungus that is usually taken in with feed. If the tumor is external it may be removed and the wound painted with tincture of iodine. Internally, give large doses of potassium iodide—some authorities recommend 3 drams daily until symptoms of poisoning are seen, when the dose should be reduced to 1 or 1½ drams or discontinued if necessary.

Anthrax, or Charbon.—Anthrax, or charbon, affects horses, cattle, and sheep and is transmissible to man. It is a dangerous disease, for which there is no satisfactory treatment. Affected animals should be destroyed and the carcasses burned or buried in quicklime. Premises occupied by such animals should be thoroughly disinfected or abandoned and all discharges from the bodies burned or buried with the carcasses. The utmost care should be observed in this work, since the disease is extremely infectious and usually fatal in man. A vaccine that is somewhat successful in rendering animals immune to the disease may be purchased from druggists.

Azoturia.—Azoturia is a disease that affects horses, particularly work horses, after a short period of idleness on full feed; it is often called *Monday-morning-sickness* because of the frequent cases that develop after the animals have rested over Sunday on full feed. Treatment should consist of supporting the animal in slings if it is paralyzed, administering a purgative, and applying hot blankets. A qualified veterinarian should be called to administer hypodermic injections and give other necessary treatment. Light, succulent feed should be given until recovery is complete.

Barrenness, or Sterility.—Barrenness, or sterility, may affect breeding animals of any species. Reduction of flesh by restriction of diet and giving abundant exercise may correct the condition in overfat animals. Tonics and a liberal ration containing an abundance of nitrogenous feed should be given in the case of depleted animals. Barrenness in cows is sometimes corrected by injecting into the vagina a quart of warm water in which a cake of ordinary compressed yeast has been dissolved. The yeast should be dissolved a few hours before injection and the treatment repeated daily for 3 or 4 da. Some cases of sterility are due to causes that require surgical aid, in which emergency the services of a veterinarian are required.

Blackleg.—Blackleg is known also as *black quarter*, and as *symptomatic anthrax*, the latter term being applied for the reason that the disease somewhat resembles anthrax, but it should be understood that the two are distinct. Blackleg affects chiefly young cattle and its ravages are most pronounced among those that are fat and thrifty. It is almost always fatal and no treatment is satisfactory. Cases should be destroyed and the carcasses treated as directed for anthrax cases. Vaccination with a protective vaccine that any stockman can administer is very successful in preventing the disease. Vaccine may be had in pill form at any drug store.

Cerebrospinal Meningitis.—Cerebrospinal meningitis is sometimes epidemic among horses and sheep. A layman can scarcely undertake treatment. If possible, a veterinarian who is familiar with the disease should be called.

Choking.—If an animal is choked the first efforts should be directed toward returning the obstruction to the mouth. If this is not successful, olive oil or castor oil should be given to lubricate the passage and thus aid in passing the obstruction to the stomach. Sometimes gentle massage of the exterior of the esophagus will assist in this. In some cases a piece of garden hose may be used to force the obstruction down, but great care is necessary or rupture of the gullet may result. In cattle severe bloating may follow a case of choking, in which case tapping the paunch as directed for hoven may be necessary. A surgeon may be able to open the esophagus by an operation and remove the body.

Colic.—Colic is an extremely common disorder among horses. It is difficult to give specific directions for treatment, as there are various forms of the disease, due to different causes, and a treatment that is suitable for one is often entirely unsuitable for another. Good authorities recognize the following forms of colic: Engorgement colic, obstruction colic, tympanitic colic, spasmodic colic, and worm colic. Horse owners will do well to familiarize themselves with the different forms of colic and from this knowledge there will follow an ability to avoid many cases and to give simple treatment when a case makes its appearance. It is obvious that a satisfactory discussion of the causes, symptoms, and treatment of these various colics cannot be given here.

Constipation.—Many cases can be benefited if not cured by giving laxative feed, abundant exercise, and good care. Purgatives are often necessary, in which case aloes are usually given to horses and Epsom salts to cattle. Linseed oil or castor oil are often useful. It should be the aim to correct the condition that causes constipation; probably in most cases it will be found to be improper feeding.

Cough.—As a rule, cough should be regarded as a symptom of a disease rather than as a disease in itself. One of the first steps in treatment is to provide dry, comfortable, well-ventilated quarters. Turpentine, mustard, and other mild counter irritants applied to the skin of the neck and chest are often of service. Equine cough syrup containing agents that tend to relieve the irritation may be procured from druggists. Opium or heroin are sometimes administered by veterinarians in cases of violent or spasmodic cough.

Eczema.—Eczema is, in most cases, due to improper feeding, hence the first step toward treatment should be directed to the correction of this condition. A laxative should be given and the affected skin may be washed with tar soap and oxide-of-zinc ointment of icthyol applied.

Farcy.—See glanders.

Foot-and-Mouth Disease.—Foot-and-mouth disease affects cattle, sheep, swine, and goats. It is extremely infectious and no satisfactory treatment is known, hence immediate destruction of affected animals is recommended. The disease is rare in the United States and Canada, but occasional outbreaks occur, probably resulting from the importation of infected animals from foreign countries. Thorough disinfection of premises occupied by diseased animals is necessary and it is advisable to leave such quarters vacant for several months before placing healthy animals in them.

Foot Rot.—Foot rot is an infectious disease of sheep. Affected animals should be isolated and unaffected ones removed from pastures that may be infected. All affected animals should be compelled to stand for a few moments each day in a shallow tank or trough containing blue vitriol solution, or a 2% solution of coal-tar dip. In advanced cases, individual treatment should be given by removing diseased horn and applying pure carbolic acid or the latter mixed with 10 to 15 parts of glycerine, after which a bandage moistened with disinfectant solution should be applied.

Founder.—For founder hot foot baths and poultices of thermofuge or antiphlogistine are a favorite treatment. If the animal is shod, the shoes should be removed and a clean, dry, well-bedded box stall provided. Bleeding and blistering are frequently practiced by veterinarians. In acute cases it may be advisable to cast the animal or place it in slings. Proper shoeing will often benefit chronic cases.

Foul in Foot.—The disease known as foul in foot is usually seen in cattle and is often due to animals being confined in wet, filthy quarters. A correction of this condition and the application of the remedies suggested for foot-rot in sheep will usually bring about a cure.

Galls.—Galls are usually due to poor fitting of harnesses or chafing, and the first steps should be made to remove the cause. Galled surfaces should be cleansed and oxide-of-zinc ointment applied. Alum dusting powders are also often affective.

Garget.—As a treatment for garget the udder should be milked dry and massaged. Cloths wrung out of hot water or applications of camphor ointment procurable from any druggist are useful. In acute cases it may be well to support the udder by means of a wide bandage around the hips of the animal. Some forms of garget are believed to be contagious, hence it is well to isolate all cases.

Gid.—Gid is a parasite disease of sheep, often spoken of as grub in the head. The only treatment consists of trephining the skull and removing the parasites, but the operation requires special instruments and skill in their use. Preventive measures such as avoiding infected pastures and destroying the heads of sheep that die of the disease are more satisfactory.

Glanders, or Farcy.—Glanders, or farcy, is an extremely contagious and practically incurable disease of horses, mules, and asses. Affected animals should be destroyed and premises carefully disinfected. The disease is transmissible to man, hence the work of destroying animals and disinfection should be done with great care.

Grease.—Grease, sometimes called *grease heels* or *scratches*, is a form of eczema affecting horses' heels. Some cases are believed to be due to filth or skin abrasions. The treatment suggested under eczema is often beneficial in early stages. The affected area should be clipped, cleansed, and a hot poultice applied. Carbolic acid and glycerine may then be applied as directed under eczema, the part bandaged, and the animal kept in a dry, clean stall well supplied with bedding.

Heaves.—Heaves are not curable but may be alleviated by moistening all grain or hay fed. An affected animal should not be watered immediately before exercise or work. Arsenic, iron, and strychnine are often given, but should be prescribed by a veterinarian.

Hog Cholera.—Hog cholera is now believed to be identical with swine plague. Attempts at curative treatment are of little avail. Diseased animals should be destroyed in a manner that will prevent spread of the infection. Thorough disinfection of pens and removal of animals to fresh pastures are essential in stamping out the disease. It is generally agreed by authorities on hog cholera that most of the so-called hog cholera cures are worthless. A protective vaccine is being used with good results, but at present its cost seems to be almost prohibitive except under certain conditions. Information as to where the vaccine may be procured can usually be obtained from a state veterinarian.

Hoose.—Hoose is a parasitic disease of calves and lambs, caused by worms in the bronchial tubes, hence it is sometimes spoken of as *verminous bronchitis.* Some cases are successfully treated by confining animals in a tent or a tight room and causing them to inhale sulphur dioxide, generated by burning sulphur on charcoal. There is imminent danger of suffocating the animals if they are kept too long in the gas, hence great care is necessary. In some cases an attendant remains with them and opens doors when he is no longer able to endure the gas. Veterinarians sometimes inject choloroform or turpentine into the windpipe by means of a hypodermic syringe.

Hoven, or Bloat.—Hoven, or bloat, is very likely to occur in cattle when they are allowed to overfeed, particularly on rank-growing forage such as clover or alfalfa. In early stages of the disease, a wooden bit or gag, retained in the mouth by means of light ropes over the horns will assist in getting rid of the gas that is accumulating in the digestive tract. A handful of salt placed in the mouth back of the gag will often make it more effective. A favorite remedy is 2 oz. of turpentine well diluted with milk or linseed oil. Other remedies are: common baking soda in 2-tablespoonful doses as a drench, and Jamaica ginger in 3- or 4-oz. doses given as a drench, well diluted with hot water. In acute cases when bloating has become so severe that there is danger of suffocation or rupture of the paunch, tapping should be resorted to. Use a trocar and canula, inserting the instrument about half way between the point of the hip or what is often called the hook bone and the last rib on the left side of the animal and choosing the point where the swelling is most prominent. It is well to first make a hole in the skin with a knife. When the puncture has been effected the trocar is withdrawn and the canula allowed to remain in the opening. A pocket knife may be used if a trocar is not available, but with the former there is danger of making the incision too large.

Intestinal and Stomach Worms.—Intestinal and stomach worms are one of the most common parasitic disorders of domestic animals. Worms in the stomach or intestines interfere with nutrition, cause irritation and spasms, and may give rise to serious complications. Some of the different forms are tapeworms, roundworms, whipworms, threadworms, and pinworms. Common remedies for worms are turpentine, diluted with linseed oil, salt, copperas and santonin. It is always advisable to withhold feed for 24 to 48 hr. previous to giving worm remedies, and shortly after giving the drug a purgative should be administered. In obstinate cases a more specific treatment than can be outlined here and one that is particularly adapted to the specific parasite that is causing the trouble may be necessary.

Indigestion.—The usual treatment for indigestion is to give a purgative, followed by Jamaica ginger and a tonic, but special cases often require special treatment. If the indigestion is due to improper feeding, the cause should be obviated by feeding sparingly for a time, or even by withholding feed entirely.

Lice.—Lice are more or less common on all domestic animals. A good coal-tar dip is an efficient lice killer and may usually be depended on to exterminate the parasites if used in accordance with directions furnished by the manufacturer.

Maggots.—Maggots are frequently seen in wounds resulting from dehorning, castrating, and accidents. The treatment is to apply coal-tar dip, kerosene, or turpentine diluted with linseed oil.

Mange.—Mange is a parasitic disease caused by minute animal parasites or mites. It is common in sheep and cattle and is often called *scab* or *scabies;* it also affects horses and hogs. Some forms of mange are more resistant to treatment than others. Dipping in a reliable coal-tar dip is the most convenient and satisfactory remedy for small animals. The dip solution does not kill eggs of the mites, hence the dipping should be repeated frequently if it is expected to exterminate the disease. If dipping is not practicable, local treatment with green soap, sulphur ointment, or carbolic acid in glycerine may be applied. The hair should be clipped and scabs softened before application in order to secure the best results. Infected quarters should be thoroughly sprayed with coal-tar-dip solution to destroy parasites that may be harbored there.

Milk Fever.—Milk fever affects chiefly dairy cows that are heavy milkers. Purgative of Epsom salts may be given early in the disease, but if paralysis has set in, medicine administered by the mouth is likely to cause strangulation. The affected cow should be propped up to a comfortable position with bags of straw, and ice or cold water applied to her head and spine. Oxygen gas injected into the udder is a treatment that is now used very extensively. If oxygen cannot be procured, pumping the udder full of air by means of an ordinary bicycle pump and a milking tube may be resorted to.

Navel Ill.—Navel ill is an infectious disease of the joints. It occurs in foals and sometimes in the young of other animals soon after birth, and is due to the entrance of germs through the navel opening. Prevention consists in keeping the dam in a clean, dry, sanitary stall, and in bandaging the navel of the young as soon as it is dropped. Treatment after a case has developed is seldom successful.

Quarter Crack and Sand Crack.—When a horse is affected with quarter cracks or sand cracks a blacksmith may draw the parts of the hoof together with a carefully fitted shoe, or by means of nails. Tar should be applied to exclude dirt from the crevices.

Rabies.—Rabies affects all animals and is transmissible to man, in the latter case being known as hydrophobia. There is no satisfactory treatment of rabies in animals. On account of the imminent danger of spreading the disease, it is advisable to destroy affected animals at once. However, in case what is thought to be a rabid animal, as a mad dog, is at large in a community and bites animals or persons it is always advisable to preserve the life of the supposedly rabid animal until a diagnosis can be made to determine whether or not rabies is actually present. This precaution is particularly important in case persons are bitten.

Rheumatism.—Rheumatism affects horses, cattle, pigs, and goats. Treatment is not very satisfactory. Clean, dry quarters and good, nourishing feed will go a long way toward preventing the disorder and will often bring about marked improvement in cases already developed. Enlarged, stiffened joints may be rubbed with iodine ointment. Veterinarians are sometimes able to fire and blister affected parts with good results.

Rickets, or Rachitis.—Rickets, or rachitis, is common in young pigs and is believed to be due to improper feeding of the dam. Treatment should be directed toward correcting the diet and providing clean, dry, sanitary quarters. Liquid feeds, such as gruels, are particularly useful.

Ringworm.—Ringworm attacks horses, cattle, sheep, goats, and swine. The disorder is due to a fungous growth. Painting with iodine or a strong solution of cold-tar dip will usually destroy the parasite. Occasionally man acquires ringworm from animals, hence due precaution should be taken in treating cases. Animals transmit the disease to animals of the same species, but it is said that cattle seldom acquire it from horses or vice versa. It is always desirable to isolate cases of ringworm and disinfect the quarters they have occupied. Green soap, boracic acid, and turpentine are other remedies that are frequently used.

Scab in Sheep.—See Mange.

Scours.—Scours affects chiefly newly born animals. Linseed oil will often assist in a freeing of the intestinal tract from irritating material. Laudanum is useful to relieve pain. Lime water is a favorite remedy with many stockmen. See that feed is clean and wholesome and milk pails or troughs are sterilized for each feeding.

Sunstroke.—Apply ice or cold water to the head and along the spine. Bleeding is not advisable. A stimulant such as whiskey is often given in these cases. Many authorities consider it inadvisable to drench animals over the entire body with a hose or by throwing pails of water on them. Many cases of sunstroke in horses may be prevented. During periods of intense heat, provide a head covering and place in this a sponge moistened with cold water. Frequent watering is also a safeguard.

Swine Fever.—See hog cholera.

Tetanus, or Lockjaw.—Tetanus, or lockjaw, is an extremely contagious disease and a dangerous one because of the fact that it is easily transmitted to man. As a general rule, treatment for the disease is useless, although good results have been reported from the use of a serum. When there is reason to suspect that an animal will develop tetanus because of infection from a wound, an immediate use of the same serum, known as antitetanic serum, is successful in preventing the disease in a large majority of cases. A qualified veterinarian should be employed to administer the serum. A wound that is suspected to contain tetanus germs should be opened and cleaned out so that every part of it will be exposed to the air, as the germs of tetanus do not thrive under these conditions. Pure carbolic acid may be used to clean the wound.

Texas Fever.—Texas fever is a virulent disease of cattle and one that is very prevalent in the southern part of the United States. It is caused by a minute animal parasite that lives in the body of the Texas fever tick or more properly the splenetic fever tick. Hence, efforts should be made to exterminate the latter pest. The method of immunizing cattle against the disease has been developed and used somewhat extensively. No satisfactory treatment is known, and it is often advisable to destroy affected animals and free the other ones from ticks by dipping or spraying and remove them to new pasture.

Thrush.—Thrush affects the frogs of horses' hoofs. Treatment consists in placing the animals in clean, dry quarters and cleaning the foot and applying a healing powder such as calomel and iodoform, equal parts. In some cases it may be necessary to cauterize the affected part, for which purpose butter of antimony applied with a swab is effective. Afterwards a dressing of tar and a bandage over the foot will serve to exclude dirt and permit healing.

Tuberculosis.—Tuberculosis affects all domestic animals. There is no satisfactory treatment for this disease, but every effort should be made to stamp it out by destroying the affected animals or at least isolating them and abstaining from the use of any products from them. A discussion of the additional measures for the control of this disease is impossible in this space. Consult a state veterinarian or board of health.

SCORE CARDS FOR FARM LIVESTOCK

SCORE CARD FOR HEAVY MARKET HORSES

General Appearance	Perfect Score	Judge's Score
Height: score according to class	1	______
Weight: score according to class	6	______
Form: according to class, broad, massive, symmetrical	5	______
Condition: carrying a good amount of firm flesh	4	______
Quality: bone moderately heavy, clean, firm, and indicating sufficient substance; tendons well defined; hair and skin fine	4	______

SCORE CARD FOR HEAVY MARKET HORSES

(Continued)

	Perfect Score	Judge's Score
Temperament: quiet, yet energetic	3	
Head and Neck		
Head: medium in size, not coarse	1	
Muzzle: fine; nostrils large; lips thin, even; teeth sound	1	
Eyes: large, full, bright, clear	1	
Forehead: broad and full	1	
Ears: medium size, pointed, well carried, and not far apart	1	
Neck: medium length, clean cut, well muscled; tapering from shoulder to head, and head attached at proper angle; crest well developed and nicely arched; throat latch fine; windpipe large	2	
Forequarters		
Shoulders: oblique, long, smooth, and covered with muscle extending into back; withers well finished at the top	3	
Arms: short, well muscled, elbow lying close to the body	2	
Fore legs: viewed from in front, a perpendicular line from the point of the shoulder should fall on the center of the knee, cannon, pastern, and foot; from the side, a perpendicular line dropping from the center of the elbow joint should fall on the center of the knee and pastern joint and back of the hoof	3	
Forearms: heavily muscled, long, wide, and tapering from the elbow to the knee	2	
Knees: large, clean, wide, straight, and strongly supported	1	
Cannons: short, wide, clean; tendons large, set well back, not tied in below the knees	2	
Fetlocks: wide, straight, strong, free from puffiness	1	
Pasterns: strong, of medium length; angle with the ground 45 degrees	2	
Feet: straight, medium size, even; horn dense; frog large, elastic; bars strong; sole concave; heel wide, high; hoof head large	5	
Body		
Chest: deep, low; girth large; width of breast in proportion to other parts	3	
Ribs: long, well sprung	3	

SCORE CARD FOR HEAVY MARKET HORSES
(Continued)

	Perfect Score	Judge's Score
Back: straight, short, broad, well muscled..	3	______
Loins: wide, short, thick, and neatly joined to hips..............................	2	______
Under line: long, flank low................	1	______
HINDQUARTERS		
Hips: smooth, level; width in proportion with other parts, but not prominent....	2	______
Croup: long, wide, muscular, not drooping..	2	______
Tail: attached high, well carried, well haired, with straight and not too coarse hair..	1	______
Thighs: long, muscular, thick, and wide; well muscled over stifle...................	3	______
Quarters: heavily muscled, deep...........	2	______
Hind legs: viewed from behind, a perpendicular line from the point of the buttock should fall on the center of the hock, cannon, pastern, and foot; from the side, a perpendicular line from the hip joint should fall on the center of the foot and divide the gaskin in the middle; and a perpendicular line from the point of the buttock should run parallel with the line of the cannon....................	4	______
Gaskins, or lower thighs: long, wide, well muscled............................	1	______
Hocks: large, strong, clean, and well defined; free from puffiness, coarseness, and curbiness..............................	4	______
Cannons: medium length, broad, flat, and clean; tendons large and set back, not too light below the hock..............	2	______
Fetlocks: large, wide, straight, strong, free from puffiness.......................	1	______
Pasterns: strong and of medium length; obliquity not so great as fore pasterns..	1	______
Hind feet: straight, medium size, even; smaller and not so round as fore feet; horn dense; frog large, elastic; bars strong; sole concave; heel wide; high...	4	______
ACTION		
Walk: elastic, quick, balanced; step long....	6	______
Trot: rapid, straight, regular, high; should not wing or roll in front or go wide or too close behind....................	4	______
Total.........................	100	

SCORE CARD FOR LIGHT MARKET HORSES

	Perfect Score	Judge's Score
General Appearance		
Height: score according to class	1	
Weight: score according to class	1	
Form: according to class, symmetrical, smooth, and stylish	5	
Condition: carrying a moderate amount of firm flesh	2	
Quality: bone clean, firm, and indicating sufficient substance; tendons well defined; hair and skin fine	3	
Temperament: spirited, yet docile	2	
Head and Neck		
Head: not too large, features well defined and regular	1	
Muzzle: fine; nostrils large; lips thin, even; teeth sound	1	
Eyes: large, full, bright, and clear	1	
Forehead: broad and full	1	
Ears: medium size, pointed; well carried, and not far apart	1	
Neck: rather long and clean cut, well muscled; crest well developed and nicely arched; throat latch fine; windpipe large; tapering from shoulder to head and head attached at proper angle	2	
Forequarters		
Shoulders: oblique, long, smooth, and covered with muscle extending into back; withers well finished at the top	4	
Arms: short, well muscled, elbows lying close to the body	2	
Fore legs: viewed from in front, a perpendicular line from the point of the shoulder should fall on the center of the knee, cannon, pastern, and foot; from the side, a perpendicular line dropping from the center of the elbow joint should fall on the center of the knee and pastern joint and back of the hoof	3	
Forearms: well muscled, medium length, wide, and tapering from the elbow to the knee	2	
Knees: large, clean, wide, straight, and strongly supported	1	
Cannons: medium length, wide, clean; tendons large, set well back, not tied in below the knees	2	
Fetlocks: wide, straight, strong, free from puffiness	1	
Pasterns: strong, of medium length; angle with the ground 45°	2	

SCORE CARD FOR LIGHT MARKET HORSES
(Continued)

	Perfect Score	Judge's Score
Feet: straight, medium size, even; horn dense; frog large. elastic; bars strong; sole concave; heel wide, high; hoof head large	5	———
Body		
Chest: deep, low; girth large; width of breast in proportion to other parts..........	2	———
Ribs: long, well sprung..................	4	———
Back: straight, short, broad, well muscled..	3	———
Loins: wide, short, thick, and neatly joined to hips..............................	2	———
Under line: long; flank low................	1	———
Hindquarters		
Hips: smooth, level, width in proportion to other parts but not prominent........	2	———
Croup: long, wide, muscular..............	2	———
Tail: attached high, well carried, well haired with straight and not too coarse hair...	1	———
Thighs: long, muscular, thick, and wide.....	3	———
Quarters: heavily muscled.................	1	———
Hind legs: viewed from behind, a perpendicular line from the point of the buttock should fall on the center of the hock, cannon, pastern, and foot. From the side, a perpendicular line from the hip joint should fall on the center of the foot and divide the gaskin in the middle; and a perpendicular line from the point of the buttock should run parallel with the line of the cannon...................	4	———
Gaskins, or lower thighs: wide, well muscled	1	———
Hocks: large, strong, clean, and well defined	4	———
Cannons: short, broad, flat and clean, tendons large and set back...............	2	———
Fetlocks: large, wide, straight and strong...	1	———
Pasterns: strong and of medium length; obliquity not so great as fore pasterns..	1	———
Hind feet: straight, medium size, even; smaller and not so round as fore feet; horn dense; frog large, elastic; bars strong; sole concave; heel wide, high...	4	———
Action		
Walk: elastic, quick, balanced; step long....	4	———
Trot: rapid, straight, regular, high; should not forge, wing, or roll in front, or go wide or too close behind.............	15	———
Total.........................	100	

SCORE CARD FOR DAIRY CATTLE

General Appearance	Perfect Score	Judge's Score
Form: wedge-shaped as viewed from the front, side, and top	5	
Form: spare, as indicated by prominent joints and clean bone and lack of muscular development along ribs and loins	8	
Quality: hair fine, soft; skin pliable, loose, medium thickness; secretion yellow, abundant	8	
Constitution: vigorous, as indicated by alert expression, evidently active vital functions, and general healthy appearance	6	
Head and Neck		
Muzzle: clean cut; mouth large; nostrils large Eyes: large, bright Face: lean, long; quiet expression Forehead: broad, slightly dished Ears: medium size; fine texture Neck: fine, medium length; throat clean; light dewlap	6	
Forequarters and Hindquarters		
Withers: lean, thin; shoulders: angular, not fleshy	3	
Hips: far apart; not lower than spine Rump: long, wide, comparatively level Thurls: high, wide apart	5	
Thighs: thin, long	2	
Legs: straight, short; shank fine	1	
Body		
Chest: deep; with large girth and broad on floor of chest; well-sprung ribs	10	
Abdomen: large, deep; indicative of capacity; well supported	4	
Back: lean, straight; chine open	2	
Tail: long, slim, with fine switch	2	
Loin: broad	2	
Udder: large, long; attached high and full behind; extending far in front and full; quarters even	20	
Udder: capacious, flexible, with loose, pliable skin covered with short, fine hair	10	
Teats: convenient size, evenly placed	2	
Milk veins: large, tortuous, long, branching, with large milk wells	4	
Total	100	

SCORE CARD FOR MARKET BEEF CATTLE

	Perfect Score	Judge's Score
Weight: estimated....pounds; actual.... pounds; score according to age........	10	______
Form: straight top and bottom lines; deep, broad, low set, compact, symmetrical..	10	______
Quality: hair, fine; bone, fine but strong; skin, pliable; mellow even covering of firm flesh, especially in region of valuable cuts; absence of ties and rolls......	10	______
Condition: prime; flesh, deep; evidence of finish, especially marked in cod, tailhead, flank, shoulder, and throat; absence of bunches, patches, or rolls of fat.	10	______
Head: clean, symmetrical; quiet expression; mouth and nostrils, large; lips, moderately thin; eyes, large, clear, placid; face, short; forehead, broad, full; ears, medium size, fine texture, erect.......	5	______
Neck: thick, short, tapering neatly from shoulder to head; throat, clean........	2	______
Shoulder vein: full....................	2	______
Shoulder: well covered with flesh; compact..	3	______
Brisket: full, broad, but not too prominent; breast wide......................	1	______
Dewlap: skin not too loose and drooping....	1	______
Chest: deep, wide, full..................	1	______
Crops: full, thick, broad.................	3	______
Ribs: long, arched, thickly fleshed.........	8	______
Back: broad, straight, thickly and evenly fleshed............................	8	______
Loin: thick, broad; thickness extending well forward	8	______
Flank: full, low, thick....................	2	______
Hooks: smoothly covered; width in proportion with other parts, but not prominent	2	______
Rump: long, level, wide and even; tailhead, smooth, not patchy................	2	______
Pin bones: not prominent, width in proportion with other parts................	1	______
Thighs: full, fleshed well down to hock.....	3	______
Twist: deep, full; purse in steers full.......	4	______
Legs: straight, short; arm, full; shank, fine, smooth	4	______
Total	100	

SCORE CARD FOR MUTTON TYPE OF SHEEP

General Appearance	Perfect Score	Judge's Score
Weight: score according to age and breed	4	
Form: straight top and under line; deep, broad, low set, compact, symmetrical	10	
Quality: hair fine; bone fine but strong; even covering of firm flesh; features refined but not delicate; stylish	10	
Constitution: chest capacious; brisket well developed; flank deep; bone strong; movement bold and vigorous	10	
Condition: thrifty; skin pink; fleece elastic; well fleshed, but not excessively fat; deep covering of firm flesh	5	
Disposition: quiet but not sluggish	2	
Color and markings: according to breed	2	
Head and Neck		
Muzzle: mouth and nostrils large; lips thin	1	
Eyes: full, bright, clear	1	
Face: short, according to breed	1	
Forehead: broad, full	1	
Ears: texture, fine; size and form, according to breed	1	
Neck: thick, short, neatly tapering to head; throat clean, according to breed	3	
Forequarters		
Shoulder: covered with flesh; compact; smoothly joined with neck and body	4	
Brisket: well developed; breast wide	1	
Fore legs: straight, short, set well apart; pasterns upright; feet squarely placed, neither close nor sprawling	2	
Body		
Ribs: long, well sprung, thickly fleshed	3	
Back: broad, straight, thickly and evenly fleshed	5	
Loin: thick, broad, firm	5	
Flank: full, even with under line	1	
Hindquarters		
Hips: level, smoothly covered; width in proportion with other parts	1	
Rump: long, level, wide and even in width; not covered at tail-head with excessive fat	3	
Thighs: full, fleshed well down to hock	2	

SCORE CARD FOR MUTTON TYPE OF SHEEP

(Continued)

	Perfect Score	Judge's Score
Twist: deep, plump, firm, indicating fleshiness	5	
Hind legs: straight, short, set well apart; bones smooth, strong, being neither coarse nor fine; pasterns upright; feet squarely placed; neither close nor sprawling	3	
Wool		
Quantity: long, dense, even, according to breed	5	
Quality: structure and color true; fine, soft, even, according to breed	5	
Condition: strong, bright, clean, slight amount of yolk	4	
Total	100	

SCORE CARD FOR WOOL TYPE OF SHEEP

General Appearance	Perfect Score	Judge's Score
Form: level, deep, stylish; round rather than square	8	______
Quality: clean, fine bone; silky hair; fine skin	6	______
Head and Neck		
Muzzle: fine; broad, wrinkly nose; pure white	1	______
Eyes: large, clear, placid	1	______
Face: wrinkly, covered with soft, velvety coat	1	______
Forehead: broad, full	1	______
Ears: soft, thick, velvety	1	______
Neck: short, muscular, well set on shoulders	1	______
Forequarters		
Shoulder: strong, deep and broad	4	______
Brisket: projecting forwards; breast wide	1	______
Legs: straight, short, wide apart, shank smooth and fine	2	______
Body		
Chest: deep, full, indicating constitution	10	______
Back: level, long; round ribbed	4	______
Loin: wide, level	4	______
Flank: low, making under line straight	2	______
Hindquarters		
Hips: far apart, level, smooth	2	______
Rump: long, level, wide	4	______
Legs: straight, short, strong; shank smooth, fine	2	______
Wool		
Quantity: long, dense, even covering, especially over crown, cheek, armpit, hind legs, and belly	15	______
Quality: fine fiber; crimp close, regular; even quality, including tops of folds	15	______
Condition: bright, lustrous, sound, pure, soft; even distribution of yolk, with even surface to fleece	15	______
Total	100	

SCORE CARD FOR BACON-TYPE BARROW

General Appearance	Perfect Score	Judge's Score
Weight: 170 to 200 pounds, the result of thick cover of firm flesh	6	
Form: long, level, smooth, deep	10	
Quality: hair, fine; skin, thin; bone, fine; firm covering of flesh without any soft bunches of fat or wrinkles	10	
Condition: deep, uniform covering of flesh, especially in region of high-priced cuts	10	
Head and Neck		
Snout: fine	1	
Eyes: full, mild, bright	1	
Face: slim	1	
Ears: trim, medium size	1	
Jowl: light, trim	1	
Neck: medium length, light	1	
Forequarters		
Shoulders: free from roughness, smooth, compact, and same width as back and hindquarters	6	
Breast: moderately wide, full	2	
Legs: straight, short, strong; bone, clean; pasterns, upright; feet, medium size	2	
Body		
Chest: deep, full girth	4	
Back: medium and uniform in width, smooth	8	
Sides: long, smooth, level from beginning of shoulders to end of hindquarters. The side at all points should touch a straight edge running from fore to hindquarters.	10	
Ribs: deep, uniformly sprung	2	
Belly: trim, firm, thick without any flabbiness or shrinkage at flank	10	
Hindquarters		
Hips: smooth, wide; proportionate to rest of body	2	
Rump: long, even, straight, rounded toward tail	2	
Gammon: firm, rounded, tapering, fleshed deep and low toward hocks	8	
Legs: straight, short, strong; feet, medium size; bone, clean; pasterns, upright	2	
Total	100	

SCORE CARD FOR FAT-TYPE BARROW

General Appearance	Perfect Score	Judge's Score
Weight: score according to age (pigs of a given age should show a certain weight)	6	______
Form: deep, broad, low, long, symmetrical, compact, standing squarely on legs....	10	______
Quality: hair, silky; skin, fine; bone, fine; mellow covering of flesh, free from lumps and wrinkles........................	10	______
Condition: deep, even covering of flesh and fat over all parts of the body..........	10	______
Head and Neck		
Snout: medium length, not coarse..........	1	______
Eyes: full, mild, bright..................	1	______
Face: short, cheeks full..................	1	______
Ears: fine, medium size, soft..............	1	______
Jowl: strong, neat, broad.................	1	______
Neck: thick, medium length................	1	______
Forequarters		
Shoulder: broad, deep, full, compact on top	6	______
Legs: straight, short, strong; bone, clean; pasterns, upright; feet, medium size...	2	______
Body		
Chest: deep, broad; large girth............	4	______
Sides: deep, lengthy, full; ribs, close and well sprung..............................	6	______
Back: broad, straight, thickly and evenly fleshed..............................	10	______
Loin: wide, thick, straight................	8	______
Belly: straight, even......................	4	______
Hindquarters		
Hips: wide apart, smooth..................	2	______
Rump: long, wide, evenly fleshed, straight..	2	______
Ham: heavily fleshed, plump, full, deep, wide	10	______
Thighs: fleshed close to hocks.............	2	______
Legs: straight, short, strong; bone, clean; pasterns, upright; feet, medium size....	2	______
Total..........................	100	

GESTATION TABLE

Date Bred	Mare	Cow	Ewe	Sow
	Due to Foal	Due to Calve	Due to Lamb	Due to Farrow
Jan. 1	Dec. 2	Oct. 12	May 27	Apr. 22
2	3	13	28	23
3	4	14	29	24
4	5	15	30	25
5	6	16	31	26
6	7	17	June 1	27
7	8	18	2	28
8	9	19	3	29
9	10	20	4	30
10	11	21	5	May 1
11	12	22	6	2
12	13	23	7	3
13	14	24	8	4
14	15	25	9	5
15	16	26	10	6
16	17	27	11	7
17	18	28	12	8
18	19	29	13	9
19	20	30	14	10
20	21	31	15	11
21	22	Nov. 1	16	12
22	23	2	17	13
23	24	3	18	14
24	25	4	19	15
25	26	5	20	16
26	27	6	21	17
27	28	7	22	18
28	29	8	23	19
29	30	9	24	20
30	31	10	25	21
31	Jan. 1	11	26	22

TABLE—*(Continued)*

Date Bred	Mare: Due to Foal	Cow: Due to Calve	Ewe: Due to Lamb	Sow: Due to Farrow
Feb. 1	Jan. 2	Nov. 12	June 27	May 23
2	3	13	28	24
3	4	14	29	25
4	5	15	30	26
5	6	16	July 1	27
6	7	17	2	28
7	8	18	3	29
8	9	19	4	30
9	10	20	5	31
10	11	21	6	June 1
11	12	22	7	2
12	13	23	8	3
13	14	24	9	4
14	15	25	10	5
15	16	26	11	6
16	17	27	12	7
17	18	28	13	8
18	19	29	14	9
19	20	30	15	10
20	21	Dec. 1	16	11
21	22	2	17	12
22	23	3	18	13
23	24	4	19	14
24	25	5	20	15
25	26	6	21	16
26	27	7	22	17
27	28	8	23	18
28	29	9	24	19

TABLE—*(Continued)*

Date Bred	Mare	Cow	Ewe	Sow
	Due to Foal	Due to Calve	Due to Lamb	Due to Farrow
March 1	Jan. 30	Dec. 10	July 25	June 20
2	31	11	26	21
3	Feb. 1	12	27	22
4	2	13	28	23
5	3	14	29	24
6	4	15	30	25
7	5	16	31	26
8	6	17	Aug. 1	27
9	7	18	2	28
10	8	19	3	29
11	9	20	4	30
12	10	21	5	July 1
13	11	22	6	2
14	12	23	7	3
15	13	24	8	4
16	14	25	9	5
17	15	26	10	6
18	16	27	11	7
19	17	28	12	8
20	18	29	13	9
21	19	30	14	10
22	20	31	15	11
23	21	Jan. 1	16	12
24	22	2	17	13
25	23	3	18	14
26	24	4	19	15
27	25	5	20	16
28	26	6	21	17
29	27	7	22	18
30	28	8	23	19
31	March 1	9	24	20

TABLE—*(Continued)*

Date Bred	Mare Due to Foal	Cow Due to Calve	Ewe Due to Lamb	Sow Due to Farrow
Apr. 1	March 2	Jan. 10	Aug. 25	July 21
2	3	11	26	22
3	4	12	27	23
4	5	13	28	24
5	6	14	29	25
6	7	15	30	26
7	8	16	31	27
8	9	17	Sept. 1	28
9	10	18	2	29
10	11	19	3	30
11	12	20	4	31
12	13	21	5	Aug. 1
13	14	22	6	2
14	15	23	7	3
15	16	24	8	4
16	17	25	9	5
17	18	26	10	6
18	19	27	11	7
19	20	28	12	8
20	21	29	13	9
21	22	30	14	10
22	23	31	15	11
23	24	Feb. 1	16	12
24	25	2	17	13
25	26	3	18	14
26	27	4	19	15
27	28	5	20	16
28	29	6	21	17
29	30	7	22	18
30	31	8	23	19

TABLE—*(Continued)*

Date Bred	Mare — Due to Foal	Cow — Due to Calve	Ewe — Due to Lamb	Sow — Due to Farrow
May 1	Apr. 1	Feb. 9	Sept. 24	Aug. 20
2	2	10	25	21
3	3	11	26	22
4	4	12	27	23
5	5	13	28	24
6	6	14	29	25
7	7	15	30	26
8	8	16	Oct. 1	27
9	9	17	2	28
10	10	18	3	29
11	11	19	4	30
12	12	20	5	31
13	13	21	6	Sept. 1
14	14	22	7	2
15	15	23	8	3
16	16	24	9	4
17	17	25	10	5
18	18	26	11	6
19	19	27	12	7
20	20	28	13	8
21	21	March 1	14	9
22	22	2	15	10
23	23	3	16	11
24	24	4	17	12
25	25	5	18	13
26	26	6	19	14
27	27	7	20	15
28	28	8	21	16
29	29	9	22	17
30	30	10	23	18
31	May 1	11	24	19

TABLE—*(Continued)*

Date Bred	Mare Due to Foal	Cow Due to Calve	Ewe Due to Lamb	Sow Due to Farrow
June 1	May 2	March 12	Oct. 25	Sept. 20
2	3	13	26	21
3	4	14	27	22
4	5	15	28	23
5	6	16	29	24
6	7	17	30	25
7	8	18	31	26
8	9	19	Nov. 1	27
9	10	20	2	28
10	11	21	3	29
11	12	22	4	30
12	13	23	5	Oct. 1
13	14	24	6	2
14	15	25	7	3
15	16	26	8	4
16	17	27	9	5
17	18	28	10	6
18	19	29	11	7
19	20	30	12	8
20	21	31	13	9
21	22	Apr. 1	14	10
22	23	2	15	11
23	24	3	16	12
24	25	4	17	13
25	26	5	18	14
26	27	6	19	15
27	28	7	20	16
28	29	8	21	17
29	30	9	22	18
30	31	10	23	19

TABLE—(*Continued*)

Date Bred	Mare: Due to Foal	Cow: Due to Calve	Ewe: Due to Lamb	Sow: Due to Farrow
July 1	June 1	Apr. 11	Nov. 24	Oct. 20
2	2	12	25	21
3	3	13	26	22
4	4	14	27	23
5	5	15	28	24
6	6	16	29	25
7	7	17	30	26
8	8	18	Dec. 1	27
9	9	19	2	28
10	10	20	3	29
11	11	21	4	30
12	12	22	5	31
13	13	23	6	Nov. 1
14	14	24	7	2
15	15	25	8	3
16	16	26	9	4
17	17	27	10	5
18	18	28	11	6
19	19	29	12	7
20	20	30	13	8
21	21	May 1	14	9
22	22	2	15	10
23	23	3	16	11
24	24	4	17	12
25	25	5	18	13
26	26	6	19	14
27	27	7	20	15
28	28	8	21	16
29	29	9	22	17
30	30	10	23	18
31	July 1	11	24	19

TABLE—*(Continued)*

Date Bred	Mare	Cow	Ewe	Sow
	Due to Foal	Due to Calve	Due to Lamb	Due to Farrow
Aug. 1	July 2	May 12	Dec. 25	Nov. 20
2	3	13	26	21
3	4	14	27	22
4	5	15	28	23
5	6	16	29	24
6	7	17	30	25
7	8	18	31	26
8	9	19	Jan. 1	27
9	10	20	2	28
10	11	21	3	29
11	12	22	4	30
12	13	23	5	Dec. 1
13	14	24	6	2
14	15	25	7	3
15	16	26	8	4
16	17	27	9	5
17	18	28	10	6
18	19	29	11	7
19	20	30	12	8
20	21	31	13	9
21	22	June 1	14	10
22	23	2	15	11
23	24	3	16	12
24	25	4	17	13
25	26	5	18	14
26	27	6	19	15
27	28	7	20	16
28	29	8	21	17
29	30	9	22	18
30	31	10	23	19
31	Aug. 1	11	24	20

TABLE—(*Continued*)

Date Bred	Mare Due to Foal	Cow Due to Calve	Ewe Due to Lamb	Sow Due to Farrow
Sept. 1	Aug. 2	June 12	Jan. 25	Dec. 21
2	3	13	26	22
3	4	14	27	23
4	5	15	28	24
5	6	16	29	25
6	7	17	30	26
7	8	18	31	27
8	9	19	Feb. 1	28
9	10	20	2	29
10	11	21	3	30
11	12	22	4	31
12	13	23	5	Jan. 1
13	14	24	6	2
14	15	25	7	3
15	16	26	8	4
16	17	27	9	5
17	18	28	10	6
18	19	29	11	7
19	20	30	12	8
20	21	July 1	13	9
21	22	2	14	10
22	23	3	15	11
23	24	4	16	12
24	25	5	17	13
25	26	6	18	14
26	27	7	19	15
27	28	8	20	16
28	29	9	21	17
29	30	10	22	18
30	31	11	23	19

TABLE—*(Continued)*

Date Bred	Mare Due to Foal	Cow Due to Calve	Ewe Due to Lamb	Sow Due to Farrow
Oct. 1	Sept. 1	July 12	Feb. 24	Jan. 20
2	2	13	25	21
3	3	14	26	22
4	4	15	27	23
5	5	16	28	24
6	6	17	March 1	25
7	7	18	2	26
8	8	19	3	27
9	9	20	4	28
10	10	21	5	29
11	11	22	6	30
12	12	23	7	31
13	13	24	8	Feb. 1
14	14	25	9	2
15	15	26	10	3
16	16	27	11	4
17	17	28	12	5
18	18	29	13	6
19	19	30	14	7
20	20	31	15	8
21	21	Aug. 1	16	9
22	22	2	17	10
23	23	3	18	11
24	24	4	19	12
25	25	5	20	13
26	26	6	21	14
27	27	7	22	15
28	28	8	23	16
29	29	9	24	17
30	30	10	25	18
31	Oct. 1	11	26	19

TABLE—*(Continued)*

Date Bred	Mare Due to Foal	Cow Due to Calve	Ewe Due to Lamb	Sow Due to Farrow
Nov. 1	Oct. 2	Aug. 12	March 27	Feb. 20
2	3	13	28	21
3	4	14	29	22
4	5	15	30	23
5	6	16	31	24
6	7	17	Apr. 1	25
7	8	18	2	26
8	9	19	3	27
9	10	20	4	28
10	11	21	5	March 1
11	12	22	6	2
12	13	23	7	3
13	14	24	8	4
14	15	25	9	5
15	16	26	10	6
16	17	27	11	7
17	18	28	12	8
18	19	29	13	9
19	20	30	14	10
20	21	31	15	11
21	22	Sept. 1	16	12
22	23	2	17	13
23	24	3	18	14
24	25	4	19	15
25	26	5	20	16
26	27	6	21	17
27	28	7	22	18
28	29	8	23	19
29	30	9	24	20
30	31	10	25	21

TABLE—*(Continued)*

Date Bred	Mare Due to Foal	Cow Due to Calve	Ewe Due to Lamb	Sow Due to Farrow
Dec. 1	Nov. 1	Sept. 11	Apr. 26	March 22
2	2	12	27	23
3	3	13	28	24
4	4	14	29	25
5	5	15	30	26
6	6	16	May 1	27
7	7	17	2	28
8	8	18	3	29
9	9	19	4	30
10	10	20	5	31
11	11	21	6	Apr. 1
12	12	22	7	2
13	13	23	8	3
14	14	24	9	4
15	15	25	10	5
16	16	26	11	6
17	17	27	12	7
18	18	28	13	8
19	19	29	14	9
20	20	30	15	10
21	21	Oct. 1	16	11
22	22	2	17	12
23	23	3	18	13
24	24	4	19	14
25	25	5	20	15
26	26	6	21	16
27	27	7	22	17
28	28	8	23	18
29	29	9	24	19
30	30	10	25	20
31	Dec. 1	11	26	21

DAIRYING

MILK CONSTITUENTS

Milk consists of water, butter fat, protein, sugar, and ash. The last four of these constituents are known as the solids of milk, and, when considered collectively in an analysis, are termed the total solids.

The average composition of cow's milk is: Water, 87.40%; fat, 3.75%; protein, 3.15%; sugar, 5%; ash, .70%.

Milk from different cows varies considerably in composition from this average. Probably the greatest difference is in the percentage of fat. Cows are known that give milk in which there is as much as 8% of fat, and there are others that give milk in which there is less than 3% of fat.

The average composition of milk from the cow, nanny goat, ewe, and mare, are given in the accompanying table, for the purpose of showing the difference in the percentages of the different constituents in the milk of these animals.

COMPOSITION OF MILK OF DIFFERENT SPECIES OF ANIMALS

Species of Animal	Water Per Cent.	Fat Per Cent.	Protein Per Cent.	Sugar Per Cent.	Ash Per Cent.
Cow	87.40	3.75	3.15	5.00	.70
Nanny goat	85.71	4.78	4.29	4.46	.76
Ewe	80.82	6.86	6.52	4.91	.89
Mare	90.78	1.21	1.99	5.67	.35

The butter fat of milk, which is also known as milk fat, is made up of small globules, the number in a single drop of milk varying from 30,000,000 to 100,000,000. The globules are arranged both singly and in aggregations. The fat is the lightest part of milk, and if milk is allowed to stand quietly for a time most of the globules rise to the surface. Some of the smallest globules, however, are not able to overcome the resistance encountered in passing upwards through the milk, and hence do not rise to the surface.

Cream is the part of milk into which a large part of the fat is gathered. The separation of cream from the other part of milk is known as the creaming of milk. Gravity creaming, or separation, can be accomplished by allowing the milk to stand quietly for a time, and then removing the upper layers, in which the fat has accumulated. Cream can be separated also by means of machines known as centrifugal separators. The principle on which these machines are based is that as cream is lighter than the other part of the milk, centrifugal force can be used in the separation of the cream.

Two of the substances of milk, casein and albumin, belong to the class of compounds known as protein. Casein forms a large part of the curd obtained when milk is allowed to sour or when milk is curdled by the addition of rennet, a material employed in the manufacture of cheese. Casein gives to milk much of its opacity.

If whole milk is curdled, the fat globules are enclosed in the curd. The removal of the curd leaves a yellowish or greenish clear liquid, the whey, which contains the constituents of the milk that are in solution. One of these is albumin, a substance that coagulates on heating and that, in appearance, is much like the white of an egg. The quantity of albumin in milk is small.

The sugar found in milk is known as lactose. It is much less sweet and less soluble than cane sugar and is obtained by condensing the milk and allowing the sugar to crystallize. It is used for medicinal purposes and for the modification of milk for children.

Some of the compounds that form the ash of milk are in solution, and hence are found in the whey; others are insoluble and are removed in the curd. The ash constituents are an important part of the milk; without them it would not be a perfect food for young animals.

BACTERIA IN MILK

Soon after milk is drawn it begins to undergo changes, the most apparent one of which is that of becoming sour, or acid. This and many of the other changes are caused by bacteria. Many kinds of bacteria are nearly always present in milk, but in varying numbers. It is known, however, that milk produced under cleanly conditions is much freer from bacteria than that produced under unclean conditions. Cleanliness, therefore, is an important consideration in milk production. Certain kinds of bacteria are responsible for diseases of mankind, and many of these disease-producing bacteria grow luxuriantly in milk and are often found there in large numbers; the best way to exclude them is by producing and caring for the milk in the most sanitary manner possible.

Bacteria thrive best where food is abundant, where the temperature is favorable for their growth, and where moisture is present. These three conditions are found in the soil and in the alimentary tract of animals; therefore, any material from these sources—mud, dirt, or manure, for example—that gets into a quantity of milk carries with it a number of bacteria. In the milk they find conditions favorable for growth—food is plentiful; the temperature, especially if the milk be warm, is favorable; and moisture is present. As a result, they multiply rapidly and in a comparatively short time the milk will contain so many bacteria that it is likely to be unfit for use.

No other food is so exposed to contamination by mud, dust, and manure, as is milk. If a solid food becomes dirty it can be washed, but when bacteria have once been introduced into milk, the harm cannot be remedied, for milk cannot be cleaned like a solid. Insoluble particles of dirt and manure can be removed by straining milk through a fine-meshed cloth, but many of the bacteria that are on the particles will be washed off and will pass through the cloth. Thus, if milk is to keep well and be an appetizing, healthful human food, it must be produced under such conditions that bacteria do not enter it in large numbers.

Cleanliness as a Means of Control.—One of the most efficient ways of controlling the number of bacteria in milk is to exercise cleanliness at every step in the production and handling. Milk that contains only the bacteria coming from the udder will not sour for days, but that containing large quantities of dirt will often be unfit for use in a few hours.

Cooling and Storing of Milk.—As bacteria multiply more rapidly at high than at low temperatures, milk will become sour more quickly if kept at a high temperature than if kept at a low temperature. For this reason, milk will keep longer if cooled rapidly soon after it is drawn than if it is allowed to cool slowly or is allowed to remain at a fairly high temperature.

Milk may be cooled in a number of ways. When the quantity to be treated is small, it may be placed in a tall, narrow can and the can placed in cold water. Stirring the milk in the can will hasten the cooling to a great extent. When a large quantity is to be treated, a device known as a milk cooler is employed. The most efficient coolers are those in which the milk is allowed to flow in a very thin stream over a metal surface on the opposite side of which is cold water, or water and ice.

Milk that has been cooled should, of course, be stored in a cool place, but the temperature should not be below the freezing point, as freezing causes the separation of the fat and casein in such a manner that they cannot be reincorporated. A temperature just above the freezing point is satisfactory, for at this temperature the milk will remain sweet for a long time.

Use of Preservatives in Milk.—The growth of bacteria in milk can be inhibited by the use of such preservatives as boric acid and formaldehyde. However, since these preservatives are injurious to human health, their use as a milk preservative is, as a rule, prohibited. Formaldehyde used at the rate of 1 part to 25,000 parts of milk will act as an efficient preservative and will prevent milk from souring for from 24 to 48 hr.; hence, there is great temptation for its use, especially in the case of the dealer who has milk that cannot be disposed of at once.

Boiled Milk.—The bacteria that cause souring of milk are almost certain to be killed by boiling the milk, but there are certain putrefactive bacteria that the boiling temperature will not kill. Any injurious bacteria will not be present in any considerable numbers in the milk until after 24 to 48 hr. Boiled milk, therefore, is perfectly healthful if used within, say, 24 to 36 hr.; after about 48 hr. it is likely to be harmful as human food. Although boiling is a means of controlling the number of bacteria in milk, there are several objections to this method of treatment. Boiled milk is not easily digested and assimilated by the human body; the boiled taste is very apparent and is objected to by most people; and there is always the danger that the milk will be a day or so old, and hence likely to contain putrefactive bacteria.

Pasteurized Milk.—A method of controlling the number of bacteria in milk by heat that is more satisfactory than boiling is that of pasteurization. Liquids are pasteurized by heating them to a temperature somewhat below the boiling point, averaging in practice from 140° F. to 180° F., keeping them at that temperature for a given period of time, and then cooling them rapidly. In milk treated thus, the bacteria that cause milk to sour, and most disease-producing forms, are destroyed. Certain spore forms that grow rapidly when acidity is not present are not killed by the heat of pasteurization, and for this reason the milk should be used before it becomes old, say in from 24 to 48 hr. Persons often think that all milk that is not sour is fit for use. Long before souring takes place in pasteurized milk, it is likely to be unfit for use as human food. It is important, therefore, that pasteurized milk be sold as such and that the consumer recognizes the fact that the milk should be used within a short time after delivery.

The city of New York requires that milk sold as pasteurized shall be marked as such, and that the date and hour when it was pasteurized be indicated on the bottle; it must be delivered to the customer within 24 hr., and must be pasteurized a second time.

Acid-Forming Bacteria in Milk.—The fermentation most commonly found in milk is that which causes it to become acid. The bacteria that are responsible for this change are known as acid-forming bacteria. Bacteria of this kind grow more rapidly than those of any other kind, and on this account souring is the most noticeable change, aside from creaming, that occurs in milk. In fact, souring is regarded as such a natural change that milk in which it does not appear is looked upon with suspicion, and justly so.

All acid-forming bacteria are instrumental in preventing the growth of putrefactive forms of bacteria. None of the putrefactive bacteria can grow in an acid substance, and as acid is soon formed in milk by the development of acid-forming bacteria, unheated, or raw, milk becomes a medium unfavorable to the growth of putrefactive forms. This seems an important provision of nature, for, were it not for the development of the acid-forming bacteria, milk in a comparatively brief time after it was drawn would become an offensive, ill-smelling, unhealthful substance.

The acid condition of milk is useful in the manufacture of butter, which, as a rule, is made from cream that has been allowed to sour. Butter made from sour cream has a desirable flavor and good keeping quality, but that from sweet cream has little flavor and is poor in keeping quality.

In addition to being useful to the butter manufacturer, acid-forming bacteria are very important in cheese making. They are helpful in the ripening process, for if none are present cheese does not ripen. The presence of the bacteria also protects the cheese against attacks of putrefactive bacteria through the acid formed by an action similar to that noted in the case of milk.

Pathogenic Bacteria in Milk.—As may be inferred from previous statements, milk may contain many kinds of disease-producing bacteria. Technically, these are known as pathogenic bacteria. They may be grouped into two general classes—those that are due to a diseased condition of the cow giving the milk, and those that are due to diseases of man and transmitted from one person to another through the medium of milk. Tuberculosis, garget, mammitis, foot and mouth disease, cow pox, digestive troubles, and inflammation of the uterus are among the diseases of cattle that may cause trouble and suffering in the human family if milk from diseased animals is used as food. Therefore, whenever a dairyman finds any of these diseases in his herd he should immediately stop selling the milk and take measures to have the diseased animals treated.

The diseases of mankind that may be transmitted by milk are those bacteriological diseases that infect through the alimentary tract. Typhoid fever and diphtheria are often carried by milk, and it has been claimed that at least a few epidemics of scarlet fever have been caused by the contamination of milk with scarlet-fever germs. In view of the fact that diseases are often transmitted by milk, great care should be exercised by dairymen and consumers to prevent infection.

If any of the germ diseases mentioned are near a dairy, the milk should not be used until all danger of infection is over, or if one of the diseases is in the family of a person employed about the dairy, he should not be allowed to handle any of the utensils used for milk, nor should he be allowed to come in contact with the milk in any manner.

ABSORPTION OF ODORS BY MILK

Milk has the property of absorbing and retaining certain odors, and the absorption will take place when the milk is either warm or cold. It is important, therefore, in dairy practice to keep milk in an atmosphere that is free from pronounced odors of any kind. Milk tainted by odors is not necessarily unhealthful, but it is unappetizing, and is sure to be objectionable to the consumer. In view of this fact, it is especially important that the air of the dairy stable be kept free from objectionable odors, especially during milking time.

Fermenting manures and feeds that have pronounced odors should be kept out of the stables. Silage is sometimes the cause of an odor in milk. If it is fed directly before the milk is drawn, the atmosphere of the barn will be filled with the silage odor and, as a result, the milk will be tainted; if, on the contrary, the feeding is done an hour or so before milking time and the barn is thoroughly aired there will be practically no silage odor in the milk. The keeping of other classes of animals, hogs for example, in a stable with dairy cattle is sometimes responsible for unpleasant odors in milk. If other animals are kept in a stable with cows, great care should be exercised in keeping their quarters clean and thus preventing the contamination of milk.

Ventilation of the dairy stable is necessary not only for the health of the herd but for preventing the excessive so-called cowy odor that is too often noticed in stables, as a pronounced cowy odor is likely to taint the milk.

Care should be exercised to prevent undesirable odors in milk after it has been removed from the stable. Placing it in open vessels in cellars or rooms where there is an odor from decaying vegetables, etc., is a bad practice. Bright, clean rooms that have an untainted atmosphere are desirable storage places for milk.

WEIGHING, TESTING, AND KEEPING OF RECORDS OF MILK

In order to determine whether a cow is a profitable one to keep, her owner must have a knowledge of the quantity of milk and butter fat that she produces in a year. Such knowledge can be secured only by keeping

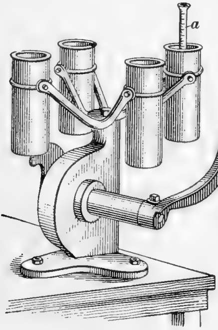


FIG. 1

a record of the quantity of milk produced and of the per cent. of butter fat the milk contains. There are several ways in which this can be done. The milk of each milking from the cow can be weighed and a small sample taken for the determination of the per cent. of butter fat; or the milk can be weighed and sampled 1 da. in each week, the figures thus obtained being used as an average for the 7 da.; or each day of every seventh week the milk can be weighed and sampled for testing. The latter method involves less work than either of the two preceding methods, and it has been shown to be accurate. The keeping of records should not be begun until at least 3 wk. after the cow has calved.

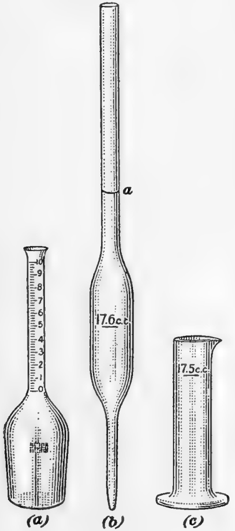


FIG. 2

The percentage of fat in milk is determined by means of the Babcock test. The essential parts of one of the cheapest and simplest Babcock testing outfits on the market are shown in Figs. 1 and 2. In Fig. 1 is illustrated a centrifugal machine, or centrifuge, commonly called a tester, for making the Babcock test. In Fig. 2 (*a*) is shown a Babcock milk bottle, at least four of which should be provided; in (*b*), a glass pipette of 17.6 cubic centimeters capacity; and in (*c*), an acid measure of a capacity of 17.5 cubic centimeters. Such an outfit as the one illustrated can be purchased from dealers in dairy supplies.

The details of the testing of a sample of milk are as follows: First, the milk is thoroughly mixed by being poured from one vessel into another. For taking the required quantity of the sample for the test, a glass pipette, such as the one illustrated in Fig. 2 (*b*), is used. A quantity of milk is drawn up into the pipette with the mouth until the top of the milk is 1 or 2 in. above the line *a* that is etched on the pipette tube. The pipette is then removed from the mouth and the forefinger is quickly placed over the top of the tube. Due to atmospheric pressure without, the milk will remain in the pipette. The pressure of the forefinger is then slightly released and the milk is allowed to drop out of the tube until the top of the milk is on a level with the etched mark on the glass. There is then 17.6 cubic centimeters of milk in the tube, which is the quantity desired for testing. The point of the pipette is now placed in the neck of a test bottle such as the one illustrated in Fig. 2 (*a*). The bottle and pipette are held in a slanting position, and the milk is allowed to flow slowly into the bottle. Care must be exercised that no milk is spilled in any way. A small quantity will remain in the point of the pipette; this should be blown into the bottle. Next, the acid cylinder is filled with acid to the etched mark on the side that indicates 17.5 cubic centimeters; for the testing of milk, sulphuric acid of a specific gravity of 1.82 or 1.83 is used. The 17.5 cubic centimeters of acid is then poured into the test bottle, the bottle being held at an angle as before. The bottle should be turned around slowly as the acid is flowing down the neck; this washes any adhering milk into the bottle. It should be understood that the quantity of acid just given may not be exactly right for all samples, and it may be desirable, after some experience has been gained, to vary slightly from this quantity. If the acid has been poured into the milk carefully, the liquids will be in two distinct layers, with a band of partly mixed liquids between them. The acid and milk are next mixed together by gently rotating the test bottle in such a manner that the milk and acid are whirled round and round inside the bottle. The rotating should be continued until all clots of curd that form are completely dissolved. The mixing of the two liquids is accompanied by considerable heat and the milk becomes dark in color. After the mixing, the bottle is placed upright in the tester as shown at *a* in Fig. 1. It is desirable to have the machine filled with bottles to balance it; in case but one sample of milk is to be tested the three other bottles can be filled with water. When the handle is turned, the chambers containing the bottles revolve around a common center and the centrifugal force that is exerted causes the bottles to assume the position shown in Fig. 3. The handle of the tester should be turned from 4 to 5 min. at the speed given for the particular machine in use.

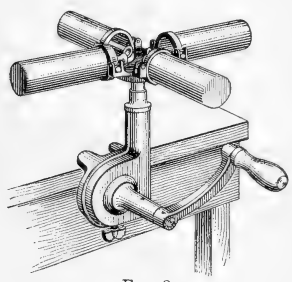


FIG. 3

After the machine has stopped whirling the bottles will again assume a vertical position, and the fat will be found on top of the liquid. Enough hot water is then added to each bottle containing a sample to fill the bottle to the lower part of the neck; a pipette or some special device can be used for this purpose. The bottles are again placed in the tester and whirled for about 1 min. After that they are taken out and hot water is added until the lower part of the column of fat comes up into the graduated neck of the bottle. The bottles are again placed in the tester and given a final whirl for about 1 min. After the completion of the final whirl the bottles are removed and the percentage of fat is determined by means of the scale on the neck of the bottle.

For the testing of whole milk, a bottle with a scale arranged as shown in Fig. 4 is used. Each division represents .2 of 1% of fat; hence, each 5 divisions represents 1% of fat. The line of separation between the fat and the mixture of milk and acid is curved, as indicated at *a*. The top of the fat column also is curved, as shown at *b*. When ascertaining a percentage, the fat is measured from the lower part of the line *a* to the upper part of the line *b*, as indicated by the brace *c*. In calculating a percentage, the reading indicated by the line *a* is subtracted from that indicated by the line *b*, and the result is the per cent. of fat in the milk.

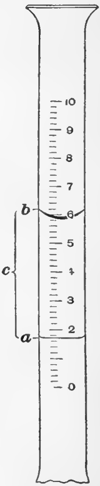


FIG. 4

MILK STANDARDS

MILK STANDARDS OF THE UNITED STATES

Government Milk Standards.—The United States government has comprehensive standards regarding the quality of the milk sold within its jurisdiction. These standards define the various kinds and forms of milk and establish certain requirements for them. The government standards of purity define milk as follows: Milk is the fresh, clean, lacteal secretion obtained by the complete milking of one or more healthy cows, properly fed and kept, excluding that obtained within 15 da. before and 10 da. after calving, and contains not less than 8½% of solids not fat, and not less than 3¼% of milk fat.

The government standards define cream as follows: Cream is that portion of milk, rich in milk fat, which rises to the surface of milk on standing, or is separated from it by centrifugal force, is fresh and clean, and contains not less than 18% of milk fat.

STATE MILK AND CREAM STANDARDS

State	Milk			Cream
	Fat Per Cent.	Solids not Fat Per Cent.	Total Solids Per Cent.	Fat Per Cent.
Connecticut	3.25	8.50	11.75	
California	3.00	8.50		18
Georgia	3.25	8.50	12.00	18
Idaho	3.00	8.00	11.00	18
Illinois	3.00			15
Indiana	3.25	8.50		18
Iowa	3.00		12.50	15
Kentucky	3.25	8.50	12.00	18
Maine	3.00		12.00	
Maryland	3.50		12.50	
Massachusetts	3.25		12.15	15
Michigan	3.00		12.50	15
Minnesota	3.50		13.00	20
Missouri	3.25	8.50		18
Montana	3.00	9.00	12.00	15
Nebraska	3.00			18
New Hampshire	3.50	9.50	13.00	
New Jersey	3.00		12.00	16
New York	3.00		12.00	
North Carolina	3.25	8.50	12.00	18
North Dakota	3.00		12.00	15
Ohio	3.00		12.00	
Oregon	3.20	9.00	12.20	30
Pennsylvania	3.00		12.00	
South Dakota	3.00		13.00	18
Texas	3.00		12.50	
Utah	3.20	8.80	12.00	30
Vermont	4.00	9.25	12.50	
Virginia	3.25	8.50		18
Washington	3.00	8.00		
Wisconsin	3.00	8.50		18
Wyoming	2.40		12.00	

The milk standards of the government are merely a statement of the consensus of opinion of experts as to what the composition of milk should be. These standards are not in any law and have no legal standing, but in the trial of a case where milk was an article of interstate commerce and deficient in milk solids or in butter fat without evidence of actual adulteration, the federal standards representing the consensus of opinion of leading authorities would unquestionably be submitted as evidence in the case and have great weight.

State Milk Standards.—The majority of the states in the United States have legal standards for milk and cream sold within their borders. The state standards are different from those of the federal government in that they have the force of law. These standards, in many cases, are lower than the federal standards. There is a general movement in progress at the present time, however, among the various states whose milk standards are lower than those of the federal government, to raise the requirements for milk so that they will conform to the federal standards.

In the accompanying table are given the legal standards for milk and cream of those states that have laws regarding the sale of milk.

City Milk Regulations.—Many cities, especially the larger ones, have rigid regulations regarding the quality of the milk sold within their limits and the manner of its production. With reference to the composition of milk, the standards of the cities are similar to those of the majority of the states. The question of the use of preservatives, however, is more important in the case of cities, as there is much temptation to use preservatives to keep surplus milk sweet from day to day; consequently, in most cities that have milk ordinances or regulations, especial attention is given to the matter of preservatives.

The ideal condition with reference to the bacterial condition of milk is to have milk delivered to the consumer in the same condition, bacteriologically, as when it was drawn from the cow. This condition, of course, can only be approximated, and in cases where the milk is shipped considerable distances, and is several hours old when it is delivered to the consumer, it is extremely difficult to control the bacterial condition. However, as the carelessness of the producer and the dealer shows in the number of bacteria in the milk, many cities have established bacterial standards for milk, and the sale of milk containing a greater number of bacteria than that of the standard is unlawful.

Various other city regulations are generally made. Usually a license must be procured by each dealer or person selling milk. The applicant must state, in his application for a license, the source of the milk sold and the conditions under which it is produced. The purpose of the license is to acquaint the health authorities with all persons selling milk in the city. Thus, the authorities are enabled to regulate, to some extent, conditions under which the milk is produced.

Some cities require that the tuberculin test be made on all animals that furnish milk for the city and that all tuberculous cows be removed from the herds. Chicago has such a provision, but in lieu of the test the milk may be pasteurized in accordance with the rules of the board of health. Certain cities require that milk shall not be shipped from any farm on which there is a case of typhoid fever, diphtheria, or scarlet fever until a permit stating that there is no danger of infection has been obtained from a physician. As it is possible for milk to become infected with typhoid baccilli at any point in its handling, milk dealers in cities having contagious-disease regulation are required to report all cases that occur in the families of their employes. During the continuance of the disease in the family the employe is not allowed to have anything to do with the milk either directly or indirectly.

MILK STANDARDS OF CANADA

Following are given the milk standards of Canada as published by the Canadian Department of Inland Revenue. It can be seen that in many respects they are similar to those of the United States.

Milk, unless otherwise specified, is the fresh, clean, and unaltered product obtained by the complete, uninterrupted milking, under proper sanitary conditions, of one or more healthy cows, properly fed and kept, excluding that obtained within 2 wk. before and 1 wk. after calving, and contains not less than 3¼% of milk fat, and not less than 8½% of milk solids other than fat.

Skim-milk is milk from which a part or all the cream has been removed, and contains not less than 8½% of non-fat milk solids.

Pasteurized milk is milk that has been heated below boiling, but sufficiently to kill most of the active organisms present; and immediately cooled to 45° F., or lower, and kept at a temperature not higher than 45° F. until delivered to the consumer, at which time it shall contain not more than 10,000 bacteria per cubic centimeter.

Sterilized milk is milk that has been heated at the temperature of boiling water, or higher, for a length of time sufficient to kill all organisms present; and must be delivered to the consumer in a sterile condition. Sterilized milk shall not be sold or offered for sale, except in hermetically-closed containers bearing the words "This milk should be used within 12 hr. after opening the container."

Certified* milk, sold as such, shall comply with the following requirements:

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*It is evident that the weight carried by the term "certified" will depend upon the character of the organization that assumes responsibility. Doubtless this will usually be a local medical association; but there is nothing to prevent any responsible body of properly qualified persons from undertaking the production of certified milk.

1. It shall be taken from cows semi-annually subjected to the tuberculin test, and found without reaction.

2. It shall contain not more than 10,000 bacteria per cubic centimeter from June to September; and not more than 5,000 bacteria per cubic centimeter from October to May, inclusive.

3. It shall be free from blood, pus, or disease-producing organisms.

4. It shall be free from disagreeable odor or taste.

5. It shall have undergone no pasteurization or sterilization, and shall be free from chemical preservatives.

6. It shall have been cooled to 45° F. within ½ hr. after milking, and kept at that temperature until delivered to the customer.

7. It shall contain 12 to 13% of milk solids, of which at least 3½% is fat.

8. It shall be from a farm whose herd is inspected by a veterinarian, and whose employes are examined monthly by a physician.

Evaporated milk is milk from which a considerable portion of water has been evaporated, and contains not less than 26% of milk solids, and not less than 7⅕% of milk fat.

Condensed milk is milk from which a considerable portion of water has been evaporated and to which sugar has been added. It contains not less than 28% of milk solids, and not less than 7.7% of milk fat.

Condensed skim-milk is skim-milk from which a considerable portion of water has been evaporated, with or without the addition of sugar.

Buttermilk is the product that remains when butter is separated from ripened cream, by the usual churning processes; or a similar product, made by the appropriate treatment of skim-milk.

Goat's milk, ewe's milk, etc., are the fresh, clean, lacteal secretions, free from colostrum, obtained by the complete milking of healthy animals other than cows, properly fed and kept, and conform in name to the species of animals from which they are obtained.

Cream is that portion of milk, rich in milk fat, which rises to the surface of milk on standing, or is separated from it by centrifugal force, is fresh and clean, and contains (unless otherwise specified) not less than 18% of milk fat. When cream is guaranteed to contain another percentage of milk fat than 18% it must conform to such guarantee. Cream must be entirely free from gelatine, sucrate of lime, gums, or other substances added with a view to give density, consistency, or apparent thickness to the article. Cream must contain no preservatives of any kind, nor any coloring matter other than is natural to milk.

Evaporated cream, clotted cream, condensed cream, or any other preparation purporting to be a special cream, except ice cream, must conform to the definition of cream, and must contain at least 25% of milk fat.

BEE KEEPING

Status of Bee Keeping as an Industry.—Bee keeping at the present time, although usually considered one of the minor branches of agriculture, is of considerable economic importance. The honey and wax products of the United States have an annual value of between \$20,000,000 and \$30,000,000. It is said that the state of California alone produced for export, in one year, 500 carloads of honey, single apiarists of that state producing as much as 80 T. One baking establishment has purchased in one lot approximately 1,000 T. of honey. It is not unusual for individual apiarists, in America, to produce from 20 to 30 T. of honey per year. These statements convey some idea of the magnitude of the industry in this country.

Objects of Bee Keeping.—The objects of bee keeping are various. The industry may be carried on as a business, as a side line to some other business, as a means of recreation, as a source of honey for home use, as a benefit to horticulture, or for a combination of these objects.

Bee keeping as a business is now pursued by a large number of persons. It affords a good profit on the money invested, and good wages for the labor and time it requires. It should be emphasized, however, that it is unwise for the average person to undertake extensive bee keeping without considerable previous experience in managing a small apiary. If a person desires to engage in bee keeping as a sole business he should begin on a small scale, make the bees pay all expenses connected with the apiary and the cost of increasing the business, and gradually increase the number of colonies as far as local conditions or his desire will permit. Many persons have made a failure at bee keeping, losing all of their bees and considerable money, because they started in the business on too large a scale.

Bee keeping perhaps has its widest field as a side line to some other occupation. In fact, it is usually not the sole occupation of the bee keeper. It is particularly suitable as a side line to general farming, gardening, fruit growing, poultry farming, and similar pursuits, but it can be practiced without difficulty in connection with most professional and commercial pursuits. If bee keeping is not attempted on too large a scale, it will not interfere greatly with other work.

Bee keeping has always been a favorite means of recreation, especially to persons engaged in sedentary occupations. It affords a desirable amount of exercise, an opportunity for outdoor work, and an intimacy with an insect whose activity has been a subject of absorbing study from the earliest times. Bee keeping has the advantage of being a recreation that pays its own way and often produces no mean profit.

Many persons keep bees for the producing of honey for home use. A few colonies will usually produce a sufficient quantity to supply a large family the year round.

The value of bees in the pollination of various fruits and seed crops is often sufficient to warrant the keeping of an apiary. The quality and quantity of many varieties of apples, pears, plums, and small fruits depend absolutely on cross-pollination. The most active agents in this work are honey bees.

Adaptability of Various Locations to Bee Keeping. Few industries can be pursued in such a wide latitude of locations as bee keeping. It may be followed in the country, in towns, and, to a limited extent, in large cities. Although at first thought country localities would seem to be the best for bee keeping, it often happens that bees kept in towns or cities find more abundant pasturage than those kept in the country.

Apiaries have been established in such unexpected places as in the heart of Michigan forests, on floating houseboats of the Ohio and Mississippi rivers, in the deserts of Arizona and Southern California, in the swamps of Florida, and on house tops in New York, Washington, Cincinnati, and other large cities. Actual experience has demonstrated that bees may be kept successfully in such a wide range of territory and under such a variety of surroundings that it would be unwise to state positively that bee keeping cannot be followed in any given locality. Of course, however, some localities are much better adapted to bee keeping than others.

The best location for bee keeping is a region in which different pollen- and nectar-bearing plants bloom in succession throughout the spring, summer, and fall seasons. A desirable succession of blossoms is as follows: Red maple, willow, and poplar flowers in early spring, immediately followed by an abundance of fruit bloom, and white-clover, basswood, and locust flowers; buckwheat blossoms in summer; and the flowers of such plants as asters and Spanish needles in the fall. It is particularly important that there be an abundance of late summer or fall flowers that will yield sufficient nectar to enable bees to gather enough for their winter stores.

In general, it may be said that bees can be kept in practically all inhabited regions, although the degree of success likely to be attained will depend largely on the abundance of bee pasturage. In addition to inhabited regions there are numerous forest, swamp, prairie, and mountain sections that are well suited to bee keeping. Many regions that at present are entirely worthless would yield a good profit if made to support apiaries.

Adaptability of Different Persons to Bee Keeping. Any person with fairly steady nerves and some patience and courage can easily learn to control and handle bees. There are, it is true, a few exceptional individuals whose systems are particularly susceptible to the poison injected by the bee, so much so that serious results follow a single sting. Such cases, however, are very rare. In most instances, the system eventually becomes accustomed to the poison, so that beyond momentary pain a sting causes no discomfort.

There is little if any ground for the belief that bees have a natural antipathy for some persons and a natural liking for others. Bees are angered by actions rather than by any peculiarity of the individual. They prefer, of course, not to be disturbed; hence they usually keep guards on the lookout for intruders. When visitors approach the hives these guards are apt to fly toward them, and if the visitors show fear by striking with their hands or jerking their heads they are likely to be stung. A person not accustomed to bees is very likely, unconsciously, to dodge the head about when a bee buzzes uncomfortably close to the face. Bees resent such actions and when angered by them are almost sure to sting. On the other hand, an unprotected person who moves about with deliberation, will, under the same circumstances, usually escape without a sting.

Bee keeping is a branch of agriculture that is particularly suitable for women. The work required by an apiary is comparatively light and does not entail close confinement, heavy lifting, or fatiguing exertion. Many women in towns and cities, as well as in the country, are turning their attention to bee keeping as a source of recreation, pleasure, and profit.

Profits in Bee Keeping.—Considering the capital and the time required, bee keeping is one of the most profitable branches of agriculture. It is impossible to give definite figures concerning the profits that may be made from an apiary, as much depends on the locality, the season, the bees, the management, and the number of bees to an area. A conservative estimate for a good locality is 25 to 30 lb. of comb honey—honey in the comb—or 40 to 50 lb. of extracted honey—honey extracted from the comb—per colony per year. It is not uncommon for a colony in a favorable locality to produce 60 lb. of comb honey in a season and even as much as 100 lb. per colony has been produced; these quantities, however, are exceptional and should not be expected each year. Wholesale prices for honey range from about 12 to 15c. per lb. for comb honey and from about 7 to 10c. per lb. for extracted honey. If sold direct to the consumer, comb honey brings from about 15 to 25c. per section—a section contains about 1 lb. and extracted honey from about 10 to 20c. per lb. Assuming that a colony produces 25 lb. of comb honey per year, which is a fair average, and that the honey is sold for 20c. per lb., which also is a fair average, the gross return will be $5.

The expense of maintaining an apiary varies as widely as the income. Aside from the item of labor, the expenses will include the purchase of comb foundations and sections, repairs, eventual replacing of hives and implements, and interest on the capital invested. It has been estimated that, on an average, the annual expense per colony, not including that for labor, will be from 50c. to $1; this estimate, however, does not provide for increase. Assuming that the average expense per colony is 75c. and that the average gross returns are $5, the net profit will be $4.25 per colony. This may seem to be a small profit, but it should be remembered that it is only an average. Many bee keepers make considerably more, some making double the sum given.

Time Required in Bee Keeping.—The amount of time required in bee keeping is an important consideration to persons who desire to engage in the industry as an adjunct to some other pursuit. Such persons are anxious to know whether bee keeping will interfere with their regular work. The element of time does not, of course, concern persons who desire to devote their entire attention to bee keeping, except as it affects the number of colonies that may be managed.

If it were not for the fact that at certain seasons, such as during the swarming season, bees require close attention, it would be possible to keep a large number of colonies, even though bee keeping is followed as a subsidiary pursuit. During most of the year all the attention that bees require, provided not too many colonies are kept, can be given before or after regular work hours. Bees, to a large extent, supply their own food and water and work on their own initiative. There are times, however, when they must be carefully attended to, and for this reason there is danger of having too many colonies. Persons such as farmers, fruit growers, gardeners, etc., who are not closely confined each day, can usually keep from fifty to one hundred colonies without hindrance to their other work. Persons such as professional men, who are more or less confined, will usually find that from ten to twenty colonies will be all they can handle successfully. Almost any one can keep from one to ten colonies without difficulty. These statements, of course, are only general. If a person begins bee keeping with only a few colonies and gradually increases the number, a good idea of the amount of time required will be obtained and the size of the apiary can be governed accordingly.

Races of Honey Bees.—All domesticated bees, commonly known as honey bees, are of one species. There are several distinct races, or strains, of this species and a considerable number of varieties. The most important races of bees are: the Italian, the German, or Black, the Carniolan, the Banat, the Caucasian, and the Cyprian. Besides these races there are a number of hybrids that are of more or less importance.

Treatment for Bee Stings.—If a person is stung by a bee it is important that the sting be extracted as soon as possible. The longer it remains in the flesh the deeper it will work and the more poison will be injected into the wound. A sting should never be grasped with the thumb and forefinger and lifted directly out, as is commonly done, but should either be brushed out sidewise or better be removed by applying pressure at the side of it with a finger nail. Grasping the sting with the thumb and forefinger injects into the wound all of the poison remaining in the sting tube. In extracting a sting it frequently occurs that the sheath only is removed, and that the lancets remain and work deeper into the flesh. The latter may work so deep that they disappear. This need cause no alarm, as the lancets are composed of material that will cause no injury, and they will be absorbed by the blood.

The Queen Bee.—The queen bee is not a reigning sovereign over her colony, as the term implies, but is, rather, a mother. The sole function of a queen is to lay eggs and thus maintain the population of the hive. She is so highly specialized for this particular purpose that she gives all of her energy to egg laying, not even expending a part of it in procuring and digesting her own food. The food is predigested by the workers and constantly offered to her; often the workers give it to her directly by inserting their tongues into her mouth. As this predigested food is of a highly concentrated, nitrogenous nature and extremely nourishing, the queen is fitted by it to perform a remarkable work. In fact, the rate of egg-laying is almost incredible, often being as high as 3,000 eggs or more per day. The laying of eggs is begun, as a rule, in January, is gradually increased until just after the height of the honey season, decreasing when nectar is scarce and increasing when it is plentiful, and is gradually decreased until, generally, about November, when it is almost or entirely ceased for the winter.

A queen sometimes lives as long as 5 yr., but it frequently happens that the fertilizing element with which she is provided is exhausted long before the end of this time. In fact, the vigor and prolificacy of a queen diminishes after the second, or at most, the third year of her life. She may continue to lay fertile eggs during her entire life, but it is probable that after the second or third year she will not be sufficiently prolific to keep up the population of the colony. For this reason it is the practice of the best bee keepers to requeen their colony every 2 yr.; some bee keepers go so far as to recommend requeening every year, but this is unnecessary if the queen is a good one.

Worker Bees.—The workers perform all of the work of a colony, aside from the laying of eggs. They gather nectar, pollen, propolis, and water; secrete wax and build comb; serve, when young, as nurses to the brood; feed the queen and, at times, the drones; act as sentinels to ward off intruders; and, within certain limits, regulate the temperature within the hive. Although the work of an individual worker may seem insignificant, that performed by the thousands of workers that constitute the chief part of a colony is amazing.

Worker bees never attain a great age. Those reared in autumn may live 8 or 9 mo., and if in queenless colonies where little work is performed, even longer. Those reared in spring or early summer usually perish in 3 mo. and, if very active, in from 30 to 40 da. The period of activity of a worker bee is usually terminated by the wearing out of the wing membranes.

When a bee is no longer able to fly it is cast out of the hive to perish.

Drones.—The function of the drones is to fertilize the queen. They serve a slight secondary service in aiding to provide and maintain heat in the colony, which is necessary for the hatching of eggs and the rearing of broods. However, they perform no work whatever, living solely on the labors of the workers. A great many more drones than queens are produced by a colony; this is doubtless a provision of nature to insure that a queen will be fertilized. The drones are usually killed by the workers as soon as the honey-flow commences to diminish.

Parthenogenesis in Bees.—Male bees, or drones, are produced by a peculiar phenomenon of nature known as *parthenogenesis.* By this term is meant the rearing of young from unfertilized eggs. If a queen fails to mate with a drone, or if her supply of the fertilizing element becomes exhausted, she has the power to lay unfertilized eggs, a power possessed also by a fertilized queen. Unfertilized eggs produce drones and fertilized eggs produce queens and workers, depending on the food given to the larvas. In no other form of animal life, so far as is known, are males produced without the union of male and female.

IMPLEMENTS AND MACHINERY

PLOWS

Beam, or Walking, Plows.—Several types of beam, or walking, plows are on the market. For plowing tough sod, plows with long moldboards are best, because they pulverize the soil but little, turn the sod smoothly, and are of light draft. For plowing stubble land, plows with steep moldboards are best, as they bend the furrow slice abruptly and pulverize the soil much more thoroughly than sod plows. There are on the market also general-purpose plows that are used either for sod or for stubble. Where land is so sloping that the furrow slice must be thrown down hill, what is known as the reversible plow is generally used. These plows are made to turn a right-hand or a left-hand furrow by adjusting the bottom, or standard.

Sulky Plows.—Wheel, or sulky, plows have provisions for interchangeable bottoms; they can be made to turn a 14-, 16-, or 18-in. furrow. These plows are usually provided with a seat for the driver, but in some of the simplest types, the truck, which is bolted to the beam, serves merely to steady the running of the plow and to regulate the depth of furrow.

Gang Plows.—Wheel plows that have two or more bottoms are called gang plows. Some gang plows are provided with hand or foot levers for raising and lowering the bottoms and others are so designed that the bottoms are raised and lowered by the team or engine that pulls the plow. Gang plows are equipped with different types of plow bottoms, each with its own form of moldboard and plowshare.

Disk Plows.—In the disk type of plow a rotating disk has been substituted for the moldboard. These plows are especially recommended for soils that are sticky or for use in very hard ground.

Subsoil Plows.—What are known as subsoil plows are frequently used where it is desired to loosen the ground to a greater depth than can be done with the surface plow. Such plows are used to follow in the bottom of the furrow made by the common plow. They simply loosen the soil, but do not bring it to the surface of the ground.

HARROWS

Spike-Tooth Harrows.—Spike-tooth harrows both pulverize and compact the soil. By means of levers the teeth may be placed in a vertical position, tilted forwards, or given a slant backwards. When the teeth are tilted forwards the harrow exercises a vigorous stirring action, but when they are given a slant to the rear, the action is less vigorous and the soil is smoothed and leveled. Sloping the teeth backwards also prevents them from gathering trash and from catching under roots or other obstructions.

Spring-Tooth Harrow.—The implement known as the spring-tooth harrow breaks up the soil, but does little smoothing or pulverizing. Spring-tooth harrows are very efficient implements for loosening up plowed ground that has become compact. The depth to which a spring-tooth harrow penetrates is adjusted by means of levers.

Disk Harrows.—A disk harrow consists of a series of sharp disks mounted in such a manner that they may be made to cut straight ahead in the direction the team is moving, or the two sections of the frame may be so adjusted, by means of a lever, as to cause the disks to cut at an angle. Disk harrows are used for cutting up heavy sod preparatory to plowing, for working down sod that has been plowed, and for cutting up clods. They are also very useful for preparing a seed-bed in corn stubble or other loose ground when it is undesirable to plow the field. They are also sometimes used for disking green manure or stable manure into the soil.

Acme Harrow.—The Acme type of harrow is equipped with a series of curved blades that slice and turn the surface soil. It is an efficient surface-working tool when the ground is mellow and a cutting action is desired.

ROLLERS AND DRAGS

Rollers.—The first rollers were made from the trunks of trees, which were cut into suitable lengths and mounted in frames. Pins passing through the frame and driven into the ends of the log served as bearings on which the roller turned as it was dragged through the field. On a level, even surface this implement is a good clod crusher and compacts the soil satisfactorily. The first improvement was a substitution of two or three sections for a single log. Such a roller is much easier to turn in the field than one made of a single log.

Steel rollers are now in the market. These can be had either as a smooth or as a corrugated cylinder. The smooth-cylinder type leaves the soil in a smooth and compact condition; the corrugated roller leaves the surface of the soil in slight ridges. The smooth roller is wasteful of moisture unless it is followed closely with a harrow; the corrugated roller is a very efficient pulverizer and leaves the soil in excellent condition for further working.

For use in the semi-arid regions of the West a special form of roller known as the subsurface packer is used for packing the ground beneath the surface for the purpose of increasing the moisture-holding capacity of the soil. This tool consists of a series of wedge-shaped wheels that are designed to penetrate the immediate surface and compact the subsurface soil and bring the furrow slice into immediate contact with the subsoil.

Drags.—Drags, which are usually nothing more or less than three or four heavy 2-in. boards lapped one over the other and well secured by strips bolted across the top, can be easily made at home. If a vigorous pulverizing action is desired, the drag is drawn through the field with the sharp edges of the planks forwards, but if a smooth action only is desired, the implement is drawn in the opposite direction. This tool crushes clods and levels the surface of a field very effectively.

CULTIVATORS

Single-Shovel Cultivator.—The single-shovel cultivator is used for marking off land with furrows or trenches in which seed or plants may be planted. It is a convenient implement for marking out a potato patch or for use in the home garden. The depth of the furrow is regulated by the driver, who walks behind and usually carries a part of the weight of the plow by means of handles. If the ground is hard, some pressure on the handles may be necessary to secure sufficient penetration of the soil.

Double-Shovel Cultivator.—A double-shovel cultivator is generally used where the area to be cultivated is small. This implement is also sometimes used in large fields after the corn is too tall to admit of the use of a straddle-row cultivator.

Straddle-Row Cultivator.—The straddle-row type of cultivator cultivates the soil on both sides of the corn row at one operation. Straddle-row cultivators can be had either for cultivating a single row at a time or two rows at a time. With an implement of the latter type one man with three horses can cultivate practically twice as much corn in a day as one man with two horses using a single-row implement.

In the modern single-row and double-row cultivators the plows are attached to a frame that is mounted on wheels, and the implement is provided with levers and other means of adjustment. Cultivators may be equipped with different kinds of shovels, or disks, depending on the character of the work to be done. Under some circumstances the spring-tooth shovel is desirable. In case vines are very troublesome in the field, gangs carrying three disks each are more effective than shovels in cutting their way through the soil. Early in the season large shovels are used on the implement, but after the first or second cultivation these should give way to short narrow shovels, which will stir the surface without disturbing the roots of the crop. If surface cultivation is desirable, sweep plates may be substituted.

WEEDERS

The weeder is a very satisfactory implement of tillage when the ground is mellow and the weeds are small. It is of particular value for cultivating corn before it is up and for several days after the plants are through the ground. The slender, flexible teeth destroy the young weeds without injury to the corn plants. Weeders are made in several sizes from those that till a single row to those that till several rows at a time.

PLANTING IMPLEMENTS

Broadcasting Seeders.—Seeders that merely scatter the seed over the surface of the field are known as broadcasting seeders, or simply as broadcasters. They are used principally for the seeding of grasses and also sometimes for the seeding of small grains. The simplest form of broadcasting machine is known as the knapsack seeder. It consists of a bag to hold the seed, and is supported by means of a strap over the shoulder. The bottom of the bag has an opening that allows the seed to pass out to the distributing mechanism, which is operated by means of gears turned by a handle. The rate of seeding is determined by the size of the opening in the bottom of the bag, and the rate at which the sower walks.

Another type of hand broadcaster is the wheelbarrow seeder. In this implement the bottom of the box is provided with openings and a vibrating rod. As the seeder is pushed across the field, the vibrating rod causes the seed to be distributed from the openings of the box. These wheelbarrow machines are made in several widths, 14 ft. being the common width.

The end-gate broadcasting seeder resembles the knapsack seeder in general principles, except that the bag is replaced by a metal hopper and the distributing disks are driven by power obtained from a sprocket bolted to the wheels of a wagon, on the end gate of which the seeder is attached.

Grain Drills.—The modern grain drill consists of the following essential parts: the hopper, the supporting frame, the wheels, the feeding mechanism, the furrow opener, and the tubes for conveying the seed from the hopper to the ground. In addition, manufacturers of drills generally equip their machines with fertilizer attachments for distributing commercial fertilizer at the time the seed is sown. The fertilizer is carried in a hopper at the rear of the seed box. The bottom of the hopper is provided with a feeding mechanism that pulverizes the material and conveys it to the tubes leading down to the soil. Another attachment often included on the grass drill is a grass-seeder. The hopper for grass seed is usually placed on the front of the main grain box and is provided with a seeding mechanism that differs from the grain-seeding device only in size. Short lengths of chain are frequently attached to the furrow openers of the implement to drag behind them for the purpose of making sure that all grain is covered. These so-called covering chains are especially useful when the soil is wet. For use in dry regions, drills are frequently equipped with what are known as press wheels, which follow the furrow opener. These press wheels are designed to compact the soil around the seed and thus to encourage the capillary movement of moisture up into the seed-bed.

Corn and Cotton Planters.—Corn planters are of two types, namely, hand planters and horse planters. Hand planters are used to a limited extent on small farms, but probably their greatest use is found in the replanting of missing hills in large fields.

The modern two-horse corn planter is designed to drill or to hill drop two rows of seed at a time. The frame of the corn planter is, as a rule, constructed entirely of steel and is made as light as is consistent with strength and rigidity. The front of the planter is usually joined to the main frame by a hinge that is controlled by a lever. This lever is used to regulate the planting by raising or lowering the furrow openers. The bottoms of the seed boxes are generally provided with revolving plates, in which are holes or notches to receive the grains of corn. As the plate revolves, a grain or a number of grains are dropped into what is known as the planter shank each time the hole in the plate comes over the opening.

In some localities, particularly in the eastern and southern parts of the United States, it is desirable to use commercial fertilizers to secure early and quick growth of corn. To meet this need, fertilizer attachments may be secured with almost any make of planter.

The single-row corn drill, for which only one horse is necessary, is extensively used in some parts of the country. The mechanical principles used in this drill are practically the same as those employed in connection with the two-row planter. The standard equipment has one dropping plate, which may be adjusted to drop one grain every 7, 9, 10, 12, 13, or 18 in. as desired.

In the semi-arid regions it is desirable to plant corn in the bottom of a deep furrow and gradually fill this furrow as the plant develops. This method of planting is known as *listing*, and the machines constructed for the purpose are called *listers*.

Combination corn and cotton planters of the same general type as the regular corn planters are to be secured on the market. In these machines only a slight adjustment is necessary to adapt the drill to either corn or cotton.

Potato Planters.—In many of the potato-growing districts, special potato planters are used that open the furrow and drop either cut or whole potatoes at regular intervals and cover the furrow. Fertilizer is used very generally by large potato growers; hence, the potato planters are usually equipped with fertilizer attachments. In these attachments the fertilizer is carried in boxes from which it is forced in the desired quantities into the furrow, where it is mixed with the soil by disks.

Seedling Planters.—In the tobacco districts and in the extensive trucking sections young seedling plants are frequently transplanted by machinery. In one of the most modern of these transplanters the essential parts consist of a barrel for carrying the water supply, a furrow opener, and a covering device. Two men riding on seats provided at the rear of the implement hold the plants in an upright position in the furrow just behind the opener until the soil is pressed around them by a covering shovel. The soil in the furrow is moistened by water from the barrel.

HARVESTING IMPLEMENTS

HAY-HARVESTING IMPLEMENTS

Mowers.—Mowers are now made in sizes of 3¼, 4, 4½, 5, 6, and 7 ft. in width of cut. The ordinary two-horse farm mowers are usually either 4½ or 5 ft. in width of cut. The cutting swath of the one-horse mower is about 3½ ft.

The best mowers are provided with roller bearings on the main shaft for the purpose of reducing friction and draft. Gears on the main and cross-shafts should in all cases be closed to prevent dust and grit from getting in and wearing out the parts.

The cutter bar of a mower is usually known as a floating bar, because it is connected to the frame in such a way that it practically floats over the uneven ground. Every mower should have some method of adjusting the cutter bar so that when the pins wear and sag in the bar, caused by the constant pressure against it, the space may be taken up.

The grass board fastened to the outside end of the cutter bar serves the purpose of turning the grass in toward the cutter bar. This board should be provided with a spring so that it may be adjusted to heavy grass without danger of breaking either the board or the outside shoe. All mowers are provided with some arrangement by which the cutter bar can be raised by the operator from the seat. Some have both a hand and a foot lift.

Windrower, or Buncher.—Where clover is raised for seed, a very handy attachment for the mower is a buncher. This implement is used for bunching clover, timothy, prairie hay, and field peas. It places the grass or vines in windrows where the sun and air have a chance to dry and cure them.

Hay Rakes.—Two classes of front-delivery hay rakes are in general use in the United States: the so-called hand-dump rake and the self-dump rake. The former is operated by means of a lever and the latter by a foot trip that throws into action a ratchet in the wheel. This raises the teeth of the rake at regular intervals and leaves the hay in the windrow.

The side-delivery hay rake is an invention of recent years and is used in connection with hay loading. With the front-delivery style of hay rake it is difficult to rake hay so that it will lie in long windrows convenient for loading with the hay loader. With the side-delivery rake, however, a continuous windrow can be made.

Where large fields of hay are to be handled quickly and taken directly to the stack, a sweep rake is used. The large wooden teeth, which are drawn between two horses, will take up the hay either from the swath or the windrow. When the load is secured, the teeth are raised and the hay is drawn to a point where the stack is being built and is dumped on the teeth of the stacker and by it elevated to the stack.

Hay Stacker.—A power hay stacker is usually used in connection with a sweep rake. By means of a stacker the hay is quickly elevated and swung to any part of the stack. Several types of stackers are in use in various parts of the country and they have been found to be economical labor-saving devices where a large quantity of hay is to be stacked.

Hay Tedder.—Hay tedders are valuable machines for shaking up hay so that the sun can cure it. They are especially valuable for stirring up hay that has been rained on or that is very heavy.

Hay Loaders.—By means of hay loaders it is possible to load a quantity of hay on a wagon in much less time than by pitching it with forks. Usually, hay loaders are mounted on two wheels and are made to be drawn after the wagon. They have a cylinder carrying hooks designed to lift the hay from the ground and deposit it upon the endless carrier that elevates it onto the wagon. One type of loader consists of a series of rakes so mounted on a crank-shaft that they grasp the hay in the swath and draw it a short distance upwards on the frame of the loader by a peculiar alternating movement of the rakes. The hooks on the under side of each rake gradually carry the hay to the top of the elevator, where it falls over on the wagon.

SMALL-GRAIN HARVESTING IMPLEMENTS

Grain Binders.—The operation of the grain binder is as follows: As the machine advances the grain is caught by the reel and pushed backwards between the cutter-bar fingers until it is cut. The grain then falls on the platform and is conveyed by the platform canvas to the elevator, which carries it to the binding mechanism. As soon as a sufficient quantity of grain has accumulated in the binding mechanism, it is bound into a bundle and deposited on the carrier. When a number of these bundles have accumulated, the bundle carrier is released by means of a lever controlled by the driver and the bundles are deposited in a convenient pile. Grain binders are made with 5-, 6-, 7-, and 8-ft. cuts for the pull machines, and 10-, 12-, and 14-ft. cuts for the push machines.

Headers.—Machines known as headers are much used in the prairie regions for harvesting small grain. They are fitted with a long reel and a cutting device that removes the heads and drops them on a moving canvas, by which they are elevated and deposited in a wagon driven along by the side of the machine. The header is pushed by attaching four or more horses abreast to tongues in the rear.

Combined Harvester and Thrasher.—In California and other localities where there is no probability of rain during the harvest seasons, use is made of a machine known as the combined harvester and thrasher. These machines head, thrash, and sack the grain at one operation. They are propelled either by horses or by a traction engine. If horses are used, from thirty to thirty-six are required to furnish the power necessary. The machines have a daily capacity of from 60 to 125 A. of grain.

Self-Rake Reaper.—The self-rake reaper is an implement used chiefly for cutting small grain. It cuts the grain and places it in bundles ready for binding. These machines are used principally in regions too hilly for binders. They are also used for cutting grain—flax, for example—that it is not desired to have bound into bundles.

CORN-HARVESTING MACHINERY

Corn Pickers.—Up to the present time there are two general classes of pickers on the market. One type is intended to pick the ears and remove the husks before the corn is elevated into a wagon that is drawn beside the machine. The other type picks the ears without any attempt to remove the husks. Neither type has come into very general use, perhaps largely on account of the expense of the implement.

Corn Binders.—During recent years corn binders have come into extensive use for the harvesting of corn. These machines cut the corn stalks and bind them into bundles. They weigh complete from 1,400 to 1,800 lb. Generally speaking, those weighing in the neighborhood of 1,500 lb. have been most successful, this weight seeming to give the proper relation between driving power and durability.

Corn Huskers and Shredders.—The scarcity of farm labor and the desirability of having corn fodder shredded for convenience in handling has led to the development of a combined husker and shredder. In most of these machines the fodder is placed on a feeding table from which it is fed into snapping rolls. As the stalks pass these rolls the ears are removed and allowed to fall directly on husking rolls, or on a conveyer, which carries them to husking rolls. The husks are removed from the ear by these rolls and are conveyed to the rear of the machine by a husk drag. After the removal of the ears, the stalks pass to the shredder head, where they are cut and split into small fragments. From the shredder head the material is carried to the conveyer at the opposite end of the machine. The ears pass from the husking rolls to a conveyer at the front of the machine. The shredded fodder passes over beaters that remove any shelled corn that it may contain.

ROOT-CROP HARVESTING IMPLEMENTS

Potato Diggers.—Single-shovel potato harvesters that are provided with an advanced furrow opener and a shaker at the rear are on the market. The shaker is operated by means of a spur wheel, which engages the soil at the bottom of the furrow and gives the rods a rapid vertical motion. This motion separates the dirt from the potatoes and leaves them in a continuous row on the surface.

Where a large number of potatoes are grown annually, a type of digger with a greater capacity than that of the single-shovel type is in use. These large machines are provided with two main drive wheels at the rear and a two-wheeled truck in front. A feature of this machine are steel rods that have a backwards and forwards motion that sifts out all the dirt and deposits the potatoes in a compact row on clean ground at the rear of the machine. At the same time, the vines and trash are deposited at one side by another set of rods, assisted by vine forks.

Beet Lifters.—The depth which sugar beets extend into the soil has made necessary a special type of plow for lifting them and breaking the tap roots without injuring the beets. Several different forms of plows designed for this purpose are on the market. In one of the best of these types the implement does not remove the beets from the soil, but simply lifts them sufficiently to break the root connections, after which they may be pulled up by hand and the tops removed.

THRASHING MACHINERY

In the modern thrashing machine the grain is conveyed to a cylinder, where it is shelled from the head by the passage of the straw between the cylinder and what is known as a concave. From the cylinder the straw passes over straw racks to the stacker and as the straw passes back over the racks, the thrashed grain sifts down through screens where a blast of air from a fan blows out the dust and fine chaff. From the screens the grain passes to what is known as the auger, by means of which it is removed from the machine. The capacity of a thrashing machine is indicated by the width of the cylinder and the width of the machine proper. A medium-sized machine will require for its operation a 15- or a 16-H. P. engine, and will have a capacity of 500 to 1,000 bu. of wheat per day, or double that quantity of oats.

Bean and Pea Thrashers.—Where beans and peas are grown extensively, special thrashers are often used to separate the grain. These differ from the grain thrashers in having two cylinders operated at different speeds.

The vines first pass through a low-speed cylinder that thrashes out the dry pods and then through a more rapidly revolving cylinder to remove the seeds from the damp pods. These machines are usually provided with a recleaner and a clod crusher to remove dirt that may be adhering to the vines.

Clover Huller.—The clover huller operates on the same principle as the grain thrasher, except that it is provided with an additional hulling cylinder. The first cylinder removes the heads and thrashes out a part of the seed. The heads are then separated from the stems and chaff and passed to the hulling cylinder, which removes the seeds from the pods. The separation of the seed from the straw and chaff is accomplished in the same manner as in the grain thrasher.

MISCELLANEOUS FARM IMPLEMENTS

Manure Spreaders.—At the present time there are several successful manure spreaders on the market. The capacity of spreaders is usually stated in bushels, and the rate of speed is designated as tons per acre. The ordinary two-horse spreader is usually rated at 70 bu. Some spreaders are equipped with lime distributors. This attachment consists of a box or hood that fits down over the beater of the machine and prevents the fine dust of the lime from being blown away.

The greatest advantage from using a manure spreader comes from the manner in which the machine pulverizes and spreads the manure. The fineness and evenness of the spreading has much to do with the crop grown, and to be effective the spreader must break the lumps into pieces and spread the manure evenly over the ground. The increase in crop production resulting from the manure spreader will usually pay for the implement in one season's use, to say nothing of the labor saved.

Sprayers.—By proper spraying a very large part of the annual loss caused by insects and fungi to fruit and vegetable plants can be prevented. To do this work effectively, spraying machines must be employed. The kind of spraying outfit to use will depend entirely on how much work is to be done. For the home garden or small orchard, hand sprayers are satisfactory. Several types of hand sprayers are on the market, from the small bucket pumps to knapsack sprayers that are carried on the back of the operator.

What are known as barrel spray outfits are satisfactory for an orchard of, say, 5 or 6 A., or for a garden of about the same size. These consist essentially of a force pump inserted either into the end or into the side of a barrel that contains the spray solution. Some kind of agitator for keeping the spray mixture in motion should also be a part of the equipment.

An outfit with a double-action force pump is used for orchards of, say, from 6 to 15 A. This double-action pump can be mounted on skids and the spray material pumped through a hose from a barrel standing beside the pump.

For a large orchard or garden, power spray outfits of some kind are necessary. These consist essentially of a large pump, a tank of some kind for holding the spray material, and some source of power. This power is generally furnished by a gasoline engine.

CARE OF FARM IMPLEMENTS AND MACHINERY

The total value of the machinery on the farms of the United States is more than three-quarters of a billion dollars, and, in addition to this amount vast sums are expended each year in adding to this investment by the purchase of new machines and in the repair of old machinery. The factories of this country produce farm machinery each year to the value of about $100,000,000, of which about $16,000,000 worth is exported, leaving a balance of $84,000,000 that is purchased by the American farmer.

From a study of these figures, it is easy to see that a very great saving would come to the farmers of this country if by careful operation and proper care the life of each machine could be extended for a term of years. The profit from this extended term of service will be realized by the greater durability and the increased efficiency that comes from proper care and expert management.

The care of farm machinery naturally comes under two heads: (1) the proper handling of the machinery while in operation in the field, and (2) the proper care of the machines when not in use.

The driver or operator of any piece of machinery should have a thorough knowledge of the working parts of the machine that he is using and should be able to detect the first indications of loose parts or lack of adjustment. A loose bolt or lack of adjustment of parts may in a very short time result in permanent injury to the machine and an expensive delay in the work. Very often the delay is more expensive than the repair, especially if the break occurs during harvest. Such a break often necessitates a trip to the shop, which consumes time during which the help is idle and the crop is suffering.

Much of this delay and annoyance can be avoided by having on the farm a small shop in which all minor repairs can be made. In fact, such a shop with a modest supply of blacksmith and carpenter tools should be a part of the equipment of every farm. The man who has any mechanical ability will soon learn to use such tools and be able to attend to all minor repairs and thus keep his machinery in a high state of efficiency. The shop should be located in a small building well apart from the barn on account of the danger of fire from the forge. It need not be a separate building, however, but may be built in connection with a wagon or a scale shed. Some means should be provided for heating the shop in winter.

The following tools will be found sufficient to equip a shop for all ordinary repair work. Other tools, of course, may be desirable, but they are not absolutely necessary. A statement of the average cost is also given.

WOOD-WORKING TOOLS

Saw	$2.00
Hatchet	.50
Draw shave	.50
Jack plane	.75
Ratchet brace	1.25
Bits	2.00
Chisels	.75
Oil stone	.50
Square	.75
Rule	.25
Screwdrivers	.25
Total	$9.50

IRON-WORKING TOOLS

Forge or blower	$5.00
Anvil	6.00
Tongs, 2 pairs	.75
Hand hammer	.50
Sledge hammer	1.00
Vise	5.00
Small tools	2.00
Total	$20.25

Total cost of all tools, $29.75.

The presence of a shop with the above equipment will in a single season often effect a saving of an amount sufficient to pay for the entire list of tools, to say nothing of the satisfaction that is derived from being able to have the machinery of the farm always in good working order.

The lack of durability in farm machinery is often due to the fact that the machines are placed in the hands of ignorant or inexperienced men who are not familiar with the operation and are therefore not capable of handling them properly.

All machines when not in use should be properly housed and protected from the weather. A season without shelter detracts more from the value of a machine than the wear caused by its use during the same season. It is a well-known fact that the iron and steel parts of a machine rust when exposed to the weather. This results in a gradual destruction of these materials and greatly interferes with the working of the machine when it is put in use. Also rusting results in loss of efficiency and a gradual weakening of the parts. From the financial side of the subject it pays well to care for and house farm implements. A well-regulated farm of, say, 160 A., for its successful operation, should have at least the following implements, which cost approximately the sum named:

1 grain binder	$125.00
1 mower	45.00
1 gang prow	50.00
1 walking plow	12.00
2 cultivators	40.00
1 disk pulverizer	25.00
2 farm wagons	100.00
1 smoothing harrow	18.00
1 planter	35.00
1 seeder	50.00
1 manure spreader	100.00
1 hay loader	45.00
1 hay rake	20.00
1 light road wagon	60.00
1 buggy	75.00
Total	$800.00

This makes a total of $800, assuming that all the machinery is new. For $200 a very convenient tool shed can be built that by a little careful planning can be made to shelter all of the above machinery very satisfactorily, especially if a floor is provided on a level with the eaves by which means considerable room can be made for some of the implements which can be easily taken apart, and for parts removed from some of the larger ones. Assume that a man starts farming with $800 invested in implements, and that if these implements are sheltered and well cared for they will last 10 yr. and if not sheltered they will last only 5 yr. If the implements stand out in the weather it costs $800 more to purchase a new set of implements at the end of 5 yr. The compound interest on this amount for 5 yr. at 5% amounts to about $215, or, the extra amount of money paid out for machinery, with its accrued interest, equals $1,015. If our tool shed costs $200, the compound interest on this amount for 10 yr. at 5% equals $125, or the shed may be considered to cost $325. After paying the expenses for the shed, it leaves at the end of 10 yr. a balance of $690.40 in favor of housing the machinery, and the shed is perhaps good for 10 yr. more. This does not take into consideration the saving in the cost of repairs.

It is very poor economy to buy good tools and convert them into poor ones by the lack of care. This is especially true of plows. In order to do good work, a plow must scour properly, and in order to do this the moldboards are made very hard and given a high polish. When plows are left in the soil or exposed to the weather the polished surface soon becomes pitted with rust and its scouring qualities are lost until a new polish can be obtained. Plows left in the field over night should have the polished surfaces covered with grease or oil. Between seasons, plows should be properly housed in the barn or in a tool shed and the polished surface covered with paint or grease. Paint is to be preferred, because mice and rats are apt to remove the grease before spring.

Rainy days and spare time during the winter season should be devoted to the inspection and repair of all machinery. For this reason the tool shed or storage room should be light and machines so placed that they are readily accessible. At this time all bolts should be tightened, the paint renewed on the wooden parts and all bearings thoroughly cleaned and oiled. If this is done much valuable time will be saved later during the busy season when the tools are in almost constant demand.

The man who expends money in the proper housing and in care of his machinery will find that it will all come back to him in the lengthened life of his machines, in the reduced cost of repairs, and in the satisfaction derived from having his machinery always in good order.

MISCELLANEOUS AGRICULTURAL TABLES

QUANTITY OF SEED REQUIRED PER ACRE

Kind of Seed	*Quantity*
Alfalfa, broadcasted	20 to 25 lb.
Alfalfa, in drills	15 to 20 lb.
Artichokes	6 to 8 bu.
Asparagus	4 to 5 lb.
Barley	8 to 10 pk.
Barley and peas, each	1 to 2 bu.
Beans, dwarf, in drills	1½ bu.
Beans, field, small variety	2 to 3 pk.
Beans, field, large variety	5 to 6 pk.
Beans, pole, in drills	10 to 12 qt.
Beet	4 to 6 lb.
Beggar weed, for forage	5 to 6 lb.
Beggar weed, for hay	8 to 10 lb.
Bent grass	1 to 2 bu.
Blue grass	25 lb.
Brome grass, alone for hay	12 to 15 lb.
Brome grass, alone for pasture	15 to 20 lb.
Broom corn	3 pk.
Broom corn, for seed	1 pk.
Buckwheat	3 to 5 pk.
Bur clover	12 lb.
Cabbage	¾ to 1 lb.
Carrot	4 to 6 lb.
Chicory	1 to 1½ lb.
Clover, Alsike, alone for forage	8 to 15 lb.
Clover, Alsike, on wheat or rye	4 to 6 lb.
Clover, Crimson	12 to 15 lb.
Clover, Japan	12 lb.

TABLE—*(Continued)*

Kind of Seed	*Quantity*
Clover, Mammoth	12 to 15 lb.
Clover, Red, alone for forage	16 lb.
Clover, Red, on small grain	8 to 14 lb.
Clover, Sweet (Melilotus)	2 to 4 pk.
Clover, White	10 to 12 lb.
Clover, Yellow	3 to 5 lb.
Corn, in hills	6 to 10 qt.
Corn, for silage	9 to 11 qt.
Cotton	1 to 3 bu.
Cowpeas	1 to $1\frac{1}{2}$ bu.
Cowpeas, in drills with corn	$\frac{1}{2}$ to 1 bu.
Cowpeas, for seed	3 pk.
Cucumber, in hills	2 lb.
Cress, water, in drills	2 to 3 lb.
Cress, upland	2 to 3 lb.
Eggplant, for 1,000 plants	1 oz.
Field pea, small variety	$2\frac{1}{2}$ bu.
Field pea, large variety	3 to $3\frac{1}{2}$ bu.
Flax, for seed	2 to 3 pk.
Flax, for fiber	$1\frac{1}{2}$ to 2 bu.
Grass, for lawns	2 to 4 bu.
Hemp, broadcasted	$3\frac{1}{2}$ to 4 pk.
Hungarian grass, for hay	2 pk.
Hungarian grass, for seed	1 pk.
Johnson grass	1 to $1\frac{1}{2}$ bu.
Kafir corn, in drills	3 to 6 lb.
Kafir corn, for fodder	10 to 12 lb.
Kale	2 to 4 lb.
Kohlrabi	4 to 5 lb.
Lettuce	20 to 30 oz.
Lupine	$1\frac{1}{2}$ to 2 bu.
Mangels	5 to 8 lb.
Meadow fescue	12 to 15 lb.
Millet, barnyard, in drills	1 to 2 pk.
Millet, foxtail, in drills	2 to 3 pk.
Millet, German, for seed	1 pk.
Millet, Pearl, for soiling	4 lb.
Millet, Pearl, for hay	8 to 10 lb.
Milo	5 lb.
Muskmelon, in hills	2 to 3 lb.
Mustard, broadcasted	$\frac{1}{2}$ bu.
Oat grass, Tall	30 lb.
Oats	2 to 3 bu.
Oats and peas	Oats, 2 bu. Peas, $\frac{1}{2}$ bu.
Onion, in drills	5 to 6 lb.
Onion, for sets	30 lb.
Onion sets	6 to 12 lb.
Orchard grass	12 to 15 lb.

TABLE—(*Continued*)

Kind of Seed	*Quantity*
Parsnip	4 to 8 lb.
Pop corn	3 lb.
Potatoes, cut tubers	6 to 20 bu.
Pumpkin	4 lb.
Rape, in drills	2 to 4 lb.
Rape, broadcasted	4 to 8 lb.
Radish, in drills	8 to 10 lb.
Red top	12 to 15 lb.
Rice	1 to 3 bu.
Rutabaga	3 to 5 lb.
Rye, early	3 to 4 pk.
Rye, late	6 to 8 pk.
Rye, for forage	3 to 4 pk.
Rye grass	2 to 3 bu.
Sage, in drills	8 to 10 lb.
Sainfoin	40 lb.
Salsify	8 to 10 lb.
Sand lucerne, broadcasted	15 lb.
Sheep's fescue	$2\frac{1}{2}$ to 3 bu.
Sorghum, for forage	$1\frac{1}{2}$ to 2 bu.
Sorghum, for seed or syrup	2 to 5 lb.
Sorghum, saccharine, for silage	6 to 25 lb.
Sorghum and peas, each	$\frac{3}{4}$ pk.
Soybeans, in drills	2 to 3 pk.
Soybeans, broadcasted	1 to $1\frac{1}{2}$ bu.
Spinage	10 to 12 lb.
Spurry	6 to 8 qt.
Spurry, for seed	4 qt.
Squash, bush, in hills	4 to 6 lb.
Squash, running, in hills	3 to 4 lb.
Sugar beet	15 to 20 lb.
Sugar cane	4 T. of cane
Sunflower	10 to 15 lb.
Sweet potatoes	$1\frac{1}{2}$ to 4 bu.
Teosinte	1 to 3 lb.
Timothy	15 to 25 lb.
Timothy and clover { Timothy	8 lb.
Timothy and clover { Clover	8 lb.
Tomato, for transplanting	$\frac{1}{4}$ lb.
Turnip, broadcast	2 to 4 lb.
Turnip, in drills	1 lb.
Turnip, hybrid	3 to 5 lb.
Velvet bean	1 to 4 pk.
Vetch, Hairy, in drills	1 bu.
Vetch, Hairy, broadcasted	$1\frac{1}{2}$ bu
Vetch, kidney	18 to 22 lb.
Vetch, spring	$\frac{5}{8}$ pk.
Watermelon, in hills	4 to 5 lb.
Wheat	6 to 9 pk.

MIXTURES RECOMMENDED FOR 1 A. OF MEADOW

Mixture	*Pounds*
No. 1:	
Timothy	8
Red clover	8
No. 2:	
Timothy	8
Red clover	6
Alsike clover	2
No. 3:	
Red top	13
Orchard grass	18
Meadow fescue	9
Red clover	4
No. 4:	
Timothy	8
Red clover	4
Alsike clover	2
Kentucky blue grass	2
Red top	2

MIXTURES RECOMMENDED FOR PERMANENT PASTURES

For fertile land:	*Pounds*
Timothy	8 to 12
Kentucky blue grass	4 to 6
Meadow fescue	1 to 4
Orchard grass	1 to 4
Red clover	6
Alsike clover	3
White clover	1 to 2
For rather poor land:	
Timothy	8 to 12
Red top	4
Canadian blue grass	4
Red clover	6
Alsike clover	3
White clover	1
For wet pasture:	
Red top	14
Alsike clover	8
Creeping bent grass	6
Perennial rye grass	2

NUMBER OF PLANTS REQUIRED TO SET 1 A. OF GROUND AT GIVEN DISTANCES

Distance	Plants	Distance	Plants
1 in.× 6 in.	1,045,440	12 in.×15 in.	34,848
1 in.× 8 in.	784,080	12 in.×18 in.	29,040
1 in.×10 in.	627,269	12 in.×20 in.	26,136
1 in.×12 in.	522,720	12 in.×30 in.	17,424
2 in.× 6 in.	522,720	12 in.×42 in.	12,446
2 in.× 8 in.	392,040	12 in.×54 in.	9,680
2 in.×10 in.	313,632	15 in.×15 in.	27,878
2 in.×12 in.	261,360	15 in.×18 in.	23,232
3 in.× 6 in.	348,480	15 in.×20 in.	20,908
3 in.× 8 in.	261,360	15 in.×24 in.	17,424
3 in.×10 in.	209,088	15 in.×30 in.	13,939
3 in.×12 in.	174,240	15 in.×36 in.	11,616
4 in.× 6 in.	261,360	15 in.×42 in.	9,953
4 in.× 8 in.	196,020	15 in.×48 in.	8,712
4 in.×10 in.	156,816	15 in.×54 in.	7,744
4 in.×12 in.	130,680	15 in.×60 in.	6,969
5 in.× 6 in.	209,088	18 in.×18 in.	19,360
5 in.× 8 in.	156,816	18 in.×20 in.	17,424
5 in.×10 in.	125,452	18 in.×24 in.	14,520
5 in.×12 in.	104,544	18 in.×30 in.	11,616
6 in.× 6 in.	174,240	18 in.×36 in.	9,680
6 in.× 8 in.	130,680	18 in.×42 in.	8,297
6 in.×10 in.	104,544	18 in.×48 in.	7,260
6 in.×12 in.	87,120	18 in.×54 in.	6,453
7 in.× 7 in.	128,013	18 in.×60 in.	5,808
7 in.× 8 in.	112,011	20 in.×20 in.	15,681
7 in.×10 in.	89,609	20 in.×24 in.	13,168
7 in.×12 in.	74,674	20 in.×30 in.	10,454
8 in.× 8 in.	98,010	20 in.×36 in.	8,712
8 in.×10 in.	78,408	20 in.×42 in.	7,467
8 in.×12 in.	65,340	20 in.×48 in.	6,534
9 in.× 9 in.	77,440	20 in.×54 in.	5,308
9 in.×10 in.	69,696	20 in.×60 in.	5,227
9 in.×12 in.	58,080	1 ft.× 1 ft.	43,560
10 in.×10 in.	62,726	1 ft.× 2 ft.	21,780
10 in.×12 in.	52.272	1 ft.× 3 ft.	14,520
10 in.×15 in.	41,817	1 ft.× 4 ft.	10,890
10 in.×18 in.	34,848	1 ft.× 5 ft.	8,712
10 in.×20 in.	31,362	1 ft.× 6 ft.	7,260
10 in.×24 in.	26,132	1 ft.× 7 ft.	6,223
10 in.×30 in.	20,908	1 ft.× 8 ft.	5,445
10 in.×36 in.	17,424	1 ft.× 9 ft.	4,840
10 in.×42 in.	14,935	1 ft.×10 ft.	4,356
10 in.×48 in.	13,068	1 ft.×11 ft.	3,960

TABLE—*(Continued)*

Distance	Plants	Distance	Plants
1 ft.×12 ft.	3,630	6 ft.×12 ft.	605
2 ft.× 2 ft.	10,890	7 ft.× 7 ft.	888
2 ft.× 3 ft.	7,260	7 ft.× 8 ft.	777
2 ft.× 4 ft.	5,445	7 ft.× 9 ft.	691
2 ft.× 5 ft.	4,356	7 ft.×10 ft.	622
2 ft.× 6 ft.	3,630	7 ft.×11 ft.	565
2 ft.× 7 ft.	3,111	7 ft.×12 ft.	518
2 ft.× 8 ft.	2,722	8 ft.× 8 ft.	680
2 ft.× 9 ft.	2,420	8 ft.× 9 ft.	605
2 ft.×10 ft.	2,178	8 ft.×10 ft.	544
2 ft.×11 ft.	1,980	8 ft.×11 ft.	495
2 ft.×12 ft.	1,815	8 ft.×12 ft.	453
3 ft.× 3 ft.	4,840	9 ft.× 9 ft.	537
3 ft.× 4 ft.	3,630	9 ft.×10 ft.	484
3 ft.× 5 ft.	2,904	9 ft.×11 ft.	440
3 ft.× 6 ft.	2,420	9 ft.×12 ft.	403
3 ft.× 7 ft.	2,074	9 ft.×14 ft.	345
3 ft.× 8 ft.	1,815	9 ft.×15 ft.	322
3 ft.× 9 ft.	1,613	9 ft.×18 ft.	268
3 ft.×10 ft.	1,452	9 ft.×20 ft.	242
3 ft.×11 ft.	1,320	10 ft.×10 ft.	435
3 ft.×12 ft.	1,210	10 ft.×12 ft.	363
4 ft.× 4 ft.	2,722	10 ft.×15 ft.	290
4 ft.× 5 ft.	2,178	10 ft.×18 ft.	242
4 ft.× 6 ft.	1,185	10 ft.×20 ft.	217
4 ft.× 7 ft.	1,556	10 ft.×24 ft.	181
4 ft.× 8 ft.	1,361	10 ft.×30 ft.	145
4 ft.× 9 ft.	1,210	10 ft.×36 ft.	121
4 ft.×10 ft.	1,089	10 ft.×42 ft.	103
4 ft.×11 ft.	990	10 ft.×45 ft.	96
4 ft.×12 ft.	907	10 ft.×48 ft.	90
5 ft.× 5 ft.	1,742	10 ft.×54 ft.	80
5 ft.× 6 ft.	1,452	10 ft.×60 ft.	72
5 ft.× 7 ft.	1,244	12 ft.×12 ft.	302
5 ft.× 8 ft.	1,089	12 ft.×15 ft.	242
5 ft.× 9 ft.	968	12 ft.×18 ft.	201
5 ft.×10 ft.	871	12 ft.×20 ft.	181
5 ft.×11 ft.	792	12 ft.×24 ft.	151
5 ft.×12 ft.	726	12 ft.×30 ft.	121
6 ft.× 6 ft.	1,210	12 ft.×36 ft.	100
6 ft.× 7 ft.	1,037	12 ft.×42 ft.	86
6 ft.× 8 ft.	907	12 ft.×48 ft.	75
6 ft.× 9 ft.	806	12 ft.×54 ft.	67
6 ft.×10 ft.	726	12 ft.×60 ft.	60
6 ft.×11 ft.	660	15 ft.×15 ft.	193

TABLE—*(Continued)*

Distance	Plants	Distance	Plants
15 ft.×18 ft.	161	30 ft.×30 ft.	48
15 ft.×20 ft.	145	30 ft.×36 ft.	40
15 ft.×24 ft.	121	30 ft.×42 ft.	34
15 ft.×30 ft.	96	30 ft.×48 ft.	30
15 ft.×36 ft.	80	30 ft.×54 ft.	26
15 ft.×42 ft.	69	30 ft.×60 ft.	24
15 ft.×48 ft.	60	36 ft.×36 ft.	33
15 ft.×54 ft.	53	36 ft.×42 ft.	28
15 ft.×60 ft.	48	36 ft.×48 ft.	25
18 ft.×18 ft.	134	36 ft.×54 ft.	22
18 ft.×20 ft.	121	36 ft.×60 ft.	20
18 ft.×24 ft.	100	38 ft.×38 ft.	30
18 ft.×30 ft.	80	38 ft.×40 ft.	28
18 ft.×36 ft.	67	38 ft.×42 ft.	27
18 ft.×42 ft.	57	38 ft.×48 ft.	23
18 ft.×48 ft.	50	38 ft.×50 ft.	22
18 ft.×54 ft.	44	38 ft.×54 ft.	21
18 ft.×60 ft.	40	38 ft.×60 ft.	19
20 ft.×20 ft.	108	40 ft.×40 ft.	27
20 ft.×24 ft.	90	40 ft.×42 ft.	25
20 ft.×30 ft.	72	40 ft.×48 ft.	22
20 ft.×36 ft.	60	40 ft.×50 ft.	21
20 ft.×42 ft.	51	40 ft.×54 ft.	20
20 ft.×48 ft.	45	40 ft.×60 ft.	18
20 ft.×54 ft.	40	42 ft.×42 ft.	24
20 ft.×60 ft.	36	42 ft.×48 ft.	21
24 ft.×24 ft.	75	42 ft.×54 ft.	19
24 ft.×30 ft.	60	42 ft.×60 ft.	17
24 ft.×36 ft.	50	48 ft.×48 ft.	18
24 ft.×42 ft.	43	48 ft.×54 ft.	16
24 ft.×48 ft.	37	48 ft.×60 ft.	15
24 ft.×54 ft.	33	50 ft.×50 ft.	17
24 ft.×60 ft.	30		

AVERAGE TIME REQUIRED FOR GARDEN SEED TO GERMINATE

Crop	Days	Crop	Days
Bean	5 to 10	Lettuce	6 to 8
Beet	7 to 10	Onion	7 to 10
Cabbage	5 to 10	Pea	6 to 10
Carrot	12 to 18	Parsnip	10 to 20
Cauliflower	5 to 10	Pepper	9 to 14
Celery	10 to 20	Salsify	7 to 12
Corn	5 to 8	Radish	3 to 6
Cucumber	6 to 10	Tomato	6 to 12
Endive	5 to 10	Turnips	4 to 8

TIME REQUIRED FOR MATURITY OF DIFFERENT VEGETABLE CROPS FROM SEEDING

Crops	Days	Crops	Days
Beans, string	45 to 65	Lettuce	65
Beans, shell	65 to 70	Onions	135 to 150
Beets, turnip	65	Peppers	140 to 150
Beets, Long Blood	150	Radishes	30 to 45
Cabbage, early	105	Squashes, summer	60 to 65
Cabbage, late	150	Squashes, winter	125
Cauliflower	110	Tomatoes	150
Corn	75	Turnip	60 to 70
Eggplant	150 to 160		

COMPARISON OF BAUMÉ AND SPECIFIC GRAVITY HYDROMETER READINGS FOR LIQUIDS HEAVIER THAN WATER

Baumé Degrees	Specific Gravity	Baumé Degrees	Specific Gravity
1	1.007	24	1.198
2	1.014	25	1.208
3	1.021	26	1.218
4	1.028	27	1.229
4.3	1.030	28	1.239
15	1.115	29	1.250
16	1.124	30	1.261
17	1.133	31	1.272
18	1.142	32	1.283
19	1.151	33	1.295
20	1.160	34	1.306
21	1.169	35	1.318
22	1.179	36	1.330
23	1.188		

CAPACITY OF CIRCULAR SILOS AND QUANTITY OF SILAGE TO BE FED TO LOWER THE SURFACE 2 IN. DAILY

Inside Diameter Feet	Depth Feet	Capacity Tons	Acreage of Corn to Fill, 15 T. to the Acre	Quantity to be Fed Daily Pounds
10	28	42	2.8	525
10	30	47	3.0	525
10	32	51	3.4	525
10	34	56	3.7	525
10	38	65	4.3	525
10	40	70	4.6	525
12	28	61	4.1	755
12	30	67	4.5	755
12	32	74	5.0	755
12	34	80	5.3	755
12	36	87	5.8	755
12	38	94	6.4	755
12	40	101	7.3	755
14	28	83	5.5	1030
14	30	91	6.1	1030
14	32	100	6.7	1030
14	34	109	7.2	1030
14	36	118	7.9	1030
14	38	128	8.5	1030
14	40	138	9.2	1030
16	28	108	7.2	1340
16	32	131	8.7	1340
16	34	143	9.5	1340
16	36	155	10.3	1340
16	38	167	11.1	1340
16	40	180	12.0	1340
18	30	151	10.0	1700
18	32	166	11.0	1700
18	34	181	12.0	1700
18	36	196	13.2	1700
18	38	212	14.1	1700
18	40	229	15.2	1700
18	42	246	16.4	1700
18	44	264	17.6	1700
18	46	282	18.8	1700
20	30	187	12.5	2100
20	32	205	13.6	2100
20	34	224	15.0	2100
20	36	243	16.2	2100
20	40	281	18.8	2100
20	42	300	20.0	2100
20	44	320	21.3	2100
20	46	340	22.6	2100
20	48	361	24.0	2100
20	50	382	25.5	2100

LEGAL WEIGHTS PER BUSHEL OF VARIOUS COMMODITIES FOR WHICH BUSHEL WEIGHTS HAVE BEEN WIDELY ADOPTED

	Alfalfa Seed	Apples[1]	Dried Apples	Apple Seeds	Barley	Beans[1]	Castor Beans (Shelled)	Beets	Blue-Grass Seed	Bran[1]	Broom-Corn Seed	Buckwheat	Carrots	Charcoal	Chestnuts	Clover Seed	Coal[1]	Anthracite Coal	Bituminous Coal	Cannel Coal	Mineral Coal	Stone Coal
U. S.					48		50					42							80			
Ala.			24		47	60																
Ariz.					45	[2]55																
Ark.		[3]50	24		48	[2]60			14	20	48	52				60						
Cal.					50							40										
Colo.					48	60			14			52				60	80				80	
Conn.		48	25		48	60		[4]60		20		48	50	20		60		80				
Del.														20								
D. C.																						
Fla.		[3]48	24		48	[5]60	48			20												
Ga.			24		47	[6]60			14	[7]20		52				60						80
Hawaii					48																	
Ill.			24		48	[6]60	46		14	20		52				60						80
Ind.			25		48	60	46		14			50				60					80	
Iowa	60	48	24		48	[8]60	46	56	14	20	50	52	50	20		60						

Kans....	60	[3]48	24		48	60	46	56	[9]14	20		50	50			60						80
Ky......			24		47	·[6]60	[1]45		14	20		56				60	76	76	76	76	76	76
La.					48																	
Me......		44			48	60		60				48	50									
Md.	60		28		48	60	[10]50		14	20			50	20		60	80					
Mass....		48	25		48	[11]60		60		20		48	50			60						
Mich....		48	22		48	60	46		14			48				60					80	
Minn....		[3]50	28		48	60		50	14		57	50	45	20		60	80					
Miss. ...			26		48	[6]60	[12]46		14	20		48				60						80
Mo......		48	24		48	[12]60	46		14	20		52	50			60					80	
Mont....		45			48	60		50	14	20		52	50			60					76	
Neb. ...	60	[3]48	24		48	[6]60	46		14	20		52				60						80
Nev.....	60	[3]48	24		48	60	46	56	[9]14	20		50	50			60						
N. H....		48	25		48	[2] [11]		60		20		48	50			60						
N. J.....		50	25		48	60		60				50	50			64						
N. Y....		48	25		48	60				20		48	50			60						
N. C....	60	[3]48		40	48	[13]60	[1]46		14		46	50			[14]50	60						
N. Dak.		50			48	60		60		20	30	42				60						80
Ohio....		50	24		48	60		56				50	50			60			80	70		
Okla. ...	60	48	24		48	60	46	60	14	20	30	52	50			60					80	80
Ore.		45	28		46							42				60						
Pa.					47							48		[15,16]18		60	[17]75		76			
R. I.....		48	25	40	48	60	46	50		20		48	50	20		60	80					
S. C.....																						
S. Dak..					48	60		60		20	30	42				60						80
Tenn....		[3]50	24	40	48	[12]1,[8]60	46	50	14	20	42	50	50	22	50	[19]60						80
Tex.		45	28		48	[6]60				20		42		22		60						80
Vt.		46			48	62		60				48	50			60						
Va......			28		48	[6]60			14			52			57	60						80
Wash. ..		[3]45	28		48							42				60						
W. Va...			25		48	60						52				60			80			
Wis.		50	25		48	60		50		20		50	50			60						

LEGAL WEIGHTS PER BUSHEL OF VARIOUS COMMODITIES FOR WHICH BUSHEL WEIGHTS HAVE BEEN WIDELY ADOPTED—*(Continued)*

	Coke	Corn[1-34]	Corn in Ear, Husked	Corn in Ear, Unhusked	Shelled Corn	Corn Meal[1]	Corn Meal, Bolted	Corn Meal, Unbolted	Cotton Seed[1]	Sea Island Cotton Seed	Upland Cotton Seed	Cranberries	Cucumbers	Flaxseed (Linseed)	Gooseberries	(Plastering) Hair	Hemp Seed	Herd's Grass[69]	Hickory Nuts	Hungarian Grass Seed	Indian Corn or Maize
U. S.		56				48								56							
Ala.			70	75	56				32												
Ariz.		54																			
Ark.			70	74	56	48			$33\frac{1}{3}$					56							
Cal.																					52
Colo.			70			50											44				56
Conn.						50				44	30			55				45			56
Del.							44	48													56
D. C.																					
Fla.				70	56	48			32	46											
Ga.			70		56	48			30					56		8	44				
Hawaii																					56
Ill.			70		56	48								56		8	44				
Ind.			[20]		56	50						33					44				
Iowa	38	[21]50	[22]70	75	56	50							48	56	40		44		50	50	

Kans.			[22]70		56									56		[24] 8	44			50	
Ky.		[25]70			56	50								56		8	44			50	
La.		56																			
Me.		56				[26]50										11		45			
Md.			[22]70		56	48								56			44	45		50	
Mass.					[27]50	50				44	30	32		55				45			[28]56
Mich.			[22]70		56	50						40		56			44			50	
Minn.			70		56							36			40	[24] 8	50			48	
Miss.			72		56	48	44	48	32					56			44			50	
Mo.				70	56	50			33				48	56			44			48	
Mont.			70		56	50								56			44			50	
Neb.			70		55	50								56		8	44			50	
Nev.		[23]70			56	48								56			48			50	
N. H.		[27]50				50						32		56				45			56
N. J.														55							56
N. Y.						50				44	30			55				45			56
N. C.			70			48			30	44				55			44		[29]50		56
N. Dak.			70		56									56							
Ohio	40		68		56									56			44			50	
Okla.			70	72	56	50			32				48	56			44				
Ore.																					56
Pa.	40	58																			56
R. I.	40		70		56	50				44	30			56			44			50	
S. C.						[30]48	48	48	[31]30												
S. Dak.			70		56									56							
Tenn.	40		70	[32]74	56		50	48	28				48	56	48	8	44		50	48	
Tex.			70	72	56				32					56			44	45		48	
Vt.																		45			56
Va.			70		56	50			32					56		8	44	12		48	
Wash.														56							56
W. Va.		56												56							
Wis.						50				44	30		[33]50	56		8	44			48	56

LEGAL WEIGHTS PER BUSHEL OF VARIOUS COMMODITIES FOR WHICH BUSHEL WEIGHTS HAVE BEEN WIDELY ADOPTED—(*Continued*)

	Kafir Corn	Lime[1]	Unslacked Lime	Malt	Millet	Oats	Onions[1]	Onion Sets	Orchard Grass Seed	Osage Orange Seed	Parsnips	Peaches[1]	Dried Peaches, Peeled	Dried Peaches, Unpeeled	Peanuts (or "Ground Peas*")	Pears[1]	Green Peas, Unshelled	Peas[1]	Popcorn[60]
U. S.				34		32												60	
Ala.						32							38	33				60	
Ariz.						32													
Ark.					50	32	57		14				33	33				60	
Cal.						32													
Colo.		80				32	57												
Conn.		70				32	52				45		33	33				60	
Del.																			
D. C.																			
Fla.					50	32	56					[35]54	33		22	60			
Ga.			80			32	57						38	33	*25			60	
Hawaii						32													
Ill.			80	38		32	57							33					
Ind.				[37]35	50	32	48		14	33	55			33					56
Iowa	56	80			50	32	57	[38]30	14	32	42	48		33	20		50		[39]70

Kans.	56		80	32	50	32	57				52	48		33				[40]60	[61]56
Ky.			35		50	[41]32	57	[42]36	14				39		*24			60	
La.																			
Me.						32	52				45							60	
Md.		80		[37]34	[43]50	[44]32	57		14			[45]40			22			[46]60	
Mass.		70				32	52				45	48	33		[47]20	58		60	
Mich.		70			50	32	54		14	33			28					60	
Minn.		80			48	32	52		14		42		[48]28					60	
Miss.			80	38	50	32	57						33		*24			60	
Mo.				38	50	32	57	[49]28	14	36	44	48	33			48	56	[50]60	
Mont.			80	30		32	57				50					45		60	
Neb.			80	30	50	32	57	25		32			33					60	
Nev.	56			32	50	32	57				50	48		[48]33				[40]60	[61]56
N. H.		70				32	52				45	48		[48]33	[47]20	58		60	
N. J.						30	57					50	33	33				60	
N. Y.		70				32	57						33					60	
N. C.	50				50	32	57		14						22			60	
N. Dak.		80			50	32	52											60	
Ohio		70		34	50	32	55					48	33					60	[51]42
Okla.	56	80		38	50	32	57	28	14	36	44	48		33	22	48	56	60	
Ore.						32							28			45			
Pa.						32	50												
R. I.		70		38	50	32	50				50	48	33					[36]60	
S. C.																			
S. Dak.		80				32	52											60	
Tenn.		[52]	80		[53]50	32	[54]56	[55]28	14	33	50	[56]50	26		23	[57]56	30	60	70
Tex.					50	32	57					50	28						
Vt.						32	52											60	
Va.			80	38	50	30	57	28	14	34			40	32	22			[58]60	
Wash.						32							28			[36]45			
W. Va.						32							33						
Wis.		70	80	[59]34	50	32	57				44		33					60	

LEGAL WEIGHTS PER BUSHEL OF VARIOUS COMMODITIES FOR WHICH BUSHEL WEIGHTS HAVE BEEN WIDELY ADOPTED—*(Continued)*

	Potatoes[1]	Sweet Potatoes	White Potatoes	Quinces	Rape Seed	Red Top	Rough Rice	Rutabagas	Rye Meal	Rye	Salt[1]	Fine Salt	Coarse Salt	Shorts[1]	Sorghum Seed	Spelt or Spiltz	Timothy Seed	Tomatoes	Turnips[1]	Common English Turnips	Walnuts	Wheat
U. S.	60									56												60
Ala.		55	60							56									55			60
Ariz.										56												60
Ark.	60	50				14				56	50				50		60		57			60
Cal.										54												60
Colo.	60									56	80						45					60
Conn.	60	54					45	60	50	56		50	70	20						50		60
Del.																						60
D. C.	60																					
Fla.		60	60	48						56	60				56				54			60
Ga.		55	60				43			56							45		55			60
Hawaii										56												60
Ill.		50	60							56		55	50				45		55			60
Ind.	60	55								56	50						45		55			60
Iowa	60	46		48	50	14		50		56	80				[62]50	35	45	50	55		50	60

Kans.	60	50								56	80				50		45	56	55			60
Ky.	[65]60	55								56	50	55					45		60			60
La.										56												60
Me.	60							60	50	50		60	70							50		60
Md.	60	60			50	[63]14				56		56	70		50		45	60	60			60
Mass.	60	54		48			45		50	56		50	70	20			45	56	55			60
Mich.		56	60			[64]14				56	56						45		58			60
Minn.		55	60		50	[64]14		52		56					57		45					60
Miss.		60	60							56	50				42		45		55			60
Mo.		56	60			[64]14		50		56	50				42		45	45		42		60
Mont.	60									56	50						45		50			60
Neb.		50	60							56	50				50		45		55			60
Nev.	60	50								56	80				50		45	56	56			60
N. H.	[65]60	54		48					50	56		50	70	20			45	56	55			60
N. J.		54	60							56							45					60
N. Y.		54	60				45		50	56		56	70	20			45					60
N. C.	[65]56	56	60		50	[64]14	44			56					50		45		50		[66]50	60
N. Dak.		46	60							56	80					40	45		60			60
Ohio	[65]60	50								56							45	56	60			60
Okla.		55	60		50	[64]14		50		56	80				50		45	45	60	42		60
Ore.	60									56												60
Pa.	56									56		[67]62	85									60
R. I.		54	60						50	56		50	70	20			45	56	50			60
S. C.																						
S. Dak.		46	60							56	80					45	42		60			60
Tenn.		50	60	48		[64]14				56	50				50		45	56	50		50	60
Tex.		55	60							56	50						45	55	55			60
Vt.	60									56	70						45		60			[68]60
Va.		56	56			12				56	50						45		55			60
Wash.	60									56												60
W. Va.	60									56							45					60
Wis.	60	54			50		45	56	50	56		50	70	20			45		42			60

NOTES CONCERNING PRECEDING TABLE

1 Not defined.
2 Small white beans, 60 lb.
3 Green apples. [wurzel.
4 Sugar beets and mangel
5 Shelled beans, 60 lb.; velvet beans, 78 lb.
6 White beans.
7 Wheat bran.
8 Green unshelled beans, 56 lb.
9 English blue-grass seed, 22 lb.; native blue-grass seed, 14 lb.
10 Also castor seed.
11 Soybeans, 58 lb. [30 lb.
12 Green unshelled beans,
13 Soybeans
14 Free from hulls.
15 Commercially dry, for all hard woods.
16 Fifteen lb. commercially dry, for all soft woods.
17 Standard weight in borough of Greensburg.
18 Dried beans.
19 Red and white.
20 Corn in ear, 70 lb. until Dec. 1 next after grown; 68 lb. thereafter.
21 Sweet corn
22 On the cob.
23 Indian corn in ear.
24 Unwashed plastering hair, 8 lb.; washed plastering hair, 4 lb.
25 Corn in ear, from Nov. 1 to May 1 following, 70 lb.; 68 lb. from May 1 to Nov. 1.
26 Indian-corn meal.
27 Cracked corn.
28 Shelled.
29 Free from hulls.
30 Standard weight bu. corn meal, bolted or unbolted, 48 lb.
31 Except the seed of long staple cotton, of which the weight shall be 42 lb.
32 Green unshelled corn, 100 lb.
33 Green cucumbers.
34 See also "Popcorn," "Indian corn," and "Kafir corn."
35 Green peaches.
36 Green pears.
37 Malt rye. [32 lb.
38 Top sets; bottom sets,
39 Shelled, 56 lb.
40 Shelled, dry.
41 Strike measure.
42 Bottom onion sets.
43 German and American.
44 Shelled.
45 Peaches (peeled); unpeeled 32 lb.
46 Cowpeas.
47 Roasted; green 22 lb.
48 Not stated whether peeled or unpeeled.
49 Top onion sets.
50 Including split peas.
51 In the ear.
52 Slacked lime, 40 lb.
53 German, Missouri, and Tennessee millet seeds.
54 Matured onions.
55 Bottom onion sets, 32 lb.
56 Matured.
57 Matured pears, 56 lb.; dried pears, 26 lb.
58 Black-eyed peas.
59 Barley malt.
60 Includes "Rice corn."
61 "Rice corn." [seed.
62 Sorghum saccharatum
63 Red top grass seed (chaff); fancy, 32 lb.
64 Seed.
65 Irish potatoes.
66 Free from hulls.
67 Ground salt, 70 lb.
68 India wheat, 46 lb.
69 In some states herd's grass is a synonym for timothy; in other states, for Red top.

The states of Idaho, New Mexico, Utah, and Wyoming have no standard for bushel weights.

LEGAL WEIGHTS PER BUSHEL OF VARIOUS COMMODITIES FOR WHICH BUSHEL WEIGHTS HAVE BEEN ADOPTED IN BUT ONE OR TWO STATES

Alsike (or Swedish) seed, 60 lb. (Md. and Okla).
Beggar weed seed, 62 lb. (Fla.) (Tenn.).
Blackberries, 30 lb. (Ia.); 48 lb. (Tenn.); dried, 28 lb.
Bermuda grass seed, 40 lb. (Okla.).
Blueberries, 42 lb. (Minn.).
Bromus inermus, 14 lb. (N. Dak.).
Bur clover, in hulls, 8 lb. (N. C.).
Cabbage, 50 lb. (Tenn.).
Canary seed, 60 lb. (Tenn.); 50 lb. (Ia.).
Cantaloup melon, 50 lb. (Tenn.)
Castor seed, 50 lb. (Md.).
Cement, 80 lb. (Tenn.).
Cherries, 40 lb. (Ia.); with stems, 56 lb. (Tenn.); without stems, 64 lb. (Tenn.).
Chufa, 54 lb. (Fla.).
Cotton seed, staple, 42 lb. (S. C.).
Culm, 80 lb. (Md.).
Currants, 40 lb. (Ia. and Minn.).
Feed, 50 lb. (Mass.).
Fescue, seed of all the, except the Tall and Meadow fescue, 14 lb. (N. C.). (N. C.).
Fescue, Tall and Meadow fescue grass seed, 24 lb.
Grapes, 40 lb. (Ia.); with stems, 48 lb. (Tenn.); without stems, 60 lb. (Tenn.).
Guavas, 54 lb. (Fla.).
Hominy, 60 lb. (O.); 62 lb. (Tenn.).
Horseradish, 50 lb. (Tenn.).
Italian rye-grass seed, 20 lb. (Tenn.).
Japan clover in hulls, 25 lb. (N. C.).
Johnson grass, 28 lb. (Ark.); 25 lb. (N. C.).
Kale, 30 lb. (Tenn.).
Land plaster, 100 lb. (Tenn.).
Lentils, 60 lb. (N. C.).
Lucerne, 60 lb. (N. C.).
Lupines, 60 lb. (N. C.).
Meadow seed, tall, 14 lb. (N. C.).
Meal (?), 46 lb. (Ala.); unbolted, 48 lb. (Ala.).
Middlings, fine, 40 lb. (Ind.); coarse middlings, 30 lb. (Ind.).
Millet, Japanese barnyard, 35 lb. (Mass. and N. H.).
Mustard, 30 lb. (Tenn.).
Mustard seed, 58 lb. (N. C.).

Oat grass seed, 14 lb. (N. C.).
Oat grass seed, 14 lb. (N. C.). (Mich.).
Plums, 40 lb. (Fla.); 64 lb. (Tenn.); dried, 28 lb.
Prunes, dried, 28 lb. (Ida.); green, 45 lb. (Ida.).
Radish seed, 50 lb. (Ia.).
Raspberries, 32 lb. (Ia. and Kan.); 48 lb. (Tenn.).
Rhubarb, 50 lb. (Tenn.).
Sage, 4 lb. (Tenn.).
Salads, 30 lb. (Tenn.).
Sand, 130 lb. (Ia.).
Seed of brome grasses, 14 lb. (N. C.).
Spinage, 30 lb. (Tenn.).
Strawberries, 32 lb. (Ia.); 48 lb. (Tenn.).
Sugar cane seed (amber), 57 lb. (N. J.)
Sunflower seed, 24 lb. (N. C.).
Teosinte, 59 lb. (N. C.).
Velvet grass seed, 7 lb. (Tenn.).
Vetches, 60 lb. (N. C.).

ARITHMETICAL TABLES

MEASURES OF EXTENSION

Measures of extension are used in measuring lengths (distances), surfaces (areas), and solids (volumes), and are divided, accordingly, into linear measure, square measure, and cubic measure.

Linear measure has one dimension (length), square measure has two dimensions (length and breadth), and cubic measure has three dimensions (length, breadth, and thickness).

LINEAR MEASURE

12 inches (in.)	= 1 foot	ft.
3 feet	= 1 yard	yd.
$5\frac{1}{2}$ yards	= 1 rod	rd.
320 rods	= 1 mile	mi.

in.	*ft.*	*yd.*	*rd.*	*mi.*
12 =	1			
36 =	3 =	1		
198 =	$16\frac{1}{2}$ =	$5\frac{1}{2}$ =	1	
63,360 =	5,280 =	1,760 =	320 =	1

SQUARE MEASURE

144	square inches (sq. in.)	= 1 square foot	sq. ft.
9	square feet	= 1 square yard	sq. yd.
$30\frac{1}{4}$	square yards	= 1 square rod	sq. rd.
160	square rods	= 1 acre	A.
640	acres	= 1 square mile	sq. mi.

sq. in.	*sq. ft.*	*sq. yd.*	*sq. rd.*	*A.*	*sq. mi.*
144 =	1				
1,296 =	9 =	1			
39,204 =	$272\frac{1}{4}$ =	$30\frac{1}{4}$ =	1		
6,272,640 =	43,560 =	4,840 =	160 =	1	
4,014,489,600 =	27,878,400 =	3,097,600 =	102,400 =	640 =	1

SURVEYORS' SQUARE MEASURE

625	square links (sq. li.)	= 1 square rod	sq. rd.
16	square rods	= 1 square chain	sq. ch.
10	square chains	= 1 acre	A.
640	acres	= 1 square mile	sq. mi.
36	square miles (6 miles square)	= 1 township	Tp.

A square measuring 208.71 ft. on each side contains 1 A.

The following are the comparative sizes, in square yards, of acres in different countries:

	sq. yd.		*sq. yd.*
England and America	4,840	Amsterdam	9,722
Scotland	6,150	Dantzic	6,650
Ireland	7,840	France	11,960
Hamburg	11,545	Prussia	3,053

CUBIC MEASURE

1,728	cubic inches (cu. in.)	= 1 cubic foot	cu. ft.
27	cubic feet	= 1 cubic yard	cu. yd.

128 cubic feet = 1 cord of wood.

cu. in.	*cu. ft.*	*cu. yd.*
1,728 =	1	
46,656 =	27 =	1

MEASURES OF WEIGHT

AVOIRDUPOIS WEIGHT

16 ounces (oz.)	= 1 pound	lb.
100 pounds	= 1 hundredweight	cwt.
20 hundredweight / 2,000 pounds	= 1 ton	T.

oz.	*lb.*	*cwt.*	*T.*
16 =	1		
1,600 =	100 =	1	
32,000 =	2,000 =	20 =	1

LONG-TON TABLE

16 ounces (oz.)	= 1 pound	lb.
28 pounds	= 1 quarter	qr.
4 quarters	= 1 hundredweight	cwt.
20 hundredweight / 2,240 pounds	= 1 ton	T.

oz.	*lb.*	*qr.*	*cwt.*	*T.*
16 =	1			
448 =	28 =	1		
1,792 =	112 =	4 =	1	
35,840 =	2,240 =	80 =	20 =	1

TROY WEIGHT

24 grains (gr.)	= 1 pennyweight	pwt.
20 pennyweights	= 1 ounce	oz.
12 ounces	= 1 pound	lb.

gr.	*pwt.*	*oz.*	*lb.*
24 =	1		
480 =	20 =	1	
5,760 =	240 =	12 =	1

APOTHECARIES' WEIGHT

20 grains (gr.)	= 1 scruple	sc. or ℈
3 scruples	= 1 dram	dr. or ʒ
8 drams	= 1 ounce	oz. or ℥
12 ounces	= 1 pound	lb. or ℔

gr.	℈	ʒ	℥	℔
20 =	1			
60 =	3 =	1		
480 =	24 =	8 =	1	
5,760 =	288 =	96 =	12 =	1

MEASURES OF CAPACITY

LIQUID MEASURE

4 gills (gi.)	= 1 pint	pt.
2 pints	= 1 quart	qt.
4 quarts	= 1 gallon	gal.
$31\frac{1}{2}$ gallons	= 1 barrel	bbl.
2 barrels } 63 gallons }	= 1 hogshead	hhd.

gi.	*pt.*	*qt.*	*gal.*	*bbl.*	*hhd.*
4 =	1				
8 =	2 =	1			
32 =	8 =	4 =	1		
1,008 =	252 =	126 =	$31\frac{1}{2}$ =	1	
2,016 =	504 =	252 =	63 =	2 =	1

APOTHECARIES' FLUID MEASURE

60 minims, or drops (♏)	= 1 fluid dram	f ʒ
8 fluid drams	= 1 fluid ounce	f ℥
16 fluid ounces	= 1 pint	O.
8 pints	= 1 gallon	Cong.

DRY MEASURE

2 pints (pt.)	= 1 quart	qt.
8 quarts	= 1 peck	pk.
4 pecks	= 1 bushel	bu.

pt.	*qt.*	*pk.*	*bu.*
2 =	1		
16 =	8 =	1	
64 =	32 =	4 =	1

MISCELLANEOUS TABLES

METRIC EQUIVALENTS OF POUNDS, FEET, ETC.

The government publishes the equivalents in pounds, etc. of the metric system, but the American shipper wants to know what the pounds, inches, feet, and gallons, to which he is accustomed, are in the metric system. The following is a convenient table showing the metric values of our measures. Some countries demand that the metric system should be used in the consular papers, and in most countries, especially in Latin-America, the consignees ask for the weights, etc. in the metric system.

Pounds	*Kilos*	*Pounds*	*Kilos*
1	= .4536	60	= 27.216
2	= .9072	70	= 31.751
3	= 1.3608	80	= 36.287
4	= 1.8144	90	= 40.823
5	= 2.2680	100	= 45.36
6	= 2.7216	200	= 90.72
7	= 3.1751	300	= 136.08
8	= 3.6287	400	= 181.44
9	= 4.0823	500	= 226.80
10	= 4.536	600	= 272.16
20	= 9.072	700	= 317.51
30	= 13.608	800	= 362.87
40	= 18.144	900	= 408.23
50	= 22.680	1,000	= 453.60

1,000 kilos = 1 metric ton (Tonelada metrico).

	Centimeters		*Centimeters*
1 inch	= 2.54	7 feet	= 213.36
1 foot	= 30.48	8 feet	= 243.84
1 yard	= 91.44	9 feet	= 274.32
2 feet	= 60.96	10 feet	= 304.80
3 feet	= 91.44	11 feet	= 335.28
4 feet	= 121.92	12 feet	= 365.76
5 feet	= 152.40	13 feet	= 396.24
6 feet	= 182.88	14 feet	= 426.72

TABLE OF DISTANCES

1 mile	= 5,280 ft.; 1,760 yd.; 320 rd.; 8 fur.
1 furlong	= 40 rd.
1 league	= 3 mi.
1 knot,* or nautical mile	= 6,080 ft.; or $1\frac{1}{6}$ mi.

* A knot is really a measure of speed and not of distance; when used in this sense, it is equivalent to 1 nautical mile in 1 hour. Thus, a vessel traveling 20 nautical miles per hour has a speed of 20 knots.

1 nautical league	= 3 nautical mi.
1 fathom	= 6 ft.
1 meter	= 3 ft. $3\frac{3}{8}$ in., nearly
1 hand	= 4 in.
1 palm	= 3 in.
1 span	= 9 in.
1 cable's length	= 240 yd.

MEASURES OF VOLUME

1 cubic foot	= 1,728 cu. in.
1 ale gallon	= 282 cu. in.
1 standard, or wine, gallon	= 231 cu. in.
1 dry gallon	= 268.8 cu. in.
1 bushel	= 2,150.4 cu. in.
1 British bushel	= 2,218.19 cu. in.
1 cord of wood	= 128 cu. ft.
1 perch	= 24.75 cu. ft.
1 ton of round timber	= 40 cu. ft.
1 ton of hewn timber	= 50 cu. ft.

Cylinders having the following dimensions in inches contain the measures stated, very closely; the diameters are given first:

Gill	= $1\frac{3}{4}$ in. × 3 in.	Gallon	= 7 in. × 6 in.
Pint	= $3\frac{1}{2}$ in. × 3 in.	8 gallons	= 14 in. × 12 in.
Quart	= $3\frac{1}{2}$ in. × 6 in.	10 gallons	= 14 in. × 15 in.

MEMORANDA

MEMORANDA

MEMORANDA

MEMORANDA

MEMORANDA

SEE FOLLOWING PAGES

The Benefits of an Agricultural Course

The benefits to be derived from a Course in Agriculture in the I. C. S. are manifold, the most important, perhaps, is that it teaches the tiller of the soil to grow not only a better crop, but realize a greater production, as well as to do it with a great deal less of labor and expense, thereby making the tilling of the soil more of a pleasure than a drudge. Farmers, as well as others, are waking up to the truth that scientific farming is the only proper method to pursue, especially in these days of worn-out land, problems of drainage, and other things too numerous to mention. In this connection, your instruction on manures is worth the price of the whole Course. I might say the same of your instruction on drainage, etc.

I have just put out twenty-five ParagonChestnut Trees, and a quantity of Catalpa Speciosa, Bald Cypress, etc., and, in the proper preparation of the soil to receive these trees, your instruction, of course, stood me in good stead. Am also growing Ginseng, Golden Seal, Pink Root, Ladies' Slipper, and others of the so-called "special crops," on the same farm; the preparation of the soil for the successful growing of such plants requires special consideration and study. I also have a problem of drainage on my hands, on the same farm, but, with the instruction given in your Agricultural Course, it will be a very easy matter to meet all the conditions.

I have endeavored to make my letter brief, but, on account of the great scope or magnitude of your Agricultural Course, it would be difficult to say it all upon a hundred sheets of paper of this size.

WAYNE CANFIELD,
84 Madison St., Wilkes-Barre, Pa.

SECURED A POSITION ON A POULTRY FARM

JACK CHAMBERLAIN, Petoskey, Mich.: "Since taking up your Course in Poultry Farming I have been employed on a poultry farm, and my wages are 10 per cent. higher than ever before, due to the knowledge gained from your Course."

WELL SATISFIED

PHILLIP BECKER, 1910 Prospect Ave., New York, N. Y.: "I desire to state that I find your Course in Agriculture all that I expected it would be. It not only explains everything, but tells what to do, when to do it, and how to do it. I am very well satisfied with the Course."

MANAGING A LARGE PLANT

PHILIP J. ROY, St. Joseph Academy, Tipton, Ind.: "From the knowledge gained from the lessons in your Poultry Farming Course that I have completed, I have been appointed manager of poultry farming for this institution, and as a special favor I ask all the assistance that the I. C. S. may see fit to give me to make my work a success. At present, I have 1,000 eggs under incubation. The president and general manager of this institution have inspected my studies thus far and they have given me their confidence in my work; they think your Course so complete that one can be successful if your teachings are followed."

FIT TO MANAGE A FARM

J. H. PENNINGTON, Pennington Gap, Va.: "My Course in Agriculture has been of great practical value to me and I am sure that any one who studies it will be fully able to manage a farm."

NOW MANAGER

CLAUDE C. ROCKE, Manager Hillair Farm, Sterlington, N. Y.: "I find the knowledge derived from your Course in Soil Improvement and Farm Crops of practical value in my business. I took up the Course with the idea of gaining all the information possible concerning agriculture, also the more advanced methods of farming. I now have charge of a gentleman's estate, and there is seldom a day but some points of the Course are of benefit to me in my work."

Worth Many Times Its Cost

I wish to express my gratitude to the faculty of the International Correspondence Schools for the assistance they have rendered me and the interest they have taken in my progress and success since I enlisted for a Course in Soil Improvement and Farm Crops. The Instruction Papers are very lucid and cover every point of importance with the utmost care, thereby making it easy for a person to grasp the meaning of what is taught. I think any one who contemplates making farming his life vocation will find an International Correspondence Schools' Course in Agriculture worth many times the cost.

WILLIAM R. HALLOWAY,
River Side Farm, Newark, Md.

MOST PRACTICAL

HAROLD BROWN, 1511 W. 8th St., Los Angeles, Cal.: "I think your Poultry Course is the most complete and practical I have ever seen, covering as it does every branch of the business thoroughly from start to finish."

WE HELPED HIM OBTAIN A POSITION

JOHN GOWDEY, Millville Poultry Farm, Millville, N. J.: "The Poultry Farming Course in which I enrolled last October is now nearly finished and I have found it to be an exceedingly valuable Course, as it contains a great amount of very valuable information along the line of poultry raising—information which no one person could gain in even a lifetime of practical experience without such aid. I consider this Course one of the best investments of my life; and would not be without the information gained through it for many times the cost of the Scholarship. I wish also to thank your Students' Aid Department for the valuable assistance they have rendered in securing a position that I desired."

SAVED HIM FROM FAILURE

JAS. ARCHER GURNEY, Charleston, S. C.: "When I began studying the Poultry Farming Course for which I enrolled with the I. C. S. I had no idea there was so much to be learned about poultry. Had I attempted to go into the business prior to the study of this Course I would have made a grand failure. The knowledge gained from each one of your Instruction Papers is worth the price of the entire Course."

NO HOBBY OR THEORY

MARSHALL J. LUNE, South Hill, B. C., Canada: "I found the Poultry Farming Course of the I. C. S. to be simple, pointed, and accurate. I have been impressed with the fine judgment, sound business methods, and scientific research which stamps the author as a scientific and practical man of long experience. The subject matter is well chosen and carefully pruned of all hobbies and unproven theories."

HIS COURSE PROFITABLE

C. L. LAW, 2036 W. 83d St., Cleveland, Ohio: "I have found my Poultry Farming Course very satisfactory. Previous to enrolment with the I. C. S. I had studied poultry raising and had bred poultry to some extent; but I must say that your Course has been of great profit to me."

Learned More in a Few Months Than in Six Years Previous

The knowledge that I have gained since I started to study your Course in General Farming has been of great assistance to me. I had 6 years of practical farm experience previous to taking the Course, but I have learned more about farming in the few months that I have studied than in the 6 years previous. The textbooks make everything so plain that any one with a common school education can easily understand them. I feel very confident that the Course will be very helpful to any one engaged in agricultural work.

C. H. SIEMER,
Bernardsville, N. J.

CANNOT FAIL TO SUCCEED

Bert White, Box 477, Burlingame, Kans.: "Any one interested in poultry should invest in the Poultry Farming Course with the I. C. S. From personal experience I can say that any one that will study the Course cannot fail to succeed. Each subject is well explained and easily understood. Since I began to study my Course the profits of my flock are rapidly increasing."

MARKED SUCCESS

Walter L. Harlan, 218 Center St., Mauch Chunk, Pa.: "After studying your Poultry Farming Course I can truthfully say that I made a marked success in raising and caring for poultry, and I will always recommend the Course to any one interested in the subject."

HIS COURSE BROUGHT SUCCESS

Moses L. Kohen, Pueblo, Colo.: "I think the Poultry Farming Course issued by the I. C. S. is fine. As a result of studying it I have been able to raise a nice lot of chickens and I know that I could not have succeeded as I have without the information obtained through your Schools."

HIS COURSE PROFITABLE

J. C. Threnhauser, Fair Haven, Pa.: "I cannot express my appreciation of the value of your Poultry Farming Course since the benefits derived are far beyond my anticipation. Since taking your Course I have spent some time at the government experiment station. Their course in some respects is quite like yours, but it it not so extensive or so complete. I have been offered two positions to take charge of poultry farms, both of which I declined, because I can do much better by caring for my own poultry."

HIS COURSE A BENEFIT

W. T. Courtney, Atlanta, Ga.: "I found the Agricultural Course to be of great benefit to me; in fact I know of no other way in which I could have gained the same practical information so readily. I was promoted to be superintendent of grounds of the Spelman Seminary. This threw a herd of dairy cows and several acres of land on my hands. Being practically ignorant of such things I turned to agricultural literature, but found nothing that helped me to systematize what I learned. I then decided to take your Course, and feel that I have learned more from it than would have been possible any other way. I have been uniformly successful in following out your instructions."

A Course that Leads to Success

I have found your Course in General Farming to be simple, practical, and of the greatest value to a prospective farmer or stockman. A study of your Course is not only a mortgage lifter, but it will put a common-sense man in a position to be envied by his fellow men. I would not part with my Course for many times the amount paid. You not only get the Course but four beautiful Bound Volumes for reference and future use. I shall always endeavor to interest my friends to the best of my ability and will advise them to take the Course, as a study of it will lead to their greatest aim in life.

Alex. R. Gaul,
272 Western St., Albany, N. Y.

HIS MOST SATISFACTORY INVESTMENT

MARTIN J. ROONEY, 408 S. Ohio St., Butte, Mont.: "The I. C. S. Course in Poultry Farming is thorough in every particular. I can honestly say that I consider the price I paid for the Course one of the most satisfactory investments I ever made."

THE BEST OF ITS KIND

FRANK H. PAYNE, 115 Patterson Ave., Ogden, Utah: "I am more than satisfied with my Course in Poultry Farming for which I enrolled in the I. C. S., and can truthfully recommend it to any one wishing a thorough knowledge of the poultry business. I have studied several books on poultry culture, but your Course is the best of its kind."

NO EXCUSE FOR FAILURE

D. H. MCFALLS, White Plains, N. Y.: "I am pleased to express my appreciation of the Poultry Course by the I. C. S. If I had had the knowledge your Course has now furnished me two years ago, I would have been spared much anxiety and saved loss, since your Paper on feeding alone would have been worth more to me than the cost of the whole Course. To any one having your Course, there need be no more excuse for failures in the poultry business.

THE I. C. S. VERSUS EXPERIENCE

C. L. SWARTZ, Detroit, Minn.: "I like your Poultry Farming Course very much and have learned a great many things that would have taken years of experience to have found out. Any one starting in the poultry business would be spending his time and money wisely by taking the Course, as when he has finished the Course, he can start right in to make a success of the business."

MANAGING A POULTRY PLANT AT DOUBLE HIS FORMER WAGES

JACK W. PATTON, Coxeyetta Poultry Farm, Box 64, Massillon, Ohio: "Since studying your Course in Poultry Farming, I have been able to increase my earnings 100 per cent. I have secured the position of manager with the Coxeyetta Poultry Farm of Massillon, Ohio. I consider the lesson papers on Poultry Feeding alone worth the price of the entire Course. Any one completing your Course should have no difficulty in securing a position as manager or superintendent of a poultry plant."

A Help to the Ambitious

The knowledge which I have obtained from my Course has assisted me materially in my general farm work. My aim in studying the General Farming Course is to learn all that I possibly can now, so that when I shall be thrown on my own resources I may make a success of my profession. I find that the knowledge derived from my Course of instruction, owing to the clear and concise manner in which matters pertaining to agriculture are explained and described, will assist me considerably toward the fulfillment of my ambitions.

JOHN BARANOWSKI,
R. R. 3, Box 6, Montrose, Colo.

THE BEST SOURCE

Gilbert M. Burr, Meshoppen, Pa.: "As a student now completing your Poultry Farming Course, I can heartily recommend it to any one engaged in raising or handling poultry. I do not believe any one can derive as much benefit from any other source as by studying this Course. As a breeder of single-comb White Orpingtons, I find it full of valuable information and practical instruction for all phases of the work."

MONEY WELL SPENT

John B. Gallagher, 418 Broad St., Bethlehem, Pa.: "In fifteen years of poultry keeping I have not had such a successful winter as the present one and I have had only the I. C. S. to thank for my success. I thought that I knew how to keep poultry, but every lesson taught me new points. I consider the Course the best investment of my life and any one interested in poultry will do well with poultry and soon learn to make money from them. If they take this Course, it will be money well spent. Wishing you success in the good work you are doing, I remain."

FOUND OUR COURSE SUPERIOR

Paul O. Arnswald, 5917 N. 12th St., Philadelphia, Pa.: "I wish to inform you that I am a student of your Poultry Farming Course, and although I have seen a great many books on this subject, those I have received from you are absolutely the best I ever came in contact with. I think every one interested in poultry should have these books and your Course. Thanking you for your interest in me, I remain."

PRAISES HIS COURSE

Lewis Furman, R. F. D. 2, Sunbury, Pa.: "I have almost completed your Course on Poultry Farming and I think it is fine. If more people took your Course on Poultry Farming there would be more successful poultrymen."

OUR COURSE INDISPENSABLE

Edw. J. Murphy, 260 Bloomingdale Road, Worcester, Mass.: "I find your Course just what you claim it to be, and anybody intending to embark in the poultry business, either the novice, amateur, or expert, should study it. To accomplish success your Course is indispensable."

Found His Course Helpful and Practical

I desire to state that I have gained considerable knowledge from your Course in Agriculture. I am engaged in farming and what I have learned from your Instruction Papers has been very helpful to me. I feel confident that any one wishing to take up agricultural work will derive great benefit from the study of an I. C. S. Agricultural Course. I do not see how the Course could be made any plainer or easier to understand. Any one who can read and write can get along with such a Course without any trouble whatever.

R. F. SNYDER,
Ashland, Pa.

NOTHING LACKING

C. H. Rosenbaum, 227 Poplar St., Norristown, Pa.: "Before taking your Course in Poultry Husbandry, I had been studying the business for several years; reading the best books published on the subject, and all that, but in them all there was always something lacking—something that was not thoroughly explained. Your Course in Poultry Husbandry leaves nothing unexplained to the smallest detail. I consider myself greatly benefited by your Course. The articles on feeding alone are worth the price of the entire Course."

NO OTHER POULTRY LITERATURE APPROACHES OURS

E. F. Staudacher, Brooklyn, N. Y.: "I have read various poultry magazines, government bulletins, different poultry-system books, etc., but I have never read any poultry literature that, in my opinion, could approach the Poultry Farming Course that you are now furnishing. It is the most practical, comprehensive, and voluminous treatise on the subject that I have ever come across; it fully covers the subject matter in all its phases; is most interestingly and entertainingly written, and it seems to me that the further I go into it, the more enthusiastic I become with it. In short, it is a clear, concise, and most excellent write-up in which the presentation of facts is attractively set forth in a manner easily understood."

STUDIED BOOKS AND FAILED—OUR INSTRUCTION TURNED FAILURE INTO SUCCESS

Chas. S. Fry, 241 Rose St., Reading, Pa.: "After having taken your Course on Poultry Farming, would say it is very interesting and instructive, and I have derived great benefits from it. I have been interested in poultry for about twenty years; read all kinds of poultry books and thought I knew a great deal about poultry, but had failures all through. Your Course has overcome these failures and cannot be recommended too highly, because it not only instructs how to house, breed, and feed all kinds of poultry, but gives all the details on diseases which must be known by all successful poultrymen."

OUR COURSE MORE VALUABLE THAN ALL POULTRY PUBLICATIONS

Ralph W. Weston, Box 26, Honolulu, Hawaii: "Having about completed your Course in Poultry Farming, I can say in all faith that the methods set forth are of priceless value to any one intending to keep poultry, ducks, geese, turkeys, or squabs. In a small way, I have applied the methods set forth in the Course and find the results as stated. In my opinion the Poultry Farming Course is worth all the poultry magazines published, and is also worth many times the expenditure of time and money."

Praises the I. C. S.

As a student of your Agricultural Course, I have received the best instruction that I could have found anywhere. To a person that already has work of some kind, as I had, it offers a good chance of gaining more knowledge without taking very much time from regular work. Also, it is not expensive. The Course starts from the beginning and treats all subjects so that any one without any previous knowledge of the subject can easily master the instruction given and can carry the work completely through. This knowledge will be of great practical assistance to any one. The volumes that are furnished with the Course are very good. I would advise any one thinking of taking a Course to do so with the International Correspondence Schools.

ERNEST E. VEST,
Scottsburg, Ind.

WORTH MANY TIMES THE PRICE

CLARENCE THEO. ANVICK, Box 23, Arcata, Cal.: "It would hardly seem just for one to finish your Course in Poultry Farming without giving an opinion on it. Every branch of poultry farming has been so thoroughly touched, and presented in such simple language that no one who takes up its study can fail to fully comprehend the text. The Course is worth many times the price paid for it and cannot be easily forgotten. It can be safely recommended to all who wish a broader knowledge of the subject, and should appeal alike both to those who intend to enter the business of poultry raising on a small scale or a large scale."

DOLLARS AND CENTS KNOWLEDGE

THOMAS H. POLLARD, 916 Eighth Ave., Brooklyn, N. Y.: "Having been a subscriber to your Mechanical Course in former years, I was pleased to learn that you were issuing a Course in Poultry Farming. Knowing the need of information on this subject, I subscribed for the Course. In reading and studying the first Instruction Papers, I began to realize the greatness and perfection of the Course. Step by step the student is led to proficiency and also I find that each step has been carefully examined beforehand from one standpoint—the question of dollars and cents. In this lies the crux of the matter, the secret of success."

SUPERIOR TO OTHER COURSES

W. A. MOORE, 143 Sherman Ave., N. Hamilton, Ont., Can.: "This is to certify that I have nearly completed the I. C. S. Poultry Course and I find it up to date and the best so far. I have taken courses in two other poultry schools and followed the experimental farms and find points completely covered in the I. C. S. Course which all others said they had no data of. Any one desiring a thoroughly practical poultry course can get nothing better."

HIS COURSE BROUGHT SUCCESS

D. BRANNAN, 223 Beech St., Grafton, W. Va.: "I can truly say that since I began to study the Course in Poultry Farming I have had perfect success with my fowls. I have 11 pullets and four cockerels and have been getting from 50 to 75 per cent. egg yield since my flock was 6 months old, and I am not troubled with colds, etc., in my flock as before. The Poultry Farming Course is very good in its teachings with regard to the commercial side of poultry raising; that is, raising fowls for meat and eggs."

Proprietor of a Prosperous Business

Before I enrolled with the I. C. S. for the Poultry Farming Course I was in the milk business. Since enrolment I have sold out and now devote all my time to poultry. I found no difficulty in completing my Course and I have to thank the I. C. S. for putting me where I am today. No one going into the poultry business for profit can do without the I. C. S. Course. There is much to learn and the Course will take you over all the dangerous places in safety. There is no branch of the poultry business omitted. I am at present making about three times as much by selling hatching eggs and day-old chicks as I did before enrolment.

G. F. KAIHLER,
508 S. Lime St., Lancaster, Pa.