PUBLIC SCHOOL AGRICULTURE

BY

J. H. HUTCHISON, B.A.

INSPECTOR OF PUBLIC SCHOOLS, EDMONTON, ALBERTA
FORMERLY INSTRUCTOR IN AGRICULTURE,
NORMAL SCHOOL, CALGARY

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The "E.P." ranch in the foot-hill country west of High River, Alberta. This ranch, owned and operated by His Royal Highness, the Prince of Wales, is stocked with many of the finest pure bred horses, cattle, and sheep.

PREFACE

In the selection of topics and material for this book only those considerations having to do directly with Agriculture in Western Canada have been stressed, and particular attention has been given, throughout, to the problems belonging to the various types of farm enterprise which are followed in the province of Alberta. As far as possible a purely technical treatment of the subject has been avoided. The effort has been to set forth the important principles underlying the science of Agriculture in an interesting and attractive way, and in a form readable and comprehensible by pupils belonging to the senior grades of the public school.

The treatment of certain topics, such as Soils, Gardening, the Potato, Stock, Poultry, Milk, Birds, Trees, Farm Accounts, Marketing, etc., has been made rather extensive in order to provide a large body of material on phases of the subject which come within the experience and appeal to the interest of boys and girls who live in the urban communities and do not enjoy the advantage of first-hand experiences with agricultural life and conditions.

The questions, exercises, and experiments cannot always be answered from the text, nor is it expected that all of these will be attempted in class. They are intended to serve as a means of enforcing the information given, and it is hoped that they will encourage teachers and pupils to gather further interesting information related to the topics dealt with in the various chapters.

In the preparation of the book the author has secured much valuable assistance and many suggestions from a large number of books upon the subject of Agriculture. In addition, wide and very free use has been made of the information afforded

in the various bulletins published by the Dominion and the several provincial Departments of Agriculture. Articles contained in the important farm and poultry journals of Canada have also furnished many valuable suggestions. The assistance received from all these sources is most gratefully acknowledged.

It is a pleasure to acknowledge here also the co-operation and the helpful criticism of all those who, with information and advice, assisted with the preparation and the checking of the manuscript. In this connection the author desires to thank especially: H. A. Craig, B.S.A., Deputy Minister of Agriculture; W. J. Stephens, B.A., Field Crops Commissioner; H. L. Humphreys, B.A., Principal McCauley School, Edmonton; F. S. Carr, B.A., Inspector of Schools, Medicine Hat; J. A. Fife, M.A., M.Sc., Inspector of Schools, Edmonton; Mr. R. O. German, Secretary, Alberta Wheat Pool; and W. C. McCalla, M.Sc., Instructor in Agriculture, Calgary Normal School.

The material for the illustrations was secured from two sources chiefly, and the author is accordingly deeply indebted to Mr. M. W. Geddes, Editor of *The Farm and Ranch Review*, Calgary, Alberta, and to Mr. Colin G. Groff, Publicity Commissioner for the Province of Alberta.

J. H. H.

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AGRICULTURE

CHAPTER I

INTRODUCTION

Divisions of Agriculture.—Agriculture is the production of plants and animals that are useful to man. It has to do with land, its cultivation, and its products. There are, however, many divisions of agriculture, the most important being *farming*, *mixed farming*, *dairy farming*, and *ranching*.

We commonly think of *farming* as the work of ploughing, disking, harrowing, and cultivating the land in order to make a good seed bed in which to grow crops. These crops may be wheat, oats, barley, rye, peas, corn, clover, timothy, as well as such roots and vegetables as carrots, potatoes, turnips, and beets.

Usually, however, the farmer does not confine his work to the growing of grains, fodders, and vegetables. Very often he also raises horses, cattle, sheep, hogs, or poultry. When he combines stock raising with the growing of grains and roots, he is said to be engaged in *mixed farming*.

If he is particularly interested in producing and marketing milk, cream, butter, and cheese, he is said to be engaged in *dairy farming*.

Some persons are occupied chiefly in raising stock. They frequently use large areas for grazing purposes, reserving only a very small portion for cultivation. On these lands great numbers of horses, cattle, or sheep roam and graze. This differs from other types of farming and so has a name of its own,—it is called *ranching*, and those who engage in it are known as *ranchers*.

Special Branches of Agriculture.—There are a few special branches of agriculture. *Horticulture*, from the Latin *hortus*, a garden, is one of the most important of these. It includes not only vegetable gardening, flower gardening, and fruit gardening, but also the growing of

A typical Alberta farm scene.

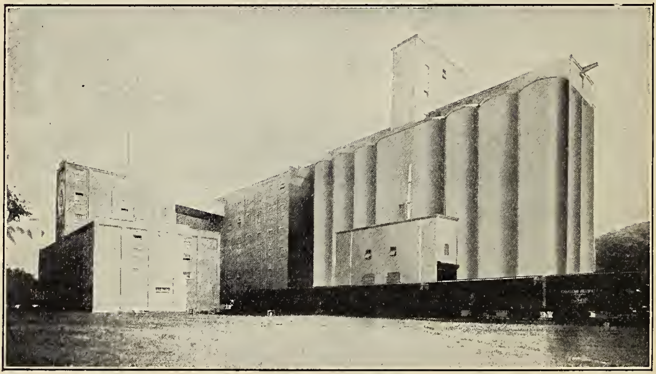
trees and shrubs for purposes of decoration. *Forestry*, from the Latin *foresta*, a wood, is another. It means the planting and growing of trees whether for wood, shelter, or beauty. *Apiculture*, from the Latin word *apis*, a bee, has to do with bee-keeping for the production of honey.

Importance of the Products of the Farm.—Agriculture is one of the most important of all occupations. It supplies many of our needs directly, and it furnishes the raw material for many of our industries. Most of our foods come from the farms, gardens, or orchards of our own or of other countries. We get not only our grains, vegetables, and fruits from these sources, but also our meat, butter, eggs, milk, cheese, and honey. So, also, we obtain the materials from which our clothing is made—wool, cotton, flax, and silk. We can readily see that an industry which furnishes so much of our food and clothing is of supreme importance. Without the products of the agricultural industry we could not exist.

Cattle ranching on the Western prairies: wide range, abundance of water, and thousands of select beef cattle.

Activities depending upon Agriculture.—But we are dependent upon agriculture for more than food and clothing. It is the industry upon which manufacturing and commerce are largely based—mills for grinding grain and making flour, bran, rolled oats, and numerous breakfast foods; sugar-beet factories for making sugar out of the beets grown on the farm; canning factories in which all kinds of vegetables and fruits are canned, and in this way preserved for shipment and storage until needed for use; packing plants, in which animals of the farm are slaughtered for meats; harness, boot, shoe, and glove factories, which make use of the hides from these farm animals; woollen and cotton mills for making the raw materials of the farm into cloth; all these and many others depend upon agriculture to supply their raw materials. The transportation systems, too—the railroads and the steamboats, — are largely dependent for their freight or cargoes upon the products of the farms, or upon the articles manufactured from these products.

The successful Farmer.—To be successful, a farmer must study three phases of the industry: the *science*, the



One of the large flour mills of Western Canada.

art, and the *business* of agriculture. Long experience, study, experiments, and investigation have brought to light a great deal of information about soils, plants, and animals. This knowledge, when tested, proved, and arranged in order, is known as the *science of agriculture*. The farmer must understand the scientific principles upon which farm practices are based. Moreover, he must be able to apply this knowledge in growing plants and raising animals. This latter is the *art of* *agriculture.* He must, in addition, be a good business man, careful and capable in his buying and selling and in his management of all the affairs of the farm. This is the *business of agriculture.* The art and the business of agriculture can be learned only through practice and experience, but the science of agriculture may be learned through reading and study, and by a close observation of soils, plants, and animals.

Questions, Problems, and Exercises

1. Which of the branches of agriculture is most important in your locality?

2. Make a list of the principal farm products marketed from your district.

3. Compare farming with ranching, with respect to: (a) the nature of the work; (b) conditions needed; (c) amount of land in use; (d) advantages.

4. What is meant by saying that "Agriculture is a *primary* or *basic* industry?" Name, in the order of their importance, the other basic industries of your province.

5. It is said that "Agriculture provides the means of livelihood for the whole community." By referring to the merchant, the doctor, the railroads, the packing plants, the mills, and the factories show that this is largely true in your province.

6. Make a list of the industries and occupations which are affected by the raising and the disposition of the following: a cow and its products; a hen and its products; a hog and its products.

7. Explain what is meant by the *science*, the *art*, and the *business* of agriculture, and show how these are related to one another.

8. Write a composition on each of the following topics: "How to prepare Oneself for Success in Farming," "Boy Life on the Farm," "Farm Life and Work to-day as compared with One Hundred Years Ago."

CHAPTER II

THE ORIGIN AND COMPOSITION OF THE SOIL

Soil.—The loose material on the surface of the earth in which plants grow, and which may be tilled, is called *soil.* If we place some of it under a lens or microscope and examine it, we see something which looks very much like a pile of stones. These tiny stones, for that is what they are, mostly have the edges worn or rounded off. They are of many colors—white, black, gray, green, red,—and some are streaked, but they do not appear to vary greatly in size. They are tiny particles which have been broken or ground from rocks, and they form a very large part of the soil. No crop, however, could grow well in a soil made up entirely of rock particles.

If we look still more closely, we shall see here and there in the soil, and clinging to some of the rock particles, little black specks; some of them look like tiny lumps of dirt sticking to the stones. Though there may be, by comparison, only a very few of these specks, they are nevertheless extremely important. They are the *organic* part of the soil; they once had life; they are the partially decayed bodies of plants and animals that once grew and lived upon the surface of the earth. The little rock fragments themselves are called the *inorganic* part of the soil. "In," here, means "not," that is *not organic*; for rocks never had life in them.

THE ORIGIN OF THE SOIL

Let us consider further these two materials of which the soil is composed, turning our attention first to the inorganic or rock particles. What was it that ground up the rocks in this manner, or broke so many fragments from them? How did the fragments from so many different kinds of rocks become mixed together? Why are the particles so nearly the same in size? To find an answer to these questions we must consider briefly how the surface of the earth came to be as it is to-day.

As the earth cooled, it shrank in size, and its surface wrinkled and crinkled into great ridges and depressions.

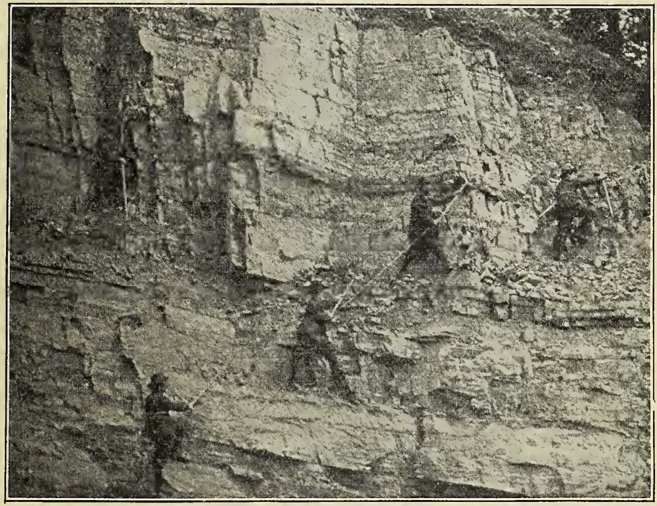
Changes in the Earth's Surface.—Scientists tell us that the earth was once a ball of molten material, red hot and spinning through space. Through long ages it gradually cooled and developed its rock-bound crust. As it cooled, it shrank in size, its outer surface wrinkling and crinkling into great ridges and depressions. The elevations made the continents and islands, while the cooling vapors condensed into water, which filled the depressions. Thus the water was separated from the land. This shrinking process is always going on, and the shape and surface of the earth are constantly changing. Sea bottoms rise above the surface of the water and become land, and land sinks to become covered again by the sea. Ridges of rock are slowly but surely being

Bad lands in the Red Deer Valley. The agents at work in soil-making are never at rest. Can you tell from the picture what forces have been active here?

broken up and crumbled away. This process is called *weathering*, and it is going on about us everywhere and all the time. It is the process by which soils are being made from rock.

FORCES AT WORK IN SOIL-MAKING

The chief agents or forces at work in soil-making are the *changing temperature, air, water, plants,* and *animals.* These forces never cease; day and night, winter and summer, they are always and everywhere at work. In the polar regions and in the sun-scorched tropics, on the level prairie and on the rugged mountain-top, in the open fields and in the depths of the forest, along the margins of the seas and far into the interior of the mainland, they



Rocks with their surfaces weathered and decayed.

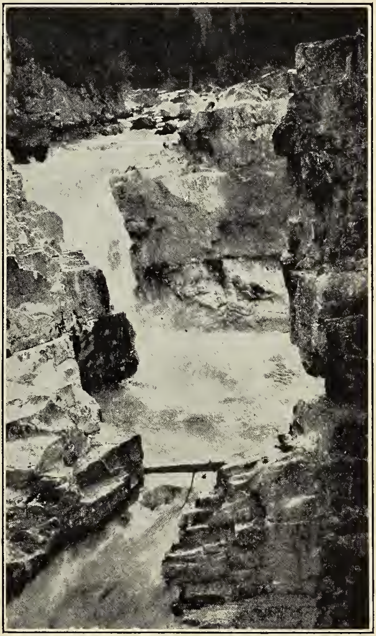
are constantly breaking down the rocks and reducing them to fragments.

Heat, Frost, and Air.—Nearly all rocks are made up of substances which we call *minerals*. This mineral matter is usually bound together into solid rock by certain cements, such as compounds of iron and lime. Solids expand, or get larger, when heated, and they contract, or get smaller, when cooled. The sun, beating down upon the rocks, heats their substances, and these expand; and later they contract in cooling. Then, too, rocks are made up of several kinds of minerals, and these do not all expand or contract to the same extent when heated or cooled.

The effect of such *uneven expansion* is sometimes seen when we pour boiling water into a thick tumbler. The surface touching the boiling water expands more than the other surfaces, and the strain breaks the glass. So it is that, as the temperature changes from day to day and from season to season, the different minerals in the rocks, at their surfaces at least, are never really at rest. Strains and stresses are set up, and tiny cracks are formed. These admit the rain, which has brought down with it from the atmosphere oxygen, carbon dioxide, and other gases.

We know that iron exposed to the weather will soon lose its hard, bright nature and become rusty. The moisture and the oxygen of the air unite with the iron to form the soft rust. In the same way these attack the cements of rocks, which are thus decomposed and later washed away by the rains. So the cracks become larger and larger. On a cold night the water in these cracks freezes, expands, and bursts off fragments of rock. Rocks with the surface weathered or decayed in the manner described may readily be found and examined. The surface, however, is not the only part of the rock affected by heat, water, and frost. Occasionally deep fissures will open in the rocks, owing to the stresses within them, and water, entering these fissures, freezes and expands, bursting off great masses of rock. These fall away and in their turn are further broken up by the same forces.

Plants.—The roots of trees sometimes grow in these cracks in the rock. In growing they press so heavily upon the rock that they often force it open and cause pieces of various sizes to be broken off. The acid produced by growing roots dissolves some of the rock particles and thus helps to make soil. Some of the lower orders of plants, such as lichens and mosses, actually feed upon the materials of rocks and so aid in decomposing them.


The power of running water is very great.

Running Water.—The power of running water is very great. It deepens the beds of streams by dissolving parts of the rock as it moves along. Swift streams carry with them heavy pieces of rock, which are tumbled along in the bed of the stream, scouring it deeper and deeper. In this way, too, the rough pieces lose their sharp, irregular edges and become the smooth and rounded stones which we see in almost every stream. As the bed of the stream is deepened, new parts of its rocky sides are exposed to the weathering effects of the sun, air, wind, and frost.

Running water has assisted also in the distribution of soil as well as in its making. It wears away the banks of streams and carries off from the surface of the fields great quantities of soil. When the speed of the river is slackened where it enters the sea, the very heavy materials fall to the bottom and remain there; the next heaviest are carried farther, and the finest materials are carried farthest of all before they settle to the bottom. In this way rivers sift the soil and lay it down in beds, some coarse, some finer, and others finer still.


A glacier is a great mass of flowing ice.

When such lands rise from the sea, as they have done in the past, the gravel, sand, and clay are all found laid down in separate beds. In high water, rivers frequently spread out over the land, and in receding leave deposits of fine soil, rich in vegetable material and thoroughly mixed. The soils thus formed are very fertile and productive.

Glaciers.—Glaciers, too, have always played a great part in soil formation and distribution. Many thousands of years ago the climate of North America became very cold, and most of Canada and much of the United States was covered by a great ice sheet. In the northern parts the snow and ice collected until it became thousands of feet thick. As the climate became milder, the ice and snow began to melt along the southern fringes of the mass. This caused the great field of ice to move towards the south. Like a huge mill it broke off great masses of rock, crushing and grinding these into ever smaller and

The waves dashing against the shore wear away the rocks.

still finer particles as it moved along. The streams running from it carried away the material, sifted it, and laid it down in beds. When the ice finally melted, the whole surface of the earth in this region was greatly changed. In some sections the rock was left bare of soil, while in others there remained vast areas of fertile soil material. The soil of our western prairies was built up in this way through the work of the great glacier.

Wind.—Wind is another agent in forming and distributing soil. It removes soil from one place and deposits it in another. In parts of the Prairie Provinces, high winds carry away enormous quantities of the best of the surface soil. In desert areas the sand grains carried by winds act as a sand blast upon the rocks and chip away tiny particles of the rock surface.

Animals that dig and burrow in the earth—the badger.

Waves.—Waves are very destructive along sea and lake shores. They strike with terrific force, and during storms will pick up stones from the bottom and dash them against the cliffs, in time battering from them fragments which are carried away as the waves recede.

Animals.—Animals, also, play a part in changing the earth's surface. Some, such as badgers and gophers, dig and burrow in the earth, bringing soil to the surface, where it is exposed to the weathering agents already described. Water and air find their way into these openings in the earth, and by their action bring about further changes. Certain worms, such as the angle or fish worms, working their way through the soil, make many channels in it, through which air can pass into the soil. These animals also work over parts of the soil, changing its nature. When they die, their remains become mingled with the soil, thus altering its composition.

All of these agents, working together through the ages, have broken up the rock and have sifted and distributed the materials, so that we now have gravel beds and sand and clay fields over wide areas where once there was nothing but the solid rock of the earth's crust.

Questions, Problems, and Exercises

1. Examine closely a small portion of dry garden soil with a microscope or a reading glass. Rub it in the palm of the hand. Press it under the blade of a knife against a glass plate. What material chiefly do you find in the soil? How do you recognize the "organic" part of the soil?

2. Experiment with pieces of rock of a coarse-grained type to see the effect of heating them in a fire and then cooling them with water. What is the cause of any breaking or crumbling of the rock which may occur? Discuss temperature changes which produce similar results on a large scale. Try to find samples of rock broken down through these changes.

3. The particles of certain rocks are cemented together with compounds of lime and iron. Describe the effect when such rocks are exposed to the air. Try to find samples of rock weathered in this way.

4. Tell of some experience which shows the strong expansive force of water in freezing. Show that this action is operating on the rocks in the fields and on the mountain slopes.

5. City authorities find it advisable to destroy plants found growing in the crevices in cement sidewalks. What injury is likely to result to the walk if this is not done? Describe the work of plants in soil formation.

6. Describe three distinct ways in which running water has helped in the formation of soil.

7. Where and how are glaciers formed? What evidences of glacial action do you find in your locality? Describe the work of glaciers in soil formation.

CHAPTER III

KINDS OF SOIL

Classification of Soils.—Gravel, sand, silt, and clay are all derived from rock and differ from one another chiefly in the size of the particles of which each is composed. If it takes twenty-five of these particles laid side by side to measure an inch, we have coarse sand. Anything coarser than this is called gravel. From coarse to fine sand, the particles run from twenty-five to 500 to the inch; where they run from 500 to 5000 to the inch we have silt; and in any soil in which the particles are smaller than this we have clay.

No soil is, however, composed wholly of particles of the same size. There are always some of the smaller grains found in sand and some of the coarser in clay. A soil may have as high as fifty per cent, or half of its weight, made up of very fine grains, or clay, and yet have sandy characteristics sufficient to make it a *sandy soil.* On the other hand, as much as twenty per cent of the weight may be made up of sand grains, and the soil may still be a *clay soil. Loams* are mixtures of sand and clay, together with organic matter, which in an agricultural soil is called *humus.* Loams may be further classified as *sandy loams* or *clay loams,* according to the relative proportions of sand or clay found in them.

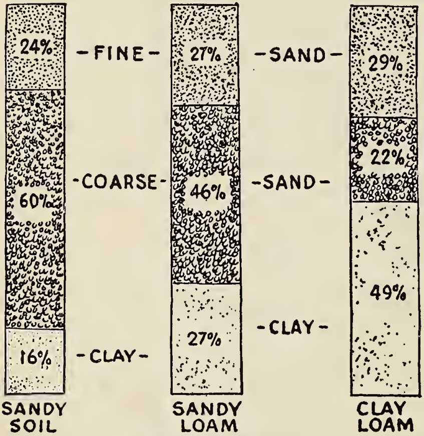
Sandy Soils.—Sandy soils are spoken of as light soils, not because they are light in weight, but because they are easy to plough and cultivate. They are open and porous, and permit water and air to pass through them readily. They will not, however, hold water well; they dry out quickly in hot weather, and the crops growing on them become parched. Moreover, sand alone has not enough plant food in it of the right kind to produce heavy crops and has to be manured to make it yield well. A sandy soil warms up quickly and is good for the growing of early vegetables. When the under-soil, or subsoil, is clay, a sandy soil with proper handling may be made quite productive. The particles of which sand is composed are mostly quartz, a very hard substance resembling glass. The particles do not stick well together when wet, and fall apart readily when dry; thus a sandy soil may safely be cultivated when quite wet.

Clay Soils.—Clay soils are spoken of as heavy. This is because they are hard to work. Owing to the small size of the particles of which they are composed clay soils are compact, that is, close and solid, and are difficult soils to drain. Pure clay, if rubbed between the fingers when it is wet, is found to be smooth and sticky. If worked when too wet, clay is apt to puddle and, on drying out, to become very hard. Clay soils, too, are likely to be cold, because they hold so much moisture that the air with its warmth cannot readily penetrate them.

Comparative sizes of soil grains: A, medium sand; B, fine sand; C, very fine sand; D, silt; E, fine silt; F, clay.

Clay itself does not make a good agricultural soil. In wet weather the roots of plants are smothered by too much moisture and suffer from lack of air within the soil, while in dry weather the ground becomes so hard that the roots cannot reach the water, nor can the water circulate so as to reach the roots. A soil containing more than sixty per cent clay, by weight, is difficult to cultivate and gives poor yields.

Humus.—Humus is found in all agricultural soils, to a greater or less extent. Such are not called humus soils, but *loams*, and these may be *sandy loams* or *clay loams*. Humus gives to a soil its dark color. It comes principally from grasses, roots, leaves, stubble, manure, decayed animal matter, etc., which has become covered up, and which has mingled with the soil. It improves a sandy soil by making it richer in plant food and by increasing its power of holding water. It prevents a clay soil from becoming too compact; it opens it, and holds it open, so that both air and moisture can circulate more freely within it. It is thus of great benefit to both types of soils. In addition to all this, humus furnishes food for certain useful organisms called *bacteria*, which are found in the soil.



The composition of soils.

There is no better agricultural soil than a proper mixture of sand, clay, and humus. That is to say, the *loams* are the best of all soils for crop production. They hold the moisture; they can be easily worked; they do not become too wet or too dry, and consequently they do not bake or crack; and they are suitable for the production of a very wide range of crops.

Alkali Soils.—Over much of the prairie patches of alkali soil may be found. Alkali soils have in them such a large quantity of salts of various kinds that plants find it difficult to live and grow there. These soils are frequently found in depressions where water has year after year accumulated in the spring and evaporated in the summer, leaving behind the mineral matter or salts which were held in solution. There are two types of alkali soils: *black alkali* and *white alkali.*

The best method of removing alkali from a soil is by flooding it with water and underdraining it. The water washes the salts down into the soil, and drainage carries them away. Black alkali soils can be improved by applying to them a dressing of gypsum or land plaster. It requires from 400 to 600 pounds to the acre to be ef[illegible]e. Of all cultivated plants, rye and barley among [illegible]ns, alfalfa and sweet clover among the fodders, [illegible]gar beets among the roots appear to suffer the [illegible] injury when grown on alkali soils.

[illegible]he **Subsoil.**—The surface soil, usually to a depth of [illegible]ut six or eight inches, is dark in color and contains [illegible]nsiderable humus and plant food. Below this there is soil of a lighter color, lacking in humus and not nearly so productive. This is called the *subsoil.* In ploughing, the farmer should not bring up too much subsoil at any one time. A little of it brought to the surface, however, is usually beneficial. When exposed to weathering agents, it is broken down, mineral plant food is released, and the surface soil is thereby made more productive.

Minerals in Soils.—An *element* is anything that cannot be reduced to any simpler form. Gold, silver, lead, oxygen, nitrogen, sulphur, and potassium are examples. Elements combine to form minerals, and minerals may combine to form rocks. A rock, such as limestone, may be composed of one mineral substance throughout, or, like granite, it may be composed of several minerals. When different kinds of rock are broken up, all of these minerals become intermingled in the soil.

Elements essential for Plants.—Of all the many elements found in the soil, in combination or separately, it is necessary to consider only ten. The reason for this is that plants are, with few exceptions, composed of but ten elements. Of the ten, four—*oxygen, hydrogen, nitrogen,* and *carbon*—may be said to come to the plant directly or indirectly from the air. The first two, in combination as rainwater, fall from the air to sink into the soil and be taken up by plants. Nitrogen is taken from the air and fixed in the soil by bacteria, in forms which can be used by plants. And lastly, carbon is taken directly from the air by the leaves of the growing plant.

The remaining six elements belonging strictly to the soil which are necessary for the life and growth of plants are *sulphur, phosphorus, potassium, calcium, magnesium,* and *iron.* They are usually found combined with other elements to form the mineral matter of the soil.

Questions, Problems, and Exercises

1. Define loam soils. What advantages have they over clay and sand?

2. For what kind of crops is a sandy soil adapted? What advantages has such a soil over a clay soil? What crops are suited to clay soils? Why is it desirable to have a certain amount of humus in the soil?

3. Examine the soil at the side of a road cut or cellar excavation. Can you distinguish soil and subsoil? Compare these as to color, coarseness, and depth. Do you see evidences of subsoil being changed into soil? of rock being changed into subsoil? Do you find sand, clay, and gravel occurring in layers? If so, in what order are they laid down?

4. Plant seeds in two pots, the first filled with soil and the other filled with subsoil. Compare the results as to (a) germination; (b) subsequent growth.

CHAPTER IV

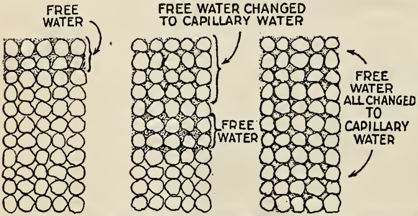
WATER IN THE SOIL

The water which falls upon the soil either penetrates it or runs off the surface. That which runs off is wholly lost, so far as crop production is concerned. On sloping ground, especially in the drier parts of the country, this means a very serious loss. Of that which sinks into the soil, a part may be returned to the surface of the soil and evaporated there; part may sink to the water level and be removed by underdrainage; and part may be removed by the growing crops.

Importance of the Size of the Particles.—As particles of sand are large, while those of clay are small, the spaces in the soil between the particles of sand will be large as compared with those between the particles of clay. On the other hand, the total surface of all the sand grains making up a cubic inch of sand is many times less than the total surface of all the clay particles in a cubic inch of clay. These facts have an important bearing on the rate at which water will enter the soil, the length of time that it will be retained, and the quantity which the soil will hold.

Hygroscopic Moisture.—If some dry soil is heated, a faint steam will be seen rising from it. It does not matter how dry it may have appeared to be, there is still some moisture there. This moisture can be removed from a soil only by heating it to a temperature quite above that of the surrounding atmosphere. This moisture is called *hygroscopic moisture.* The quantity is not very great, usually not more than two per cent of the weight of the soil. It may have some use in dissolving mineral plant food from the soil particles. However, it will not supply sufficient moisture to keep plants alive and growing, for it is well known that they will begin to wilt long before the hygroscopic water has been reached. It seems to form an extremely thin film on the surface of the soil particles, and it may serve a useful purpose in preventing the soil from becoming heated to such a degree as to cause injury to the roots of plants.

Free Water.—Water falling upon the soil will penetrate between the soil particles, sinking deeper and deeper. But, as it does so, a film of water will be left around each particle. The water which is between the spaces is called *free water*, or sometimes *gravitational water*, owing to the fact that it moves down into the soil by the action of gravity.

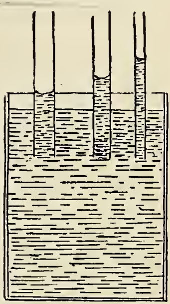


The movement of soil water downward among soil particles. See Questions, Problems, and Exercises, No. 8, page 26.

Capillary Water.—The film which the free water leaves around each soil particle is much thicker than the hygroscopic film, and is known as *capillary water*. Soil containing capillary water becomes darkened and moist. On the prairies, where the rainfall is limited and the soil is dry, all the free water is soon used up in moistening the soil, or in putting capillary films around the soil particles. But where rains are heavy and frequent, the *free water* may penetrate to the underground water table, from which it is either drained away, or left standing in the soil, making it wet and cold.

Water-holding Capacity of Soils.—Owing to the variation in the size of their particles, soils differ considerably in the amount of water which they will hold in the capillary state. Clay will hold more than sand, but humus will hold more than either one. This shows that the size of the particles does not wholly determine a soil's capacity to hold water.

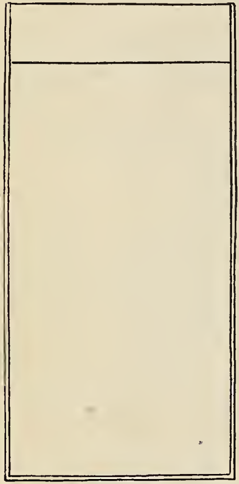
The larger and more open spaces among the sand grains permit the air to circulate freely, and for this reason sand dries out more quickly than clay. The presence of some humus, because of its spongy nature, always increases the water-holding capacity of any soil in which it is present. The amount of capillary moisture that can be held by the different classes of soils is about as follows: sand will retain twenty-five per cent of its weight, clay fifty per cent, loam seventy-five per cent, and humus 200 per cent.



Capillarity. See Questions, Problems, and Exercises, No. 5, page 31.

Movements of Soil Moisture.—Capillary moisture moves freely in the soil in any direction, because of the action of certain forces. These forces operate between the soil particles and the water, and are strong enough to lift water just as oil is lifted in a lamp-wick. If evaporation is going on at the surface of the soil, the water will move in that direction. If roots are feeding and using up the film of water on the soil grains about them, water will move from any direction to keep up the supply at that point. In fact, whenever from any cause the film around certain particles is thinned, the water moves from grain to grain to keep the thickness as nearly uniform as possible throughout the whole mass.

Soil Solution.—A growing plant feeds *in* but not *on* the soil. The soil itself is not a plant food, but the elements found in some of the minerals of the soil are plant food materials. These mineral elements, however, cannot be taken in by the plant rootlets until the minerals have been dissolved in water. Mineral substances, even the hardest, will dissolve to some extent; and so we find silicates, nitrates, phosphates, sulphates, carbonates, iron, potash, and many other substances dissolved and intermingled throughout the soil water. Whatever the plant takes from the soil must be in liquid form, or, in other words, whatever material it obtains by means of its roots must be taken from the soil solution.



Water and dry matter. The diagram shows the amount of water needed to produce the seed shown.

Quantity of Water required by Plants.—The quantity of water required by growing crops is enormous. Almost any crop in its green stages is ninety per cent water. But even so, the water that enters into the composition of the plant and gives it so much of its weight is but a fraction of that required to keep the plant growing. This amount varies with the kind of crop, the state of the soil, and the climate in which it is being grown. But, when all of these are favorable, it requires on the average 325 pounds of water for every pound of dry matter produced. That is to say, even under the most favorable conditions, it will require about 20,000 pounds of water to produce one bushel of wheat. And this takes into consideration the grain only; it will require quite as much more to produce the straw, making the total water requirements for a bushel of wheat 40,000 pounds, or twenty tons. Where high winds prevail and the atmosphere is dry, it will take two or even three times that amount to produce one bushel of grain.

Questions, Problems, and Exercises

1. Heat a quantity of dry road dust in a glass beaker or large test tube, over an alcohol flame. Moisture is seen to collect on the sides of the vessel condensed by contact with the cold glass. Explain the nature of the moisture thus shown.

2. Experiments should be attempted with various types of soils to show their capacity for holding moisture.

Pass samples of sandy soil, clay soil, and loam through a sieve. Fill cans of equal size with these within two-thirds of the top, and compact each equally by tapping the can on the table. The bottoms of the cans should be well perforated with many fine holes. Now pour equal quantities of water on each, sufficient to cause it to run through the bottom of each of them, catching separately the water that comes through each.

Which kind of soil allows water to drain most freely? Which allows the least water to drain? What force in nature causes drainage, and what name is therefore given to drainage water? What natural force holds water in soils? Which of the three forms of soil water is most useful to the plant and why? Which kind of soil is likely to withstand drought conditions best?

3. What is humus? What is its effect upon the moisture-holding capacity of soils? What is its importance in relation to plant life?

4. Attempt some form of experiment to find the amount of moisture in soils. One way of doing this is to take a given weight, say eight ounces of each kind of soil, clay, black loam, and sand, and bake them in a hot oven until dry. Weigh again and make a tabulated record of the amount of moisture lost in each case.

5. What are two uses of soil moisture to the plant? Why is a water-soaked soil not a suitable one for plant growth? What moisture conditions are best?

6. To produce thirty bushels of wheat per acre, which including grain and straw contains 3600 pounds of dry matter, a rainfall of eight inches (making no allowance for losses) is used in the growth and maturing of the crop. Calculate (1) the number of tons of water required to produce a bushel of wheat; (2) the number of pounds of water needed to produce one pound of dry matter (an acre-inch of water, that is, a depth of 1 inch of water over an acre, weighs 115 tons).

7. Crops withstand drought better on deeply ploughed land than on land where the cultivation has always been shallow? Account for this.

8. Fill a glass jar or tumbler with pebbles, marbles, or large shot, and observe the spaces between. Fill the jar with water. When the water is poured off, notice the film of water around each pebble. The water which ran off when the jar was emptied is *gravitational* water, while the moisture collected around the pebbles is *capillary* water.

The smaller the pebbles the more capillary water will be held, because the smaller pebbles will have a greater total surface area. Does this help you to understand why clay will hold more moisture than sand? Explain.

9. Secure three glass cylinders (lamp chimneys will do) and tie a piece of thin cloth over one end of each. Fill these with clay soil, sandy soil, and loam soil. Now place the cylinders in shallow water and watch the result. In which soil does the moisture rise quickest? Explain.

CHAPTER V

DRY FARMING

The Moisture Problem.—The moisture problem is the biggest problem confronting the grain grower in the Prairie Provinces. Over large areas of the country the rainfall is either insufficient or does not come at the proper time to meet the needs of the growing crop. Where the annual precipitation (that is, the atmospheric moisture—hail, mist, rain, snow, or sleet—deposited upon the earth) is twenty inches or less, as is the case over much of the prairie, special methods of farming must be adopted if sufficient moisture is to be assured. The method which is adopted to meet these conditions is called *dry farming*.

Purposes of Dry Farming.—Dry farming aims at two things: first, to get all the moisture possible down and into the soil, and, second, to keep it there so that it may be available for the crop. No system of farming has yet been devised whereby it is possible to store in the soil and preserve for crop production all of the moisture that may fall upon the land. It is possible, however, by certain methods of cultivation to preserve a very considerable portion of it, and this is what every farmer in the dry districts should strive to do.

Much of the snow will be melted and evaporated by the winds, and little can be done to prevent that loss. Another rather large loss is due to the fact that much of the rain and melted snow runs off the surface into coulees, creeks, and streams. This "run-off," or lost water, can be partially prevented by ploughing, disking, harrowing, and cultivating along the sides rather than up and down the slopes. In this way the run-off may be checked, and the water may be retained a longer time in the furrows and so be given more time to soak into the soil.

Storing up Moisture.—Deep ploughing is of the utmost importance. It opens up the soil, and enlarges

Sometimes the fields are cultivated in alternate rows of crop and summer-fallow to prevent soil-drifting.

the spaces between its particles, so that the rains can sink in speedily away from the evaporating influences of sun and wind. Keeping the soil moist and preventing it from drying out completely is of greater importance than it first appears to be, as the more moisture there is in the soil the more it is possible to put into it. The reason for this is that when the soil is moist, and the rains fall upon it and penetrate it, the water will slip by those particles already moist and moisten those which lie still farther down. In this way the water can be stored deeply, and that is precisely what is wanted. If the soil is dry, the water will not go down very far and soon returns to the surface to be lost by evaporation. This also explains the advantage of the *summer-fallow*—a method of tillage by which the ground is left idle, but is kept worked up so that the rainfall will sink speedily into it, each rain causing the moisture to go deeper into the soil. In this way it is possible to preserve a considerable portion of two years' rainfall for the production of one crop.

Loss by Evaporation.—But no sooner has the water been stored in the soil than it begins a return journey to the surface, where it is lost by evaporation. The sun, air, and winds, acting on the surface layer of soil, dry it out. The under-surface water then commences to creep from particle to particle towards the surface, to be disposed of in the same manner as that which went before it, just in the same way as more oil is drawn up in the lamp wick to take the place of that at the end of the wick which was removed by burning. If something is not done to check the movement towards the surface, the soil water will all, in time, be lost.

The Dust Mulch.—The way to check this surface evaporation is to form what is called a *dust mulch* or powdered surface. This is done by stirring the top soil to a depth of two or three inches with the cultivator or harrow and allowing that depth of soil to dry out. The moisture in the top layer will be lost, and the sooner it is lost after a rainfall the better. Capillary water moves very slowly through dry soil, and so, when once the surface layer is dry, it lies on the top of the under layers like a blanket and prevents the moisture from below from passing through it. Several inches of loose, dry soil on the top of a field almost completely protects the moisture beneath against the forces that would evaporate it. Any rain that will moisten this blanket will start the capillary movement again. For this reason a farmer who would use the summer-fallow to store water in the soil must be on his guard. As soon after a rain as the fallow is sufficiently dry to work, he should be on it with

Soil-drifting.

the harrow, stirring and loosening the top soil to get it dried out speedily and so form the mulch again.

Soil-drifting.—In some localities the prevalence of high winds has discouraged the practice of dry farming. So persistent and strong are these winds that a dust mulch is no sooner formed than they sweep it from the fields in clouds and carry it far away. Wind-breaks and shelter-belts of trees afford much protection in these areas, but even these are only partially effective in checking the ravages of the winds.

Likewise, cropping the fields in alternate strips has afforded some protection to young plants against the smothering effects of the drift. Clover, grasses, and thick-rooting crops, such as corn, have also been used to great advantage in preventing soil-drifting. However, in many such sections, unless irrigation is possible, ranching seems to be the safest form of agriculture that can be pursued. The growing of grain in regions of high winds has been, and in the circumstances continues to be, a most uncertain undertaking.

Shelter-belts of trees afford much protection in areas where high winds prevail.

Questions, Problems, and Exercises

1. What is the effect of a surface mulch in conserving moisture? How is the mulching done in the case of a summer-fallow, a potato crop, a flower garden, around shade trees?

2. What are the harmful effects of soil-drifting? What can be done to prevent the drifting of soils during the period of high winds in spring?

3. Place a lamp wick with an end in each of two glasses, one glass being filled with water and the other dry; allow to stand overnight and observe the results. Explain.

4. Put several glass tubes of different bores in a cup of water. How does the size of the bore affect the height to which the water will rise? Does this help to explain why clay will hold more moisture than sand?

5. Cover one side of a cube of loaf sugar with pulverized sugar and set in shallow water. Does the water rise as readily through the powdered sugar as through the lump? What does this suggest as to the effect of a dry surface mulch?

CHAPTER VI

DRAINAGE

Wet Soils are cold.—While there are many soils that have insufficient water, there are, on the other hand, some soils that have quite too much. If crops are to be grown on the latter, these soils must be drained. The water which they contain keeps the temperature low, and, as air cannot penetrate to warm them up, they are cold and unproductive. Warmth in the soil is necessary both for germination and for growth. Where the soil is cold, germination takes places very slowly. If the soil temperature is below 45° Fahrenheit, most seeds will decay in the soil and not germinate at all. It is only after a temperature of 65° or 70° has been reached that germination goes on actively and plants grow well.

Air needed in Soil.—In a well-drained soil the spaces between the soil particles are filled with air; in a poorly drained one they are filled with water. Air in those spaces is absolutely necessary for growing crops, because the plant must breathe through its roots as well as through its leaves. If the spaces are filled with water, it cannot breathe, and so it dies. We say in such cases that the crop was "drowned out."

There are still other reasons why air, rather than water, is required in the spaces between the soil particles. Air contains nitrogen gas, from which the bacteria of the soil form nitrogen compounds. Air contains also ammonia gas and carbonic acid gas, both of which are of great importance, because they help to dissolve minerals and thus make the soil more fertile. Drainage will remove the free water from the interspaces of the soil, and at the same time it will deepen the area in which plants feed.

Natural Drainage.—Some soils have good natural drainage. The subsoil may be loose, open, and porous, and the water table so far down that all free water is soon converted into film water, so that artificial drainage is not necessary. Again, the slope may be such that

Rolling lands have good natural drainage.

free water is readily removed by natural means. But, where artificial drainage is necessary, there are two systems in use, namely, draining by *open ditches*, and draining by means of the *closed tile drain.*

Surface Drainage.—Open ditches take up a considerable portion of the land and interfere with the working of the fields. They are rather costly to maintain, as the sides keep slipping even when given considerable slope, and they carry off much of the surface soil that is washed into them. Also, they become choked up with noxious weeds and other plants, and so require frequent repairing and cleaning out. In draining marshes, sloughs, muskegs, and bogs, where it is necessary to remove much surface water, they serve a useful purpose, and are frequently the only drain that can be used under such conditions.

Underdrainage. — Tile drains are made by laying hollow tiles, which are unglazed, burnt clay pipes, end to end in the bottom of ditches and then covering them up. Main drains are laid along the lowest parts of the field, and side drains lead into these at intervals. The number of these and their location are determined by the character of the soil, the amount of water to be removed, the slopes of the field, and the area to be drained. The water enters the drain either through the tile itself or at the joints. The tile drain removes free water only; film water is in nowise disturbed.

Irrigating sugar beets, Bassano, Alberta.

Irrigation.—Irrigation is the name given to an artificial system of supplying water in large quantities to the land. The water for such purposes is usually obtained from some river or stream large enough to furnish a constant supply. The river is tapped by means of a ditch at some higher point in the river bank, so that the ordinary flow of the river is partly conducted through this ditch to the area to be irrigated. The water is thus led into a large storage reservoir, where it may be kept to be drawn upon as needed. From the reservoir it is carried by smaller ditches and laterals to where it is needed on the fields.

The value of irrigation is beyond question. It assures an abundant supply of moisture to the growing crop, no matter how scant the rainfall may be, or how long drought periods may continue. In fact, it makes the farmer independent of the annual rainfall. Moreover,

Irrigating at Brooks, Alberta.

it enables him to grow a greater variety of crops than he would otherwise be able to do. The cost of an irrigation system is somewhat high; but this is generally more than offset by the increased value of the land, once it has come under the benefits of the system.

Ans

Questions, Problems, and Exercises

1. Why are wet soils cold soils? What is the disadvantage of such soils at seeding-time? during the growing season? in harvest-time?

2. How can you show by simple experiment that ordinary soils contain air among their particles? What benefits come from the presence of air in soil? How does drainage help in this?

3. What sort of soils are naturally well drained? What are the artificial methods of draining marsh lands and farm soils?

4. Irrigation on a small scale is provided for house plants, window boxes, lawns, and gardens. Why is soft water best for this purpose? Why should drainage be provided in the case of flower pots and window boxes?

The Lethbridge Northern Irrigation System, under construction.

5. What are the advantages and also the drawbacks of farming in dry areas with the aid of irrigation?

6. If possible, visit an irrigated farm and have the farmer explain his method of irrigation.

Write to the Department of Agriculture, Edmonton, for the bulletin on *Practical Irrigation for Alberta.*

CHAPTER VII

THE FOOD OF PLANTS

Composition of Plants.—Plants are composed of elements taken both from the soil and from the air. The soil gives to the plant its necessary supply of *sulphur, phosphorus, potassium, iron, magnesium, calcium, hydrogen,* and *nitrogen.* The first six of these are solids. Moreover, they are strictly soil elements, as they are derived from the breaking down of rock materials. Hydrogen and nitrogen are different; both are gases, and the decaying of the rocks gave neither to the soil. The hydrogen which the plant uses is taken up in combination with oxygen in the form of soil water absorbed by the roots. The nitrogen supply is secured from nitrates. These are compounds of nitrogen which the plant can handle. They are formed, in part, from the nitrogen of the air by bacteria working in the soil. A small percentage of oxygen and all of its carbon are taken by the plant directly from the air.

Soil-derived Elements.—*Sulphur,* combined with other metals, is usually quite abundant in the soil. Occasionally, however, it is necessary to supply a fertilizer containing sulphur, such as land plaster or gypsum. Sulphur forms part of the tissues of plants.

Phosphorus is almost everywhere in the soil, but in rather limited quantities. It is never found there in the uncombined state. As it forms a part of the nucleus of all living plant cells, growth cannot proceed, nor can seeds fill out well or become plump and mature without it.

Potassium is a silvery white metal which will take fire if placed in water. As in the case of phosphorus, it is never found in the soil in the uncombined state. When united with starch and other substances within the plant, it forms compounds which are very necessary for growth. It is found most abundantly in the trunks of fruit trees, in the woody parts of the stems of plants, in juices, in fruits, and in all root crops.

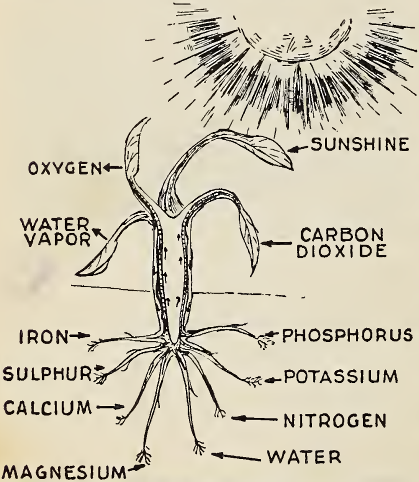


Diagram showing the substances taken in by roots and leaves, the ascent and descent of the liquid solutions in the plant, and the waste material thrown off by the leaves.

Iron, which is used by the plant in small quantities, is always sufficiently abundant in the soil.

Calcium and *magnesium* are two other plant foods. They are essential for the production of seeds. Wheat, for instance, contains twelve per cent magnesium and eight per cent calcium; in peas the proportions are eight per cent magnesium and four per cent calcium.

Air-derived Elements.—*Hydrogen* may be considered either as an air-derived or as a soil-derived element. In union with oxygen it forms the moisture of the air. This moisture, condensing, falls to the earth as rain; the rain, percolating through the soil and dissolving soil minerals as it moves and holding them in solution, becomes the soil water which is absorbed by the plant roots. No free hydrogen is taken in by roots, leaves, or any other part of the plant,—it is always combined with oxygen and is taken up as water.

In this combination, too, it is evident that much of the oxygen necessary will be acquired. Oxygen, however, is also taken directly in its gaseous form from the air by the leaves, buds, flowers, and roots of plants.

Carbon itself is a solid. A combination of carbon and oxygen is a gas. In this state it exists in the air, from which it is taken by the plant. This gas, called carbon dioxide (CO_2), is taken in by the leaves and broken up into carbon and oxygen. The oxygen is given off, but the carbon is retained to be used in the making of starch.

Nitrogen forms four-fifths of the volume of the atmosphere, and thirty-one tons of it rest upon every acre of ground. Nevertheless, it is the one element in the food of plants for the lack of which they suffer most. They cannot take it directly from the air, and the quantity in the soil is limited.

Questions, Problems, and Exercises

1. Hold a cold flat-iron in a flame. The moisture formed on the iron is made by the uniting of hydrogen from the fuel with oxygen from the air.

2. Make a collection to represent the ten elements essential for plant growth. Wood ashes contain potassium; lime contains calcium; flash-light powder contains magnesium; saltpetre contains nitrogen; matches contain phosphorus. Iron, sulphur, charcoal (carbon), hydrogen, and oxygen (water), may be readily obtained.

3. Seeds will not grow without air. Secure two large bottles; place a few seeds in one and fill the other about one-quarter full. Add moisture to each and cork tightly. Observe and account for the results.

4. Cover a growing plant so as to exclude the light; cover a patch of grass with a board. Is sunlight necessary in the production of healthy green plants?

CHAPTER VIII

THE PARTS OF PLANTS AND THE FUNCTIONS OF EACH

THE ROOT

Kinds of Roots.—The roots of plants differ to some extent in form. Some, such as the grasses, have a great many thread-like roots, which, from their point of origin, extend in all directions into the soil. Since they resemble threads or fibres, they are called *fibrous roots.* Other plants have one central root, called a *tap root,* much more prominent than all the others, and extending for a considerable distance straight down into the soil. Alfalfa has such a root. Sometimes these roots are greatly thickened by reason of having much food stored in them, as in the case of the turnip, beet, parsnip, and radish. They are then called *fleshy roots.*

Functions of Roots.—The root has three functions; or in other words, it exists for three different purposes. One of these is to anchor or fasten the plant firmly in the soil, so that it will not be blown over by the wind. Another is to absorb water for the plant, and with this water small quantities of food materials. To do this it must send its branches widely through the soil. Still another is to serve as a place in which to store up food until such time as it may be required. Most of the plants with fleshy roots store up food the first year to be used the second year, when the plant is producing seed.

Root Hairs.—If some seeds be sprouted on blotting paper and the developing roots observed, it will be seen that they are covered near the ends with a fuzzy sort of substance. The tip of the root is bare and hard. It has to be so in order to force its way through the soil. This tip is called the *root cap;* just back of it is the growing point. The fuzzy material is nothing more or less than an immense number of root hairs. So small and so numerous are they that there may be as many as 40,000 of them to the square inch. They live only a few days

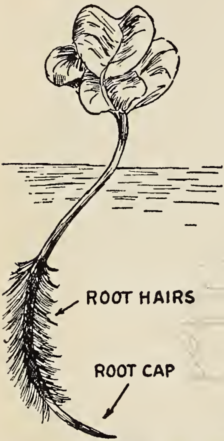
A tap root.

A fleshy tap root.

A fibrous root.

and never develop into roots. These are, however, the important feeders of the plant, and they are practically the only feeders under the soil. By a sort of mucilage, or gummy liquid, which they secrete, they are able to cling close to the soil particles and are at the same time immersed in the film of soil water that surrounds these particles. They are found only on the very finest of the plant roots.

As the root advances through the soil, the root hairs are being constantly renewed in front and are constantly dying off further back: they thus keep close to the tip of the advancing root. When they die off, the root corks over, and no more absorption can take place there. The roots of a plant may branch and rebranch until the whole of the soil all around the plant, and for a considerable distance down, seems to be filled with roots. However, these roots do comparatively little feeding. They serve chiefly to carry to other parts of the plant the food materials which have come to them through the root hairs.



A plant showing root hairs and the root cap.

Osmosis.—The root hairs are composed of cells, within which there is a liquid known as the *cell solution.* This liquid is denser, that is, thicker and heavier than the water solution outside of the root. There is a movement of the water from the outside to the inside, and this water carries with it, in solution, the mineral substances which are needed for plant growth. This soil solution passes directly through the thin cell walls in order to get to the inside of the root hairs. Such a movement of liquids is called *osmosis.*

When two liquids of different densities are separated by a membrane, they tend by the process of osmosis to change places until the liquid is of equal density on both sides of the membrane; but the less dense liquid always moves through more quickly than the other. This is why the soil solution, which is the less dense of the two liquids, passes into the cell more rapidly than the cell sap can pass out. In an alkali soil, it frequently happens that the soil solution is the more dense, and then the greater movement is from within outward, and so the plant dies.

Selective Power of Root Hairs.—Now, the root hairs do not absorb with soil water anything and everything that it may hold in solution. They have a remarkable power of absorbing only those mineral substances in solution which the particular kind of plant needs, and of rejecting, to a greater or less extent, others which it does not require.

Thus it comes about that different plants contain minerals in their tissues compounded in different proportions, although the soils in which their roots feed are identical. Wheat, for example, takes relatively large amounts of the compounds of nitrogen and phosphorus, while corn and potatoes absorb considerably less of these and more of potash, that is, compounds of potassium.

An egg prepared to show osmosis. Chip the shell away from the bottom of the egg, leaving the membrane intact. Set this end in a bottle filled with water. Puncture the shell and membrane of the upper end and after a time observe the results.

THE STEM

Uses of the Stem.—The stems of plants have three main functions. They furnish the channels by means of which the liquids, solutions, and sap may travel up and down the plant between the roots and the leaves. They serve as storehouses wherein starches and other foods may be kept in reserve for future uses. They furnish places of attachment for the branches or for the leaves, so that the plant may hold its leaves up and spread them out to the air and sunlight.

Structure.—The stems of many plants are cylindrical or pipe-like in form and hollow at the centre, having joints or *nodes* at intervals along the stem. The grains and grasses have such stems. This arrangement makes for economy. It gives a strong stem using the smallest amount of material. In other plants the centre is filled with a spongy material called the *pith.* The corn and the sunflower furnish good examples of pithy stems. In trees the stem is composed of a woody centre surrounded by an outer covering of *bark.*

Sap Movements.—The movement of liquids within the plants can best be learned by reference to the stems of trees. From the interior to the exterior the parts of a tree stem or trunk are: the *heartwood,* the *sapwood,* the *cambium layer,* and the *bark.* The cambium layer is a thin covering which closely surrounds the trunk and lies between the sapwood on the inside and the bark on the outside. It is very much alive and very active. There are two sets of tubes running up and down the stem; one set is in the sapwood, and the other is in the bark. Both are near the cambium layer. There are no such tubes either in the heartwood or in the outer layers of the bark. The liquid solutions within the plant keep moving, or circulating. From the roots they move upward through the tubes in the sapwood out into the branches and into the leaves, where the solutions undergo a change; they then begin their downward movement, through the tubes in the inner bark, to the roots, and the circle is complete.

Sap movements.

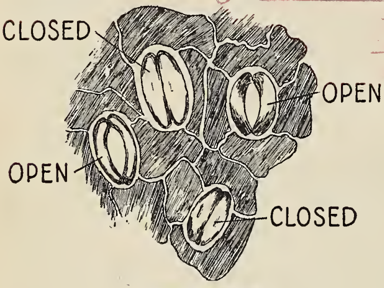
The downward-moving sap is richer in food content than that moving upward, because the former contains not only the mineral substances that came through the roots in the soil solution but also the additional food materials that were added to these in the leaves. Moreover, all these food materials have been changed in the leaves into plant foods. As the sap moves downward, it is constantly giving up to the cambium layer its food products, and from these the cambium is building up the wood cells. New cells are added just inside the cambium layer to the outside of the sapwood. This is where the growth of the trunk is taking place. Even when growth is not under way, plant foods are being constantly removed from the sap and stored in the heartwood or in the roots. The sap thus reaches the roots with its solution weakened by the loss of food materials, and must gather new supplies before it begins its round again.

THE LEAF

Structure.—The leaves of plants are usually numerous, broad, flat, and so placed as to receive all the air and sunlight possible. There is on both sides of the leaf a thin covering, which is transparent and readily admits the sunlight to the cells within. Between these coverings there are many soft, thin-walled cells containing a green-colored substance called *chlorophyll.* Running through the leaf can be seen *veins,* which branch out into numerous *veinlets,* and these again branch and rebranch until the whole interior has the appearance of a lace-work composed of the tiniest threads. On the under surface of the leaf, and commonly on its upper surface as well, are the *stomata.* They are many times more numerous on the under surface, however, than on the upper surface. The word stomata means "mouths," and that, in reality, is what they are—little mouths which may be opened and closed. So small and so numerous are they that there may be as many as 100,000 of them to the square inch.

Functions.—The veins in the leaf allow the fluids to circulate freely and to come into contact with the cells within. The stomata enable the plant to breathe, and to throw off much of the surplus water that has come in through the roots and has been passed up through the stem to the leaves. Breathing, or the inhaling and exhaling of gases, is called *respiration*; and throwing off the water, *transpiration*. Both of these processes are necessary to enable the chlorophyll to perform its work, which consists in the making of starch.

Starch-making. — Starch is composed of three elements—namely, carbon, hydrogen, and oxygen. It is produced by the action of the chlorophyll, assisted by the sunlight, upon these elements. This starch-making process which goes on in the leaf may be compared to the work of a factory in which carbon dioxide and water are the raw materials used, chlorophyll is the machine or mill, sunlight the power, and starch the finished product.

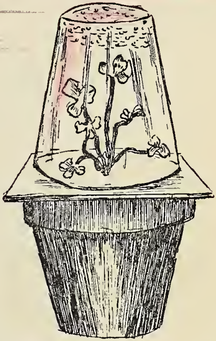


Stomata of a leaf.

Changing Starch into Sugar.—Now starch is a solid substance and as such has to be changed into some soluble substance before it can be transported to other parts of the plant. Sugar is soluble; the plant cells have the power of changing the starch into sugar, and it can then be transported wherever it may be required.

Assimilation.—The sap contains sugar and the other mineral elements that have come from the soil. It holds these all in solution while it circulates freely through the plant, coming into contact with all of the living cells. These cells take from the sap the sugar, phosphorus, nitrogen, potassium, lime, iron, or whatever they may require, and combine them in such proportions as may be necessary to form the actual materials of the plant itself. It may be wood, or fruit, or grain, or flower, or leaf; all substances of which the plant parts are composed are formed by the cells in this way from the materials held in solution in the cell sap. This work of the cells, consisting of building up actual plant structures from the food materials of the sap, is called *assimilation.*

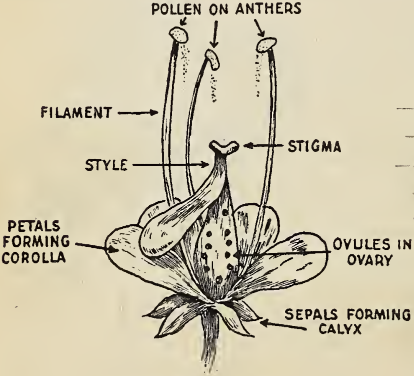
Respiration.—Respiration is not confined wholly to the leaves. Roots breathe, and so, too, do the younger portions of stems and twigs. And they breathe for the same purpose as do animals, namely, to take in oxygen, in order that the substances within the plant may be oxidized, that is, burned up in the production of energy, and the waste materials thrown off.


Transpiration. See Questions, Problems, and Exercises, No. 2, page 51.

Transpiration.—From the leaves of plants there is constantly rising an invisible vapor. This is water that has come up from the roots through the stem to be passed out into the air by the leaves. The soil solution is weak, and large quantities of it have to be taken up by the plant in order to get from it the necessary amount of mineral matter to meet the requirements of growth. This partially accounts for the enormous quantities of water used by plants. The stronger the soil solution the less the quantity of water that will be necessary. But there are other factors that affect transpiration. The strength of the sun, the winds, the kind of crop, and the vigor of growth, all have an influence on the quantity of water that will be transpired. No matter what the conditions may be, however, plants pass out large quantities of water. Just as animals breathe out water vapor with every breath, so, too, do plants.

THE FLOWER

Structure.—There are four rather distinct parts that make up the flower of a plant. These are the *calyx*, *corolla*, *pistil*, and *stamens*. The purpose of flowering is to produce seed, but the only parts of the flower that are absolutely necessary for this are the pistil and the stamens; hence these two are commonly spoken of as the *essential organs* or *essential parts* of the flower. The calyx, composed of little green leaflets called the *sepals*, forms a protecting circle around the base of the flower. The corolla, with its brightly colored *petals*, is for show; not for our delight, however, but to attract insects. The stamens usually consist of a long stalk, the *filament*, on the end of which is a sac, the *anther*, containing the *pollen*. The pistil consists of a sac or pouch, the *ovary*, which contains the *ovules*. The



The parts of a flower.

ovary tapers upward to form the *style*, on the top of which is the *stigma*, a knob or point, usually sticky so as to retain any pollen that may fall upon it.

Fertilization.—A *pollen grain* is a little sac, or as it is more commonly called, a cell, within which is a living substance. The ovule is also a cell, and, like the pollen cell, it contains a living substance, differing somewhat from the former. The pollen falls upon the stigma or is carried there by insects. Then the pollen cell sends forth a tube, like a delicate rootlet, downward through the style until it reaches the ovule at the bottom. The contents of the pollen cell pass down this tube and mingle with the material in the ovule, with the result that a new seed commences to develop in the ovary. The process by which this is brought about is called *fertilization.*

After fertilization has taken place, the new cell, which is formed from the blending of the contents of the two, immediately begins to grow. If supplied with nourishment, it will continue to develop until its growth has been completed and a new, mature, and fully-formed seed has been produced. The mature seed is the offspring of the plant. When placed in the soil, so that it can get moisture, warmth, and air, it will begin to grow, and will keep on growing until maturity, when it stands with all its parts complete in the image and likeness of the parent plant from whence it came.

Pollination.—Pollination has to do with the manner or way in which the pollen is transferred from the anthers of the stamens to the stigma of the pistil, so that fertilization may be effected. Some flowers are perfect; that is, they produce both stamens and pistil on the same flower. Others are imperfect; that is, on one flower there are produced stamens, but no pistil; on another flower there is produced the pistil, but no stamens. Sometimes these two types of imperfect flowers, the one producing stamens, and the other producing the pistil, are found on the same plant, as in the case of the cucumber, squash, and corn. In other cases, the flowers producing stamens are on one plant, and those producing pistils are on another. This is true of trees such as the willows and poplars.

Close pollination, or *self-pollination,* as it is more commonly called, would result if the pollen of a perfect flower were to fall upon the stigma of the same flower and thus fertilize the ovule. In many instances this is most undesirable, since it would produce an offspring of lower vitality than the parent. In time such plants would so deteriorate that they would lose out in the contest with other plants to hold their place in the world. Hence plants seldom resort to self-pollination; in fact, they seem to try to prevent it. The most common way of doing this is to have the stamens mature first and shed their pollen before the stigma of the flower is mature, open, and ready to receive it. Then, after the pollen of its own flower has all been shed, the stigma opens and is ready for any pollen that may come to it from any other flower of the same kind. The grains and grasses, however, are examples of plants which are largely self-pollinated.

Cross-pollination takes place when the pollen from the stamens of one flower is carried to and deposited upon the stigma of the pistil of another flower of the same kind. The carrying may be done either by the wind or by insects such as bees. Attracted to the flower by its bright colors, its odor, or its nectar, the insect alights upon the flower and becomes dusted over with pollen. It then flies to the next flower, and some of the pollen is rubbed off upon the stigma. Plants which depend upon the wind to carry the pollen do not require anything special to attract. As a result, they are without nectar and odor, and frequently lack petals or sepals or both. But, since the wind is a wasteful distributor of pollen, such plants must produce it in large quantities.

Questions, Problems, and Exercises

1. Make a collection to illustrate the various forms of roots. Explain the suitability of the root for the particular plant in each case. Make drawings of the roots of wheat, the carrot, and the dandelion.

2. Cover a pot of moist soil containing a growing plant with oiled cloth or rubber, leaving an opening for the stem of the plant. Invert a glass jar over the plant. Observe the interior of the jar. Where did the moisture come from?

3. Cut the stem of a growing bean or corn plant across with a sharp knife. Observe the appearance of the end of the stem. What conclusion do you reach?

4. Place the freshly cut stem of a small plant having a heavy leaf growth in a bottle containing water colored with red ink, and set in the sunshine. After a few hours, cut through the stems and leaves at various points. Through what parts of stem and leaves does the water ascend?

5. What facts show that the stems of the following plants are stored with food; Indian corn, potato, grass or hay, sunflowers, asparagus, wheat?

6. Why are the stems of most plants at the time of flowering taller than at other times? How is it provided that the leaves of plants are spread out to the sunlight and the air? State facts to prove that the stem is a means by which sap moves between root and leaf.

7. What differences are there between the sap which rises from the root through the stem and that which moves downward from the leaves?

8. Describe, in the case of a tree, how growth takes place.

9. What advantage is it to the plant that leaves are thin and broad? Name examples of other forms.

10. Describe and give the use of the chlorophyll, stomata, leaf veins.

11. Distinguish transpiration from respiration.

12. Give the function of the four sets of organs in a complete flower.

13. What is meant by pollination and by fertilization? How is cross-pollination provided for in nature? Why is it undesirable that self-pollination should take place? Discuss the means of pollination in the case of the sunflower, corn, poplar, clover, wheat, peas, cucumber.

14. Examine large flowers to find the parts described. Make drawings.

CHAPTER IX

SOIL FERTILITY

Loss of Fertility.—In the older provinces of Canada, there are farms which at one time yielded abundant harvests, but, as the years went on, the crops upon them became poorer and poorer, until at last it was no longer

This looks like prosperity, but how many years will the land hold out against the toll of the elevator and the grain tank, if proper methods of soil conservation are neglected ?

profitable to cultivate their fields. The mistake was made in supposing that their fertility, or crop-growing qualities, would last forever. The present condition of these farms, however, shows clearly the error of such a belief. It is feared that too many farmers on the new and fertile lands of the Prairie Provinces have failed to profit by the lesson taught by the abandoned farms in the older sections of Canada.

No farm can continue to yield up its food supply to growing crops year after year and maintain its fertility, unless something is done to make good this loss. The amount of plant food in any soil is limited, and we cannot continually be taking away and putting nothing back without, in time, exhausting the supply. Soils do run out; fields can be cropped to death; and the most fertile farm can, in time, become completely impoverished. The value of such a farm is gone; no one wishes to work it, and no one wants to buy it. One of the biggest problems facing the farmer is that of taking crops from his fields, and yet, at the same time, maintaining their fertility. All the information which he can get as to the best means of accomplishing this end is worthy of his closest attention.

One way of making plant food available—deep and thorough cultivation with abundance of power.

Plant Food in the Soil.—The amount of plant food which is in the soil is one thing; the amount which may be available, that is, in condition to be absorbed by growing plants, is quite another. Plants do not suffer because of the lack of iron, sulphur, or magnesium. They do suffer, however, at times, from the lack of potassium, phosphorus, and nitrogen, and occasionally from the lack of calcium or lime. This would seem to indicate that there is not a sufficient supply of one or more of the three elements, potassium, phosphorus, or nitrogen, to meet the needs of growing plants for any considerable time.

Available Plant Foods.—Now these plant foods may be in the soil in considerable quantities and still not be available. To be *available*, these food materials must be in such form as to enable the plant to make use of them. They may be locked up in compounds from which it is difficult to release them. Or it may be that these compounds are not soluble in soil water, and hence they cannot be absorbed when water is taken in by the plant roots. Some of the methods which may be adopted to free unavailable plant food for the use of plants will be discussed in the section dealing with *Tillage* in Chapter X.

NATURAL FERTILIZERS

Some soils, however, actually do become impoverished, and it is necessary to adopt measures to increase their plant food content. Nitrogen is the plant food more likely to be lacking in the soil than any other. When the supply of this element is low, the plants are of a pale green color, and their growth is slow and weak. Abundance of nitrogen promotes a strong, vigorous growth of stem and leaves. Its compounds are quite soluble and are easily lost through leaching. Much nitrogen, too, is lost by escaping from the soil in the form of a gas. Plants, with the exception of the legumes, get their nitrogen

The root of a legume showing the nodules.

principally from the humus of the soil. The legumes get it from the humus and also indirectly from the air.

Leguminous Crops as Fertilizers.—Leguminous crops —peas, beans, vetches, alfalfa, and the clovers—all feed liberally on nitrogen and remove from the soil and build into their structure considerable quantities of it. Nevertheless, they usually leave the soil richer in this element than they found it. The legumes are, therefore, the most valuable of all plants for maintaining soil fertility, and for restoring again to usefulness those soils that have been worn out.

Nodules on the root of a young pea plant.

The bacteria which dwell in the *nodules* or swellings that form on the roots take nitrogen directly from the soil air, and make it available for the plant. Then again, the roots of some of the legumes penetrate the soil to great depths, and bring food material from the subsoil to be used by the plant or to be left in the roots near the surface. If, therefore, a soil is badly in need of nitrogen, there is no surer, speedier, or cheaper way of supplying this need than by growing a crop of some of the legumes and then ploughing it under as green manure. The plants themselves are rich in nitrogen, and, when they are ploughed under, there is added to the soil not only that which has been procured from the air by the bacteria but also that which is in the plant itself.

If, however, the legume has no nodules upon it, it will draw nitrogen from the soil without putting any back into it from the air. In such a case the legume feeds upon the nitrogen in the humus, as does any other plant. This happens when nitrogen-forming bacteria are not in the soil in which the plant is being grown. When this condition prevails, the farmer should see to it that the bacteria are put into the soil. This is called *inoculating* the soil. It consists in taking some of the soil from fields where legumes that have nodules have been growing and sprinkling a thin coating of it over the field to be inoculated. One hundred pounds to the acre, harrowed in immediately, will give the desired result. Another and, perhaps, a better method is to inoculate the seed with a *nitro-culture*. This can be obtained from the Schools of Agriculture for thirty-five cents a bottle. Full instructions for use accompany each bottle.

Nodules on the root of a young bean plant.

Green Manures.—The legumes, however, are not the only crops that may be grown and ploughed under as green manures. Rye, oats, buckwheat, mangels, rape, and, in fact, any kind of crop may be grown for this purpose. Such crops will not add nitrogen to the soil to the same extent as will the legumes, but they will increase considerably its humus content. From an average crop, five to ten tons of organic matter can in

Ploughing down a green crop to enrich the soil.

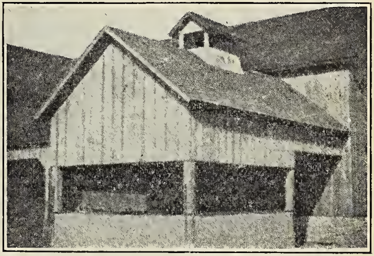
this way be added to every acre. The time to plough down a green crop is at the flush of the growing season, that is, when plants have reached their full size, as the more water they contain the more readily they will decay and be converted into humus. Green manure does not put back into the soil any more mineral matter than was originally there; but that which it returns is in more available form, and this in itself assures more abundant crops later.

Barnyard Manures.—At the price at which fertilizers are sold, the quantity of ordinary barnyard manure produced by each head of stock upon the farm represents a value of thirty-two dollars per year. This is the average; and, of course, it assumes that the manure has been properly cared for and applied. In the case of certain classes of animals the value is even higher. The manure from a cow, based on the market price of fertilizers, is worth thirty-eight dollars per year. Two inferences may be drawn from this. One is that the way to maintain the fertility of the soil is to keep live stock upon the farm; and the other is that manure has too great a value as a fertilizer to be treated in the neglectful and wasteful manner so common to the careless farmer. The plant food in manure is very soluble and easily lost. The loss occurs in two ways: by *leaching* and by *heating*.

Fully one-half of the fertilizing value of the manure is lost when exposed in this way.

Care and Use of Manure.—Leaching occurs where manure is piled outside, and thus is subject to the action of rains, winds, and snows. The rains and melting snows wash out much of its richness, leaving in the barnyard black puddles of fertility that should be upon the fields. The winds, following, dry out the heap until it resembles an old straw pile rather than a heap of manure. Over half the nitrogen and potash in farm manure is in a soluble condition, and it is in these two substances that the heaviest loss occurs through leaching. Manure left outside in this way will in six months lose fifty per cent of its fertilizing value.

Heating also results in heavy loss. The heating is accompanied by decay. A loose and hot pile of manure is precisely what certain kinds of bacteria, producing fermentation, require. The nitrogen in the manure is changed into ammonia, and this escapes into the air as a gas with a well-known odor. Sometimes the heap becomes so hot that part of the vegetable matter which it contains is burned. White, dry, "fire-fanged" manure has little fertilizing value left in it.



Protecting the manure in this shed and using the manure on the land were responsible for increasing the grain yield from thirty bushels to more than eighty-five bushels per acre.

Caring for manure properly is well worth the labor expended in doing so. It should be stored under cover, firmly packed to exclude the air by allowing stock to trample over it, and should be kept preferably on cement floors. It should not be left to leach in heaps even on the fields.

Questions, Problems, and Exercises

1. What is meant by "conservation of soil resources"? Discuss the various ways and means of accomplishing this. What methods are employed by the gardeners or farmers of your locality?

2. Make a collection of plants which have nodules on their roots. Examine the leaves, the flowers, and the seeds of these plants.

3. What different varieties of legumes are grown by the farmers of your neighborhood? Explain how these plants may be used to enrich the nitrogen content of the soil.

4. Discuss the value of barnyard manures, explaining their proper care and use as fertilizers.

CHAPTER X

TILLAGE AND CROP ROTATION

TILLAGE

The term *tillage* is applied to ploughing, disking, cultivating, harrowing, hoeing, and, in general, working over, breaking up, and fining the soil with any or all of the many implements used for that purpose.

Benefits from Tillage.—The working-over of the soil brings underlying portions to the surface; and thus, by their exposure to heat, light, air, and moisture, plant food is unlocked, the unavailable plant foods become available, and the soil is, in consequence, made richer and more suitable for the growing of crops.

This is one of the great benefits to be derived from thorough tillage, but it is by no means the only one. Tillage helps the soil in other ways. Ploughing not only brings the underlying soil to the surface, but it also loosens up the whole to a considerable depth; and, if done when the soil is in the right condition, it crumbles it so that with the instruments of shallow tillage, the harrow and the cultivator, it is possible to produce a fine and uniform seed bed. Then, too, ploughing turns under stubble, weeds, stalks, and vines, all of which, by their decay, increase the humus content of the soil. When it is desired to increase the humus by the addition of barnyard or green manures, the plough is the one implement used everywhere upon the farm to get these under the ground. Ploughing, moreover, deepens the feeding area for plants, lowers the water reservoir, makes moisture conditions more suitable, warms the soil by opening it up to the air, and makes it a better home for beneficial bacteria.

Tilling for the purpose of maintaining a dust mulch, and so conserving moisture, has already been fully discussed in the treatment of soil moisture in Chapter V.

Soil Preparation by Tillage.—Shallow tillage of the surface soil is done at different times of year, depending

Breaking the prairie by tractor.

upon the object to be attained. In the spring of the year the disking and harrowing is done to fine the soil and make it ready for the seed. Later on, harrowing, cultivating, and hoeing are done to destroy or root up weeds. Weeds extract from the soil and pass into the air moisture that should be saved for the growing crop; moreover, they shade, crowd, and smother out the more useful plants. Hence, the farmer realizes that, if he is to keep his farm clean and gather an abundant harvest, he must be constantly fighting weeds.

CROP ROTATION

Crop rotation means the growing of a succession of crops on the same ground, year after year, until, in the course of a number of years, the same succession of crops comes around again.

Fertility maintained by Crop Rotation.—Rotating the crops has proved a much better practice than growing the same crop, year after year, on the same field. It has been proved by experience that no soil will maintain

Turning down the stubble with four-horse outfits. Count the teams.

its fertility and produce a uniformly high yield of the same crop for any considerable period of time. The reason for this is not only that the same crop, grown successively upon a field, will use large quantities of its own particular food, but also that it poisons the soil for itself by the materials which it throws off. It is a well-known fact that plant roots not only feed and breathe but also excrete, or throw off, certain waste materials, and that these are poisonous to the plant itself if re-absorbed. Strange as it may seem, these excretions are not poisonous to plants of a different kind. For instance, a field may be poisoned by waste materials from wheat roots so that wheat will no longer grow upon it, and yet the soil will be wholesome for oats, barley, hay, or other crops. As these are grown in rotation, the soil gradually purifies itself until it again becomes fit for the growing of wheat.

Other Benefits from Rotation.—There are many other benefits, however, to be derived from rotating crops.

(1) Plants vary in their rooting habits; some are shallow rooters while others are deep rooting. The shallow-rooting crops naturally feed near the surface of the soil; the deep-rooting ones search for their food much farther down in the earth. The benefits to be derived from rotating shallow-rooting crops with deep-rooting ones will thus be quite apparent.

Making a good seed bed.

(2) If the same kind of crop is grown successively for a number of years in the same soil, the insect enemies and diseases that attack that particular kind of crop feed, breed, and multiply more readily at the farmer's expense. It clearly puts these enemies to a decided disadvantage, if some other kind of crop is presented to them to deal with. In fact, when insects and disease have made such headway that they are causing heavy loss in the production of a certain kind of crop, one of the most effective remedies is to rotate for a few years with crops of a different kind.

(3) Moreover, rotating crops makes it possible to cultivate the fields in different ways and at varying seasons of the year. Where grain is followed by a cultivated crop, such as potatoes, corn, turnips, carrots, etc., it is possible to continue cultivation well on into the growing season. In this way weeds are kept down and moisture is conserved.

The summer-fallow and the cultivated crop give the best preparation for a grass crop.

(4) Then again, if grain only is grown, the harvesting comes at approximately the same period year after year. But if grain growing is varied with hay production, the harvesting season also varies, since hay is ready to cut earlier than the grains. This makes it possible to use the farm labor to better advantage by distributing the work of harvesting over a longer period.

(5) At the same time varying hay production with grain growing enables the farmer to combat weeds more successfully. By the earlier harvesting of the hay crop some kinds of weeds that could fully mature, ripen, and

scatter their seeds in a grain field are cut down before maturity and are thus prevented from polluting the field.

(6) If the field is used for grazing live stock, the spreading of weeds will be still further prevented.

(7) As has been shown elsewhere, there is no way to keep up the nitrogen content of the soil except by buying expensive nitrogenous fertilizers or by growing legumes. Rotation of crops makes the growing of legumes a regular farm practice. Every scheme of rotation should include the growing of legumes, whether for fodder or for green manure.

It should be possible for every practical farmer to work out a system of crop rotation suited to his own farm. Grains, hoed crops, legumes, hay crops, and pasture crops should be varied in the rotation, so as to avoid the evil results of regular cropping with the same kind of plants.

Suggested Crop Rotations.—Among the rotations practised in the Prairie Provinces the following have proved most satisfactory. They illustrate the principles involved in crop rotation.

(1) Wheat—Summer-fallow—Wheat. The objections to this rotation are that the soil becomes depleted, humus is lost, food is removed, and soil-drifting is encouraged.

(2) Summer-fallow—Wheat seeded with Sweet Clover, eight to ten pounds to the acre. This is a practical rotation for the intensive wheat grower. It puts nitrates and fibre back into the soil. The sweet clover is a biennial. It is sown with the wheat crop and establishes itself the first year. It comes up the following spring, and should be used as a pasture and ploughed under in early July. Continue to disk for the rest of the year, and harrow in the spring, returning to the wheat and sweet clover.

(3) Summer-fallow—Wheat—Oats. This is a good rotation for the stock grower who wants oats for stock and wheat as a grain crop. It adds no fertility to the soil and gradually depletes it. It is not regarded as the best farming practice, but it is preferable to straight grain growing.

(4) The last mentioned rotation may be improved by the following: Summer-fallow—Wheat—Oats with Sweet Clover. This process adds nitrates and fibre, and at the same time affords a good opportunity to eradicate weeds.

(5) The last three rotations may be varied by the introduction of a cultivated crop, such as corn, potatoes, or sunflower. But in this rotation no sweet clover may be used. This rotation would be:

(a) Cultivated crop—Wheat—Cultivated crop.
(b) Cultivated crop—Wheat—Oats—Cultivated crop.

(6) Summer-fallow—Wheat with Sweet Clover—Summer-fallow.

Wheat alone—Cultivated crop—Wheat with Sweet Clover. This is a valuable rotation.

(7) Summer-fallow—Wheat—Oats—Barley. This may cause dirty farms by permitting weeds to thrive to such an extent that the barley and oats are fit only for feed; no fertility is added to the soil; fibre is removed; drifting is encouraged.

(8) Summer-fallow—Wheat—Oats—Barley and Western Rye or Timothy. Use the last crop for pasture or hay for three years. In the third year break up the sod early in July and work down. The following year seed to wheat, and follow the rotation. This adds fibre and fertility. This rotation may be varied by adding some alsike clover to the grass seed.

Questions, Problems, and Exercises

1. Explain tillage, and discuss its benefits.
2. What is meant by crop rotation? Discuss its advantages.
3. What crop rotations are practised by the farmers of your district?
4. Select a field near your home or near the school and, beginning when the first work is commenced upon it in the spring, keep a record, with dates, showing each and every operation which the farmer carries out on this field, giving the reasons for the operation in each case. Make your record show also the dates when the grain plants first appear above the ground; when they flower; mature; are cut; stooked; and threshed.
5. How must the fields on a farm where crop rotation is practised compare in size? Make drawings to illustrate the way in which three of the rotations mentioned in the text would be carried out.
6. Visit the local implement dealer. Ask him to show you, and describe, the purpose and the working of the different farm implements and machines.

CHAPTER XI

THE CEREALS

The Grass Family.—Botanically, wheat, oats, barley, and rye all belong to the grass family. The roots of all are fibrous and extend downward and outward in all directions. The stems are usually hollow, round, and long, and have, at intervals, solid joints, called *nodes*, to give them strength. The leaves are long, slender, and grass-like. The flowers are not bright, large, or showy, for, being either wind or self-pollinated, they have no need to attract pollinating insects. The seeds, called *kernels*, are either set closely along the upper end of the stem, as in wheat, in which case the head is called a *spike;* or they are at the ends of little branches that spring from the upper portion of the stem, as in oats, and are then said to form a *panicle*.

WHEAT

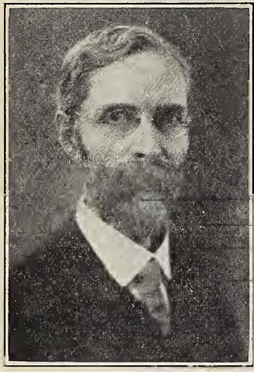
Origin and Value.—Wheat is one of the most important, most widely grown, and most ancient of all our grains. It was grown by the Chinese 5000 years ago, and even the people of the Stone Age, living 50,000 years ago, appear to have known of it and used it. Wheat is so valuable as a food for man that very little of it, unless spoiled for his use, is fed to other animals. In fact, his preference for the flour made from it over that made from any of the other grains is so pronounced that the price is usually high, and he cannot afford to feed it to his stock. Sometimes he cannot even afford it for himself, and the poorer people in some parts of the world are forced to use flour made from the cheaper grains such as rye, barley, millet, or rice. But the flours from these grains are not nearly so good as wheat flour.

Wheat flour makes the whitest, the lightest, the most palatable, and the most healthful bread of all. And besides, it can be used in more ways in the making of bread, buns, cakes, pastry, puddings, and breakfast foods than any other kind of flour. The straw of wheat is rather hard and dry, and, although stock will eat it, they much prefer oat straw or barley straw to that of wheat. Wheat chaff, however, they rather relish, and, when they use it as a rough feed, they usually do quite well on it.

Wheat heads and kernels.

Classes of Wheat

There are two broad classes of wheat: *spring wheat,* which is sown in the spring, and *fall* or *winter wheat,* which is sown in the fall of the year. Many varieties of each of these classes have been developed. They are the result of constant experimenting in an effort to breed strains of wheat which will possess the qualities always sought by growers: hardness, high yield, strong straw, rust-resistance, and good milling qualities. Now these results are not attainable everywhere with the same strains of wheat; and the problem is, therefore, to find varieties which, under the prevailing conditions of climate and soil, will give in the highest degree a wheat crop having these desirable qualities.



Dr. Charles Saunders. To Dr. Saunders and his father belongs the credit of originating the famous Marquis wheat, the variety which is grown to the greatest extent in the Prairie Provinces.

Experimenting and breeding new Varieties.—The Universities and Agricultural Schools and Colleges of the Prairie Provinces have done very valuable work along this line. In addition, there are a number of private investigators who have done much to assist in finding varieties suited to Western conditions. Dr. William Saunders, and his son, Dr. Charles Saunders, of Ottawa, carried out a long series of experiments in the crossing of wheats and in the breeding of new varieties. *Marquis* is the best known of their products. Seager Wheeler, of Rosthern, Saskatchewan, is another well-known experimenter and breeder of new varieties. Some of the most popular of the varieties which he produced are *Early Triumph*, *Supreme*, *Kitchener*, and *Red Robs*, all good hard spring wheats. John Bracken, premier of Manitoba, has also made important contributions in the way of seed breeding and selection.

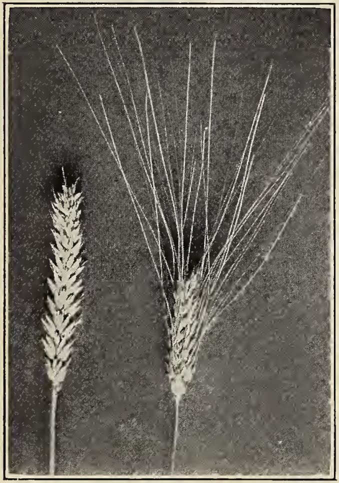
Varieties of Spring Wheat.—Some years ago one of the best-known and most widely raised varieties of spring wheat was *Red Fife.* It is a Russian wheat. It was exported from Danzig to Scotland and from there David Fife, an Ontario farmer, obtained samples, which he planted, and from these have sprung the various strains of Red Fife wheat. This wheat, owing to its lateness and comparatively weak straw, is not now raised extensively on the prairies. There is, however, a selection of this wheat known as Early Red Fife, which is rapidly gaining in favor. It is a hard, red, beardless, spring wheat, considerably earlier than Red Fife and with a stronger straw.

Herman Trelle of Wembley, Alberta, World's 1926 grain champion. Mr. Trelle carried off the grand championship at the International Competition, Chicago. His prize-winning wheat was of the Marquis variety, taken from a fifty-eight-acre field which yielded approximately seventy bushels per acre. The prize-winning oats were the Victory strain and yielded 150 bushels per acre.

Marquis was produced by crossing Calcutta Hard Red, a very early wheat, with Fife. It at once became very popular. It was found to be medium early, made flour of excellent quality, and rivalled Fife in yield. The kernel is short and broad; the grain weighs heavy; and the straw, being fairly stiff and strong, does not readily go down or lodge.

Kota and *Kubanka,* owing to their rust-resisting qualities, are popular in some sections of the country. *Ruby,* another spring wheat, is quite early but does not yield heavily. *Garnet* is a hard spring wheat of comparatively recent introduction, is very early, and yields well. *Renfrew,* owing to its drought-resisting qualities, is particularly well adapted to the dryer parts of the Prairie Provinces and is extensively grown in these areas. *Red Bobs* is another early wheat. It yields well and has strong straw. *University 222*, a selection of Red Bobs, is a wheat which is rapidly gaining in favor. It is very early, is a high yielder, has a strong straw, and is of good milling quality.

Among other varieties which have been tried out and have been found to be good spring wheats, may be mentioned *Stanley*, *Prelude*, and *Coldstream*.



Wheat. There are two types of heads of wheat—the bald and the bearded.

Fall or Winter Wheats. *Turkey* or *Crimean* wheat was brought to America by the Mennonites in 1873. It is a winter wheat, red-grained, fairly rust-resistant, and hardy. Its introduction made possible the growing of fall wheat over much wider areas than had been possible previously. Its hardiness and drought-resisting qualities made it especially suitable for the prairies.

Kharkov promises to be one of our best winter wheats. It is now raised quite largely in the southern areas of Alberta. It is a high yielder, stands the winter well, and is of fine milling quality.

Hard and Soft Wheats.—The kind of wheat and the amount of moisture in the country where it is grown have much to do with its hardness or softness. As a rule, hard wheat makes the best flour for bread-making. *Durum*, however, is an exception; it is very hard but produces only a poor grade of flour. It is used in the making of macaroni. Soft wheat makes the best pastry flour. Good grades of flour are obtained by blending the hard spring wheats of the Prairie Provinces with some of the softer varieties. Hard wheat is rich in gluten. This is a gummy material that may be obtained by chewing a

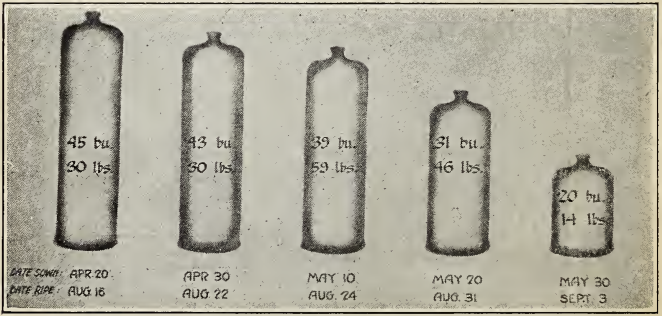
A field of Marquis wheat.

few wheat kernels long enough to dissolve out the starch. The term "soft" wheat does not refer to the softness of the kernel but rather to its composition. Soft wheats contain more starch and less gluten, and so have not the high bread-making qualities of the harder varieties.

Irrigated lands and rich, black soil tend to produce the best qualities of soft wheat. A cool, moist, growing season, followed by long, hot, dry, bright, sunshiny days, such as we have on the prairies, when the grain is ripening, is the best possible weather for the production of hard wheat. Until the last few years fall wheat was not grown to any great extent on our prairies, as the winters are too severe and tend to kill it out. The success of the Kharkov variety, however, has induced many farmers to try it out in Southern Alberta, and the area sown to fall wheat is now gradually increasing.

Sowing Wheat

Soil and Preparation.—The soil for wheat growing should be rich, with plenty of humus and abundance of

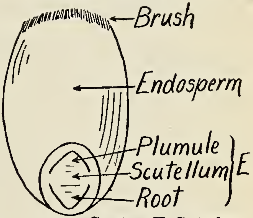


The proper date of seeding must be studied each year, but reasonably early seeding is always to be preferred.

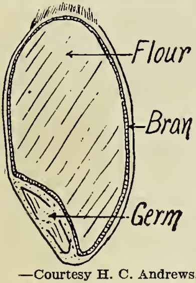
plant food. It should be ploughed deeply, well cultivated and fined at the surface with a disk or harrow to produce a good seed bed. The grain should then be sown with a drill to a depth of about two inches. Newly broken land, summer-fallowed land, corn land, or land upon which sweet clover or hay has been grown the previous year makes the best possible land for wheat.

If wheat is to be sown on old land, fall ploughing has been found to be better than spring ploughing in northern and wooded areas, while in southern areas spring ploughing has given the best results. On irrigated lands fall ploughing and fall irrigation are both recommended.

Stooling.—Wheat is a shallow-rooting plant and gathers most of its food near the surface of the soil. After it sprouts, it has three roots. A little later from six to eight other rootlets appear. From the first shoot or stem, there commence to grow several other little stems; and so, as the wheat grows, it is found to have several stems all attached to the one root. The growth of a number of stems in this way from a single planted seed is called *stooling* or *tillering*. If only one stalk and head were produced from each seed, it is easily seen that the yield would not be nearly so great as would result from stooling. Wheat stools best where it has plenty of moisture, and where the soil is rich.



—Courtesy H. C. Andrews.
The parts of a wheat seed.
E, embryo.



—Courtesy H. C. Andrews.
A lengthwise section of a wheat kernel.

On the prairies the soil is very rich in plant foods, but it frequently lacks sufficient moisture to produce a heavy crop. Wheat on the prairies is, on this account, sown more thinly than on lands in moister climates. If there is sufficient rain, the wheat will thicken by stooling, and the crop will be heavy. If the rainfall is not adequate, the crop will not stool much, and will be light; but, if the seed has been sown thinly, what there is will grow and mature. On the contrary, if the seed has been sown thickly, there will be too many stalks for the moisture present, and in all probability the crop will not be worth cutting when harvest time comes.

A stool of wheat.

Seed Selection

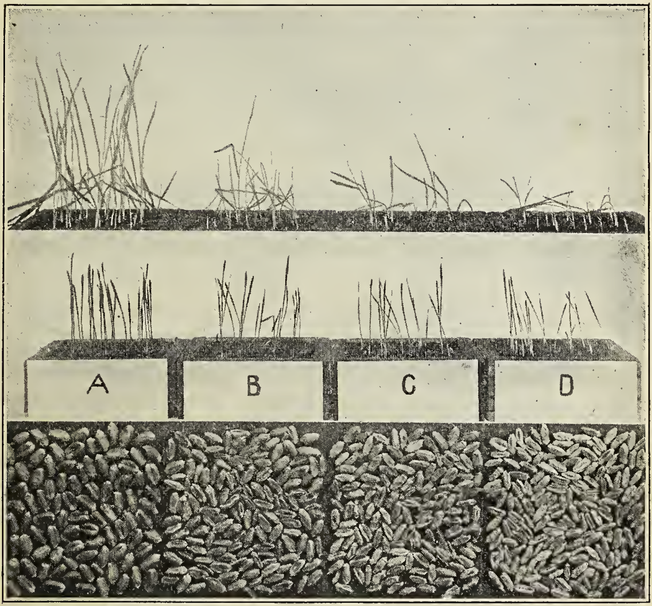
6

The seed selected should be large, plump, of good color, free from smut, pure, and of high germinating powers. Frozen, musty, shrunken, shrivelled, smutty, or diseased wheat should not be sown. The bigger and plumper the seeds the better. Such seeds have a larger and healthier embryo, or young plant, lying asleep within them, and they have more food in store to nourish it until it is able to gather food for itself.

Pure Seed.—To be pure the seed must be free not only from weed seeds but also from other kinds of grains, and even from other varieties of the same kind of wheat. Weed seeds, oats, barley, or any such seeds, sown with the wheat, will grow and be harvested with it, and this will lower its marketing value. Some varieties of wheat ripen earlier than others, and, if much of the one is sown with the other, part of the grain will be ready for harvesting while the remainder is still green. If harvested in this state, the green kernels are apt to shrivel, and the grade will be lowered.

First-prize wheat kernels, uniform and plump. These were grown at Fenn, Alberta.

Testing for Vitality.—Seed should be tested for its vitality or germinating powers. There is a germ within every wheat kernel. If this germ should die, the kernel can never sprout and grow. To sow wheat with many



Notice the vigor of growth from the unrusted sample A, as compared with that from the samples B, C, and D, affected with various degrees of rust.

dead kernels is a great waste of time, labor, and money. All seed should be tested to find out before sowing what percentage of it is dead and what percentage is alive. Fill a soup plate nearly full with damp sand and cover with moist blotting paper; count out 100 seeds—selecting neither the best nor the worst, but just the average of what will be sown—and lay them on the blotting paper, covering them with another sheet of damp blotting paper; then invert another soup plate over all and set in a warm place. Keep moist and warm for from four to ten days, and then count the number of seeds which have germinated at four days, at seven days, and at ten days. An estimate can thus be made of the vitality and vigor of the seed and of the percentage that will grow.

OATS

Origin.—Very little is known about the origin of oats. Apparently, however, nearly all of the cultivated

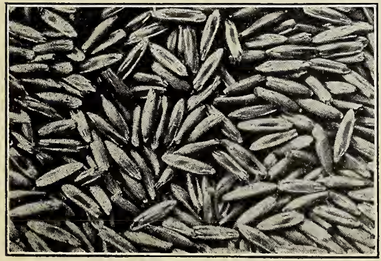
A plate germinator.

forms were derived from the wild oats of Eastern Europe and Western Asia. There are two distinct forms, to each of which belong many varieties. These forms are the *spreading* and the *side* types. In the former the panicle is open and spreading. In the side oats it is more compact and turned to one side, and thus gives them the appearance of being a heavier producer than the spreading, though this is not always the case. Hulless oats originated in Eastern Asia, where they are still raised in greater abundance than either of the other kinds. They include both the spreading and the side form of panicle.

Varieties.—Some of the leading varieties of the open-panicled forms grown in the Prairie Provinces are the *Daubeny, Victory, Banner, Abundance, Sixty Day, Gold Rain,* and *Swedish Select.* Common varieties of the side oats are the *Tartarian Black, Tartarian White, Russian White,* and *Leader.* The last mentioned is perhaps the commonest variety of side oats grown in Alberta.

A typical head of Victory oats.

Centres of Production.—Oats grow best where the climate is moist and cool. They do not thrive in the tropics, except in the highest parts, but they may be successfully raised almost anywhere in the temperate zones. In Norway, Sweden, Finland, and Russia, they are raised as far north as, and in some cases even beyond, the Arctic Circle. In Canada, Bonanza oats have been successfully raised and matured north of the sixtieth parallel. Europe is one of the leading producers of oats; the United States and Canada raise large quantities; the South American republics, Australia, New Zealand, North and South Africa, Abyssinia, China, Turkestan, and many other countries produce according to their varying capacities.



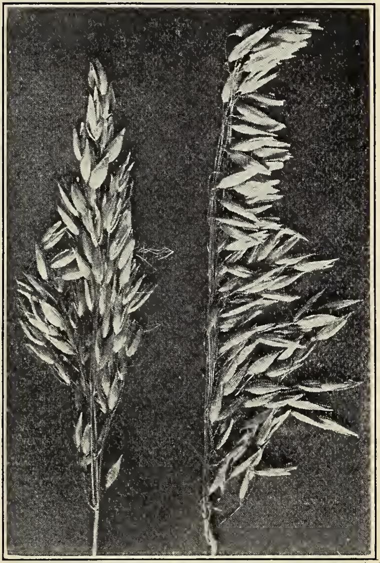
First-prize oats.

This wide distribution is not the result of climate alone. It is largely due to the fact that oats will grow and yield some crop, at least, on lands too poor to raise wheat, corn, or other grains. On moderately rich soil the yield will be heavier, but, if too rich, the growth is likely to be rank, and the grain will lodge. For this reason, oat lands are not heavily manured, unless they are extremely poor, and nitrogenous fertilizers are used sparingly. Oats will grow, too, on less carefully cultivated fields than many of the other grains.


Progress oats.

Feed Value.—As a food for certain kinds of stock, no other grain is so safe or so satisfactory. Oats contain a percentage of protein equal to and in some cases higher than the average of other grains, with the single exception of peas, which lead the farm-grown grains in this respect. Then, too, oats have a comparatively heavy hull, and, whether fed whole or ground, they make a good ration, since they are both light and bulky. Owing to their flavor and palatability, they are greatly relished by horses; and the protein which they contain makes up for the lack of this substance in the hay. They are equally valuable as a food for dairy cows. When fed with clover hay, corn fodder, or mixed hay as roughage, oats will be found to produce as great a flow of milk as that produced by an equal weight of either bran or corn meal.

Nor are oats less valuable as a food for calves or other young stock. The protein and the ash, or mineral matter, which they contain builds bone and muscle, and their lightness prevents them from causing digestive troubles. Because of their cheapness and their protein, mineral matter, and tissue-building qualities, oats in various forms have long been regarded as one of the most popular of all breakfast cereals for mankind himself.



Two distinct types of oats—the panicled and the side oats, the latter compact and turned to one side.

Preparation of the Soil.—The best oat crops are raised by sowing on land that has had a cleaning crop, that is, a hoed or cultivated crop, the year before, or on sweet clover, timothy, or other grass fields that have been broken. In the dry areas oats do best on summer-fallow. On irrigation lands the first method just noted produces the best results.

BARLEY

Origin.—Barley belongs to the same group as wheat and rye. It is one of the oldest of the cultivated grains. The ancient Egyptians grew it, and so, too, did the other Eastern nations of that time. It is known, also, that it was used as a food for man as early as the dawn of history. Its original home appears to have been the country lying between the Red Sea and the Caucasus Mountains, and there, barley, the ancestor of many of our modern varieties, still grows wild.

Two distinct types of barley—the two-rowed and the six-rowed.

Distribution.—Barley, like oats, is grown very widely throughout the world. It is grown even farther north than oats and at higher altitudes.

Varieties.—There are two types, the *two-rowed* and the *six-rowed.* These numbers refer to the number of rows on the heads. Of these there are numerous varieties. The *Canadian Thorpe, Hanna, Odessa,* and *Swan*

Neck are common two-rowed varieties. *O.A.C. No. 21*, *Manchurian*, and *Barks* are common six-rowed varieties. Barley is usually bearded; this fact makes it bad to handle and very annoying to stock. Efforts have been made to breed off the beards, but it has been found that the beardless varieties do not yield so well. In time, a smooth bearded type may be bred to replace the present bearded varieties.

A field of barley.

Uses.—Barley was the principal bread-plant of the world until the sixteenth or seventeenth century. It is used largely in making malt for the manufacture of beer. As a food for stock it is regarded as too strong to be fed alone, but, when fed as a half-grain ration along with some other grain, such as oats, it is quite satisfactory. Owing to its heating qualities, care must be exercised in feeding it to some kinds of stock.

Soil Preparation.—Land similar to that recommended for oats, with the same preparation, gives the best and purest crops of barley. Brewing companies and seed houses give premiums for barley that is clean and true to type.

RYE

Origin and Distribution.—Rye has not been cultivated for anything like the same length of time as the grains already considered. It made its first appearance in Western Asia and in Southern Russia, parts of the world in which it is still largely grown. A cool climate suits it best, its range of suitable latitudes being about similar to that of barley. It does better, however, in northern than in southern latitudes. It has one outstanding merit that commends it to the farmer of the prairies; it will stand more drought than will any of the other grains. This is, without doubt, one of the principal reasons for the large increase in acreage sown to rye in the Prairie Provinces within recent years. A clay or sandy loam is the soil best adapted for the growing of rye. It will do better on a poor soil than wheat, barley, or oats, provided that the soil is well drained. Then, too, it requires less heat for its development; it will do better on an acid soil; and there is less evaporation of moisture from the plants than from those of any other grains.

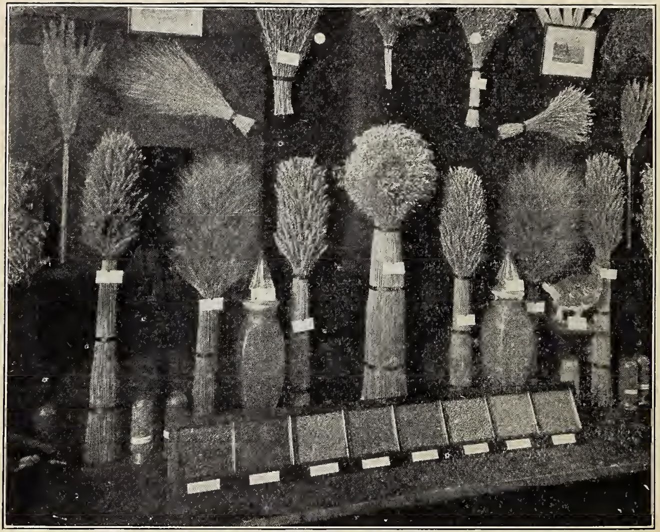
Spring rye six feet tall.

Varieties.—There are two kinds of rye—*spring,* and *fall* or *winter rye.* Winter rye is gaining in favor rapidly in all parts of Alberta. Very satisfactory crops of rye have been grown in the dry years, providing pasture, hay, and grain, when other crops have been almost, if not wholly, total failures. *Rosen, Common,* and *Dakold* are the leading varieties grown.

Advantages of growing Rye.— There are several reasons for the increasing popularity of winter rye. Being sown in the fall, it develops a root and leaf system ready to make the earliest possible start the following spring. It is, therefore, able to utilize the early spring moisture to a greater extent than spring-sown grains. Cutworms damage it but very little. The reason for this is that cutworms are not active in the fall when the plants are young and tender, and, by the time they do become active, in May or June, the plants are sufficiently far advanced to resist successfully their attacks. Rye can be sown in July or August and used as pasture in the fall; then, if it is cut for hay the following year when it comes into head, a second growth springs up, which again affords good pasture in the fall of the second year. The hay, although not equal to that of some of the grasses, is none the less of very fair quality, and, in a dry season, will greatly surpass them in quantity.

Rye is one of the best crops to sow to prevent soil-drifting. If sown early enough in the fall, the leaf system covers the ground, and the root system binds the soil particles together. Then, in the spring, there is a more vigorous development of both, and the winds cannot get to the soil to lift and move it with the same effect as when the ground is bare, or when it is loosened up and sown to a spring crop.

Uses.—The grain may be used for cattle, horses, or hogs, but it should not be used alone. It is best as a half-ration with oats or bran to give it lightness, for when wet it is of itself too heavy and pasty. The straw does not rank in feeding qualities



Samples of Alberta grain on exhibit at the Legislative Buildings, Edmonton, Alberta. The tags reading from left to right are: Top row—Alfalfa, Flax. Middle row—Rosen Rye, Kharkov Wheat, Garnet Wheat (in container), Marquis Wheat, Banner Oats, Red Bobs Wheat, Winter Rye (in container), Kota Wheat, Stanley Wheat.

with that of either barley or oats; it does, however, compare favorably with wheat straw in this respect. Like the latter, it is dry and hard, and stock fed on it should have their ration balanced by some more succulent or laxative food. They should also have access to salt and to abundance of water.

Sowing and Soil Preparation.—Spring rye should be sown in the spring at the same time as spring wheat, and on land similarly prepared.

Fall rye should be sown not later than August 15th. The land should be carefully summer-fallowed during the same season. Double disk the soil as early as possible in the spring, then plough five inches deep, early in June; harrow behind the plough, and by the frequent use of a duck-foot cultivator keep the land black until the time of seeding. Fall rye is a splendid weed destroyer, because the land is cultivated before seeding, and also because fall and winter frosts kill wild oats and other weeds.

Marketing.—Rye is used in the manufacture of liquors of various kinds and in bread-making. A ready market for any surplus rye is found in Minneapolis, to which point it is shipped in carload lots. All elevator companies handle it. The biggest market for rye at present is for seed purposes. Rye is sown frequently for early spring and late fall pasture.

HARVESTING, STORING, AND MARKETING OF GRAINS

Cutting.—Most grains are ready to cut when the straw becomes fairly yellow. Where high winds prevail, the grain should not be permitted to become too ripe, as the loss by *shelling* is then likely to be heavy. The kernel need not be hard. If it has passed the milk stage and has reached the hard-dough stage, just so that it can be indented by pinching with the fingers, the grain is ready to cut. The sheaves should be carefully shocked and capped to prevent too rapid drying and to keep out the rains. If the grain is somewhat green when cut, too rapid drying will cause the kernels to shrivel, but, if well capped in the stook, the sap will travel up the stems into the heads and help to fill the kernel.

Stacking.—Threshing is done either directly from the stook or from the stack. Stacking has some advantages. If the grain has to remain for some time before being threshed, stacking affords the best protection from

Harvesting oats.

the weather. Or, if the farmer does not wish to sell immediately and is short of storage space, it is a convenient way in which to keep the grain stored for a time. Barley should be stacked, as it is darkened by rain. Stacking keeps the color bright, thus preserving its marketing qualities. The bottom of the stack should be well off the ground. Straw or boards should be placed underneath, so that the grain may be kept dry.

Threshing.—If threshing is attempted when the straw is damp, it will be "tough" to thresh; and there is likely to be considerable loss, because all the grain will not be removed from the heads, and much of it may thus be blown out with the straw. Moreover, in such circumstances, the threshed grain is apt to heat and mold when stored in the bins.

Storing.—Sheet metal tanks make good bins. They keep out mice and gophers; they can be readily cleaned and, if necessary, fumigated to destroy such pests as

Threshing from the stook.

the granary weevil; they can be set up off the ground, and can be covered with caps of sheet tin to keep out the rains. They can also be placed at convenient points in the field or moved from field to field for convenience in filling. They thus have some marked advantages over the stationary wooden granary. Many farmers haul their grain to the elevators directly from the threshing machine, and there store it, or send it to the large terminal elevators where it may be stored at a small charge per bushel.

Grading.—When the grain is sold or shipped, it is graded, and the price paid is determined by the *grade*, Grain to be of the highest commercial or registered grade must be of good color, sound, dry, plump, and clean. If it is dirty, that is, if it contains many weed seeds or seeds of other grains, the grain is *docked*, that is, cut down in price.

The Seed Grain Industry.—The business of growing "registered" seed has increased rapidly in recent years. The grain is registered by the Canadian Seed Growers' Association at Ottawa. The Alberta Seed Growers' Association is composed of farmers of the province who are raising registered wheat, oats, and barley. They ship their seed to the government cleaning and grading plant at Edmonton, where it is cleaned, graded, inspected, registered, and sold on a *pool* basis. This means that all expenses are *pooled*, that is, distributed among the members on the basis of the amount sold by each member, and prices for different varieties of grain are pooled so that a uniform price prevails for the same variety of grain.

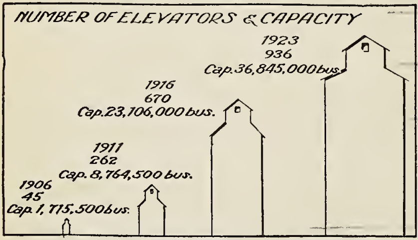


Diagram showing the increase in elevator capacity in Alberta from 1906 to 1923.

There are a number of these seed grain pools. The Registered Seed Growers' Association of Brooks, Alberta, markets Grimm alfalfa seed by the pool method. The Pincher Creek Co-operative Association of Pincher Creek handles the timothy seed raised by the members of that association. In Saskatchewan the Saskatchewan Registered Seed Association does like work. Manitoba has a number of such associations, among them being the

Registered Oat Growers' Association at Solsgirth, Manitoba.

QUESTIONS, PROBLEMS, AND EXERCISES

1. Which are the six principal cereal crops of Alberta?

2. Wheat and oats are grown on almost all farms. Which is the more important so far as care and preparation of the soil is concerned? What differences in respect to cultivation are required?

3. What qualities make Marquis wheat the most desirable variety for the Prairie Provinces? Why should a community grow one variety of wheat only? What are the faults and also the merits of Kubanka? of Fife? of Preston?

4. What is "stooling" or "tillering" of wheat? Under what conditions does it occur? How does it affect the yield? the time of ripening?

5. What are the commoner defects which cause a loss of grade when wheat is marketed? Discuss means of getting the best grade. Why should seed-wheat be so treated?

6. What cultural and climatic conditions are most favorable for the growing of oats? Railroads discriminate against the shipping of black oats. Why? What are the advantages of oats as a farm crop? What are the main classes of oats, and which are the principal classes cultivated in the Prairie Provinces in your locality?

7. Name the principal kinds of barley grown in this province. What are the uses of barley? Compare its feeding value with that of oats.

8. What are the merits of rye as a field crop in the prairie region? Compare its soil requirements with those of barley and wheat. Why is winter rye a particularly satisfactory crop?

CHAPTER XII

CEREAL DISEASES AND INSECT PESTS

RUST

Kinds of Rust.—Rust is a fungous disease, which, in some form or other, attacks all the grains and many of the grasses. Some kinds of grain are affected by one kind of rust, others by a different kind, but there are some forms of rust that will attack any or all of the grains. For example, *orange-leaf rust* attacks wheat, rye, and some of the grasses; *dwarf rust* attacks barley; *crown rust* is the common rust on oats; while *yellow rust* will attack all others except oats; but *black stem rust*, the worst of all, will attack any one of the four. Rust, as its name indicates, produces spots resembling rust on the leaves or stems of the plants. These rust spots may vary from a few in number to a dense, almost solid mass.

Courtesy Grain Growers' Guide.
Black rust on the stem and leaf of wheat, the red stage on the left stalks and the black stage on the right one.

Damage.—The damage done by rust to the grain crops is enormous. It interferes with the work of the leaves and stems, preventing them from making food and from carrying it to the parts of the plant where it is required. The spikes or panicles with their kernels are starved. Instead of filling, they shrivel, and the whole crop is sometimes not worth the cutting. A humid

Courtesy Grain Growers' Guide

The smuts of wheat: (b) a wheat head infected with stinking smut (note the four smut balls); (c) a head partly infected with stinking smut; (a) a sound head; (d) two heads destroyed by loose smut. (After Güssow.)

atmosphere, a late crop, and an excess of nitrogen in the soil help to cause rust. The barberry was long supposed to be the breeding ground of black rust, but it is known now that black rust occurs hundreds of miles away from the barberry bush. No effective remedy has been found for rust; it can, however, to some extent be controlled. It may be avoided by early seeding and the use of early-maturing varieties of the grains. Also, certain varieties of grains are less subject to attack by rust than others, and in districts where this disease is prevalent, rust-resisting varieties should be sown.

SMUT

Kinds of Smut.—Smut is another fungous disease of grains, and, like rust, it attacks them all. There are several kinds of smut affecting the cereals. *Bunt* or *stinking smut of wheat* is one of the worst diseases that attack this cereal. The infected wheat kernels, instead of being filled with food, contain a black mass of spores, which, mingled with the grain, greatly lowers its quality and its grade, and gives to the flour an offensive odor. *Loose smut of wheat* frequently destroys everything on the spike.

Loose smut of wheat.

There are two forms of smut that attack oats—the loose and the covered. *Covered smut* attacks the kernels, leaving the outer glumes or leaflets intact enclosing the smut balls, whereas *loose smut* attacks the entire flower, converting into smut spores not only the kernel but also the glumes that enclose it. *Covered smut of barley* and *naked smut of barley* are very similar both in their action and in their development to those already described, but they have not caused such great losses. Smut is found to a certain extent on rye, but as yet it has not seriously affected that grain in Alberta.

Nature of Smut.—In the case of many of the smuts, the seed becomes infected from other smutty spikes the year before the smut appears. The smut spores from a diseased spike are ready for distribution at the time when the healthy spikes are in bloom. These spores, falling on the blossoms, infect the seed for the next year's crop.

A, covered smut of barley.
B, loose smut of barley.

Treatment. — Steeping in fungicides, copper sulphate or formalin solutions, or sprinkling these solutions on the grain are the commonest methods of treating the seed. The copper sulphate solution consists of five pounds of copper sulphate dissolved in fifty pounds of water. The formalin solution is prepared by mixing one pound of formalin with forty gallons of water. The grain should first be run through the fanning mill, so as to blow out as many smut balls as possible. If the grain is then put into a basket and dipped into the fungicide solution, any smut balls that remain will rise to the top of the solution and may be skimmed off. The liquid will not permeate the smut balls, so that, if these remain in the grain and afterwards become broken, they will infect the treated seed.

OTHER DISEASES

Ergot.—Ergot is the principal disease found on rye. It frequently attacks barley and sometimes wheat. The spike or panicle is the part of the plant attacked. The kernels are converted into hard, purplish masses, and poisonous compounds are produced which make it dangerous to feed the grain or straw to stock. The formalin treatment has no effect on ergot, but it is easy to remove from the seed, as it is lighter than the rye kernels and will float on water, whereas the rye grains will sink. Ergot loses its vitality after one year, and affected seed may be sown after that time without danger.

Take-all.—Take-all is becoming much too prevalent in some parts of the prairies. It is a very serious disease in France, Germany, England, Australia, and other countries. Sometimes it destroys half of the wheat crop of these countries. It is a fungous disease which attacks the crop in its early stages. The fungus is in the base of the culms and so remains in the stubble when the grain is cut. The base, where the infection is, appears blackened. When attacked, the leaves and culm turn yellow, and the plant dies before maturity. In *white head*, a form of this disease, the grain appears to have reached maturity with culm, leaves, and spike fully formed. It then takes on a bleached or prematurely ripened appearance. But the kernels within do not develop, and they shrivel greatly. This disease may attack any kind of wheat, but more especially the early varieties.

Ergot on rye.

As the fungus is in the stubble, a second crop of wheat sown on diseased land is almost certain to be attacked. When the disease appears, it should be kept in control by crop rotation.

Root Rot.—This disease is becoming quite too widespread in the grain fields of the prairies. It is rather widely distributed, and in some localities as high as eighty per cent of the roots of the plants are either wholly or partly rotted. Wheat and sweet clover are especially subject to its attack.

Mold.—Mold has been found to some extent. It appears first in circular spots on the spike when green. Later it covers and kills the plant, and may be seen on the stubble after the grain is cut.

THE HESSIAN FLY

Damage.—This small, dark fly, about one-tenth of an inch in length, is a well-known pest of wheat. The eggs are laid in grooves on the surface of the leaves. There the young hatch and work their way down into the stem of the plant. The plant soon takes on a sickly hue. The green color fades, and the stems become spindly and frequently break over before the grain is harvested.

Control.—This and other pests, such as the joint worms, the wheat midge, and the bulb worm, may be controlled by burning the infested stubble, or by deep ploughing early in the fall. The latter method buries the larvae so that they are prevented from maturing to injure the crops the following year.

A hessian fly, enlarged.

SAW-FLIES

Nature.—The name "saw-flies" has been given to a certain family of insects, because of the fact that the females are furnished with saws. There are two of these set side by side near the exterior of the abdomen. They are genuine saws, and can be shoved out at will and worked back and forth for the purpose of sawing or making openings. The female uses them for the purpose of making openings in the stems and leaves of plants. In these holes she deposits her eggs. This is the extent of the harm that the adults do, but the larvae that hatch from the eggs are very destructive to many kinds of vegetation.

Damage.—One species of saw-fly that attacks wheat makes the openings and deposits the eggs in the upper part of the culm or stem. When an egg hatches, the larva bores its way to the inside of the stem and keeps feeding, growing, and working downward. When full grown, it girdles the culm on the inside, nearly severing it; then it descends below the girdle, fashions its cocoon and goes to sleep for the winter, to emerge the following summer as an adult saw-fly. The purpose of girdling the culm is to enable the fly to escape from the interior of the culm. This girdle so weakens the stem, however, that it breaks, and the grain lodges. In some fields this species does great damage.

A saw-fly, enlarged.

Another species of saw-fly that attacks wheat lays its eggs in holes along the margins of the leaves. The larvae feed mostly upon the leaves, but they may also attack the culms, severing them just below the head.

Control.—These pests are combated by deep ploughing. If the stubble is turned down in the fall or early in the spring, the cocoon is buried, and the young dies. The field should be ploughed six inches deep, and only crops that are entirely immune, such as oats and flax, should be sown. Winter rye and barley are also very little affected.

GRASSHOPPERS

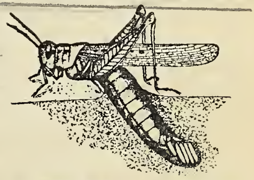
Grasshoppers have become such a serious menace to grain and other crops in Alberta that the government has found it necessary to take special measures to destroy them. A fine up to $100 may be imposed on any landowner who fails to take steps to control the grasshoppers upon his land.


The roadside grasshopper.

Kinds. — Of the thirty or more different kinds of grasshoppers found in Alberta, there are only three kinds that are likely to injure crops. These are the *roadside grasshopper*, the *lesser migratory grasshopper*, and the *two-striped grasshopper*.

Habits.—Grasshoppers lay their eggs from August to October. The roadside species lays them in the sod around fields, in small pastures, and around sloughs. The lesser migratory lays them in hard and weedy stubble land, and in deserted fields. The two-striped lays them in rye fields, and among weeds and grass, often in blown soil. The females drill a hole in the ground an inch or thereabouts in depth, and there deposit their eggs in little sacs, known as egg pods. The eggs remain in this state during the winter and hatch out early the next summer.

Eggs of the roadside grasshopper.


The lesser migratory grasshopper laying eggs.

Control.—The methods of control consist of ploughing, burning, and poisoning. Fall or spring ploughing should be deep, and the furrow should be turned completely over, so that the young that hatch out will find it impossible to reach the surface. Shallow ploughing or spring cultivation which does not bury the eggs does little or no good. In summer-fallowing infested fields, ploughing should commence at the outside and should proceed around the field, gradually working towards the centre. The grasshoppers will be driven to the unploughed area within, and when this is sufficiently small, poisoned bait may be scattered over it, or it may be burned and the hoppers killed. Great numbers of hoppers can also be destroyed after they first hatch out by scattering straw or dry weeds along roadsides and fence rows, and around sloughs, and setting fire to it at night when the hoppers have gathered into it.

Poison Bait.—The poisoned bait recommended by the Department of Agriculture as producing the best results is a mixture composed as follows:

Bran and Sawdust (half and half by weight)......	100 pounds
White Arsenic....................................	4 pounds
Salt..	4 pounds
Molasses...	½ to 1 gallon
Water..	10 to 12 gallons

The bran and sawdust should be spread on the floor of the barn or granary and the arsenic scattered over it. The whole should then be thoroughly mixed with a rake or shovel. The molasses and salt should be dissolved in the water and well stirred. This should then be thoroughly stirred into the mixture. The bait may be used immediately, or it may be kept in bags for forty-eight hours and then used.

How to use Poison Bait —Grasshoppers begin to feed from half an hour to an hour after sunrise, and that is the time when the bait should be applied. It should be scattered broadcast, and should cover the ground so thinly that it can scarcely be seen. More than this is pure waste, as the hoppers will come a considerable distance to feed upon it, and one flake will kill several of them. The bait should not be applied when it is dried out, as it is the moisture in it that attracts the hoppers. For the same reason it should not be applied in the afternoon or at any time when the sun is strong. If scattered over the breeding grounds within two weeks after the young hatch, this bait will be found very effective. As it is very poisonous, great care must be taken to keep it away from stock, and to prevent it from being spread too thickly or from being spilled upon the ground.

THE WHEAT WIREWORM

The wheat wireworm is another very destructive pest which sometimes does great damage to the grain crops. Wireworms and the methods of combating them are discussed in Chapter XV.

Questions, Problems, and Exercises

1. Secure samples of unthreshed wheat and examine for rust. Compare the heads and the kernels on stalks affected with rust with those on unaffected stalks.
2. Try to find examples of smut. Compare the straw and the grain of plants thus affected with that of healthy plants.
3. Try to find, examine, and study the work of insects described in this chapter.

CHAPTER XIII

CROPS OF SECONDARY IMPORTANCE

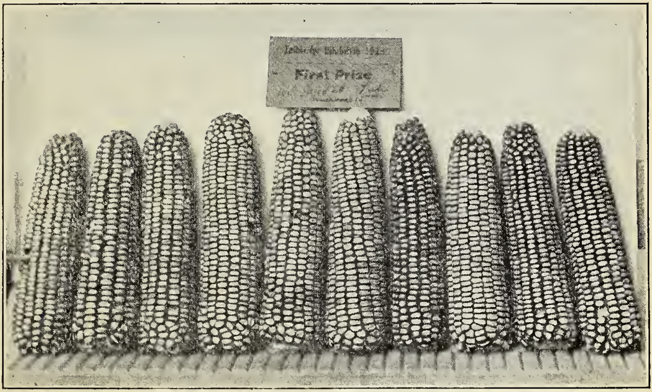
CORN

Origin.—Corn is a native of North America. Its original home appears to have been in Mexico. It was grown and used by the Indians before the white man came to America. The word "corn" is in Europe applied as a general term to any of the small grains, especially to wheat; in fact, its use there is almost identical with our word "grain." Hence the American product was distinguished by calling it "Indian corn" or "maize."

Types.—The principal types of field corn are—*dent corn* and *flint corn*. There are also two garden types—*pop corn* and *sweet corn*. Of these four types there are many varieties, strains, and crosses. *Howes' Alberta Flint*, for example, is the descendant of a cross between flint and *Golden Bantam*. Golden Bantam is a sweet corn, whereas Howes' Alberta Flint, as the name implies, is a flint corn; but yet it has certain characteristics of sweet corn, derived from its sweet ancestor Golden Bantam. The different varieties of flint corn fall into two groups, known as *Early Flints* and *Late Flints*. The different varieties of dents also fall into two groups, known as *Early Dents* and *Late Dents*. And there are a number of crosses between the flints and the dents, known as *semi-dents*.

In selecting the variety of corn to be grown in any locality, the factors to be taken into account are: climate, moisture, early and late frosts, length of the growing season, and the purpose in view. If it is desired to grow corn for silage or fodder, and the intention is to cut it before maturity, the producer will not be greatly concerned as to whether or not the ears will ripen. On the other hand, if he desires to produce seed, he must select a variety likely to mature under the conditions prevailing in his district.

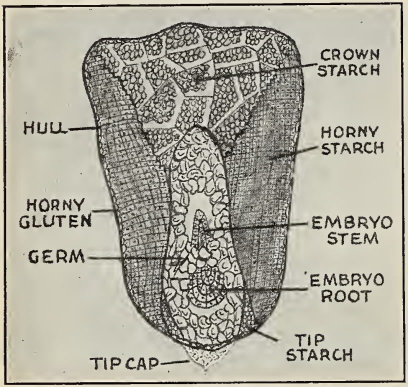
Structure of the Seed.—The seeds of corn vary somewhat in shape and appearance, size, hardness, and con-



Northwestern Dent corn, grown at Taber, Alberta.

tent. Yet, if some be soaked so as to soften them and make examination easier, they will be found to have certain characteristics in common. There is on the outside a thin, tough covering or skin; within this is found the endosperm, part of it oily and yellow and part white and starchy-looking. By cutting the soaked seed open, the little rootlet and the tiny stem can also be discovered.

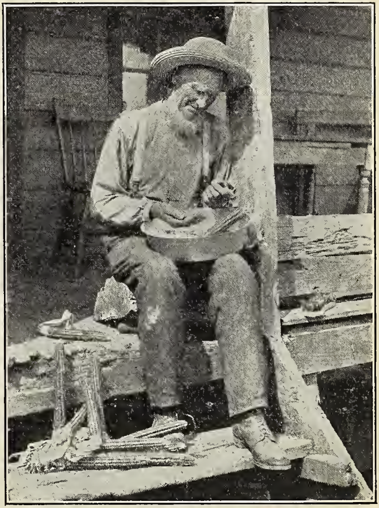
In *pop corn* the kernels are small and very hard. In fact, the outer portions are so hard that the moisture within is retained when the kernel is warmed. But when the heat is increased, the imprisoned moisture expands, bursting the kernel, and the corn *pops*. *Flint corn* has also a very hard kernel, but, although hard like flint on the outside, there is soft starch in the centre. The kernels are commonly, though not always, short and rounded, and have no dent in the top. *Dent corn*, as the name implies, has a depression or dent in the crown. This is due to the fact that there is soft starch not only in the interior but also in the crown, and 'that which is in the crown shrinks, leaving the dent when the kernel dries. The kernels are longer and flatter than those of flint, and, as they contain more soft starch, they are not so hard. The ears are no longer than those of flint, but they are larger and have more rows of kernels; and the yield per acre, where it matures, is the heaviest of that of any corn.



The structure of the corn seed.

Structure of the Plant.—As with the great majority of plants, corn consists of root, stem, leaves, flower, and fruit.

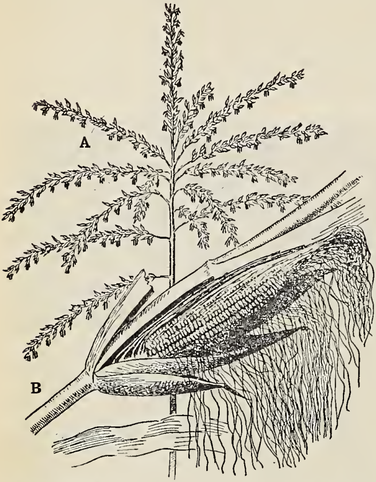
Roots.—The first roots thrown out by the germinating seed are temporary. They last only until the tiny plantlet puts out its leaves and begins to gather food for itself. The permanent roots then develop about an inch below the surface of the soil. They spread out on every side, until they have taken possession of the upper soil round about the plant for a considerable distance. They go downward also to an almost equal distance, if the soil is not too hard. Most of the roots, however, are to be found in the upper foot of soil. Later other roots, known as brace roots, are developed. These grow from the stem above the surface of the soil. They branch out and brace the stem, and they also enter the soil and feed the plant.



Selecting the seed. Grandpa knows good seed corn.

Stem.—Corn varies in height, depending upon the types and conditions under which it is grown. The flints grown in Alberta are comparatively short. The stem is not usually more than from four to six feet high, and has a number of nodes or joints to give it strength. In those sections of the United States where corn is produced, the dent varieties often grow to a height of fifteen feet or even more.

The ear contains the cob with the rows of kernels attached to its surface. When the kernels are about one-fourth developed, they send out long silk-like threads. The function of the silk is to receive the pollen. Every silken thread must receive its pollen grain, or the kernel to which it is attached will shrivel and die.



A. A tassel of corn. B. An ear in the silk stage.

Tassel.—The tassel which is borne on the upper end of the central stalk is really made up of a large number of imperfect flowers which produce the pollen. As corn is wind-pollinated, that is to say, it must depend on the wind to carry the pollen from the tassels to the silk, there have to be millions of pollen grains produced on every tassel in order to assure fertilization.

Climatic and Soil Requirements.—In general, corn requires for its best development warm, sunshiny weather, a fertile soil, and a moderate supply of moisture. In northern latitudes and at elevations from 2000 to 3000 feet above sea-level, although the days may be warm, the nights are likely to be cool; and cool nights delay the ripening of corn. This is one reason why many varieties of corn that do well in the East and South cannot be successfully grown in Alberta. Howes'

A corn crop grown on the Western prairies.

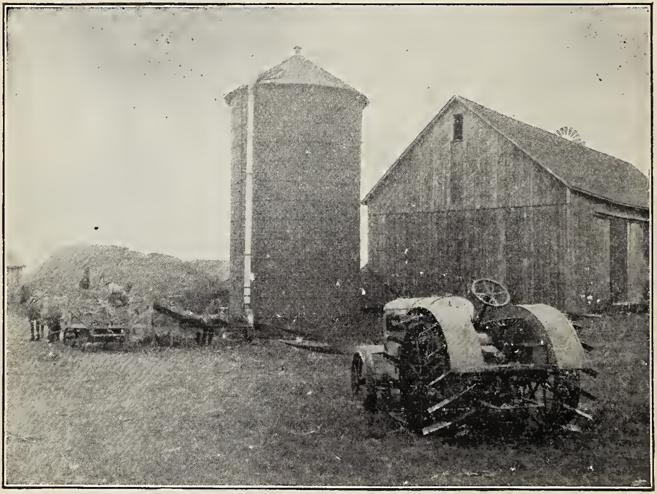
Alberta Flint has been successfully grown and matured even as far north as Fort Vermilion. This is a dwarf corn, adapted to a wide variety of soil and climatic conditions. It is very early, ripening its grain in about ninety days; and in the vicinity of Edmonton, where it has been successfully grown for a number of years, it has produced yields of shelled corn as high as forty bushels to the acre.

Favorite Varieties.—Certain varieties of the Early Flints such as *Squaw*, the *Improved Squaws*, *Gehu*, and

Squaw corn growing at High River, Alberta.

Dakota White Flint, find considerable favor among producers in Alberta. These varieties are all short, with rather fine, leafy stalks, and with the ears borne low on the stalks. They can usually be depended upon to mature successfully throughout large areas of the province. The yield of ripened grain from these varieties is also quite satisfactory.

Brown County Dent and *Rustler's White Dent*, which are about the only varieties of the Early Dents grown in Alberta, are from ten days to two weeks later than the Early Flints. These and the Late Flints and the Late Dents have been tried out to some extent for fodder purposes in Alberta, but without much success. *Quebec No. 28*, a variety of Early Flint, and *North-Western Dent*, a variety of the semi-dent, have been



Filling the silo. The silo shown here is forty feet high. The size of the silo should be determined by the number of stock kept upon the farm. To ensure the silage feed being in wholesome condition about four inches from the top of the heap should be fed daily.

found to be most suitable for fodder. They produce a greater proportion of leaf and stem than the smaller growing varieties, and they mature sufficiently to give them high feeding value whether used as fodder or silage.

Economic Importance of Corn.—The chief value of corn is as a food for live stock. The grain makes excellent pork,—firm and of fine flavor; the stalks and leaves make splendid food for cattle. The yield per acre, under normal conditions, is usually high, and it has been found to be a dependable source of fodder in places where other crops have failed. It may be used in several ways. It can be fed while green, stooked and fed when dry, or cut up and put into the silo to be fed to all classes of stock during the winter months.

Cutting sunflowers on a farm near Edmonton, Alberta.

Moreover, owing to the fact that it is a tilled crop, it is of particular value in any system of rotation, especially in a country, such as ours, where roots are not extensively grown. It has been found too, by experiment, that if tillage is consistently and properly done, the ground is prepared for wheat almost as well, and under some conditions even better than can be done by resorting to the bare summer-fallow.

SUNFLOWERS

Climatic and Soil Requirements.—Sunflowers may be sown even earlier in the spring than corn, as they are not so easily damaged by frost. In fact, cool weather, which retards the growth of corn, is ideal for the growth and production of sunflowers. They, however, require about ten per cent more moisture than corn and will die for lack of moisture where corn will grow and do well.

Corn and sunflowers growing at Lethbridge, Alberta.

Economic Importance.— Sunflowers are grown principally for silage. The results of feeding trials go to show that they are not equal to well-matured corn for this purpose. They have, however, considerable value as silage, as they contain a comparatively high percentage of both protein and carbohydrates, two essentials in the food of all animals.

FLAX

Climatic and Soil Requirements.—Flax requires for its best development a rich soil, free from weeds. It is slow of growth, has a weak stem and fine leaves, and hence may be easily choked by weeds. Newly broken prairie soils are usually clean, and flax is commonly grown to advantage on these the same year that they are broken. It thrives in both dry and humid climates, but, as it is quite sensitive to frost, it must be sown in the spring only after all danger of frost is past.

Economic Importance.—Flax is grown both for its seed (called linseed) and for its fibre. A dry climate is the best for the production of seed, and a cool, humid one for fibre. The seed is very rich in both oil and protein. It is ground, heated, and pressed to extract the linseed oil, which is used in the manufacture of paints, varnishes,

The light-colored is sunflower silage, and the dark is thistle silage.

and printer's ink. The remainder, known as oil cake, is used in the feeding of stock. The fibre is used in the making of linen.

PEAS

Climatic and Soil Requirements.—Field peas can be grown on almost any type of soil. For heavy clay they are one of the best of all crops to grow. They require a moderate amount of moisture and are partial to cool summers. Moreover, they are not readily injured by early or late frosts.

Economic Importance.—Peas yield well, usually from twenty to forty bushels per acre being harvested. The grain has valuable feeding qualities, especially for hog fattening. Sometimes a cereal, such as oats, is sown with them, and the crop is then cut for forage. It makes very fair silage, but it is not equal in this respect to corn.

RAPE

Rape is grown principally as a pasture for sheep. However, it makes good pasture also for hogs, cattle, or other stock. It does best where the summers are cool, and it is not easily injured by even quite heavy frosts in the fall.

Questions, Problems, and Exercises

1. How is corn different in its origin from the other grains?
2. Describe the different varieties of Indian corn. What are the uses of this crop so far as Alberta is concerned?
3. Describe the soil, cultivation, and climate most suitable for corn.
4. Make a diagram of a grain of corn somewhat enlarged and on it mark the covering, endosperm, and embryo.
5. Describe the root system of corn. Why is it not good practice to cultivate the soil deeply about the roots after the first month of growth?
6. What is the importance of the tassel and the silk, respectively, in the development of the ears of corn? Why are the ears poorly filled where stalks grow singly?
7. What is the value of corn in a system of rotation?
8. Compare corn and sunflowers as to feeding value. Which seems preferable and why?
9. Write notes on the culture and economic importance of flax. Why is flax a very suitable crop to be sown on breaking, the same year that the breaking is done?
10. For what purposes are field peas grown?
11. How is rape fed to stock? What are its chief values?

CHAPTER XIV

FORAGE CROPS

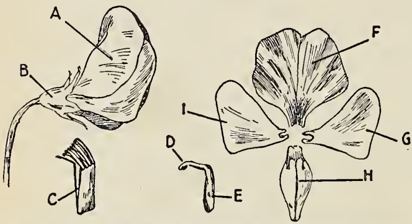
Nature of Forage Crops.—Forage crops are plants that are raised not for their seeds or grain but for their stems and leaves, to be used as feed for farm animals. Animals have a stronger digestive system than man, and they are very fond of, and thrive well on, the stems and leaves of many plants. A *pasture* field is one upon which animals gather their own food, grazing upon the stems and leaves of grasses. If the grass is permitted to grow, and is then cut and cured, it is called *hay. Green feed* consists of grain crops cut green and cured for feeding in that condition. A *soiling crop* is one in which the feed is cut green and fed without curing. If cut and stored in silos, while still green, and preserved in that state for feed, it is called *silage.* All crops which are grown for the feed value of their stems and leaves are known as *fodder crops.* The term *fodder* is applied also to straw.

LEGUMES

Nature.—Legumes or leguminous plants, although used as fodder, are quite different from the grasses. Legumes belong to the pea family. Peas, vetches, beans, alfalfa, and the clovers are legumes. Many of these are of the greatest value as fodders.

Stems.—The stems of leguminous plants are usually erect, although in a few, such as white clover, they are creeping. In others, some of the vetches for example, they are erect but are so weak that they require external support to prevent them from falling down and lying upon the ground.

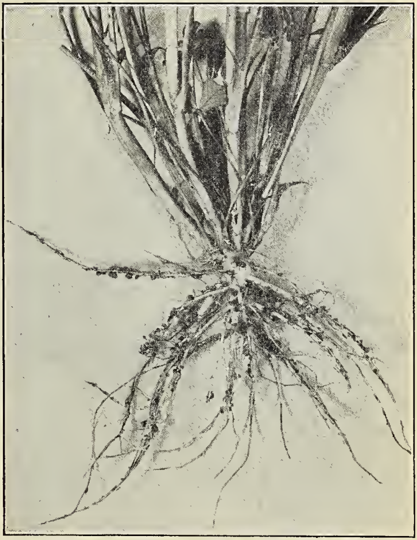
Leaves.—The leaves are compound; that is, the leaf is made up of a number of smaller leaflets, each entirely separated from the others. In alfalfa, red clover, white clover, alsike clover, and some others three leaflets make up the leaf. In the vetches and peas there is a mid-rib to which the leaflets are attached. From the upper end of this there are a number of twisted tips, called *tendrils*. The tendrils are very sensitive, will move if gently rubbed, and will grasp firmly anything that may be near. They even appear to sense the direction of the nearest object to which they may cling.



The flower of a legume. A, corolla; B, sepals; C, stamen; D, stigma of pistil; E, ovary of pistil; F, standard; G, wings; H, keel.

Flowers.—The flowers of these plants are either in heads or in racemes. In a raceme the flowers are not so densely crowded together as in a head; but they are arranged more openly along a little stalk called an axis. All the flowers of leguminous plants, whether arranged in heads or racemes, that is, in the loose or open form, are alike in general construction and quite different from the flowers of any other kinds of plants. At the base of the flower there are five little leaflets, called *sepals*, joined together except at their tips. Above these there are five other leaflets, or *petals*, colored and showy. One of these petals is much larger than the others, and is called the *standard;* the two side ones form the *wings;* and the two lower, the *keel*. The *stamens* number ten, nine of which grow together and one separate. There is one *pistil* which has a broad lower part, the *ovary*, and a narrower upper extension sharply bent and terminated by the *stigma*. The stamens and the pistil are enclosed by the keel.

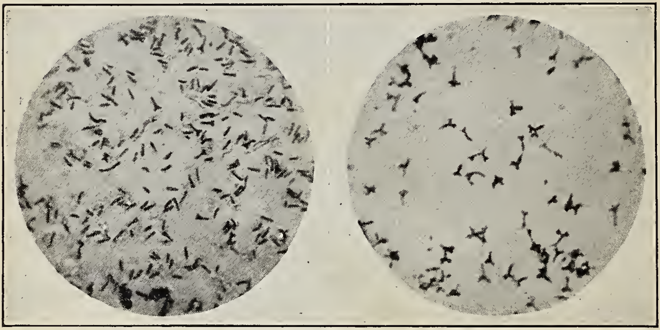
Legumes are cross-pollinated, the pollen being carried from flower to flower by insects, chiefly by bees. To attract the insects the flowers are made showy, and many of them are sweetly and strongly scented. In some of the legumes, if insects do not visit the flowers and fertilize them, self-fertilization is resorted to. That is, the pistil of the flower will be fertilized by the pollen from its own stamens.



A red clover plant, showing the nodules on the roots.

Fruit.—The fruit of legumes is a pod, in which there may be one or more seeds. When ripe, the pod splits open, sometimes with considerable violence, and the seeds are thrown some distance from the parent plant.

The Root System of the Legume.—The root system of some legumes consists of a rootstalk or underground stem which carries the roots of the plant. Such plants gather their food materials near the surface. Other legumes have a tap root which goes deep into the soil, and these plants gather food materials far under the surface. On the roots of legumes are numerous little lumps, called *nodules* or *tubercles*. These nodules are the homes of bacteria, which have the power to take the nitrogen from the air in the soil and change it into compounds of nitrogen, called nitrates. This is called *nitrogen fixation*. These nitrates are soluble in the soil water and are thus available as plant food materials.



Legume bacteria from the interior of a nodule: on the left from red clover, and on the right from pea.

Thus legumes leave the soil richer in nitrogen than they found it.

This power of increasing the nitrogen content of the soil, together with the fact that so many of the legumes are deep feeders, and thereby bring food materials from the lower depths to leave them near the surface, makes such plants very valuable ones to grow, altogether apart from their own food values. Unless the bacteria are in the soil, however, these plants will not thrive and grow well. It is necessary to inoculate either the soil or the seed.

Alfalfa

Characteristics.—Alfalfa, of which there are many varieties, is one of the most valuable of all the fodder plants. It is a perennial, and, once established in suitable soil, it will live, thrive, and produce abundant returns for years. Some varieties have a strong, straight tap root, which will penetrate the soil to a great distance if the subsoil is at all open and porous. Others of the hardier varieties have a fleshy, branched tap root. On the fine branches of the roots are to be found the nodules, characteristic of the legumes, in which the nitrogen-fixing bacteria live. The top of the tap root forms the crown, on which grow many stems.


Alfalfa.

Varieties.—The position of the crown is one of the characteristics considered in hardiness. In *Common alfalfa*, the least hardy group, the crown is above the ground. In the *Variegated* group, the crown is level with the surface. In the *Yellow-Flowered* group, the crown is below ground. The flowers grow in heads and are usually purple in color. *Grimm alfalfa*, however, is the best variety for Alberta. It belongs to the Variegated group. The flowers of this group range all the way from purple-white to a smoky green color. The group is a cross between the Common type and the Yellow-Flowered type. The stems are considerably branched, and the leaves somewhat narrow and long. The irrigated areas produce the best grades. The Brooks Grimm Alfalfa Seed Association of Brooks, Alberta, has for sale annually over 100,000 pounds of alfalfa seed of unsurpassed quality.

Cultivation.—Alfalfa does best in deep loams, with an open subsoil. It will stand drought fairly well, but must have a moderate supply of moisture for abundant growth. It will not do well, however, in a water-soaked soil. If cut and cured at the proper time, no plant can compare with it in feeding qualities. It is relished by all kinds of stock, has great fattening power, and, owing to the large percentage of protein in it, makes one of the best of all fodders for dairy cows. If it is to be used for pasture, it should be allowed the first three years to get itself firmly established. It is well to remember that this is a plant which cannot grow without the aid of bacteria, nor can it produce the best seed without the aid of bees or other insects.


Saving the leaves by stacking alfalfa with wagons and slings. Usually it is stacked with sweep rakes and swing stackers.

Sweet Clover

Nature.—Sweet clover is a biennial. The first year it grows from ten to twelve inches high and develops a large tap root. In the second year it makes its greatest growth, sometimes reaching a height of six or eight feet.

Varieties.—The leading varieties in Alberta are the *White Blossom*, the *Arctic*, and the *Yellow Blossom*. White Blossom is a heavy producer, especially valuable as a silage. Yellow Blossom is somewhat earlier than White. It has a finer stock and has more leaf than any of the other varieties, but it produces less per acre.

Cultivation.—Sweet clover is usually seeded with a nurse crop of wheat, oats, or barley, but to ensure a crop

Alfalfa needs room. The picture shows the results when planted in rows twelve, eighteen, twenty-four, thirty, and thirty-six inches apart.

special precautions must be taken in regard to inoculation. If it is to be grown on lands that have not at some time previously produced a crop of either alfalfa or some of the clovers, the seed should be inoculated before it is sown. Or, if not, then the soil should be inoculated by spreading over it, at the rate of about one hundred pounds to the acre, soil from some field that has grown either clover or alfalfa.

Value.—Sweet clover makes its greatest growth in the second year and will then pasture more stock than almost any other crop. For hay, it can be cut and cured in the same manner as alfalfa; or it may be cut green and made into silage. The cutting should be done when one-tenth of the stand is in blossom; for, if left later, it becomes coarse and dry. Sweet clover has particular value, moreover, because of its ability in fertilizing poor or worn-out soils. Not only does it increase the nitrogen content of such soils, but it adds also much fibre to them, and this helps to bind the particles together, and so prevent soil-drifting.

White sweet clover. The plants at the left developed the heavier growth as a result of inoculation.

Altaswede Red Clover

Nature.—The chief difficulties encountered in growing Common red clover in Alberta have been: first, that it winter-kills, and, secondly, that it is not sufficiently drought-resisting. Some years ago a variety of a descendant of Swedish red clover was introduced with a view to finding a clover more suitable to Alberta conditions than Common red clover. This new clover is known as *Altaswede*, a word compounded from the words *Alberta* and *Sweden.* It has been tested out in many parts of the province with very encouraging results.

Altaswede is apparently a perennial; at least, it has certain perennial characteristics. How long it will live has not yet been fully determined. In any case, under normal conditions, it does not die at the end of the second year, but it continues on during the third, fourth,

The difference in crop after sweet clover and non-clover land.

and fifth years. The yield of fodder the first year is low; the second year it is better; the third year it is very high; but after that it gradually decreases.

Habits.—During the first year the plants do not grow higher than six or eight inches. They have at this time many fine leaf stalks, which in the second and third years grow to a height of two or three feet. These stalks branch and bear a heavy mass of foliage. Seeds are produced the second and following years.

Merits.—One of the outstanding merits of Altaswede is its ability to withstand low temperatures. In localities where, through frost, Common red clover suffered heavily, or was killed out completely, Altaswede came through the winter in excellent condition. Its survival is due to the heavy mass of leaf stalks which is produced the first year and which forms a dense mat almost wholly protecting both the crown and the roots. It does not resist drought as well as it does frost. To grow best it requires an average precipitation of fifteen inches or more. Consequently, sowing it in the prairie parts of Alberta is hazardous.

Alfalfa plants growing in sand containing the essential plant nutrients except nitrogren. To the pot on the left nodule bacteria were added, and the alfalfa was able to make normal growth through the utilization of atmospheric nitrogen. The pot on the right was not inoculated, and the plants failed through lack of nitrogen.

Soil and Preparation.— Altaswede has a strong tap root, extending into the soil to a depth of three or four feet. This root has many laterals and numerous fine feeding roots. Consequently, the soil should be deep, moderately rich, and well drained. Also, if it has not previously grown clover, it should be inoculated. Special cultures for all clover may be procured through the School of Agriculture at Vermilion, Alberta, or through the Departments of Agriculture of the various provinces. In a crop rotation, this clover may be made to follow wheat, oats, or barley. Also, it may be grown successfully on summer-fallow.

Uses.—As a forage plant, Altaswede is highly nutritious and may be used either as cured hay or as green feed. Moreover, it produces an abundance of rich pasture,

Red clover.

Alsike clover.

which is much relished by all kinds of live stock. It is not, however, advisable to pasture it the same year in which it is seeded. If cut before it is too ripe, chopped, and carefully packed, it makes excellent ensilage.

Other Legumes

Common Red Clover.—Common red clover is another legume. It is a biennial and dies after the second year. From the crown of its tap root it sends up a number of leafy stems, the uppermost branches terminating in dense heads of reddish-purple flowers. It has nodules upon its roots and depends upon bacteria for successful growth. Red clover cannot fertilize itself, and so, unless visited by bees, it is sterile. Bumble bees and a few butterflies are the only insects with proboscides, or sucking tubes, long enough to reach the nectar. The

This field of alsike clover at Tilley, Alberta, produced 12.5 bushels of seed per acre in 1917.

ordinary tame bees cannot reach it, but in visiting the flowers for pollen they thereby help to fertilize them. Red clover has high feeding values, if cut at the proper time and cured without undue exposure to heavy dews or rain. These cause it to turn dark, destroy its fine flavor, and injure the feeding qualities. Clay loams or sandy loams, with considerable lime and organic matter and moist but not too damp, suit it best.

Alsike.—This is an erect growing clover. The flowers, which are reddish-white, resemble those of white clover, and for this reason alsike is frequently mistaken for the latter. It has not been grown successfully on the prairies, as the dry weather appears to retard its growth. For the best results it requires a humid atmosphere and a soil with abundant moisture. If sown along with grasses, it makes very fair hay and pasture.

White Clover.—White clover has a creeping stem, and the leaf and flower stalks spring from these. As it is a perennial and will grow in a great variety of soils, it is often found in pastures where it grows naturally among the other grasses. Generally speaking, it is not well adapted to the prairies, owing, no doubt, to the dryness of the soil and air.


White clover.

The Vetches.—The vetches, of which there are a number of varieties, resemble peas. They have numerous compound leaves which end in tendrils. Some varieties, when green, are regarded as of special value for milk production and hence as a good fodder for dairy cows. There are two kinds, *winter* and *spring vetch.* They should be sown with oats, as the oats help to hold them up. The crop may be cut for hay or green feed, or it may be pastured.

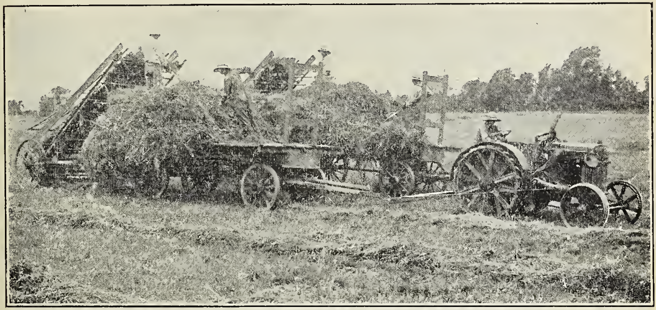
GRASSES

All the grasses are perennials, the root parts living on from year to year. The leaves, with the exception of the lower part, are long, narrow, and flat. The lower part encloses the stem in the form of a sheath. The flowers are arranged on little branches of the stem. As a general rule, when these branches are long, as in oats, the flowering system is known as a *panicle*; when short, it is known as a *spike*. The *pistil*, that is, the part containing the future seed, is enclosed in tiny leaflets called *glumes*. These open and permit the pollen to reach the pistil. In this way either cross-pollination or self-pollination is assured. In cross-pollination the pollen is carried from flower to flower by the wind, and hence there is no necessity for the flowers to be showy.


A field of white clover at Bassano, Alberta.

Timothy.—This grass, named after Timothy Hanson, who first brought it to this country, is a perennial widely grown and much prized as fodder for horses. It does not do well in the drier parts of the country, unless on irrigated lands. It will stand a good deal of cold, but not too much drought. In the drier parts and in dry seasons, the yield will be light. It is a shallow-rooting plant, and, owing to the fact that it grows in bunches and is too easily tramped out, it is not a good pasture plant, unless mixed with other grasses. It should be cut for hay before it gets too mature, as it then becomes rather hard and woody. It is deficient in protein and so does not make the best of feed for dairy cows and growing stock. It is, however, excellent for work horses, as the lack of protein may be made up by the grain ration.

Western Rye Grass.—Western rye grass is a perennial that grows in tufts or bunches. It is deep rooting, stands drought well, and is not readily affected by extreme cold. It is therefore a good hay grass to



Loading timothy by means of a loader.

grow on the prairies. If cut and cured before or when in bloom, it makes a valuable hay, but loses much of its feeding value if allowed to mature its seed before being cut. It is not a good pasture grass, as the second growth is likely to be quite light.

Brome Grass.—This is one of the surest and, on the whole, one of the best grasses to grow for hay on the prairies. It will do well on comparatively poor soil, but its greatest value lies in its ability to resist drought. It does not produce a heavy crop the first year, but the growth increases in the second, and gives, in the third, its heaviest yield. It is an excellent grass for pasture, as it commences growth early in the spring and keeps on growing all summer. Also, it will stand any amount of trampling without the roots being killed out. All kinds of stock are fond of it, whether it is used as pasture or for hay.

Kentucky Blue Grass.—Kentucky blue grass will grow almost anywhere that any other grass will grow. It will survive the severest frosts and may be buried

Western rye grass does well on the prairies and makes splendid hay.

with snow without killing out. Extremes will check its growth, but it will nevertheless survive. It is rather slow in getting a foothold, requiring about three years to establish itself firmly and form a dense sod. In the moister parts of Alberta it makes excellent pasture mixture, as all kinds of stock eat it greedily, and it is a splendid food either for fattening or for growth. One of the best lawn mixtures for either home or school grounds is Kentucky blue grass with a mixture of white Dutch clover. Two-hundred and fifty pounds of the grass mixed with two and a half pounds of clover will sow one acre. The mixture may be obtained from any seed house in quantities as desired.

Red Top.—Red top, of which there are many varieties, does not yield heavily as a hay grass; but for lawns and pastures it is one of the best. It does not grow in tufts, as do so many of the other grasses, but has a creeping rootstock from which runners are sent out. These runners root at the joints and send up shoots, which themselves grow into grasses. Thus the sod in time comes to be both dense and continuous, and, instead of being injured, seems to be improved by trampling. Another quality which gives it value as a pasture grass is the fact that, no matter how much it is eaten, it will continue to produce leaves and stems throughout the whole summer and even until late into the fall. It prefers a moist soil, and does well on low lands and in places where the ground is quite damp. In heavy or dry lands the root system cannot develop so well, and the yield is likely to be light.

RAPE

Rape is another plant which is grown as a fodder. It is not a legume and has none of the characteristics of those plants. It resembles the turnip. The leaves are large, spreading, sweet, succulent, and tender. It makes an excellent pasture, especially for sheep, hogs, or cattle.

SOILING CROPS

Corn, oats, peas, alfalfa, and clover are frequently grown and cut when green, and are fed in that condition. These are called *soiling crops.* The reason for the growing of such crops is that pasture is often uncertain. During dry spells, when the pasture becomes parched, it may be quite necessary to supply some kind of additional feed. If the supply of milk is to be kept up in the dairy herd during such periods, a supply of green feed to fall back upon is almost a necessity. Green feed is also useful for growing stock.

SILAGE

Soiling crops provide green feed during the summer. *Silage* provides it during the rest of the year.

A trench silo.

The purpose of the silo is to provide green, succulent feed that may be fed at any time. The crops for the silo are cut before they mature and are packed away in that condition. The silo should be air-tight, reasonably frost-resisting, and smooth on the inside, so that the silage will pack down without leaving air spaces. Silos are usually built round in form, of wood, brick, cement, or sheet iron. They are from twelve to twenty feet in diameter, and from twenty to forty feet high. They are usually filled from the top, the green feed being cut with a cutter and elevated to the top of the silo. It

Filling a trench silo.

must be firmly packed, so as to exclude the air. Some of the silage will usually mold on top, but, if properly packed, the rest will come out palatable and succulent.

Almost any juicy green crop may be turned into silage. Corn, sunflowers, peas, vetches, and even the tops of some vegetables may be preserved for feed in this way. Corn is, however, the crop most widely grown for silage. It should not be cut too green, as it will neither keep so well nor possess the same feeding value as when more mature. There is, in fact, sixty per cent more dry matter in it if it is allowed to stand until it is fully glazed and some of the lower leaves are dead. When first put in the silo, fermentation sets in, and the silage becomes very hot. The air within the silage becomes changed to carbon dioxide, and, with the exhaustion of the air, the fermentation is checked. The silage will then keep for a long time, providing fresh air is fully excluded.

The Trench Silo.—The trench silo, because it costs little, is in general use in some districts. It is simply a trench dug in the ground. It has straight or sloping sides, and is ten or fifteen feet wide, about ten feet deep, and any convenient length. It is more easily filled than the vertical type, and, when filled, it is covered over with straw or any waste material. Since there is not the weight to pack down the silage that there is in the upright types of silo, the trampling and packing must be done far more thoroughly. Horses are commonly used for this purpose, being driven back and forth over the silage, not only while the trench is being filled but at intervals of every few days for a couple of weeks thereafter. In this way the silage is pressed into a firm mass and will then keep quite well.

Questions, Problems, and Exercises

1. Distinguish among the following types of fodder: hay, green feed, silage, straw, soiling crop.

2. Name common members of the legume family. Why should they not be classed as grasses? How are they alike in flower, leaf, pollination, fruit?

3. The root systems of the legumes are a valuable means of enriching the soil. The student should observe the tubercles for himself by digging up and washing off carefully the roots of a clover or alfalfa plant. They appear in the form of round lumps attached in hundreds to the roots and

ranging in size from that of a pin-head to that of a bean. What powers have the bacteria in these nodules which make the legumes valuable? How may such bacteria be brought to a soil where they are lacking? Name an especially deep-rooting legume.

4. Of what special value is timothy hay as a fodder?

5. What is a perennial grass? Name four of these. Which are adapted for dry areas, and which for low, moist lands?

6. Describe the flower structure of the grasses. How is cross-pollination made somewhat certain?

7. Give brief descriptions of the following and estimate their value as fodder crops in this province: red clover, alfalfa, alsike, white or Dutch clover.

8. Name crops suitable for soiling. What is the convenience of such crops?

9. Describe the structure and the proper method of filling silos of the two chief types? What is the nature of the changes which take place causing the curing of the fodder in the silo? Show the advantage of silage in farm economy.

10. Secure some alfalfa and clover plants, examine the roots, leaves, stems, flowers, and seeds. Make drawings of these parts.

11. Gather specimens of as many different kinds of legumes as you can find in your district.

CHAPTER XV

THE VEGETABLE GARDEN

Importance of the Garden.—No home, whether in the city or on the farm, is complete without its garden. The vegetable garden gives the best of all crop returns upon the investment of time and money. It also affords great interest, enjoyment, and satisfaction. To the boy who likes to do something upon his own account, the garden offers an excellent opportunity. Many boys, and girls too, make money from their gardens. Some have grown prize roots and vegetables, while others have even produced seed of such rare quality as to command attention and an excellent price. The garden is the place to learn how to till the soil and become acquainted with the needs of plants and the habits of birds and insects. Nature is always an interesting and instructive companion.

Moreover, in looking after a garden, boys and girls learn how to care for the things which require frequent and regular attention. They learn how to use tools carefully and skilfully, and how to apply labor so as to obtain profitable results. Gardens are being used everywhere to beautify ugly and neglected spaces, and the work as well as the products have contributed to the health and well-being of many families.

Value of the Garden.—The garden supplies at little cost fresh vegetables for the table throughout the growing season. If carefully harvested and stored, a supply of vegetables for winter use may be provided. In the country, there is not always a convenient grocery store where vegetables may be procured at short notice; or the quality and variety offered for sale by the grocer may not be tempting. Many vegetables begin to *deteriorate*, that is, lose their value, the moment they are lifted from the ground, and to enjoy the full flavor they should be used as soon as possible after they are gathered. Vegetables fresh from the garden are always palatable and wholesome. They add variety to the diet and, when properly prepared and served, make the meal appetizing.

The vegetable garden is interesting and profitable. Notice the great variety of vegetables produced.

PLANNING AND CARE OF THE GARDEN

Planning the Garden.—The garden should be located close to the house. This makes for convenience in caring for the garden and in gathering the supplies as needed. If possible, a southern slope and a protected position should be chosen. It is always well to plan the arrangement with care, making due allowance for gateways, paths, fences, and convenience in attending to the garden. The appearance which a good arrangement will give when the plants begin to grow should also be kept in mind. On the farm it is better to plant in rows than in beds, as the cultivator may then be used between the drills, thus saving much hand labor. If the rows run north and south, rather than east and west, the growing plants will have more sunlight. Coarse vegetables, such as peas, beans, potatoes, cabbages, beets, and turnips, should be in rows thirty inches apart. Horse power is always cheaper than man power, and where horses are kept, as much of the labor as possible should be done by them. If, however, the labor must be done by hand, a space of from twelve to fifteen inches between the rows is sufficient for most vegetables.

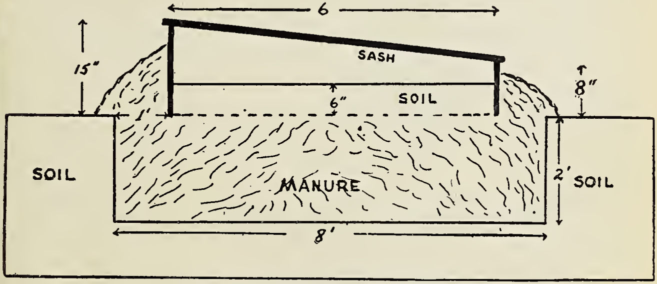
Where garden space is limited, as is the case in many cities and towns, the garden may be so planned as to produce what is called a double crop, or a companion crop. For example, cabbages and lettuce may be planted in alternate rows, half the distance apart that would be necessary for either alone; or radishes may be sown in the same rows with carrots, beets, or parsnips. Lettuce and radishes mature early and are removed before the companion vegetable requires the space and soil.

The Hot Bed and the Cold Frame.—The *hot bed* is of great aid in giving vegetables an early start. Plants are started in it and later transplanted, or set out, when the season is sufficiently advanced to avoid danger of frosts.

The parts of a hot bed are the *pit*, the *frame*, and the *cover*. The pit is made by digging a hole two feet deep and about two feet wider than the frame, so that there will be plenty of room for banking up the frame. Banking is important, because it helps to retain the heat.

The length and width of the pit must be governed by the size and the number of window sashes at hand to cover it. A frame of boards should be made to surround the pit. This frame should be eight or nine inches above the level of the ground on the south side and about twice as high on the north side, in order to provide a suitable southern exposure.

The pit is filled to a depth of two feet with fresh horse manure containing a considerable quantity of straw. This should be firmly tramped down and then covered



An end view of a sub-surface hot bed.

with fine loamy soil to a depth of about six inches. The fermenting manure supplies the heat for early starting of the vegetables. The frame is covered with glass. Window sash will do; but special sash, in which the glass runs in rows and overlaps so as to shed the rain, is preferable. The temperature within the hot bed should not be allowed to vary too much. If the nights become threateningly cold, the sash should be covered with blankets or old carpets. If during the day the sun becomes very hot, the sash should be raised a little in order to let out the moisture and the hot air.

The *cold frame* serves the same purpose as the hot bed. It differs from the hot bed in that there is no pit and manure is not used. A frame similar to that of the hot bed is built of heavy planks and placed with the same exposure. As the cold frame depends upon the sun for heat, it is well to place it on the south side of a building.

Making the hot bed ready for seed.—After five or six days, and when the temperature in the hot bed stands at about 80° Fahrenheit, the soil should be worked over to a depth of about two inches and the surface levelled and made fine. The bed is now ready for sowing.

Seeding the hot bed.—The seed is usually sown in rows four inches apart at about the same depth as for outside seeding. After the plants come up, to prevent them from becoming spindly and weak, the frame should be kept sufficiently aired by raising the back of the sash. Otherwise the plants are apt to *damp-off*, that is, to become weak and spindly through excessive growth. Care should be taken, on the other hand, to prevent them from being chilled or frozen.

Watering the hot bed.—The soil in the hot bed must be watered when necessary. Care must be taken not to overdo this, or the plants may damp off. No single operation connected with the care of a hot bed is of more importance than watering. The time and method of watering determines the growth of the plants, their freedom from disease, and the success of the hot bed generally. Watering should be done in the morning and on bright days only. The use of water in the evening hours lowers the temperature of the hot bed at the most critical time of day. A moist atmosphere at night also aids the development of disease and has a tendency to weaken the plants.

"Picking out" plants in the hot bed.—After the plants have developed to a height of an inch or an inch and a half, they should be transplanted into another part of the same bed or into a cold frame. The transplanting of the little plants at this early stage helps to produce sturdy, healthy plants with better root systems. Plants

Careful planning and good arrangement add much to the beauty and attractiveness of the garden.

in the hot bed should be set out in this way at least twice before transplanting to the garden. In setting out the first time, each plant should be allotted a space of an inch and a half or two inches each way. The second transplanting in the hot bed should come two or three weeks after the first, and the distance between the plants should be increased to six inches each way. They should now be left for ten days or two weeks. In the Prairie Provinces cabbages may be transplanted to the garden any time after May 15th, and tomatoes in early June.

Hardening off plants in hot beds.—To have success with transplanting hot-bed plants to the garden, the plants must be properly hardened off. The term "hardening off," as applied to vegetable gardening, means accustoming the plants to outside conditions. This is done by removing the sashes from the hot bed for a number of days prior to setting the plants into the garden. For the first few days in this period the sashes are removed for only a few hours during the warm part of the day. The length of time is gradually increased, until the sashes are left off nearly all the time for a day or two before setting out.

Preparation of the Garden.—The soil best suited to gardening is a sandy loam; but, as this is not always available, the best must be made of what soils there are. Garden soils should be ploughed or spaded deeply and well worked up, so as to make a fine seed bed. They require a plentiful supply of humus so as to hold the moisture, and consequently should be heavily manured. This will give a rich soil; but to get the best results one thing more is necessary—the soil must be well drained.

Garden Seeds.—As special instructions for the planting and raising of all kinds of vegetables are usually printed on the seed package, or are supplied in little booklets which are distributed free, it is necessary here only to make a few general observations on some of the more important vegetables.

The seed must be fresh, or alive. From two to ten years is the average life of most vegetable seeds. The seeds of corn, onions, parsnips, and salsify will live for two years; those of beans, peas, parsley, and rhubarb for three years; tomatoes, carrots, and pumpkins for four years; cauliflower, spinach, radish, and lettuce for five years; and so on. After that time most seeds are dead and should not be sown. Some plants, such as beans, corn, squash, cucumbers, and tomatoes, are easily injured by frost, and the seeds of these should not be planted out-of-doors until all danger of frosts is past. Such vegetables are usually sown in hot beds or window boxes to give them an early start, and are afterwards transplanted to the garden, when the season is sufficiently advanced.

Potatoes. The rows in bloom were sprouted for six weeks indoors before planting and were planted at the same time as the centre row. The sprouted seeds came on much faster and gave almost twice the yield.

Planting.—The surface of the soil in the garden should be worked carefully just before planting to break down the lumps, to level the surface, and to work some of the moisture lying beneath the surface mulch into the surface soil. This practice of ning the soil just before it is seeded provides right conditions for a uniform and a quick germination of the seeds.

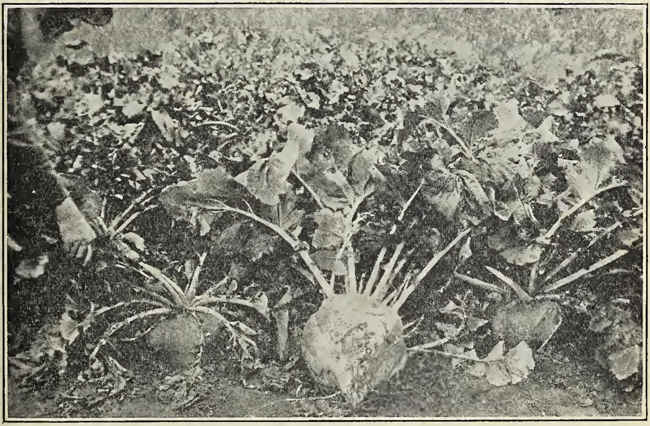
In planting the garden it is advisable to use plenty of seed. Some of the seed may be of low germination; and some good seed, owing to adverse soil and weather conditions, may not develop plants. Therefore, in order to provide for an average stand, it is advisable in most cases to use an abundance of seed. If the stand of the crop proves to be too thick, it is a simple matter to do a little thinning. It is always easier and more economical to do a certain amount of thinning than it is to fill in blank spaces in a poor stand by reseeding or transplanting.

The smaller vegetable seeds and those that are light in weight should be planted about an inch in depth. The larger, heavier seeds may be planted much deeper.

The seed may be planted with the Planet Junior or with a hoe. The Planet Junior is the quickest method, and possibly gives better satisfaction than any other that can be used in planting small seeds. In planting with the hoe a small trench is opened deep enough to reach moisture, usually from a half-inch to one and a half inches for the smaller vegetable seeds. The seeds are spread along the trench, then covered with soil, which should be pressed firmly about the seed with the garden rake. In this way quicker germination will be ensured.

Cultivation.—It has been said that it is advisable to grow the vegetables in rows. This makes cultivation easier and allows more sunlight to reach the plants. It also enables the gardener to fight the weed enemy more successfully. Soil cultivation has three important functions. These are: (1) to conserve moisture, (2) to make plant food available, and (3) to control weeds. The gardener must be constantly fighting weeds during the growing season, but the best time to kill them is just as they are showing through the ground. The garden rake, the hoe, and the horse or hand cultivator are the best implements to use for this purpose.

On the farm, the cultivator can be made to do most of the work. It should be used at frequent intervals during the early part of the growing season and at longer intervals as the season progresses. The cultivator may be allowed to enter the soil between the rows to quite a depth during the first part of the season, but should be run very shallow later in the season. This practice prevents the roots of the plants from being injured by the cultivator; for plant roots extend for a considerable distance into the space between the rows during the latter part of the growing season.



Turnips grown near Peace River. For size, sweetness, and succulence the vegetables of the Peace River Country are unrivalled.

Transplanting.—Transplanting is the process of uprooting plants from one place and replanting them in another. It is done when plants are transferred from one place to another in the hot bed, when plants are set into the ground after being started in the hot bed, cold frame, or greenhouse, and also when plants are used in rows of vegetables, to fill blanks caused by seeds failing to grow. Great care should be taken in handling the young plants while they are being transplanted. The soil around the plants should be moistened before they are lifted. This causes the soil to stick to the roots of the plants while they are being handled. The soil remaining on the rootlets should not be allowed to dry out, and, therefore, the plants should be kept out of the soil for the shortest time possible.

If the soil is well tilled and contains plenty of moisture, there will be no need to water it immediately. Make a hole a little deeper than the one from which the plant was taken, place the young plant in it, and push the earth evenly and firmly about its roots. If it is necessary to water the plants, put the water in the hole first, allow it to soak away, and then place the plant and soil as directed. After transplanting, there should be a soil mulch worked up about the young plants to help to retain the moisture.

Spacing.—The distance between the vegetables in the garden rows should be regulated by the product desired. It is very often wise to allow beets and carrots to remain quite thick in the rows during the early part of the season, and then, later on, to thin them so as to allow a space of from three to four inches between the roots. Beets and carrots of medium size are more tender and hence are better for table use than larger varieties. The same is true of turnips and parsnips. Onions, on the other hand, should be planted one and a half to two inches apart, because, while some of the onions may be used when young, ultimately a good-sized and well-developed plant is required. The gardener, therefore, must be guided largely by the use which is to be made of his product.

Thinning.—The vegetable garden is thinned in order to secure the greatest possible production. The purpose of thinning is to allow the plant enough soil and air-space so that it may have plenty of food, sunlight, and air. As a rule, generous space should be allowed for root and top development. Most gardeners do too little thinning, rather than too much. Due to a desire to economize or to a fear of injuring the plants, or possibly to both, the young gardener is disposed to thin with a too sparing hand.

As far as possible the thinning should be done so that some of the pulled plants may be utilized. Lettuce is usually sown thickly; if some of it is used before the leaves are full grown, the rest will develop and produce a steady supply. The same is true of radishes; some of them should be pulled as soon as the first large ones are ready, and, as the rows are thinned out, the new radishes will grow. In the case of vegetables planted in hills, such as melons, cucumbers, etc., where large growth is looked for, it is a good practice to remove the weaker plants as early as possible, leaving only two or three strong plants to the hill. This is a good general rule for the thinning of plants in hills. The vine plants are usually sown in hot beds or window boxes to give them an early start, and are afterwards transplanted to the garden, when the season is sufficiently advanced.

VARIETIES OF VEGETABLES

Beets.—Beets have been cultivated for 2,000 years. Their ancestors still grow wild on the shores of the Mediterranean, and on the Canary Islands. When cut across, some beets are red, others are white, and others are banded red and white. Sugar beets, from the root of which sugar is made, are white or yellow in color. Table beets are usually red or banded. To avoid stringiness, beets should be planted in rich, deep soil and kept growing rapidly by an abundant supply of water. They should be weeded and thinned out as they grow, and used before they pass the tender stage. In cooking beets, the skin should not be broken, and the stubs of the leaves should be left on so that there may be no loss of food value. A coarse variety of beet, known as

Root, vegetable, and vine crops, all Alberta grown. How many of these can you recognize and name?

mangel-wurzel, is grown as a feed for stock. It is quite nutritious and much relished by the cattle.

Carrots.—Carrots grow wild in Europe and America. The root of the wild carrot is strongly flavored and stringy, and cultivated varieties, if neglected, tend to become like them. To prevent this they must be planted in rich garden soil, and carefully watered and tended. There are two layers of flesh in the carrot. The outer layer is the richer in food content and is also less fibrous than the inner one, which is called the *core.* Carrots vary in shape from long and tapering to short and round. The red or orange varieties are grown for the table, while the white ones, which are coarser and larger, are grown as feed for stock.

Radishes.—Radishes are among the earliest vegetables ready for the table. They, too, like carrots and beets, must be kept growing rapidly for the best results.

Lettuce.—Lettuce is the most popular of all salad plants. The juice of lettuce leaves is good for the human system. A salad of lettuce and celery helps to soothe tired nerves. There are many varieties of lettuce. The ones in most favor are those which develop a head, with crumpled marginal leaves and a tender white centre richly flavored. Being a leaf crop, lettuce requires good, rich soil and should be kept growing rapidly. Growth takes place in daylight only, and the plants rest at night. Gardeners sometimes force growth by providing artificial light during the night. The plants should be used when at their best; they speedily go to seed and are then of little use for the table.

Swiss Chard.—Swiss chard is a variety of beet. It is grown not for the root but for the leaves. These are broad, with thick, tender mid-ribs. Some people eat the whole leaf; others use only the rich, fleshy mid-ribs. Served with sauce, these make a very palatable dish. If the outer leaves are taken and the root is left undisturbed, it will continue to produce leaves until autumn. The leaves of this plant make excellent green feed for poultry.

Parsnips.—The parsnip has been long in use as human food. The Spaniards brought it to America. So also did the Pilgrim Fathers, who were surprised to find that the native Indians had already been using it for generations. The best varieties have a short, fleshy, succulent root. The parsnip requires a rich and mellow soil. It is a valuable food not only for man but also for horses, cattle, pigs, and poultry.

Beans.—There are many varieties of beans: *Kidney beans, Lima beans,* and *Broad beans.* Some grow like bushes, and others climb poles. Kidney beans, our common garden variety, are natives of South America and were carried to Europe by the Spaniards. From Spain they spread all over Europe, Asia, and parts of Africa. In some parts of the world beans take the place of meat. In our own country beans are used quite extensively. They contain a high percentage of protein and are a good food for those who have to work out of doors in cold weather. Almost one-fourth of the bean is protein, and so they are splendid muscle-making foods.

Peas.—The garden varieties of peas are sweet and delicate. A new variety has been developed, of which the pods, as well as the seeds, are cooked and eaten when tender and fresh. Field peas are grown very largely for stock, for pasture, and for green manure.

Corn.—The *Squaw* and the *Improved Squaw* are good varieties to grow in the garden. A sweet corn, called *Pickaninny,* has been grown with much success in the gardens of the West.

Cabbages.—Cabbages belong to the Mustard family. They grow wild in Europe, almost to the Arctic Circle. Our forefathers ate the wild cabbage, which was juicy and tart. Where soil conditions are favorable, the stem grows higher and higher year by year. If a cabbage is left in the garden after the head has formed, the stalk will soon burst through the head and run up to a height of a foot or more. The top will then open in yellow flowers. When these fade, their place is taken by pods, which are filled with seeds. The relation of the cabbage to the mustard is thus clearly seen. Our wild ancestors no doubt munched these pungent leaves to give variety to a diet of meat and berries.

Our garden cabbages came from the wild species, but so did other varieties of vegetables that are so unlike the

A cabbage patch near High River, Alberta.

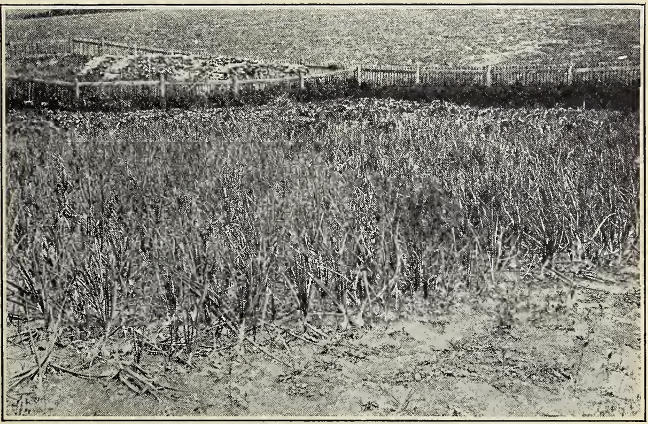
cabbages of the garden that many who use them are not aware that they are children of the same parents. These varieties are *Brussels sprouts*, *cauliflower*, *kohlrabi*, *Swedish turnips*, *kale*, *Pe Tsai* or *Chinese cabbage*, and *Pakchoi*. All of these varieties were developed by selection and breeding.

The Italian gardeners developed the cauliflower by breeding not for the leaves, but for a white, coral-like mass of stem flowers. Brussels sprouts were produced by breeding for the development of little heads that appeared in the wild varieties in the axils, or joints of their leaves with the stalks; turnips, by developing the root; kale, by breeding for more and better-spreading leaves. To produce the best specimens of any of these a fine, rich, moist soil, free from weeds, is necessary. Plenty of water

Chard and cauliflower make choice food.

and quick growth are necessary to produce the biggest and tenderest plants.

For early cabbage, the plants must be started in a window box, a hot bed, or a greenhouse. After four to six weeks the plants should be set in the garden slightly deeper than they were in the plant box. Each plant should be set in a hole, dug with a trowel, and the soil firmed about its roots. The soil should then be moistened with a little water and covered with dry earth to prevent the formation of a crust around the plant. Cabbages should be transplanted on a cloudy day or late in the afternoon. Early cabbages may be set in rows from twenty-four to thirty inches apart and from fourteen to eighteen inches apart in the row. The early crop should be harvested and used as soon as the heads are solid, because cabbages will not keep during the summer months.



A quarter of an acre of these onions were grown on a farm near Peace River.

Onions.—The onion is another wholesome garden vegetable. It is a native of Western and Central Asia. Both the leaves and the bulbs are used for food. The wild variety has been improved by making the bulb larger, more tender, and more delicate in flavor. Related to the onion are leeks and garlic.

CULTURAL DIRECTIONS FOR SPECIAL CROPS

Celery.—The wild parent of this plant, which grows in the waste places of Europe, is bitter and so poisonous that no one would think of eating it. But, by cultivation, a wholesome and deliciously flavored vegetable has been produced. Celery is eaten raw, seasoned with salt. Sometimes it is cut up and used for salads along with other vegetables. Frequently it is cut in small pieces, boiled, and served with a white sauce. It is also used as a seasoning for soups. The roots are equally good, either

A school garden supplies the ground floor of an education.

for soups or to be eaten raw. The seeds are good for seasoning or for salads. Celery is valuable as a medicine.

Celery may be started in the hot bed. The seed is slow in starting, requiring about two weeks to germinate. During this time the soil in the bed should be kept moist. In order to prevent the surface soil from drying out too much, a covering of cheese cloth may be spread over the bed in the daytime, for the first ten days or so, until the plants appear. When the true leaf appears, the plants should be transplanted to one and one-half inches apart.

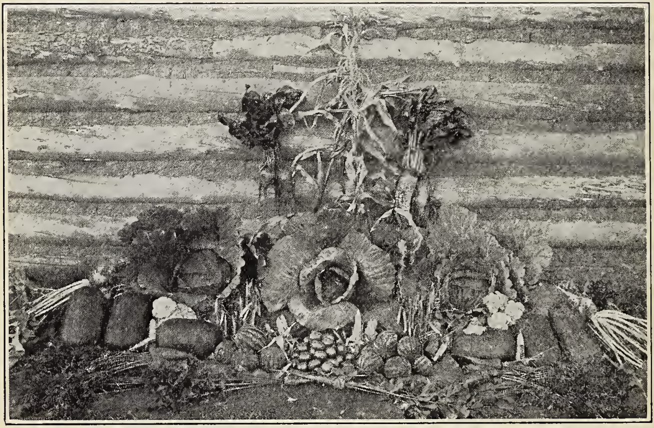
They should then be given the care which hardy plants need to reach full growth. The plants may be set out in the open any time from May 15th to June 10th.

A rich, moist, cool soil is best for celery. It is usually provided by trenching. The trench should be dug one foot deep and of a similar width. It should be filled to a depth of eight inches with good soil, into which fifteen to twenty-five per cent of well-decayed manure has been thoroughly mixed. After the soil in the trench has been carefully firmed, the plants are set in it six inches apart. As the plants develop, earth is banked against them. In banking, the stalks should be held together to prevent the soil from settling in between the stalks and the centre of the plant. Later, when the plants grow larger, banking is continued in order to blanch the stem of the plant.

Asparagus.—Asparagus does best on a deep, sandy loam soil. With proper care, however, a heavier soil can be made to grow this crop profitably. Plenty of manure should be thoroughly worked into the soil before planting.

Asparagus should not be planted until the garden has been permanently located. The usual method of growing this vegetable is to set large roots—one-year-old roots being best—from two to three feet apart in a trench twelve to fifteen inches in depth. They should be covered with about two or three inches of soil at first, and, as the shoots come through the surface, more soil should be added until the trench is finally filled. The roots may be obtained from a good seed house and should be set out early in the spring.

Mulching the row with straw, with strawy manure, or with soil produces blanched shoots; but the green stalks are easier to grow, have a more pleasing flavor, and are generally more popular. All the shoots should be cut off during early spring; if they are allowed to grow, the plants will stop producing. By careful manuring and good cultivation one planting should last indefinitely. Asparagus should be cultivated and manured each year after the cutting season. From one hundred to two hundred plants are needed to supply the average family.



This display was grown on a Peace River homestead.

The edible part of asparagus is the young, tender shoot. These shoots should not be cut until the plants are at least two years old.

The Vine Crops.—*Melons, squashes, marrows, pumpkins,* and *cucumbers* are much alike in their manner of growth and in the kind of care which they require; therefore, in general, the instructions for successfully growing the cucumber will apply to all the others. These vine plants are all warm-climate plants, and, therefore, should never be set out in the open until all danger of frost is past and the soil has become warm.

Cucumbers thrive in a warm, well-drained, rich soil. When making the rows for cucumbers, it is a good plan to open a furrow and cover the bottom with well-rotted manure. The manure should be mixed with the soil, so that none may come in direct contact with the seed. The seed may be planted in the hot bed in paper bands or in old strawberry boxes. When well started, the plants may be moved to the cold frame to harden off, and should finally be set out in the garden in hills four feet apart each way.

To protect the young plants from the cucumber beetle, they should be covered with mosquito netting, and the foliage should be sprinkled with air-slaked lime. The netting is placed over a stake driven into the centre of the hill, and its edges are covered with earth.

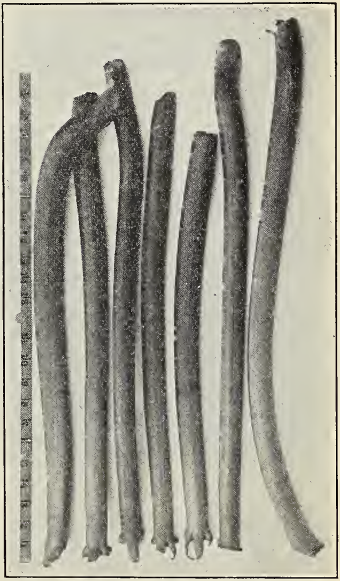
The depth of planting and the distance between the hills varies with the nature of the plant. The small seeds, such as those of the cucumber, should be planted about half an inch deep and about four feet apart each way. The larger seeds of the pumpkin and squash should be planted twice as deep and allowed almost twice the room in which to grow. Several seeds should be planted in each hill, but the number of plants should be thinned to two or three for each hill.

Tomatoes.—Tomato seeds are planted about eight weeks before the time for setting in the field. An early variety should be used. The plants should not be transplanted to the garden until all danger of frost is past. A good method in growing the plants is to plant two or three seeds in paper bands, pots, or berry boxes, and thin to one plant. When transplanting time arrives, set the plant in the garden without disturbing the soil around the roots. Good plants can also be grown by transplanting the seedlings once or twice before setting in the field, allowing more space at each transplanting and never permitting the plants to become crowded.

In the garden the plants should be set from two to three feet apart in the row, on the south side of some kind

Tomatoes are one of the most valuable of foods.

of shelter. A stake should be driven into the ground beside each plant and the plant trained upon it. Training consists of tying the plant to the stake and pruning out the suckers, or shoots, which come out just about the point where the leaf stem joins the main stem or stalk. The plant should be tied loosely with old rags or tape just under the leaf stem. By pruning off the suckers, as they start, the plant will develop but one stem. The suckers should be pruned out every week or ten days, and the plant tied up as soon as it needs more support and the fruits get heavier. This will have to be done five or six times during the season. This training will produce larger fruit and more uniform ripening, will permit closer planting, thereby increasing the yield, and will keep the fruit off the ground.

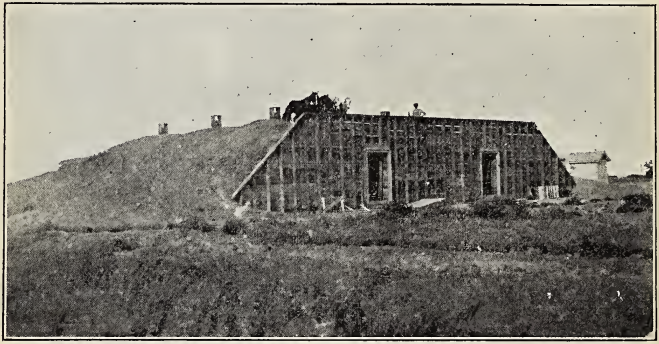

Rhubarb grown in Alberta without forcing.

Rhubarb.—Rhubarb is usually started from roots, which can be purchased from a seedsman or obtained from a former planting. The soil for rhubarb should be a deep, well-manured loam, and the roots should be set out early in the spring, three feet apart each way. It should be planted in the centre of the garden with the perennials. It is advisable, however, to set out new roots every second or third year. This is necessary, because the older plants become spindly and throw out a lot of seed stalks. Rhubarb is used principally in early spring for sauce or pies. Stewed rhubarb, too, is a favorite dish with many people. The stalks may also be canned or combined with other fruit to make jam. In the fall the roots may be dug, allowed to freeze, and placed in a cellar for forcing. From ten to twelve roots are enough for the average family.

HARVESTING AND STORING THE GARDEN CROP

Harvesting.—The gardener who takes up vegetables for immediate use needs no instructions for harvesting them; but, where vegetables are removed from the garden for market purposes, and for winter storage, a few helpful hints may be given.

In the first place, all of the vegetables must be dug and in the root cellar before heavy fall frosts come.



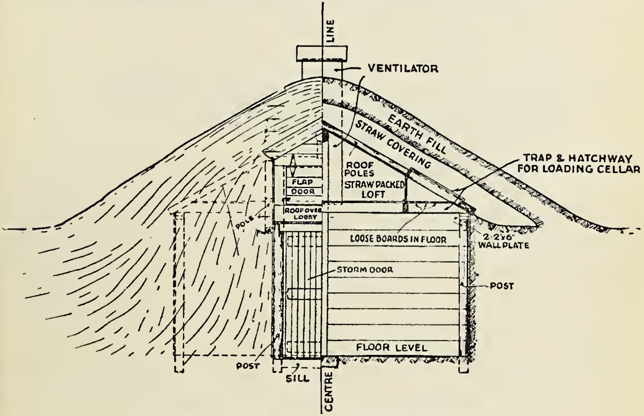
A root cellar.

This means that they must be taken up not later than the latter part of September.

With onions it is a good practice to pull by hand, when ripe, usually in August, and leave the tops on, piling them in thin rows to dry out. Later the tops may be twisted off and the onions spread out on a shed floor to dry still more, before they are placed in the cellar.

In the case of beets, carrots, turnips, and such vegetables, it is a better plan to twist off the tops, as cutting may not be done in the right way. If a knife is used, it is important to avoid cutting close to the crown.

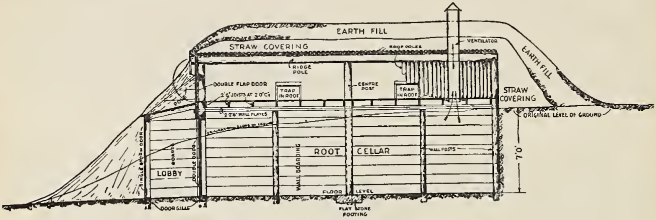
Storing.—The proper storing of vegetables is very important, particularly on the prairies, where root-houses and cellars are not always available. A root-house may be dug from the side of a hill and covered with alternate layers of straw and earth sufficiently deep to keep out frost. Of course, many houses have good cellars or basements. If the basement contains a furnace,



The construction of a root cellar: an end view.

the vegetable room should be partitioned off. Bins for storing vegetables for winter use may be built along the side of the room. Cabbages keep best when hung up by the roots, so that they may not touch each other or the floors or the walls.

Beets, carrots, turnips, parsnips, etc. may be stored in boxes full of sand, which will keep them moist and in an even temperature. The sand should not be too damp, and the room should be as cool as possible, though it must remain above freezing point. Onions are best kept by spreading them one layer deep on shelves made of slats. If piled together in sacks or bins, they are almost certain to decay. Bulletins on "The Storing of

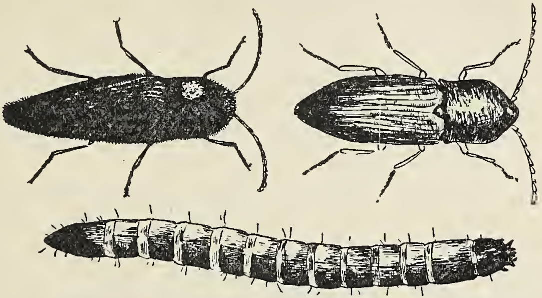


The construction of a root cellar: a side view.

Roots" are published by the Departments of Agriculture of the various provinces, and may be obtained by writing for them. These bulletins contain full and detailed instructions for building root-houses and for storing roots and vegetables.

INSECT ENEMIES OF THE GARDEN

Wireworms.—A beetle which, when caught and placed upon its back, springs into the air with a sharp click, is a click beetle. It was at one time a wireworm. A wireworm is the larva of a click beetle. The chief business of the beetle is to produce wireworms,—those pests which infest the soil and do so much damage to field and garden crops. Click beetles and wireworms are found in unbroken sod and in prairie soils, feeding upon the roots of prairie and other native grasses. When these lands have been broken up and native grass roots are no longer available, they turn for their food supply to the crops that have been sown upon the fields or planted in the gardens. They feed on many different kinds of crops. Potatoes, beets, carrots, cabbages, onions, lettuce, radishes, corn, wheat, oats, and other grains all suffer more or less from their attacks. They eat the small and tender roots



A wireworm and click beetles, enlarged to show their structure.

of plants; they gnaw and eat into the surface of tubers; and they sometimes bore tunnels right through the underground portions of stalks.

Structure.—A wireworm is from one-half to one inch in length. It has three pairs of legs, placed quite far forward on the body. The body itself is distinctly divided, is smooth, shining, cylindrical, slender, very hard for a worm, and wire-like. It is yellowish or reddish in color.

Control.—Wireworms develop slowly. The worm does not mature until from two to three years after the egg hatches. Thus there are worms three years old, two years old, one year old, and worms just hatching and coming on in a continuous succession to take the place of any that may be destroyed. They cannot be starved to

A May beetle and larva. White grub are very destructive to the roots of plants. The beetles, the parents, eat voraciously upon the leaves of plants.

death by keeping the ground bare; and, owing to feeding habits, their hardiness, and their hardness, they are not easily poisoned. No poison applied to the ground can be made strong enough to kill them without at the same time killing all vegetation that grows upon it. Poison bait left upon the surface of the ground, or put around about the plants, is of little use, as the worms live beneath the ground and feed during their whole lives within the soil and rather deeply beneath its surface.

The following methods, however, may result in more or less success. Corn soaked in water containing strychnine or arsenic is scattered over the ground and raked or harrowed into it about ten days before the regular crop is planted. This will kill any worms that may attack the poisoned kernels. The beetles may be killed by poisoning, in the same manner, clover, pigweed, or corn-meal dough, and placing it about the fields, fences, or under boards. Fall ploughing is recommended for badly infested fields. This breaks up the cells in which the pupae are resting, exposing them to their enemies and to the weather, thus destroying many of them. Digging the garden in the fall has the same effect. In a crop rotation, clover and buckwheat, owing to the toughness and hardness of their roots, appear to suffer the least injury from the pests. It is not advisable to plant a second year, on the same soil, a crop that has suffered much from wireworms the year previous, nor even to plant upon it a crop of the same nature.

A W-marked cutworm.

None of these remedies will wholly wipe out the wireworm pest, but they will help to keep it in check.

Cutworms.—In the spring, just after the young plants have pushed their way through the soil, there can be found, usually in the morning, a beheaded stalk with the top lying near it on the ground. The worm that did the damage is nowhere to be seen; but by digging down an inch or so near the ruined plant, the fat, greasy-looking culprit, curled up and motionless, can generally be found.

Life stages and habits.—Cutworms are the larvae of owlet moths. The moths fly in July and August, and lay their eggs on grasses and weeds. The young worms that hatch out feed for a few weeks and then descend into the ground to pass the winter. In the spring they waken up ravenous and are ready to attack whatever green vegetation may be at hand. In gardens or on ploughed and cultivated fields there is not much for them to eat except what has been planted or sown. The first green plants that show up in the garden or field are cut off and destroyed, and such great damage and heavy losses result that it sometimes becomes necessary to resow or replant.

A greasy cutworm and moth.

Control.—Keeping down weeds and fall cultivation of the ground will help to keep cutworms in check on the grain fields and in the garden. Many of those that have survived the winter in the garden may be destroyed by scattering a poison bran mash over the ground for them to feed upon before the plants come up. To compel the worms to eat the mash, the ground should be bare, so that they can get nothing else. Garden plants may be protected by putting around them a collar of paper or tin inserted in the ground to a depth of an inch or so.

The poison bran mash is a mixture of bran, sweetened water, and Paris green. To two gallons of water, sweetened by adding to it one quart of molasses and thoroughly stirred, there should be added half a pound of Paris green and twenty-five pounds of bran, and the whole again thoroughly stirred and mixed. Or, if only a small quantity is required, one quart of bran, one teaspoonful of Paris green, and one tablespoonful of molasses should be thoroughly mixed as before with water until it becomes quite moist but not too sloppy.

The mixture may be spread on the ground in the evening and worked into the soil a half-inch or so with a rake. Or it may be put on the ground around the plants in the infested area. As cutworms feed on the part of the plant either at or just below the surface of the ground, the poison, to give the best results, should be worked into the soil a little distance.

A fiery ground beetle and larva—the gardener's ally. It preys on cutworms and other noxious forms of insect life.

Cabbage Worms.—Hovering over the cabbages and cauliflowers of the gardens, throughout the summer, may be seen white butterflies, marked with black near the tips of the forewings. They are the parents of the velvety green worms which eat holes in the leaves and heads of these vegetables and disfigure them with their deposits.

Life stages.—The eggs hatch in from four to eight days. The caterpillars eat ravenously and complete their growth in from ten to fourteen days after hatching. They then pass into the chrysalid stage, and in the summer months they emerge in from seven to fourteen days as full-fledged butterflies. The life circle is thus from three to five weeks. Late chrysalids, however, pass the winter in that state and emerge the following spring.

Control.—Paris green, mixed with water and sprayed over the plants, is an effective remedy. The mixture is prepared by putting a heaped teaspoonful of the poison into three gallons of water, and adding to this about two ounces of lump lime to prevent the arsenic from injuring the foliage. Sometimes an ounce of resin soap is added to make the mixture stick to the leaves. It should be sprayed on when the plants are young, and this may be done as often as necessary until the heads are about half formed. The bran mash used for cutworms may also be used as a remedy. Water at a temperature of 130° Fahrenheit will not injure the plants and will destroy insects with which it comes into contact.

A, a cabbage worm, and B, a male butterfly. The female has two spots instead of one on each forewing.

Questions, Problems, and Exercises

1. Draw to scale a diagram for your home garden plot. Compare your plan with those of the other pupils. Select the best.
2. What considerations should determine the choice and location of the garden plot?
3. What parts of the following plants do we use as food: radishes; horse-radish; cabbage; cauliflower; lettuce; celery; onions; asparagus; potatoes; rhubarb; spinach?
4. Are all blossoms on a cucumber vine alike? Which produce fruit?
5. Which of your garden crops have been attacked by insects? What remedies were used? Write a short composition on the topic,—"How we made our garden pay".

CHAPTER XVI

THE POTATO

Origin.—The potato grows wild high up in the Andes of Chile and Peru. It is found in its wild state also along the coast and on the highlands of Central America and Mexico. The wild potato grows well in many different soils, temperatures, and climates, and in this respect the garden varieties resemble it.

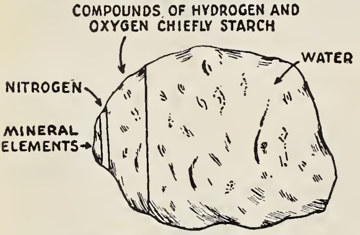
Early History.—It was the Spanish invaders of America who taught the Indians how to use the potato. Before that time the Indians did not know it as a food. The Spaniards introduced it into Europe in the sixteenth century. Sir Walter Raleigh, however, first brought it to England, where he grew potatoes in his own garden. He presented some to Queen Elizabeth, that she might grow them in the royal gardens. When they were ready to use, the cook, not being familiar with the new vegetable, took the tops and prepared from them a dainty-looking salad. Elizabeth, after eating some of it, became suspicious that an attempt had been made to poison her. Sir Walter was immediately summoned. He succeeded, however, in convincing the queen that the cook had blundered and that no harm was intended.

Distribution.—From such romantic beginnings, this tropical plant has spread over a great part of the world. It can be grown wherever there is a growing season of four months, free from raw winds and frosts. The fact that it is grown almost everywhere and in such great quantities shows that the potato is highly valued as a food by man. More than 300,000,000,000 pounds of potatoes are grown in the world each year. Corn, which comes second, and wheat, which comes third, each fall almost 100,000,000,000 pounds below the world's potato yield.

All European countries grow potatoes. Germany raises more than any other country in the world. Enormous quantities are raised in Russia, Hungary, and Ireland. France imports large quantities from Algeria in North Africa. They are grown everywhere in the United States, but early potatoes are imported from Bermuda. In Canada potatoes are raised from sea to sea, and from the southern boundary as far north as Great Slave Lake, and even beyond. The Maritime Provinces produce the largest crop.

Some of the most popular varieties of potatoes.

Food Value.—What is there in a potato that gives it its food value? It is made up nearly as follows: water seventy-eight per cent, carbohydrates or starch nineteen per cent, protein or flesh-forming elements two per cent, and ash, which contains the mineral matter, one per cent. Of the protein about one half is digestible, and this contains .14 per cent of nitrogen. That is, there is about two ounces of nitrogen in a hundred pounds of potatoes, so that one does not get very much nitrogen in a meal of potatoes. The amount of phosphorus is about the same—two ounces per hundred pounds, and potash about six ounces per hundred pounds. It is clear that it is for the starch, rather than for these other elements, that potatoes are eaten, although the others, such as there are of them, are valuable. Starch is oxidized, or burned, in the body to give energy.



The composition of the potato.

Soil Qualities needed.—The soil best suited to potato growing is a rich sandy loam, with plenty of humus and an open subsoil. The tubers cannot develop so well in clay and are more likely to be attacked by rot. If the soil is light without much humus, it is likely to become too dry; if clay, too wet. The roots often reach a depth of three or four feet; but, if the subsoil is hard, this is not possible, and growth is slow. The soil must be rich; but, if manure is supplied, it should be spread in the fall, and ploughed in. Fresh manure applied in the spring may cause scab. Whenever applied, it should be well rotted.

Preparation of the Soil.—In the fall the soil should be ploughed deep so as to open up the subsoil. In a crop rotation, the potato should follow clover or hay; or, if the ground is well manured, it may follow any of the grains. If clover sod is ploughed down, the soil is likely to contain all the nitrogen necessary. If not, an artificial nitrogen fertilizer may be used, or a catch crop of some of the vetches may be grown and ploughed down. Both are valuable fertilizers. In the spring, the ground should be cultivated to fine the soil and make a good seed bed, and the potatoes should be planted before the ground dries out.

Seed.—There are many ways of cutting for seed: some are halved, some are quartered, and some are planted whole. The eyes of a potato are buds, whose work it is to send out branches, or stems, and grow more potatoes. The potato itself is an underground stem. It is greatly enlarged and filled with food material to nourish the young stems until they have grown roots and leaves and are able to gather their own food.

In cutting, then, two things must be kept in mind: there must be eyes in the piece, and the piece must be large enough to provide plenty of food for the young plant. All pieces should be chunky and not thin. Usually two eyes, at least, are left on a piece; but the size of the piece is of more importance than the number of the eyes. The objection to small pieces is that they do not contain enough food material to give the plant a strong start. The objection to large pieces is that they send up too many sprouts, and the potatoes are likely to be small; also, they are a waste of seed. A piece weighing about three or four ounces, that is, about the size of a hen's egg, gives the best results. The pieces should be planted as soon after cutting as possible. If it is necessary to keep them for some time, they should be set in a cool place and covered with a damp cloth, so that they may not wilt or dry out.

Planting.—The general practice now is to plant potatoes in rows, the rows being from thirty inches to three feet apart. The seeds should be planted singly about fourteen inches apart. Potatoes so planted stand both drought and wet better than when planted two or three pieces together. Four inches is an average depth; they may be planted a little less deeply (three inches) in clay soil; and rather more (five or six inches) in sand.

Cultivation.—The soil should be cultivated often during the growing season. The first cultivation should

Irrigating potatoes at Duchess, Alberta. This farmer is using water from an irrigation canal to "water" his potatoes. He knows that it is not wise to depend entirely upon the rainfall for a good crop.

be deep, especially if the ground is very weedy; but, as the plant grows, cultivation should be shallower. Level cultivation is better than hilling. Many of the roots are surface-feeders, and hilling may do some injury and little good. Potatoes should be planted deep enough (about four inches) so as to make hilling unnecessary. Towards the end of the growing period, however, the plants may be hilled up slightly in order to prevent the tubers from being exposed and becoming sunburned.

Seed Selection.—If potatoes for seed are selected from the bin, there is no way of telling what kind of hills they came from. They may have come from hills with many small potatoes and with only one or two large ones in them; and the large ones are those usually selected from the bin. Such seed, when planted, will produce hills of potatoes like those from which it came. Seed

Harvesting potatoes with a modern machine. It does the work rapidly and well.

should be selected from the hill rather than from the bin. It is advisable to choose seed from those hills where the potatoes are moderately large, true to type, of uniform shape, free from disease, and plentiful in numbers. A medium-sized potato, with a smooth, clear skin and few and shallow eyes, is the best. These qualities are the ones likely to be passed on to the next generation. The seed potatoes should be stored in a special bin to prevent them from being mixed with the general stock. In the spring tubers which show any sign of disease should be discarded. Care in choosing seed is the best way to prevent disease.

Harvesting and Marketing.—New potatoes may be dug for early market as soon as they are large enough. The time to dig the bulk of the crop, however, is when the tops or vines are dead, unless danger of frost makes

Sacking potatoes. Estimate the yield.

earlier digging advisable. If dug on a dry day, less dirt will cling to the tubers; also, they will dry off better and are less likely to rot. The field crop is usually dug with the digger or plough, and the garden crop with the fork. The fork is better than the spade or hoe, as it is not so apt to cut or injure the tubers. They should not be allowed to lie in the sun for any length of time after being dug. They should be stored in a cool, well-ventilated, dry, and dark place. Before marketing they should be graded. Potatoes for market should be of uniform size, shape, and color, and of one variety; and they should be clean and smooth. No producer, if he values his reputation, should offer for sale diseased or frozen potatoes.

Diseases.—Potatoes are subject to many fungous and bacterial diseases and to attacks by insects. They may also be injured by their surroundings. Care should be taken not to plant them again for a number of years in ground from which diseased potatoes have been taken.


Early blight.

Early blight is a fungous disease. The fungus attacks the leaves, eating away the surface, which is needed to make food for the plant. Dark spots, with rings around them, appear on the leaf where the fungus has begun to grow within the tissue of the leaf. The plant, thus attacked, should be sprayed frequently with bordeaux mixture to kill the fungus before it has entered the leaf. Early blight attacks the leaves only; the tubers are not affected.

Late blight is another fungous disease. It is much more harmful than early blight. The fungus enters the leaf through the stomata, and, once established within the tissues, if the weather is favorable, it quickly destroys the leaf. The spots are not ringed as in the case of early blight, and the odor is more unpleasant. If the spores are washed to the ground by rain, they will attack the tubers, producing in the skin dark, sunken spots, and allowing soft rot bacteria to enter. As a result, musty brown spots and streaks are found within the potato. In damp weather the disease spreads quickly over the patch, and early digging is advisable to save the crop. To kill the fungus, bordeaux mixture should be sprayed on the plant before the fungus enters the leaf. For future protection the vines should be burned, and none of the tubers from the infested field should be used for seed.

Late blight tuber rot.

Scab, too, is a fungous disease which attacks the skin of the tuber, causing rough, brown scars to form on the surface. The fungus may be either on the seed or in the ground. In fact, it is nearly always present in the soil, being found even in prairie soils; but in some soils it is present in much greater abundance than in others. The tubers are attacked very early after they have begun to form.

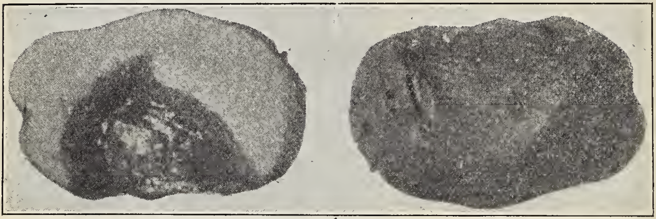
There are two kinds of scab—*common* or *corky scab*, and *powdery scab*. Powdery scab was brought from Europe, and for a time caused much alarm. Potato growers should watch for it, for our climate encourages it, and, when once it gets into the soil, it remains for years. The scabs are powdery, brown or olive-colored, and frequently surrounded by a withered area. They do not continue to grow after the potatoes are mature, or after they have been dug. No perfectly satisfactory remedy has yet been found. Treating the seed with corrosive sublimate and with formalin solutions is helpful. The potatoes should be soaked for two hours in a mixture of one pint of formalin to thirty gallons of water. They should then be spread out to dry. Great care should be taken to prevent the seed from being re-infected through contact with unclean bags or other potatoes. Care should be taken to plant the seed on clean ground. These measures will at least destroy the fungus spores that are on the seed.

Powdery scab.

Dry rot. — The parasites of this disease are found in the ground, in pits, bins, cellars, and other places where potatoes are stored. They enter the tuber through wounds in the skin, and increase rapidly if the temperature is high. The skin on the outside becomes shrunken, hard, and dry. On the inside the affected portion is a dry, powdery-looking substance. To control and stamp out dry rot care must be taken in storing potatoes. The infected tubers must be removed.

Soft rot is a bacterial disease. The bacteria enter the tuber through cuts or bruises, and under favorable conditions soon rot the potato completely. The disease is quickly carried from one potato to another. Affected tubers should be removed, and the crop should be stored in clean places. Cut or bruised potatoes should be kept apart from the rest.

Warts, Cracks, Knobs, and Hollow Heart.—These are not diseases. They are the result of soil conditions. *Warts* are produced when the soil is too wet. *Knobs* and *cracks* occur when the soil is not kept uniformly moist throughout the season. If the skin hardens and sets, internal growth will crack the tuber. *Hollow heart* is the result of too rapid growth in rich soils and alternate



Dry rot of the tuber.

moist and dry periods. These deformities are not passed on, if such tubers are used for seed.

Sweetening and Discoloring.—Sweetening and discoloring are due to improper storing. If the temperature is below 40° Fahrenheit, sugar collects in the tuber, but will disappear if it is kept for a time at a higher temperature. Discoloring is caused by too high a temperature, or, in newly-dug potatoes, by too long exposure to a hot sun. Black heart will develop, if the ventilation is poor and the temperature is above 90° Fahrenheit.

Freezing.—Freezing tends to kill the tissues. If not too badly frozen and allowed to thaw out slowly in a dry place at low temperature, the tubers may recover. But if thawed out quickly at a high temperature, they will not recover. Chilling also injures potatoes. They should not be brought to market, exposed, or offered for sale when the temperature is below 32° Fahrenheit. The person who buys such potatoes, although they appear to be alright, is likely to find, when he comes to use them, that the interiors of many of the tubers are browned or blackened, especially after cooking.

Insect Pests.—Of the various insects that attack the potato, the Colorado beetle is the most common and the most destructive. Fortunately, this pest has not yet made as much headway in Alberta as in some of the other provinces. The method of control is to poison with Paris green, applied to the leaves either as a powder or as a spray.

Judging Potatoes.—In judging potatoes the points to be considered are the size, shape, skin, soundness, color, eyes, and the yield per acre. Potatoes should be of medium size, uniform, and free from deformities. The skin should be bright, clean, and of the same color throughout. The eyes should be neither deep-sunken nor standing out. The flesh of the potato should be free from dark spots, tough fibre, rot, sunburn, bruises, and other defects. A judge should also take into account the percentage of the potatoes in the crop which are of proper size for marketing.

Questions, Problems, and Exercises

1. Select two potatoes of medium size, one being regular in shape, smooth, and with shallow eyes; the other irregular, and with deep-set eyes.

Which is easier to pare? Which lost most in paring? Which looks better for the table? Which is better for market? Which should be chosen for seed?

2. Bring to school samples of as many different varieties of potatoes as can be found by the class. Learn the important breed characteristics

so as to be able to identify the following: Early Rose; Early Ohio; Gold Coin; Wee Macgregor, etc.

3. What are the names of the principal early varieties? late varieties?

4. What plan does your father follow in selecting seed for his potato crop?

5. Secure and examine samples of potatoes affected by: scab; dry rot; warts; cracks; discoloring; freezing.

6. Examine plants affected by blight.

7. After discussing the matter carefully with farmers, compare the cost of producing an acre of potatoes; an acre of corn; an acre of wheat. Compare also the profits.

8. How can a yield of potatoes be increased on a given area?

9. Conduct a potato-judging contest at your school.

CHAPTER XVII

FRUIT GROWING

Some of the smaller fruits do quite well in Alberta and should have a place in every home garden. The fruit is appetizing, and the shrubs are an ornament to the garden. They increase the value of city, town, or village property, and, moreover, caring for them is a pleasant and profitable form of recreation.

RED RASPBERRIES

Among the best-known of the brambles are the red raspberries, black raspberries or thimbleberries, dewberries, and loganberries. All are shrubs, although some are trailing in habit. They are all perennials and have more or less prickly stems, white flowers, and edible fruit. The red raspberry is the only one of these grown to any extent in Alberta, and so is the only one necessary to consider here.

Propagation.—Red raspberries are propagated, that is, new ones are produced, chiefly by means of suckers. Around the parent plant shoots or suckers are sent up. By digging up the suckers with a goodly supply of earth attached, new plants for setting out are obtained. These should be dug up in the spring. They should then be transferred directly to where they are to be planted. If preferred, they may be grown for a year in the nursery row and then set out.

Soil Requirements.—Red raspberries will grow quite well on almost any soil in Alberta, providing it has in it a reasonably abundant supply of humus. Sandy or clay loams, which contain abundant plant food and are able to hold the necessary moisture, are best. Although the soil must be moist, it should not be wet. A wet soil, through freezing and thawing, results in heaving and winter-killing.

Not only the smaller fruits, but plums also do well on the prairies, as shown by this illustration of plum trees at Coaldale, Alberta.

Preparation. — One purpose in preparing the soil for the growing of raspberries is to put it in such condition that it will retain moisture and keep damp throughout the growing season. Another is to ensure that it will have in it at all times plenty of decaying vegetation. The ploughing should be deep — ten inches at least; and a liberal supply of well-decayed barnyard manure should be worked into the soil. It is important to cultivate deeply and to have much vegetation mixed in the soil before setting out the plants. Once set out, they are likely to remain for a number of years, and it is difficult to cultivate or get the necessary humus into the soil while the plants are growing in it. After ploughing, the soil should be thoroughly cultivated, as it cannot be cultivated deeply once the roots are developed.

Setting out.—The plants are usually purchased from the nursery. When received, the bundle should be opened out and the roots set in water for a few hours. If they cannot then be set out immediately, they should be heeled in, in cool, moist sand. They should be set out in the garden as soon as the ground is dry and mellow enough to work. The rows should be about six feet apart, and the plants three feet apart in the rows. If set too close together, cultivation is made more difficult, and the growth of the canes is weaker. The old cane is of no value other than to mark the spot where the plant is set, and to support it until it grows new canes. It should be cut to one foot or so in length. The hole in which the plant is set should be large enough to hold all the roots without crowding or twisting, and the plant should be set an inch deeper than it was before. When set, the roots should be covered, and the soil firmly pressed about the plant. The varieties most suitable to Alberta are *Cuthbert*, *Herbert*, *Latham*, and *Sunbeam*.

Cultivation.—Cultivation should start early and should be thorough but shallow. All weeds, suckers, and grass between the rows should be kept down, as they take moisture required by the plant and retard its growth. Grass and weeds among the canes should be removed by hand. Potatoes or cabbages may be planted between the rows the first year, but after that the rows should be left free for cultivation and for the benefit of the plants themselves.

Winter Protection.—Owing to the severity of the weather in Alberta, winter protection is a necessity. If left standing, exposed to wind, storms, and frost, plants are apt to become frozen. To prevent this, the canes should be bent down just before the severe freezing weather sets in. A little earth may then be thrown over the tips to hold the canes down, after which they should be mulched, or covered with straw or hay. The mulch should be removed before growth starts in the spring.

Methods of Growth.—At the end of the first season raspberries, if properly cared for, should have sent up from the crown of the plant a number of tall, strong, succulent canes. These may or may not have developed side branches. They will, however, have developed buds, either on the canes themselves or on the branches. From these buds lateral shoots are sent out the second year, and these bear the fruit. Although the roots are perennial, the canes are biennial. They bear fruit one season only. New canes start up from the crown. In the following year, these new canes develop shoots from their lateral buds, bear fruit, and die.

Pruning.—Old canes that have borne fruit are of no further use and should be cut out when the fruiting season is over. Where more canes are sent up than is desirable, the weak ones should be removed. This gives light, room, and air to those that remain, and they make a better growth.

CURRANTS AND GOOSEBERRIES

Currants and gooseberries are among the hardiest of the small fruits. They are comparatively easily grown, and they may be depended upon to produce a crop year after year. They yield a large quantity of fruit for the ground that they occupy, and are worthy of a place in every garden.

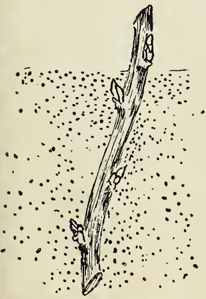
Varieties.—Currants are *black*, *red*, or *white*. The whites are the mildest in flavor, and the blacks are the strongest. The red and black varieties are more commonly grown for the market, but all are grown to some extent for home use. The commonest varieties are as follows:

Reds: *Fay, Cherry, Perfection*, and *Red Dutch.*
Whites: *White Grape, White Imperial.*
Blacks: *Victoria, Naples, Lee's Prolific, Basket Giant.*

Gooseberries are of two types—*European* and *American.* The former type is the larger. This is their principal difference. The best-known varieties are: *Downing, Houghlin, Pearl*, and *Smith.*

A cutting of a currant bush.

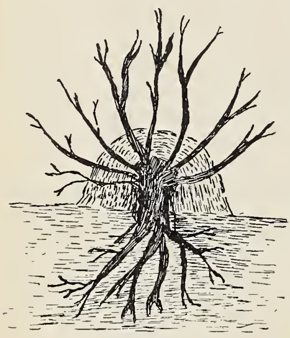
Propagation.—*Currants* are propagated principally by hard wood cuttings. In autumn, after the leaves have fallen, well-ripened shoots of one season's growth are selected and cut from the plant. These are then cut into pieces six or eight inches long. The butts are all put one way, and the cuttings are tied into bundles. The bundles are then buried with the butts up, covered with two or three inches of soil, and left there for the butts to callous, or become hardened. Later the cuttings may be taken up and planted the same fall; or they may be buried in five or six inches of sand, left in the cellar over winter, and planted early the following spring. When planting, the cutting should be set in the ground with one bud showing above the surface, and the earth should then be tramped firmly about it.



The depth at which a currant bush should be planted.

Gooseberries are commonly propagated by layers. In the fall the plants are cut back to induce the growth of numerous shoots the following spring. When quite well developed, about July, the earth is thrown up about them, leaving only the tips exposed. Late in the fall, or before the ground freezes and after the shoots have rooted to some extent, the earth is thrown back, and the shoots are cut out. They may then be buried in sand in the cellar over the winter and set out in nursery rows early the following spring.

Planting.—On the whole, for both currants and gooseberries, spring planting is preferable to fall planting. Fall planting, unless done early, is risky in Alberta. If, however, the plants are lifted early—about the time the leaves fall—and are set out in time to allow the roots to take hold of the ground before it freezes, the risk in fall planting is lessened. The plants should then be mulched with straw to prevent them from being injured by the alternate thawing and freezing of the ground. Unless these conditions are observed, fall planting is likely to result in dead plants in the spring. For both currants and gooseberries, the rows may be from four to six feet apart, and the plants set from three to five feet apart in the rows. It is not well to crowd them; ample room for growth and cultivation should be allowed. Before setting out, the tops may be cut back one-third to one-half to make good the damage done to the feeding roots. Broken ends of the roots should also be trimmed off, so that they will heal more quickly.



Mound layering.

The holes in which the plants are to be set should be of good size, and the planting should be done in the same manner as in planting trees. The roots should be given plenty of room, the plants set considerably (one to two inches) deeper than they were before, and the soil pressed firmly about them.

Tillage.—The ground should be loosened up on the surface after planting, so as to leave a mulch that will prevent the loss of moisture. To maintain the mulch, to keep the ground from drying out and becoming hard, and to keep down weeds, frequent tillage throughout the entire season is necessary. But, as the plants are shallow rooted, all cultivation after they have taken root must of necessity be shallow. It is a good plan to mulch the plants in the fall with well-rotted manure and to work as much of this as possible into the ground the following spring.


Gooseberries are easily grown.

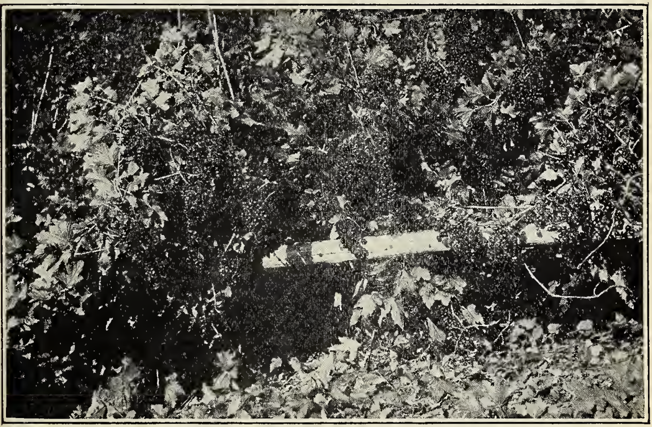
Pruning.—Pruning should be done in the fall, or very early in the spring before the buds start to shoot. The bushes should not be allowed to become too thick. The only pruning that is necessary for the first three years is to cut out the weak young shoots, and to head back the overly strong ones. About one-third of such shoots may be cut off after the third year, and from then on the aim should be to keep all the old canes cut out, to keep ten or a dozen young canes growing well, and to keep the bushes open to light and air. In the case of red and white currant bushes the best fruit is borne on wood two or three years old. After that the canes begin to lose their strength, and the fruit becomes smaller and poorer. Hence, after canes are three years old, they should be removed to give the younger and stronger ones a chance. If the pruning is carefully done, a supply of strong young canes can be kept coming constantly to maturity year by year, and thus the bush will produce abundantly season after season. The black currant bush produces its fruit on wood of the previous season's growth, and so requires a somewhat different system of pruning.

Sylvia gooseberries. Gooseberries should have a place in every garden.

Bearing Habits.—*Currants.*—There are two types of wood in currant bushes: the young canes and the old canes. The strong young canes are light grayish in color, with prominent buds. Though they have no fruit on them, these are the canes which, in the following season, will bear the heaviest clusters of large and luscious fruit.

They are full of vigor and vitality. The old canes have seen their best days; their strength is leaving them; and their usefulness is about over. Their bark is rough, black, and scraggy. The fruit that they bear is mostly on short spurs of branches along the main stem. The clusters are small, and the fruit, too, is small and poor.

Gooseberries.—In gooseberries, the older canes branch more than do those of currants, and the branches retain

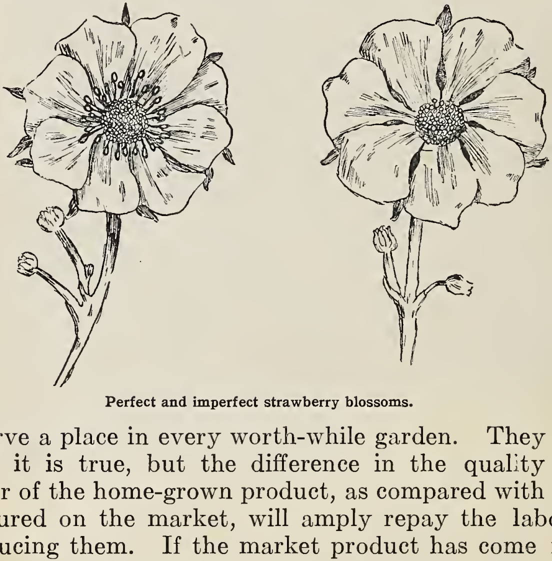


Victoria red currants, grown at Beaverlodge, Alberta. Six bushes yielded seventy-five pounds, an average of twelve and one-half pounds of fruit from each bush.

their strength longer. As the branches grow, the fruit-bearing portions of them are extended outward each year. On these younger portions of the branches the largest and best fruit is produced. After three years, however, the canes begin to lose their strength, and the fruit produced becomes poorer and poorer. Many growers, therefore, make it a practice to cut out all canes that are more than three years old.

STRAWBERRIES

Strawberries in every Garden.—Although some soils and climates are more favorable for growing strawberries than others, this plant can be grown successfully almost everywhere. If the soil is dry, it can be irrigated; if it is hard, it can be cultivated and fined; if poor, it can be enriched; if the climate is severe, the plants can be mulched. If properly cared for, strawberries give large returns for the space that they occupy, and therefore they



Perfect and imperfect strawberry blossoms.

deserve a place in every worth-while garden. They need care, it is true, but the difference in the quality and flavor of the home-grown product, as compared with that procured on the market, will amply repay the labor of producing them. If the market product has come from far-away plantations, the fruit, to stand shipment, must have been picked when from half to three-quarters ripe. This half-green fruit has neither the richness nor the flavor of fruit that is picked when fully matured. Strawberries have their best flavor when eaten within forty-eight hours after they have been picked.

Structure.—Strawberries belong to the Rose family of plants. They are low-growing, stemless herbs with fibrous roots and many runners. In some varieties the flowers are perfect; in others they are imperfect. Perfect flowers have a calyx, a corolla of five white petals, from ten to twenty stamens, and numerous pistils. The receptacle of the flower, upon which the pistils stand, enlarges as the seeds mature. This enlarged receptacle, containing the naked, ripened seeds, is the fruit. Imperfect flowers may have no stamens at all; or, if they have any, these are only partially developed and useless. Such flowers cannot, unless their pistils are fertilized from some other source, mature their seeds or produce fruit.

Varieties.—Cultivated strawberries of a great many varieties have been developed from the wild native strawberries of North America. The variety which is most popular and most widely known in Alberta is the *Senator Dunlap*. It is a good variety for beginners to grow, because it is hardy, reproduces well, and fertilizes readily, and its fruit is of excellent quality. Other varieties, such as *Ever-bearing*, *Gaudy*, *Glen Mary*, or *Crescent*, may be attempted as one learns more about the habits and care of the plant.

Propagation.—Strawberries are propagated principally by means of runners. These are long, slender, cord-like extensions that run out from the parent plant. The runners throw out roots and leaves at the various nodes or joints along their course. A runner may root at only one node, or it may root at three or four nodes. At every point where the runner roots, a new plant is produced. To obtain these plants for setting out, the runner is cut on each side, and the rooted portion, with its leaves, is dug up. The young plant may then be transferred and planted where it is henceforth to grow. The strongest runners of the previous season's growth should be selected, and preferably from those plants that have not yet borne fruit. Plants from old runners should not be taken. As the plants even on the same runner may vary in size and vigor, a selection of only the best should be made for the new strawberry patch.

Soil Requirements and Preparation.—Almost any kind of soil, gravelly, sandy, clays, or loams, will grow strawberries, but only a rich, moist soil will grow them luxuriantly. Sandy or light clay loams suit them best and will produce most abundantly if properly enriched. While the soil must be moist, free or standing water, either within the soil or upon its surface, will kill the plants; "they cannot stand wet feet." It is a good practice to manure heavily the year before planting, to plough deeply and cultivate thoroughly, and then to grow that year a hoed crop upon the land. The manure has then had time to decay and to become part of the soil, and hoeing has cleaned it of weeds. The next spring the soil should be ploughed or spaded deeply again and worked up and made fine like an onion bed. The soil is then in the best possible condition for setting out the plants.

Strawberry crops. It requires a rich soil to produce plants like these.

Planting.—Strawberries may be set out either in the spring or in the fall. In northern latitudes early spring planting is preferable, as fall planting, where the winters are extreme, is likely to be followed by heavy loss. The rows should be three feet apart, and the plants should be set from twelve to twenty inches apart in the rows. Before setting, all the dead leaves should be removed, and, in addition, some of the older ones, so that the plant may not lose too much moisture before it has taken root.

Considerable care must be taken in setting the plants. The spade is a good tool to use for this purpose. It should be thrust into the ground at an angle of forty-five degrees to a depth of eight inches, and then pressed forward, making an opening for the plant. Holding the spade in this position, the plant should be set in the ground carefully at the proper depth. The spade is then withdrawn, and the soil is permitted to fall back about the roots. If the soil is dry, it is well to pour a pint of water about the roots when set. The soil should then be pressed down firmly, leaving some of it loose and dry upon the surface for a mulch. The plant must be set just right: neither too deep nor too shallow. The crown bud should be just above the surface of the soil. If this is buried, the plant will probably die. If set too shallow, the roots are likely to dry out too much, and this again may cause the plant to die.

Training.—When the plants are established, they will send out runners. Whether these should be allowed to run and set at will, or whether they should be trimmed and trained in certain ways, is a matter of choice. As a rule, the more runners there are, the more plants there will be. And, although the fruit may be abundant, it will not be so large or of such good quality as it would be if some of the runners were cut off. The more a plant puts into runners, the less it has to put into fruit. There are a number of ways of training the runners. Perhaps, for the beginner, the *hill system* is the safest and best. In this system all runners are removed as soon as they appear, thus leaving the plant free to put all its strength into the production of sturdy and

Picking strawberries. The straw between the rows forms a mulch for preserving moisture, and it serves also to keep the fruit clean.

fruitful crowns. The fruit from such plants will be large and of good quality.

Cultivation.—Cultivation must be thorough to keep down weeds, but must not be deep, as the plants are shallow rooting. The plants require plenty of water. If water is not readily available, the ground should be gone over frequently to keep the dry dust mulch in good condition and so preserve for the plants what moisture the soil contains. When watering garden strawberries, the ground should not be sprinkled lightly, but should be soaked well. If it is porous or has good drainage, there is no danger in this.

Winter Care.—Strawberry plants in our climate require to be mulched in the fall in order to protect them during the winter. Straw is suitable for the purpose. It should be spread over the beds to a depth of two or three inches before the severe frosts set in. This straw mulch is not intended to protect the plant from frost, but rather to prevent the alternate thawing and freezing of the soil, which is very harmful to the roots. The mulch should not be removed so long as there is danger of frost. The whole of it need not be removed, but only such part as lies immediately over the plant. The more mulch which can be retained about the plant, while still allowing the plant to come through, the better it will be. The mulch will help to hold the moisture, will check the growth of weeds, and will keep the berries clean.

Renewing the Bed.—The number of crops which can be taken from a strawberry bed is limited to one or possibly two. It is not usually profitable to attempt to take more than two, and among the best growers the plant is discarded after one crop is taken. The first year the crop will be both the best and the biggest, although frequently very fair crops are harvested the second year. After two years, however, the plants in the bed should be renewed.

One method of renewing the strawberry bed is to set aside a few hills for the purpose of producing new plants. These are prevented from fruiting by pinching off the fruit buds, so that the plant may put all its strength into the production of runners and new plants. If it is desired to have the new plants ready to produce fruit the following year, they should be lifted and set out in August. The new plant may be freed from the runners by cutting them away on each side. It should then be lifted with the matted roots and the earth attached. If carefully reset in this condition, it has a chance to become established and, if properly mulched during the winter, will produce fruit the following summer.

In another method the plants for the new bed may be left attached to the mother plant, and all mulched during the winter. They should be freed in the spring and set out in a new place. These new plants will not produce fruit until the next year.

Questions, Problems, and Exercises

1. Visit some expert fruit gardener and have him show you how to recognize the different varieties of fruit-bearing shrubs and vines.
2. Ask this gardener to show you how these different plants should be pruned. Ask him to show you young plants in preparation, and show you the way in which he propagates different plants.
3. Examine these plants during the bearing season to find out when and how the fruit is borne. Make drawings to illustrate.

CHAPTER XVIII

WEEDS

Weeds are plants in the wrong place. When plants grow where they are not wanted, and when they interfere with the growth of other more useful and desirable plants, they are called *weeds*. Many weeds are very hardy and thrive despite the utmost efforts to get rid of them. They greatly interfere with those crops which the farmer tries to raise.

CLASSES OF WEEDS

Annuals.—Annuals grow from seeds. The seeds germinate, and the plants grow, flower, produce seeds, and die, all in the same year. Most annuals produce large quantities of seeds. Usually they have small fibrous roots, but many, such as *lambs' quarters, shepherd's purse*, and *ball mustard,* have tap roots. Other examples of annuals are *ragweed* and *wild oats.*

Winter Annuals.—Winter annual is the name given to annuals that live through the winter. For instance, there are plants some seeds of which may germinate in the spring, while other seeds will not germinate until the fall. Those seeds that germinate in the fall cannot, in the short season remaining, produce plants that will complete their growth that same year. But they do produce a small plant that will get a good hold on the soil, develop its root system, and produce a few leaves that will survive the winter. The plant then makes an

—Courtesy Grain Growers' Guide.

Weeds retard growth. These two sweet clover plants were grown under the same conditions, except that the one on the left was in a weed-infested field and the other in a clean field. Notice the difference in development.

early start in the spring, and during the growing season maintains its lead over the crops which the farmer may sow. *French weed, tumbling mustard,* and *shepherd's purse* are examples of plants which are both annuals and winter annuals.

Biennials.—Biennials require two years to complete their growth. The first year is spent in developing the plant and storing up a supply of food ready for seed production, which is the principal business of the second year. The part of the plant above the ground is not usually greatly developed the first year, but it is sufficiently developed and has enough leaves to enable it to make plenty of food, which is then stored in the thick, fleshy root. *Tansy mustard, evening primrose,* and *burdock* are examples of biennials.

Perennials.—Perennials are plants that live on from year to year. Although the part above the ground, after producing seed, dies down in the fall, the part beneath the ground will survive the winter and produce new plants the following year from its running root-stock. *Canada thistle* is an example of a deep-rooted and *couch grass* of a shallow-rooted perennial.

INJURIOUS EFFECTS OF WEEDS

Weeds, by drawing up water from the soil and evaporating it through their leaves, are wasteful of capillary moisture and reduce the supply for other useful crops. In those localities where the rainfall is light and the soil dry enough in any event, this unnecessary loss of moisture presents a problem quite too serious to be disregarded. Moreover, weeds rob other plants of food, shade them, deprive them of sunlight, and crowd them out of space in which to grow.

Weeds increase the labor and cost of crop production. Some are of such rank growth that they make it extremely difficult to operate binders or other farm machinery upon the fields. Where weeds have to be bound up with the grain, more twine will be required in cutting the crop, and more labor will be necessary in stooking, hauling, and threshing the bundles. Their seeds in the grain increase

Tumbling mustard arrested in its travels.

the weight of the loads hauled to the elevator, add to the freight charges, and result in loss through cleaning and dockage. Then, too, they reduce land values. A clean farm is worth more than one infested with weeds. The weed-infested farm is, moreover, a menace to other farms in the vicinity. It is almost impossible to keep clean a farm which has for its neighbor a dirty farm.

HOW WEEDS ARE SPREAD

Man.—Man himself has been largely responsible for the introduction upon his farm or into his locality of some of the most pernicious weeds with which he now has to contend. He has brought in impure seed and sown it without any consideration of what impurities it contained. He has brought in oats with weed seeds and hay with strange and unknown weeds, and fed them to his horses in the condition in which they were received. He has spread the manure over his fields before it was rotted, and he has been careless in the matter of transferring farm machinery from dirty fields or localities to those that were clean.

Rivers.—Rivers and irrigation ditches frequently have many kinds of harmful weeds growing along their banks. If these weeds or their seeds fall upon the water, they may be carried long distances and spread on fields far from where the weeds were growing.

Winds.—Winds are carriers of weed seeds. Some weeds, such as Canada thistle, sow thistle, and dandelion, are provided with tufts of hairs or parachutes for the special purpose of enabling the winds to carry them. Others, like tumbling mustard or tumble weed, are constructed with stems brittle where they meet the ground, but with the remainder of the stem and the branches tough, and with the whole somewhat spherical in form. When the stem breaks, the weed is rolled over the ground, scattering its seed gradually as it rolls, and polluting the country over the entire length of its course.

Animals.—Animals carry weed seeds. Some weed seeds, like those of the burrs, are enclosed in seed-coats which have little hooks upon them. When an animal comes into contact with the weed, these hooks catch hold of and cling to its coat. As it moves about, the seed-coats open, a few at a time, and the seeds are scattered over the country.

PREVENTION AND ERADICATION OF WEEDS

How to prevent Weeds.—The farmer should take every precaution to guard against the introduction of weed seeds upon a clean farm or field. Seed grain should be pure; if it is so dirty that it cannot be satisfactorily cleaned, it is better to sell it and buy pure grain for seed. Threshing machines, wagons, farm machinery, etc., which have come from a dirty farm, should not be used until they have been thoroughly cleaned. Grain con-

A cultivated, clean road allowance near Gleichen, Alberta.

taining noxious weed seeds should not be fed to stock without first being ground or crushed, and the manure should be well rotted before being spread upon the fields. Weeds growing along the roadside or fences should be destroyed. They will thus be prevented from going to seed and polluting the farm.

Weeds already on the Farm.—Weeds that have already established themselves on the farm present a different problem. Many kinds of weed seeds have amazing vitality. Some, such as French weed and other mustards, will lie in the ground and retain their germinating power for a great many years. Whenever tillage brings the seeds near to the surface, they will germinate and grow. In order to apply eradication methods intelligently and effectively, it is necessary to know to what class a weed belongs and the habits of its class, how it reproduces itself, and how it spreads its seeds.

Burning the stubble and weeds behind the harrow.

Eradication of Weeds.—*Annuals* are propagated or reproduced in one way only,—by their seeds. The parent plants die at the end of every year. If they can be prevented from flowering and producing seeds, such weeds may be brought under control. Where they are few in number, the best method of doing this is to pull them by hand and burn them. But, if they are numerous and spread over much of the farm, thorough cultivation is necessary. By disking, cultivating, harrowing, or shallow-ploughing the fields immediately after harvest, the seeds near the surface may be induced to germinate and will then be killed by the winter frosts. Early cultivation the following spring will cause more of the seeds to germinate and grow, and, if the field is ploughed deeply in June, these, too, will be destroyed. If the field is then sown to oats or barley, these crops will tend to smother many remaining weeds that grow. In order to prevent those that still grow from flowering and producing seed, the oats or barley must be cut for green feed. This process may have to be repeated from year to year, or it may be necessary to summer-fallow occasionally if the weeds still continue to grow.

Dandelion seed. Notice the parachute—A.

Winter annuals will not be killed by frost. The method of dealing with them is to cultivate, as in the case of annuals, immediately after harvest. Early in the following spring the ground should be ploughed shallow to kill the plants that have survived the winter. Later in the season, as other seeds germinate and grow, the ground should again be tilled and afterwards sown to oats or barley. Crops that may be cut for green feed, or hay, which may be cut before the weeds flower, are the best kinds to grow. For, if the weeds are given a chance to flower, there is frequently quite enough vitality in the stems to complete the flowering and mature the seed even after the weeds have been cut down. Summer-fallowing, too, should be practised for their destruction. The ground is tilled to cause the seeds to sprout and grow; it is then tilled again to kill those that grew. This

Types of burr seeds, enlarged to show the hooks.

process is repeated as frequently as is necessary throughout the season.

Biennials are destroyed by keeping them cut off at the ground. No flowering plant can live long if it constantly loses its leaves. Unless the crown is cut off, the plant will send up other leaves to take the place of those removed. Biennials, therefore, must be cut close to the ground so as to destroy the crown. Many farm implements do not destroy the crown, and so it is necessary to cultivate often to destroy the leaves as they appear. If this is done two or three times in a season, the plant will usually die.

Perennials are not easily brought under control. They must be attacked by methods different from those used in destroying other weeds. The fact that they reproduce their kind not only from the innumerable seeds which they produce, but also from their underground rootstocks or even from portions of these that may be cut up by farm implements, makes the task of destroying them specially difficult. The plough or disk will cut up the rootstock, and the harrow will drag the pieces to other parts of the field. These pieces will produce new plants, but, if the field is repeatedly tilled and the young leaves are destroyed, the plants will, in time, be killed. Consequently, summer-fallowing with frequent tillage is one of the control methods adopted. Another is to rotate crops, so that a cultivated crop may come around frequently in the rotation. A corn or potato crop is especially good for this purpose. Badly infested fields may be pastured to sheep. Sheep will eat almost any weeds when the plants are young and tender, especially if there is a scarcity of their favorite grasses. As they are very close nibblers, they prevent the young leaves from forming, thus weakening and finally killing the plant.

COMMON VARIETIES OF WEEDS FOUND IN GRAIN


Tumbling mustard.

The Mustards. — The mustards can usually be distinguished by the four little yellow or whitish leaflets of their flowers being in the form of a cross, and by the fact that the tiny seeds grow in pods.

Tumbling mustard has long, slender pods, and so numerous are the seeds that sometimes as many as a million of them are found on a single plant. The flowers are pale yellow or almost white, and the stem is tall and erect and has many branches.

Wild mustard has small, yellow flowers, and slender, knotted pods with the tip empty. It is not so much branched as the tumbling mustard, nor does it grow so tall or produce so many seeds. It may be from one to three feet in height and produce ten thousand seeds. It is not a winter annual; hence, if the seeds can be made to sprout in the fall, many of them will be killed by the frosts of winter.


Wild mustard.

Ball mustard is another of the very common mustards. The flowers are small and yellow, and the seed pods are round. The seed is fairly large for a mustard, and there is only one seed in a pod. Nevertheless, it is a weed that has spread widely. It is found almost everywhere in fields in the central and northern parts of Alberta. It is an annual and a winter annual.


Ball mustard.

Wormseed mustard has small, yellowish flowers. Each pod is on a little stem and is about an inch in length. There may be as many as 20,000 seeds on a full-grown plant. It is a common weed in the southern part of Alberta. It is both an annual and a winter annual.


Wormseed mustard.

French weed or *stinkweed* has small, white flowers. The pod is flattish with side wings. Each pod has about fourteen seeds, and the number of seeds on a mature plant is about 15,000. It is an annual and a winter annual.

Shepherd's purse is another very common weed belonging to the Mustard family. Like so many of the others, it also is an annual and a winter annual. It is fairly common in grain, hay, and pasture fields in Alberta. It is also frequently found in gardens and around buildings. It has very small, white flowers and

Stinkweed.

triangular pods notched at the top. This and the rosette of leaves lying flat upon the ground, around the base of the stem, are distinguishing features of the plant.

False flax, or as it is sometimes called *balloon mustard*, grows tall and erect, its branches growing from the upper part of the stem. The flowers are small and greenish yellow in color. The pod, which contains about ten seeds, is pear-shaped with a tiny projection on the top. The seeds are very oily and give to grain, with which they may be ground, an objectionable flavor. It is both an annual and a winter annual.

Shepherd's purse.

Tumble Weed.—This weed is common in the southern part of Alberta. It is an annual, low growing but wide and bushy. When mature, it breaks off near the ground, and may then roll with the wind, spreading its seeds as it goes.

Canada Thistle.—The Canada thistle is easily distinguished by its deeply notched, very prickly leaves, and by its numerous heads of light-purple-colored flowers. It is a perennial and spreads by means of both its seed and its roots. There are about 5,000 seeds on an average plant; and from its long rootstalk running along under the ground numerous other thistle plants may spring. It is a very difficult weed to destroy and an exceedingly troublesome one when growing in grain, as its prickly nature makes the straw very difficult to handle.


False flax.

Perennial Sow Thistle.—As its name indicates, this is another perennial. Its flower, a bright yellow in color, somewhat resembles that of the dandelion. The leaves are covered with soft prickles, and it has a long underground stem or rootstock. It is becoming quite widespread throughout the Prairie Provinces. It should be known and watched for, as, once it gets a hold, it is one of the most persistent and most difficult of all weeds to get rid of.


Tumble weed.

Blue Lettuce.—Blue lettuce is another perennial that is very hard to wipe out, when once it has established itself. The pale-blue flowers, which grow near the top of the plant, are about an inch across. Usually it is first found growing in patches, and, if among grain, the grain where it grows is poor.


Canada thistle.

Wild Oats.—Wild oats is an annual resembling some varieties of cultivated oats. The seeds are, however, slimmer, have stiff bristles at the base, and a twisted awn or beard bent at a sharp angle. The easiest way to distinguish them is by the "colt's foot" at the base of the oat. This is a scar resembling a horseshoe and is caused by the way in which the oat is attached to the tiny stem on which it grows. Wild oats ripen the topmost seeds first, and, as these fall to the ground before the other grain is ready to cut, the weed will soon take possession of a field.

Wild Barley.—This weed is a perennial. It is a roadside weed found in waste places and is common on the wild range land and old pastures. It does not grow in cultivated fields. When ripe, the awns or bristly hairs, of which it has a great many, become hard and stiff. They get into the wool of sheep, and into the eyes, lips, or gums of stock, thus setting up inflammation and sometimes even causing blindness.


Perennial sow thistle.

POISONOUS WEEDS

The poisonous weeds most dangerous to live stock are the *larkspur, death camas, loco-*

weed, and *water hemlock*. These weeds may grow on ranges and other grazing areas and may be found in hay cut on our native meadows. They begin to grow early in the spring, offering tempting forage before the native pastures are ready for grazing. Hence stock are apt to eat of this poisonous food before good forage becomes plentiful.

Blue lettuce.

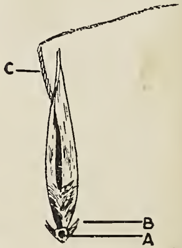
In the early spring months, during rain storms and late snow storms, stock often seek shelter in coulees and ravines When they come out from their places of shelter, they are usually hungry and are not careful in choosing forage. Also, during dry seasons and on stony pasture, feed may become scarce, and stock are then apt to eat any food that may be at hand. Lack of sufficient salt and of plenty of good water so affects the appetites of animals that they are led to eat poisonous weeds which otherwise they would not touch.

Wild oats.

The greatest losses of sheep from poisoning occur when they are being taken from one range to another. This is because they cannot choose forage as carefully while being hurried over the range as they usually do when they are allowed plenty of time to spread out and select their food. It is a well-known fact that poison acts more quickly when the sheep are hot and hungry.


Wild barley.

Tall Larkspur.—This plant is usually found in the foothills of the Rocky Mountains. It flourishes in the underbrush of poplar and willow scrub. It requires shade and a rich, fairly moist, well-drained soil. The young stalks begin to shoot up early in May and by the 24th of that month they are about six inches high, bearing green, succulent leaves. The flowers, borne on stems from three to five feet high, are bluish purple, and each has a cone-shaped spur a half-inch long, growing upward and shaped like the spur on a lark's foot. The root of the tall larkspur is perennial and consists of a number of fibrous branches, which grow to a depth of six to eight inches.



Wild oats. Notice: A, the colt's foot; B, the bristles; C, the twisted awn, bent at the top.

Symptoms.—The first symptom which appears in an animal poisoned by larkspur will probably be the sudden falling of the animal. There is usually a general stiffness of the legs and a difficulty in walking, which causes the animal to lag behind the herd and finally to lie down. The muscles of the sides and the legs twitch at intervals. Bloating and drooling, or dribbling at the mouth, are commonly caused by this poison.

Treatment.—As stated previously, bloating is common and should be relieved by draining the contents from the first stomach with the trocar or cannula instruments. At one time bleeding was supposed to be helpful, but its value is doubtful.

Tall larkspur.

Death Camas.—The other common names by which death camas is known are *poison camas* and *mystery grass*. This plant is slender and grass-like, with a cluster of from five to seven pale-green, grass-like leaves. In the centre of this cluster is an erect flower stem, from five to twenty inches high, with many small, greenish-yellow flowers. The leaves and the flower stem grow from a perennial, underground, onion-like bulb.

Death camas.

The death camas is found on the open prairie, on the sides of hills, and in coulees and ravines. It begins to grow in the spring; flowers appear in May and June, and the seeds mature in June and July. All classes of stock that eat this plant are said to be injured by it, but, apparently, sheep alone become poisoned by it. The bulbs are particularly poisonous, and in wet weather when the ground is damp and soft, sheep frequently pull these bulbs out by the roots and eat them, especially if the pasture is poor.

Symptoms.—The first symptom of poisoning by the death camas is stiffness in the legs and difficulty in walking. There is frothing at the mouth, rapid breathing, increased flow of saliva, sudden jerking of the head, and intermittent spasms following in rapid succession. Finally paralysis takes place, and the victim sinks into unconsciousness and dies.

Treatment.—Many people hold that medicine has no effect upon animals suffering from this poison. The experience of the sheep men, however, proves that potassium permanganate and aluminium sulphate are effective in a great many cases. A teaspoonful of each of these drugs dissolved in a pint of water is sufficient for from ten to twelve sheep.

Loco-weed.—There are several loco-weeds found in the Prairie Provinces. The one causing the greatest loss to live stock, however, is probably the *white loco,* familiarly known as *crazy weed.* The white loco is a silvery white plant from three to ten inches high, growing in tufts or bunches from a perennial root. The leaves are feather-like and always shorter than the flower stem. It belongs to the Pea family and has one or more clusters of yellowish-white flowers that resemble in shape those of the pea.

Of all classes of stock affected by loco-weed, sheep probably are the chief sufferers. Horses, also, are poisoned by it frequently, but cattle usually escape it. Young sheep and horses more commonly form the habit of eating the weeds.

Symptoms.—Loco poisoning develops slowly. In the early stages it apparently affects the nervous system, making the animal stupid. It loses control of its muscles and cannot see clearly or judge distances accurately. Affected animals usually wander from the herd and remain in some infested area, where they will eat nothing else but the plant if it can be obtained. The coat becomes rough and shaggy, the gait staggering and slow, and the teeth grow long and become loose. In many cases the affected animal walks around in circles, always turning in the same direction and apparently unable to go in the opposite way.

White loco-weed.

Treatment.—Drug treatments for loco poisoning are very unsatisfactory. The animals should be put on good, wholesome food, given access to plenty of pure drinking water, and kept confined so that it will be impossible for them to return to the spot where they were obtaining the plant.

Water Hemlock.—The common names by which this plant is known are *poison parsnip*, *wild parsnip*, and *beaver poison*. It is a tall, erect marsh plant from two to six feet high. The stems are streaked with purple and bear a few pale-green, doubly compound leaves and many quite flat clusters of very small, greenish-white flowers. The rootstock is short, thick, and varies in diameter from one-half inch to three inches. The end of the rootstock is divided by partitions into chambers. In the spring these are filled with a liquid, but later they become empty. Most of the poison of the plant is contained in the rootstock and the root. Cattle are the most frequent sufferers from water hemlock poisoning. Horses and sheep are affected occasionally.

Symptoms.—The first symptom frequently appears in from thirty to sixty minutes after the root has been eaten. This is frothing at the mouth. The animal becomes very uneasy and soon falls to the ground. Violent convulsions then take place, accompanied by champing of the jaws and gnashing of the teeth. The breathing is hurried and irregular, the pulse is rapid and weak, and there is a gradual stiffening of the legs, with the head and neck frequently bent backwards. The animal gradually passes into coma and soon dies.

Water hemlock.

Treatment.—This form of poisoning is seldom relieved by treatment. On account of the exceedingly rapid action of the poison, the animal is usually found dead or too far gone for medical aid. Large doses of melted lard, raw linseed oil, or milk will probably be as effective as any other form of treatment.

Eradication of poisonous Weeds.—The only means of destroying poisonous weeds is to cultivate the soil in which they grow. Grub them out, oı fence them off from the rest of the range. The best time for grubbing out is when the plant is in flower, as it can then be more readily distinguished. Loco-weeds, if cut off with a spade a few inches below the ground, will die.

Questions, Problems, and Exercises

1. Collect as many weeds as you can, belonging to each of the following classes:—Annuals, Winter Annuals, Biennials, Perennials.

Give the methods for eradication in the case of each of these classes of weeds.

2. Learn to recognize and name the weeds occurring in your district.

3. Make a collection of weed seeds, placing the seeds in small bottles, which may be labelled, or mounted on cardboard, with the name under each bottle.

4. Send, at once, to the Department of Agriculture, Edmonton, Alberta, for a copy of *Alberta's Weed Problem*, Bulletin No. 1. It contains full descriptions of weeds and is beautifully illustrated in colors.

CHAPTER XIX

LIVE STOCK

SECTION I.—STOCK BREEDING

Domesticating wild Animals.—As man progressed from a crude savage to the highly civilized being that he is to-day, he gradually came to live a settled life, instead of roving from place to place, and to depend for his food supply upon *agriculture* rather than upon hunting. During all these centuries he has tamed and trained wild animals and has constantly improved the breeds. All of our domestic animals were once wild, but man has caught and tamed them and made them his companions and helpers. Though we know very little of the way in which it was done, we do know that primitive man did domesticate these wild animals. Records show that he used the horse for meat and to carry

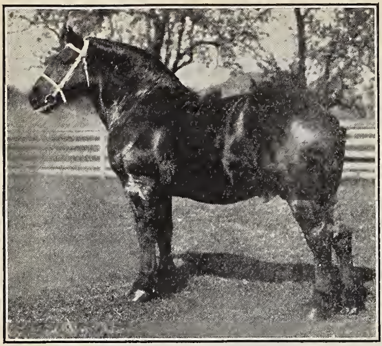
Making friends.

him from place to place; that he used the cow for milk, its flesh for meat, and its hide to provide clothing for himself and leather for his bows; that he used the hog and the sheep for meat, and the latter also for its wool; and that he used fowl for both eggs and food. We know, too, that he improved these animals very considerably.

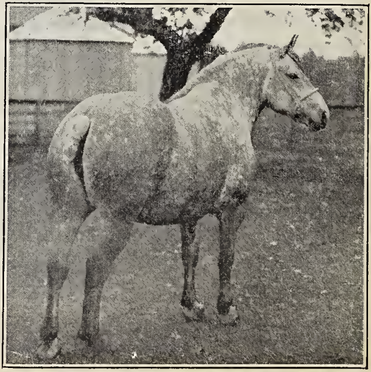
The more marked improvements in the breeds of these animals were left, however, to a later age. Even within the last few generations the improvement has been very great. The horse has been improved in form, in speed, and in power. The choice lard and bacon hogs have been bred up from the scrawny, angular, wild boar; the sheep, with its scant covering of poor-grade wool, has become the heavy, lustrous wool bearer of our own time; the cow that gave barely enough milk to support her own calf has become the rich or heavy milk producer of the dairy farm; the jungle fowl that laid only enough eggs to keep the race from extinction has been developed into breeds that produce eggs abundantly.

Wild animals can be used to help man in his work. This wild caribou was captured, tamed, and trained by his Eskimo rider.

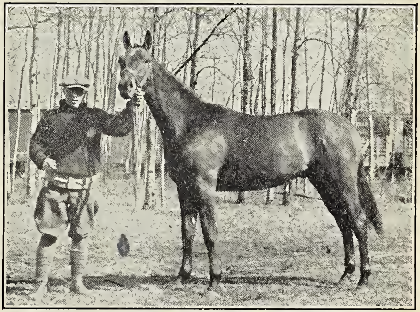
Breeding.—Breeds have been improved in two ways; by *heredity* and by *variation and selection.* Heredity means the transmission of the characteristics of the


A Percheron stallion. The choicest are selected as breeders.

parents to the offspring, down through generation after generation. But if heredity alone were at work, it would maintain the same type unchanged for ages. Although there is a similarity in offspring of the same parents, no two are precisely alike. There are some variations or differences, however slight. The individual which possesses in the most marked degree those peculiarities of form, structure, and quality which it is desired to perpetuate, is seized upon and kept as a breeder of the next generation. From the offspring of this parent the choicest again are selected as breeders, and so on down through the generations. In time there comes to be a breed in which those qualities which the breeder aims to produce are the distinct features of the type. The offspring will have these peculiarities, although not all to the same degree.


A Percheron mare.

For example, a number of Percheron horses are exhibited at a fair. They may all be splendid animals of the Percheron breed; but, when they are inspected by the judges--who are experts in determining how near the different individuals come to the breeder's ideal,—it is found that there is one which comes nearer to the type than any of the others. The difference between that horse and the others may be very slight, for all may be close to perfection, but it is enough to cause the judges to declare it the winner of the first prize. In all breeds of stock there is an ideal, a perfect animal, that the breeder is constantly striving, through the selection of only the best, to produce.



"New York" by "Yorkshire Lad," the champion Thoroughbred stallion at the Edmonton Spring Show.

Pure Breeds.— Live stock are either *pure bred* or *grade*. Pure bred stock are those which have been bred for certain qualities for a number of generations, a record of which has been kept by some recognized organization. In Canada this organization is known as the National Live Stock Records Association, with headquarters in the city of Ottawa. This association has been given authority by the Dominion government to keep a register of all pure bred animals in Canada. Only those so registered, and for which there is a certificate of registration, properly may be called pure bred or registered. The word *thorough-bred* has not the same meaning as pure bred. It applies only to a breed of horses known as Thorough-bred. These horses are noted for their speed in running or galloping on race tracks.

Grades.—Grade live stock may be defined as animals which are not registered. A cross bred animal is a cross between two pure breeds. For instance, a cow, one of whose parents is a Hereford and the other a Shorthorn, is a cross bred.

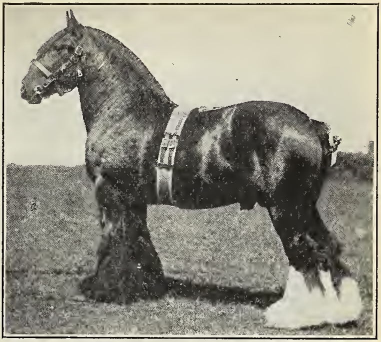
High Grades.—High grade animals are those which show in a marked degree the characteristics of one particular pure breed, but are not eligible for registration, owing to the fact that all of their ancestors have not been registered. These high grade animals may be bred up by the use of good pure bred sires and by always selecting the best females as mothers.

SECTION II.—HORSES

The horse is known to have existed upon the earth for a very long time. The early horse did not resemble very closely the horses of our time. He was much smaller and was striped like a zebra upon a ground color of fawn. Instead of one toe, as at present, he had a spreading foot with five toes.

Types of Horses

When men caught and began to tame and train these wild horses, they used them principally for two purposes, for food, and as beasts of burden, that is, the horses carried heavy loads upon their backs, instead of hauling them as at present. The usefulness of the horse as a means of carrying man from place to place was early discovered. Man also learned how to fight while on horseback, and the horse thus became a great factor in warfare. As there were two methods of fighting in vogue, two types of horses were accordingly developed: the light type and the heavy type. Some warriors, like the Arabs, attacked by rushing in upon the enemy, delivering their blows, and fleeing before they themselves could be attacked.



Bred heavy and strong to carry the weight of the man and two sets of armor.

Moreover, when pursued, the man on the swiftest horse had the best chance of escape. Hence one type was bred entirely for purposes of speed. The racing breed of to-day, the Thorough-bred, is a descendant of this type.

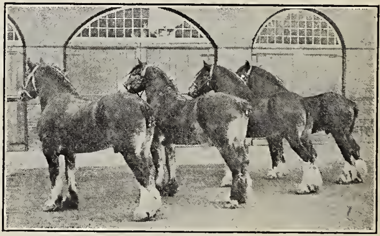
Other warriors prepared for battle by encasing themselves and their steeds in heavy armor. In order to carry the weight of its rider with the added burden of two sets of armor, the horse had to be very heavy and strong. This led to the development of large, powerful, but comparatively slow-moving animals. We find the descendants of these horses in

Champion Clydes on parade.

European countries to-day. It was upon the ancestors of the Clyde, the Shire, the Belgian, and the Percheron that the knights of old travelled over the country, fought their battles, and engaged in tournaments.

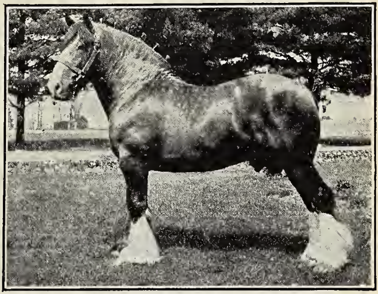

The Bronco is high-spirited and tricky.

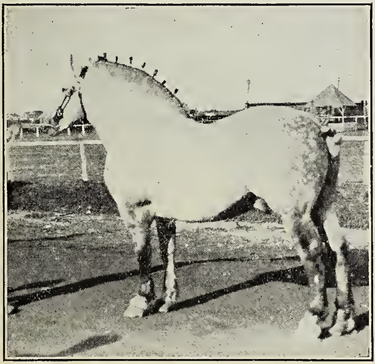
The Light Breeds. — Of the lighter types, the *Standard-bred* is the trotting or pacing horse, and the *Thorough-bred* the galloping horse of the race-tracks. Both are bred for speed. The *Hackney* is the coach or carriage horse; it is not a fast traveller, but is a very high stepper, with fine knee and hock action. With its intelligent head, its beautiful outline, and its proud bearing, it is one of the most handsome and graceful performers among all our horses. Its grace and beauty, however, have not protected it from the onset of the modern automobile. This horse, so common and so highly prized a generation ago, is now, unfortunately, seldom seen in our city streets.


Clydesdales.

The Bronco. — The term Bronco is used to describe the unbroken horse of the prairies. When these horses are halter-broken, and broken to harness so that they will pull loads, they are no longer called Broncos; they are then broken horses.

The Cayuse. — The term Cayuse is applied to the small native horse of the prairies which does not possess any special line of breeding, or, in other words, does not closely resemble pure breeds of horses. The Cayuse stands about fourteen hands high and weighs between 600 and 800 pounds, whereas the ordinary heavy work horse stands about fifteen or sixteen hands high and weighs from 1200 to 1500 pounds. A hand measures four inches. It is the term always used in describing the height of horses.

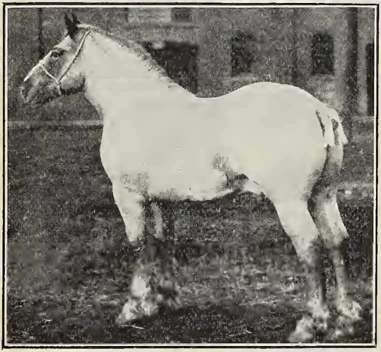

A Shire.


A Percheron.

The Heavy Breeds. — More important, however, are the heavy horses, or draft types. Of these the *Clyde*, the *Shire*, the *Belgian*, and the *Percheron* are in common use.

The *Clyde*, or *Clydesdale*, is the heavy horse of Scotland. It was bred originally in Lanark county, and derives its name from the river Clyde, which flows through that district. The color is usually bay or brown, though black, chestnut, and even gray are not uncommon. The lower parts of the legs are covered with fine, long hair, usually spoken of as *feather*. The legs below the hocks and the feet may be white, or black, and there is generally some white on the face.

The *Shire* is the same in color as the Clyde. It is frequently difficult to tell the two breeds apart. The Shire has shorter and straighter pasterns (the part of the leg between the fetlock and the hoof), and a straighter shoulder. The hair, or feather, on the legs is not as fine and is usually more plentiful. The outlines of the two horses also differ slightly.



A Belgian.

The *Percheron* has been bred for many years in France and has been imported extensively to the United States during the last twenty years. Recently the breed has become popular in Canada. The common colors are gray and black. The solid black or the dappled gray are very attractive colors on the street or in the show-ring when the teams are well harnessed. As a breed they are a little more upstanding than the Belgian. The breeders of this horse have paid especial attention to the trueness of outline and style. The legs are almost free of long hair; they have strong hocks and medium length and slope of pastern.

The *Belgian* is a stout, blocky horse. Chestnut, bay brown, dark bay, and roan are the common colors. There is usually a dish or hollow in the front of the face. As a breed they are low set, with well-sprung ribs and full hips and thighs. All of these features give the body a full rounded appearance. The legs have very little hair. The pastern is of medium length and medium slope.

George Lane's choice Percherons, which were bred and raised on the $\bar{U}$ (Bar U) Ranch near High River, Alberta.

The horse is one of the most useful of all man's allies. The tractor, the gas engine, and the automobile may relieve it of some of its burdens, but they can never wholly replace it. It may be largely replaced in the city streets, but not on the farm.

To handle a horse and care for it properly requires patience, judgment, and experience. It should be fed and watered at regular periods and carefully groomed after the day's work. The stable should be well ventilated, and the stalls should be kept clean. A horse that is compelled to breathe foul air can no more be kept in the best of health than can a human being under similar unfavorable conditions.

SECTION III.—CATTLE

Classes.—The various breeds of cattle fall into three classes—namely, *beef cattle*, *dairy cattle*, and *dual purpose cattle*. All are kept for profit, or for the return which they bring to the farmer for their food and for the labor bestowed upon them. A poorly bred animal will eat just as much food and requires almost as much attention as one that is better bred, while the returns from it will be very small in comparison with those from the well bred animal. It is not good business for a farmer to continue raising poor animals in a country where it is possible to obtain high grades or pure breds.

An Alberta boy with his prize-winning calf. He, himself, fed and prepared the animal which won five prizes at the Edmonton Spring Show in 1927.

Beef Breeds.—The beef breeds are not raised for milk, but for beef. If they give enough milk to feed their calves, that is considered sufficient, so far as their milk use is concerned. The beef breeds are the *Shorthorn*, *Aberdeen Angus*, *Hereford*, and *Galloway*. All are blocky and compact, broad on the back, with full rounded and deep bodies, short legs, wide, deep, and full chest, and thick, fleshy hind quarters.

The *Shorthorn* is one of the commonest of the beef breeds. It has short horns; one variety, the *Polled Shorthorn,* has no horns at all. *Shorthorns* have a wide range of color,—white, red, red and white, and roan are all quite common among them. Many farmers regard Shorthorns as very profitable to keep on the

A Shorthorn, an Aberdeen Angus, and a Hereford—three of the best kinds and each one the best of his kind.

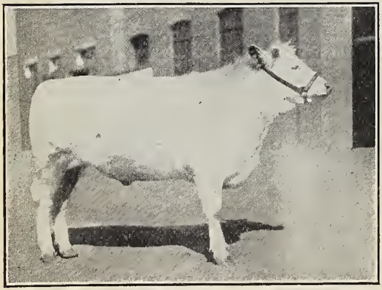
farm, not only because of their excellent beef qualities, and the high price which they bring on the market, but also because of the quantity of milk which they produce.

Herefords are large cattle, with red bodies and white faces, the white sometimes extending along the back and over the shoulders. They have long, upturned or curved horns. Their bodies are covered with a thick, mossy coat of hair. They are very hardy and do well both on farms and on the ranges. They are extensively raised in Canada, the United States, and the Argentine.

The *Aberdeen Angus* is black in color and has no horns. The poll, or top of the head, should be prominent. The body is round and deep, sometimes described as tubular to distinguish it from the Shorthorn, which is block-shaped or rectangular. The legs are short, making the animal low set. The meat is fine in grain and of high quality. They produce especially good baby beef.

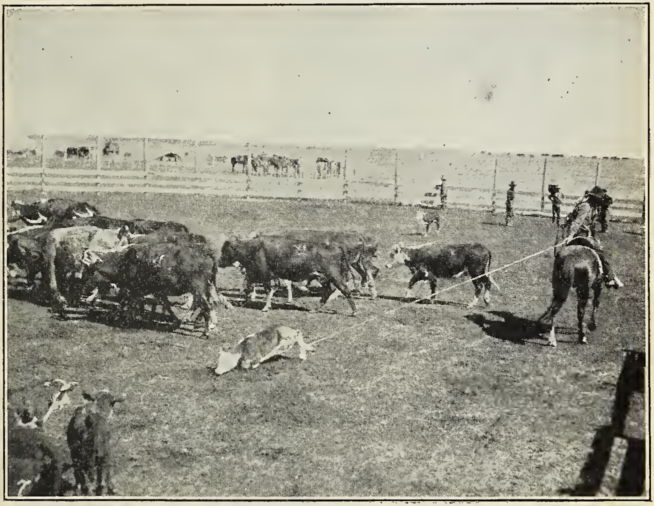
An Aberdeen Angus.

The *Galloway* is another breed that is black in color and without horns. The poll is low or flat, and the head is not so clean-cut as in the Angus. It has very thick, long, curly hair, especially in the winter. As a breed it has a longer body than the Aberdeen Angus, with less spring of rib. It is not quite so large as any of the other three breeds mentioned, but is noted for its hardiness and its ability to withstand cold. The meat is fine in grain and of good flavor, and the hide makes excellent robes.



This picture shows what a boy can do. Edward Chessor, aged 11, exhibiting this pure bred Shorthorn calf, "Silver Commodore," at the Edmonton Spring Show of 1926, carried off the Prince of Wales shield, and the Lieutenant-Governor's medal, and took home cash amounting to $811.80. Edward is a sixth grade pupil at the Mountain Grove School, near Lacombe, Alberta.

Dairy Breeds.—The leading dairy breeds are the *Holstein*, *Ayrshire*, *Jersey*, and *Guernsey*. The production of milk, rather than beef, is the object of the dairy farmer. The quantity and quality of the milk that dairy cattle produce determines their value. In general they are angular in form, and, whether viewed from



Catching and branding calves at the round-up.

above, from the side, or from the front, the body appears wedge-shaped. The skin should be smooth and pliable, and the hair fine. The udder should not be meaty, but should be large, coming well up behind and extending far forward, with large teats. The milk veins should be long, large, crooked, and branching, ending in a well-defined milk well.

Holsteins are large animals, black and white in color. The head should be of fair length, broad between the eyes, with strong muzzle. They were first bred in Holland, but are now very popular in both the United States and Canada. They are regarded as the heaviest producers of milk of any of the breeds.

A Holstein.

Ayrshires are of medium size. They are white, red, or red and white. This is the cow of Scotland and has also become popular in Canada. In quantity of milk produced it ranks high, and its milk tests well for butter-fat. Not only is it a good milker, but the steers and even the old cows make beef of good quality and flavor.

Jerseys are small cattle. They are usually solid fawn in color, but they may be fawn and white. As a rule, this breed has a black nose, black tongue, black switch, and black or amber-colored horns. The head is short, and the face should have a decided dish. The skin is of very fine quality, pliable and elastic. These cattle were first bred on the island of Jersey. The Jersey has long been famous, not so much

An Ayrshire.

for the quantity of milk produced as for its exceeding richness. For both butter and cheese Jersey milk ranks very high. It is not claimed that as a breed the Jersey possesses any satisfactory beef-producing qualities.

A Jersey.

The *Guernsey* breed resembles the Jersey but is larger. In color it is rich fawn and white. The face should have no dish, and the head should be slightly longer than that of the Jersey. Like the Jersey, its milk is very rich in butterfat, and the butter has that natural yellow color so much desired by consumers. It does not rank high in beef production. This breed is a Channel Island breed also, from the island of Guernsey.

Dual Purpose Breeds.—Several of the breeds possess dual purpose qualities; that is, they are adapted to be both beef and milk producers. It is recognized, however, that the *Shorthorn* and *Red Polled* breeds are the two which have been developed most along this line. Dual Purpose Shorthorns are sometimes called Dairy Shorthorns. They are registered in the same herd book of the National Live Stock Records Association as the Beef Shorthorns. Dairy Shorthorns have a special

A Dual Purpose Shorthorn.

milk registry record. Animals giving a certain amount of milk, testing a certain percentage of butterfat, may be registered in this record. The difference in type between Dairy Shorthorns and Beef Shorthorns is not great. The Dairy Shorthorn is not required to carry as much flesh as the Beef Shorthorn, but it must have

"Rosalind of Old Basing," the champion dairy cow of the British Empire, owned by C. A. J. Sharman of Red Deer, Alberta.

better udder and milk-vein development, showing the capacity to produce milk. It must be remembered, however, that the Dairy Shorthorn is required to produce beef as well as milk, and, therefore, it must possess in a reasonable degree beef-producing qualities.

The Red Polled is an English breed. It is well covered with flesh on the parts where the high-priced cuts of meat are produced and at the same time is a good milk producer.

SECTION IV.—SHEEP

Types.—There are three types of sheep — the *long wooled*, the *medium wooled*, and the *fine wooled.*

The long and medium wooled types are raised not only for their wool but also for their mutton. In fact, so high are their mutton-producing qualities, and so much consideration is given to this characteristic, that they are commonly known as the *mutton type.* This distinguishes them sharply from the short wooled type, which is never raised for mutton. The wool of this type is short, fine, silky, and of superior quality, and it is for the wool alone that they are kept. They are known as the *wool type.*

Sheep are kept for two purposes.

There are a considerable number of breeds belonging to each of these types. We shall consider here a few of the more outstanding breeds which are raised on the farms of the Prairie Provinces.

The Mutton Type

Sheep of the mutton type are low set, with short legs. The ribs are well arched, and the back is broad. The chest is broad and deep, thus indicating a strong constitution and the capacity for putting on flesh. The loin and leg of mutton are the two most valuable cuts in the carcass, and, therefore, the loin should be broad and thick and the leg well filled with meat.

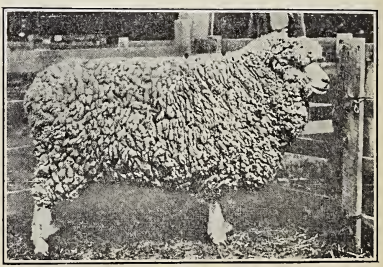
The Long or Coarse Wooled Breeds.—Among these breeds are included the *Cotswolds*, *Lincolns*, and *Leicesters* (the latter is pronounced "Lester"). They are all fairly large breeds, and all have long, coarse fleeces.


A Cotswold.

The *Cotswold* breed has long, open wool. The head is white in color and has a tuft of wool which hangs down over the forehead in heavy, wavy tassels.

The *Lincoln*, with its broad level back and rump and large head, is a big, massive sheep. Its face should be white, and it should have a tuft of white curly wool for a foretop.

The *Leicester*, though the smallest of the three, is by no means a small sheep. It is easily distinguished from the other two long wooled breeds by the fact that the head is finer and, from the ears forward, is entirely free from wool. The head is white and is very clear-cut. The legs are bare from the knee and hock down. The wool is of moderate length and noted for its lustre.


A Lincoln.

In rough or hilly country, where food is scarce and much foraging is necessary to produce enough for their needs, none of these breeds do so well as on the plains or ranges where food is more abundant and can be much more easily obtained.

Medium Wooled Breeds.—The popular medium wooled breeds are the *Southdowns*, *Shropshires*, *Oxfords*, and *Hampshires*. These are general purpose sheep, being kept for both wool and mutton. All four breeds have dark faces, dark ears, and dark legs. Their lambs

Feeding pens make for economy.

mature early; and, as the mutton is of good quality and fine flavor, they bring high prices on the market.

The *Southdown* breed is the smallest of the four and is fine of bone. It is thick and well-fleshed and has good weight for its size. The mutton is fine in grain, without excessive fat, and of splendid flavor. The wool is fine, and close as compared with that of the other breeds already considered.

The *Shropshires* are somewhat larger than the Southdowns; they are a compact, well-fleshed sheep.

In the best show-ring type the head is short, broad between the eyes, and well covered with white wool. This wool should come out to the tips of the ears, completely covering the face and coming well down to the point of the nose. The nose and ears should be dark in color. The legs should also be dark and be wooled down below the knee. The wool is of medium length, close, and of medium fineness.

A Shropshire.

Because these sheep are very hardy and mature early, they are raised very extensively on the smaller farms.

The *Oxfords* are larger than the Shropshires. They can be distinguished from the Shropshires also by the fact that the wool does not come below the eyes. The fleece of the Oxford is not so compact as that of either of the two breeds just considered; it is more open, coarser, and longer.

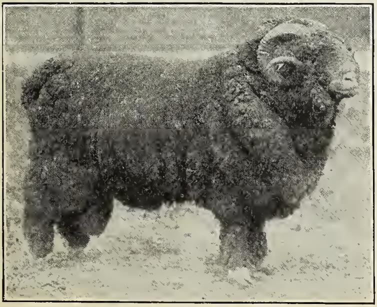
An Oxford.

The face and ears of the *Hampshires* are dark, with white wool coming down over the face. The ears are of medium length and pointed forward. The legs should be strong and well wooled down below the knee and hock. They are a good mutton sheep and yield an unusually heavy clip of wool. They are noted as a quick-maturing, hardy breed.

A Hampshire.

The Wool Type

Short or Fine Wooled Breeds.—To this group belong the *Rambouillet*, *Dorset*, and *Merino*. The wool is very fine in texture. It is short, dense, and oily. They are all especially adapted for range conditions, as they are hardy, and they naturally keep together in a large flock, whereas most of the other breeds will scatter, thus making the work of the shepherd much more difficult.

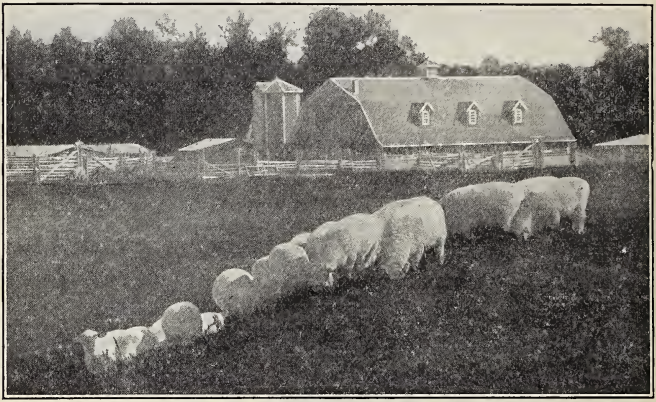


A Rambouillet ram.

Advantages of Raising Sheep

It is doubtful if there is any class of stock that will yield larger and quicker returns for the money invested than sheep. It does not require very much money for a farmer to commence with a flock of a dozen fairly good sheep. By the end of the year they will, with ordinary good fortune, have doubled in numbers; and also they will have produced a considerable quantity of wool. If the farmer chooses to sell both lambs and wool, he will have almost recovered his outlay the first year.

Sheep are among the best foragers of any class of stock and will obtain a living almost anywhere, whether in pastures, stubble fields, or summer-fallow. They will



Sheep on the Prince of Wales' ranch.

eat weeds of many different varieties and are about the only kind of stock that will grind them up sufficiently to destroy the germinating power of the seeds. They do not require expensive stabling for the winter months, as they have heavy winter coats of their own and therefore do not need to be in warm buildings. In bad weather, however, they do need some protection in the form of cheap buildings, where they may be kept dry and free from draughts. There is not nearly as much labor involved in caring for sheep as in caring for other kinds of stock.

Sheep should be provided with good water, and should be given plenty of roughage in the winter months, such as hay, clover, oat straw, pea straw, chaff, and screenings. The breeding ewes should also be given some roots or silage and a light feed of grain once a day. In the lambing season, sheep require special

Sheep should have access to good water.

attention. If a new-born lamb becomes chilled, it is almost sure to die. It pays to give the flock a little extra attention at this season. The damage done by dogs and coyotes in some parts of the country discourages many farmers from trying to raise sheep. Tying bells on the sheep and keeping a couple of good dogs, preferably Russian wolf hounds, afford good protection against these marauders, since they usually rely upon darkness and silence for safety and success in their efforts.

SECTION V.—SWINE

A Poland China.

Types.—Swine are of two rather distinct types: — the *lard* and the *bacon* type. To the former belong the *Poland China*, the *Duroc Jersey*, and the *Chester White*; and to the latter belong the *Yorkshire*, the *Tamworth*, and the *Berkshire*. There are other breeds also belonging to each type, but those mentioned are the most common.

Lard Hogs

Characteristics.—The fat types all grow to be very large, but farmers market them before they become too old, big, and heavy. They have short legs and wide, deep bodies. They are broad across the back, have heavy hams and shoulders, and heavy, drooping chops. They all take on fat readily and so can be fitted for the market quite early if desired.

A Duroc Jersey, a good example of the lard type.

Breeds.—*Poland Chinas* are black, with white markings about the head, legs, and tail. They have a short nose with short, drooping ears pointing forward. They grow rapidly and mature early.

Duroc Jerseys are solid red in color. They have medium length of snout, with medium length of drooping ears. They fatten rapidly and are early maturing.

Chester Whites, as the name suggests, are pure white in color. They have medium length of snout, and short, drooping ears. The sows are good breeders, good milkers, are quiet in disposition, and make good mothers. The meat, like that of the others, contains a great deal of fat.

Bacon Hogs

The bacon hog is the most popular type in Canada at the present time. It is raised most extensively because it has been proved to be the most profitable. The meat

Bacon hogs.

packers throughout Canada have agreed to pay a premium of ten per cent for all hogs which will grade select bacon. This is to encourage farmers generally to raise bacon hogs. The packer is able to pay a premium of ten per cent, because he can sell this class of hog in the British market for a higher price than the thick, fat hog. There is no sale for the thick, fat hog except in Canada, and even the Canadian market for it is quite limited.

Desirable Qualities.—A bacon hog should weigh from 180 to 220 pounds. It is bred and fed so that the highest quality of cured bacon can be secured from its carcass. This bacon, to be of best quality, must contain a large proportion of lean meat. The fat must not be too thick; both the fat and the lean must be of good quality, and the meat should be streaked with both. The hams and shoulders must not be too heavy and must also contain a large proportion of lean meat. An animal must reach the desired weight at six or seven months of age, in order that the meat may be of proper quality, and that the feeding of the animal may not be so expensive as to be unprofitable.

A Berkshire.

In type the bacon hog should be of good length between the shoulder and the ham. The ribs should be well sprung, with sides and chest deep. The back should be well arched and strong. The shoulder should be smooth on top and at the sides; the hams rounded, full, and tapering neatly to the hock. The jowl should be light and the head strong; the bone of medium strength and of good quality. The animal should be very active and vigorous.

A Yorkshire.

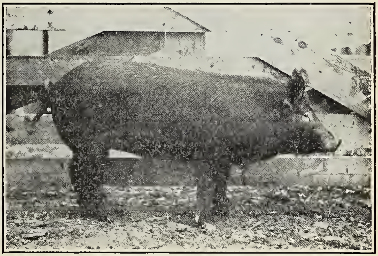
Breeds.—*Berkshires* are black in color and usually have white on the face, white feet, and white on the tail. The face is considerably dished, and the ears are carried erect.

Yorkshires are white in color with erect ears. They originated in Yorkshire, England, and are now found in almost every part of the world wherever hogs are raised. They are the largest breed of the bacon type. They produce a very excellent quality of bacon. The sows are noted as good mothers.

Tamworths are another breed of English origin. They are solid red in color; the snout is long, and the ears are erect. The bacon is of excellent quality, with a large percentage of lean meat of very fine flavor.

Relation of Hog Production to Crops

Whether it is more profitable to feed hogs and then sell the pork, or to sell the feed directly, is a question which each farmer must answer for himself. A good deal depends upon the location of the farm, its size and nature; the distance from railroad or market; the kind of crops which it grows and matures best; the number and kinds of other stock kept; the average price of the crop as compared with the average price of pork; and the kind of labor available on the farm. Many farmers have learned by experience that it is not wise to depend solely upon the growing of grain, especially of wheat, as their only source of revenue from the farm. They know that they are on a much more secure basis, if they have some stock to fall back upon, in case the grain crop should fail or the price of grain be low.



A Tamworth.

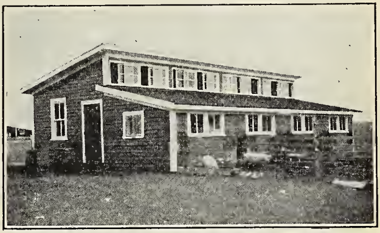
The prairies are specially well suited, both by climate and season, to the growing of the coarser grains: oats, barley, rye, and peas. Corn and sunflowers also can be grown, and these make good silage. Potatoes, too, and many kinds of roots thrive in Alberta. Frequently the market for these is none too good, the demand is weak, and the prices are low; whereas the demand for pork is

A herd of swine at Spirit River, Alberta. The large Yorkshire is raised extensively in the Peace River Country.

fairly constant, and prices are usually steady. Most of the crops just mentioned make good hog feed, and the farmer may find it much more profitable to feed them to pigs and sell the pork than to try to dispose of the crop itself, particularly if haulage and freight charges are high. Five or six pounds of grain can be converted into one pound of pork, which can be placed on the market with less labor and expense than is involved in marketing the grain direct.

Care of Hogs

Hogs require considerable attention and more or less hand feeding at all times. As much of the feed has to be carried to them in pails or buckets in the form of grain, chop, mashes, slops, milk, or water, the hog lots should be near the feed supply. The farmer is a busy man, especially in the summer months, and, if the lots are not too far away, the boys or girls of the farm can attend to the feeding of the hogs.


The piggery of the Western Stock Farmers, Limited, at Crawfort, Alberta.

On most farms a certain number of milk cows are kept, and, since cream separators have become so common and the cream is shipped into the cities, there is always a considerable quantity of skimmed milk on the farm. There is no market for skimmed milk, but it can be used for hogs in such a way as to bring in very considerable returns. When used with grains, it makes a splendid feed for hogs. For young pigs from six to eight weeks old, a wet mash, composed of finely ground grains or shorts and a liberal supply of skimmed milk, makes a very wholesome food.

To raise hogs successfully without undue expense a good hog pasture is necessary. Hogs do better during the growing period if allowed to run on pasture than they do if shut up. Given a good pasture, plenty of fresh water, a little grain, and some shelter from the sun during the heat of the day, the hogs will do well. A hog, moreover, appreciates a good dry bed and should not be compelled to live and lie in dirty, wet quarters.

Questions, Problems, and Exercises

1. Make a list of the important breeds of horses, cattle, sheep, and swine, indicating the outstanding characteristics of each. Refer to general appearance; head; shoulder; chest; body; feet; mention particular characteristics, such as legs and feet of horses, wool of sheep, etc.

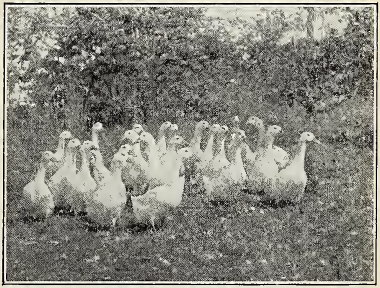
2. Attend stock shows and fairs or visit government farms to study the important breeds of horses, cattle, sheep, and swine. Learn to distinguish the breeds and to recognize the desirable qualities in the various breeds.

3. Try to find out by talking to stock men or farmers what breeds are most suitable for your locality.

CHAPTER XX

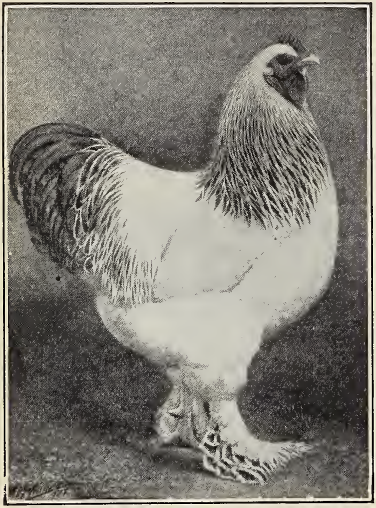
POULTRY

Poultry History.—Turkeys, geese, ducks, pigeons, and chickens are all included under the term poultry. Of these, hens and chickens are by far the most widely raised and are therefore the most important. All our present breeds of chickens are supposed to have descended from the jungle fowl of India. These fowl still run wild in the jungle and resemble fairly closely some of our present domestic breeds. They lay their eggs and hatch them, scratch and cackle and crow much as do our domestic fowl, but they are wild and shy, and they avoid the society of man. Some of these were caught and tamed for home use before the Christian era, and all the many varieties that we know to-day have been bred since that period.



Pekin ducks, twelve weeks old. For a quick turnover of money, ducks are most profitable.

The Egg and Poultry Industry.—In modern times there has been a tremendous development of the egg and poultry business. No other form of animal food is more highly prized than eggs and poultry. The value of the eggs sold annually in this country amounts to millions of dollars. The demand for eggs is fairly constant, and the price is relatively high; high, that is, compared to that which prevailed twenty years ago, when eggs were selling at from six to ten cents per dozen, or compared to that of 700 years ago, when eggs sold at sixteen dozen for a cent. The increased demand and the advance in prices are due to several causes: to the growth of cities where people are so crowded together that they cannot produce their own food; to the building of cold storage plants where eggs may be kept in good condition for use during the season when hens are not laying; and to the fact that many more people live now without the heavy toil of former days and therefore prefer a lighter diet than that provided by meat.



A Brahma.

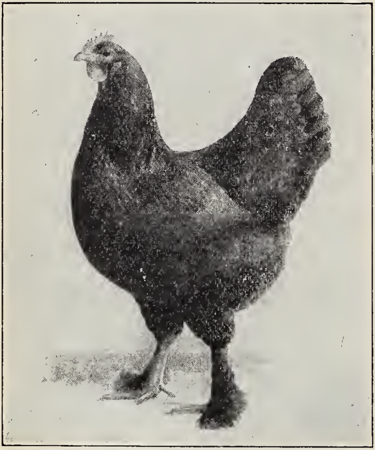
Poultry on the Farm.—Nearly every farmer keeps a few hens. It does not take very much capital to make a beginning in the poultry business, and the returns on the investment come back early. During a large part of the year poultry on farms need very little attention, and will gather much of their food from the fields or barnyard, where it would otherwise go to waste. They provide the farm table with fresh eggs, and the farm wife with grocery or pocket money. The returns which they yield should well repay the farmer for the little extra food or the attention which they may require at certain seasons of the year.

CHICKENS

Types and Classes.—From the jungle fowl two types of poultry evolved. These were the *Asiatics*—large, fleshy, slow, and heavily feathered; and the *Mediterranean* — much smaller, more active, more nervous, and much more lightly feathered. From these two types over one hundred different breeds and varieties have emerged. The breeds are all grouped into four classes: namely, *meat breeds*, *general purpose breeds*, *egg breeds*, and *fancy breeds*.

A Cochin.

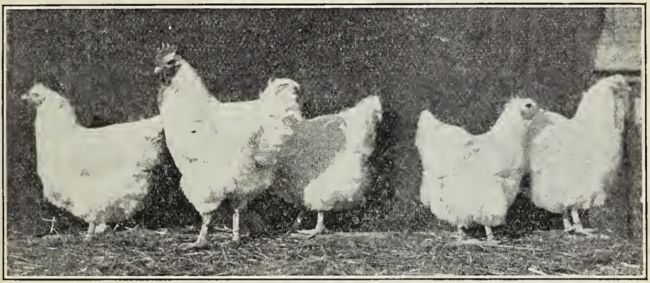
Meat Breeds.—These breeds belong to the Asiatic class. They are large, slow in movement, gentle in disposition, poor foragers, and poor layers. They mature late and are inclined to be broody. The Brahmas, Langshans, and Cochins are the leading representatives of the meat breeds. The *Brahmas*, of which there are two varieties, the *light* and the *dark*, are the largest of the three breeds. They are supposed to have come from the Brahmaputra district in India. They have heavily feathered legs. On account of their size they are much in demand for broiling or roasting. They lay brown eggs. The *Cochins,* of which there are four varieties, the *white, black, partridge,* and *buff,* were first bred in China. They are large hens with loose, open feathering. The *Langshans,* like the Cochins, originated in China. They are better layers than either of the other two breeds, but their meat is not considered so good.



A Langshan.

The term "meat breeds" as applied to poultry is somewhat misleading. They have not been developed for meat in the same sense as have the meat breeds of cattle or sheep. The meat breeds in poultry have been bred with very little attempt to produce meats of finer flavor, or more meat in proportion to bone and offal than in any of the other breeds. In a good table breed the percentage of bone and offal should be relatively small in comparison with the percentage of fine, nicely flavored, edible meat. So long as poultry are sold as they are in the market with head, legs, offal, all included in the weight and price, there will be little incentive to produce fowl of superior table quality. Under present marketing conditions, too, a heavy frame and much bone in comparison with the meat are an advantage, as the weight is thus increased, and the price obtained is better than it otherwise would be. A change in the marketing conditions would soon bring about a change in the meat qualities of marketed fowl. Under present conditions only from fifty to sixty per cent of the weight of a fowl is edible.

General Purpose Breeds.—To this class belong the Plymouth Rocks, the Wyandottes, and the Rhode Island Reds. They are of medium size and are fair layers. There are five varieties of *Plymouth Rocks*, of

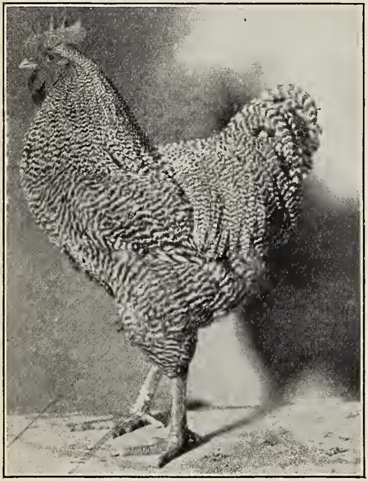


White Plymouth Rocks.

which the *Barred* is the most popular. All are quiet in disposition, and are moderately fair layers. The meat, too, is considered to be of excellent quality. The *Wyandottes* are smaller and more blocky than the Rocks. They produce as many eggs as the Plymouth Rocks, but the eggs are somewhat smaller. The *Rhode Island Reds* lay brown eggs and are good setters and good mothers. They are not quite so heavy as the Rocks, and are longer and less compact than the Wyandottes.

Egg Breeds.—These are smaller than the other breeds considered. The Leghorns and the Minorcas are the most common. The *Leghorns* are white, brown, buff, or black in color. They derive their name from the city of

Leghorn in Italy, and they are frequently spoken of as the Italian fowl. They have long and slender bodies and white ear-lobes. They are unsurpassed as egg layers. The young males make good broilers. The *Minorcas* are usually black or white in color. Their eggs are larger than those of the Leghorns, but they do not lay so many of them. They came originally from the island of Minorca off the coast of Spain and are known as a Spanish breed. The eggs are white and frequently weigh as much as twenty-eight ounces to the dozen. There are two varieties of the blacks; the single comb and the rose comb varieties. The very large combs and wattles of the breed, although they add to its beauty, are somewhat of a disadvantage in this country as they are apt to become frozen in extreme winter weather.


A prize Barred Plymouth Rock.

The good Layers.—There are certain characteristics that usually distinguish the good from the poor layers. It has been found that, on the average, the lighter weights among any breed are the best layers. This does not necessarily mean that the smallest hens of a flock should be constantly selected for the purpose of breeding layers, but it is a warning against the too common practice of selecting the largest hens and heaviest males for this purpose. Usually the good layers have a somewhat long body, fairly broad and deep, showing health and vigor. The head should be small and trim-looking. A hen with a large head, a coarse, dull comb, and a beefy face is not usually a good layer. A muscular or bulky body is not necessary. Good layers are of a nervous temperament, are active, and carry the tail and head well set up. Although tame and friendly, they do not mope about but are constantly on the go.


A White Leghorn.

Egg-laying Capacity.—It is a well-known fact that all the eggs—called at this stage *oocytes*—that she will ever lay, are present in the hen before she commences laying at all. It was long supposed that the greatest number that she could possibly lay was limited to 600. It is now known that the possible number is much greater than that. Actual count has shown that the number of eggs in a hen, which she might lay if she laid them all, would run from 900 to 4,000. Yet no hen has ever laid eggs approaching the latter in number. There are a few records of hens having laid 1,000 eggs. In fact, a hen that lays half that number is considered to be a very good layer. If a hen has the capacity of laying so many eggs, the question naturally arises: Why does she not lay them? Her failure is partly due to the fact that too often she is not provided with suitable conditions, good feeding, proper housing, and sufficient care.

The Hen's best Years.—The vast majority of hens lay most of their eggs during the first two years of their lives. So far as egg laying is concerned, the average hen will not pay for her keep after the second year. This

The world's record pen.

means that, to be profitable, the flock must be renewed every two years. Many hens never lay any eggs after the second year, and it is rare for any hen to lay as many eggs the second year as she does the first.

Eggs

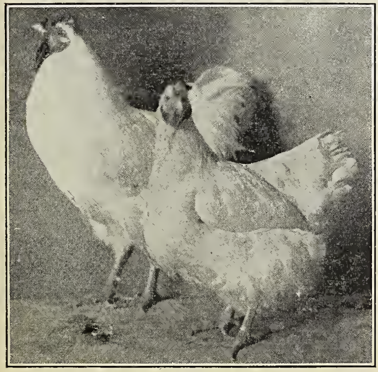
How Eggs differ.—Eggs differ in several ways. The principal differences are in size, color, flavor, and quality. As all of these affect the price, they are important considerations in egg production.

Color.—Some hens lay brown eggs, others white. For instance, the eggs of the Barred Plymouth Rock are


This hen laid 319 eggs in 365 days.

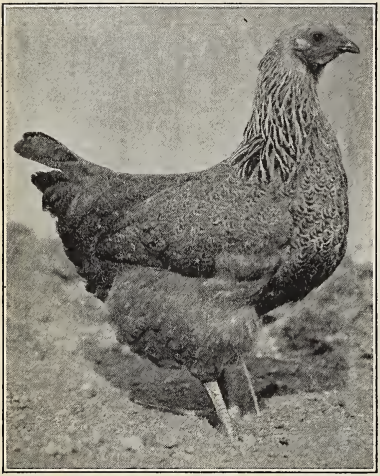
brown, while those of the Leghorn are white. Where crossing of breeds has occurred, there may be a blend of colors. The color does not affect the quality. Some people, however, prefer white eggs, and in certain markets white eggs command a higher price than do brown eggs. In other markets the reverse is true, and the brown eggs are preferred to the white ones. These preferences, however, are only fads.

Flavor.—Flavor is more important than color. Eggs are not all of equally good flavor, even though they are fresh. The food which a hen eats will not greatly affect the flavor unless she is very hungry and eats too much of some particular food. Even then, in some cases it does not affect it very noticeably. The eggs from hens that have fed heavily on beef scraps will be strongly flavored. Onions, too, and fish, if eaten in any considerable quantity, will impart their flavors to the eggs. Clover and alfalfa give to eggs a fine flavor, whereas kale, rape, and cabbages, if


Prize White Wyandottes.

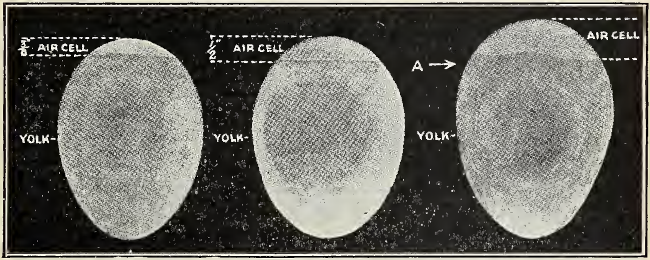
eaten to excess, impart undesirable flavors. If eaten in small or even moderate quantities along with other foods, these strongly flavored foods will not affect the flavor of the eggs.

Size.—Size is another important consideration. Eggs vary so greatly in size that the method of selling by the dozen is manifestly unfair. All eggs should be sold by weight. Though the breed of the fowl and the nature of the hen herself have much to do with the size of the eggs, they are not entirely responsible for it. Feeding has much to do with the size. A hen, if given an abundance of good food and plenty of exercise in the open, will be healthier and will produce larger eggs than will the same hen if she is closely confined and scantily or improperly fed. The aim of the poultry raiser should be to bring the size of the eggs up until he has obtained an average weight of at least two ounces per egg, or twenty-four ounces per dozen. If the hens are healthy and the weight of the eggs falls much below this standard, he should begin to weed out the light-weight producers.



A Silver Pencilled Wyandotte.

Quality.—The quality is the most important consideration in egg production. The percentage of water, protein, fat, and mineral matter in eggs varies scarcely at all, no matter how the hens are fed. Nevertheless, it is a well-known fact that the food which a hen eats does affect the quality of her eggs, and that, if eggs of the highest quality are desired, food of good quality must be supplied. It is not, however, before but after the eggs are laid that quality is likely to suffer most. An egg is a perishable article, and under certain conditions it deteriorates rapidly and soon becomes unfit for food. Also, it deteriorates much more readily if it is a fertile

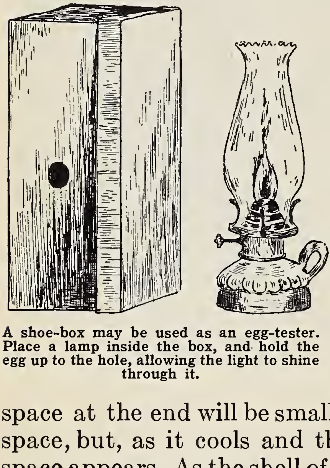


Stages in egg deterioration. Notice the increasing air cell and the darkening of the yolk as the egg becomes older.

egg than it does if it is an infertile one. If the males are kept from the flock during the laying season, so that the eggs will not be fertilized, the keeping quality of the eggs will be vastly improved. while the yield will not be affected in the least.

In the case of fertile eggs it is very easy to start embryo development, and with this the trouble begins. Providing too few nests so that they must be constantly in use, allowing broody hens to remain with the flock, neglecting to gather the eggs regularly or often enough, and leaving the eggs exposed to the sun during the hot summer months are all conditions which help the embryo to develop. Eggs should be gathered every day, and in the summer time twice daily. The nests should be kept clean. When the hen lays the egg, it is pure and clean; but, if her feet are dirty or if the nests are unclean, the eggs are likely to become dirty. Disease germs in the dirt enter the egg through the shell; decay—whether the egg is fertile or infertile—begins, and the quality of the egg is destroyed. Eggs should always be stored away from odors and in a temperature of 43° to 50° Fahrenheit.

Candling.—*Reveals age.*—Candling is a method of finding out the quality of eggs by examining them with the aid of the light of a candle, kerosene lamp, or electric light bulb. The light is placed inside a closed box. Any box that will hold the light will do. A hole, a little smaller than the egg, is cut in the side of the box. If, in a darkened room, the egg is held up to the opening in the box, its condition will be seen. If the egg is fresh and of good quality, it will be transparent, and the air space at the end will be small. A newly-laid egg has no air space, but, as it cools and the contents contract, the air space appears. As the shell of an egg is porous, the moisture contained in the egg evaporates, and the air space becomes larger. The temperature at which the egg has been kept will affect the rate of evaporation and, consequently, the condition of the egg. Evaporation will always be more rapid in a high than in a low temperature. The air



A shoe-box may be used as an egg-tester. Place a lamp inside the box, and hold the egg up to the hole, allowing the light to shine through it.

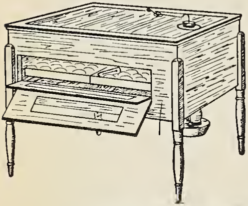
space in a fresh egg will be small; as the egg gets older the space will show larger. The air space thus becomes, in a sense, the measure of an egg's age, and thus of the quality of its contents.

Tests quality.—Candling, however, reveals more than the age of the egg. Heated eggs, in which chick or embryo development has begun, will show slightly darker in the yolk than will normal eggs. If blood rings are evident, there has been considerable development of the embryo. If the contents appear blackish and the air cell is very prominent, hydrogen sulphide gas has formed, and black rot has set in. If the contents appear watery, if the yoke and white are mixed, and if the smell is offensive, the egg is affected with white rot. Mold and spot rot may be seen as dark particles cling to the inside of the shell. Any kind of rot renders the egg unfit for food.

Selection of Eggs for Hatching.—An egg may be fresh, and yet not be fertile. If not fertile, it will not hatch. There is no way of telling whether an egg is fertile or infertile until it has been brooded for several days. If candled, the fertile egg will show dark, and the infertile one will show clear with a little larger air space than in a fresh egg. Hens that have free range produce more fertile eggs than do hens that are kept in close confinement. There is no way of telling whether the egg will hatch a male or a female chick. The shape or appearance of the egg has nothing whatever to do with the sex. Small eggs, too, will hatch as well as large ones.

If, however, it is desired to breed up the flock to the production of larger eggs, then clean, moderately large eggs, smooth of shell and well shaped, should be selected. The eggs of poor layers should not be selected, as such characteristics are likely to reappear in the offspring. It is important that the eggs be fresh, for an egg loses in hatching qualities the longer it is kept. If they must be kept over for some time until the setting is collected, they should be kept in a cool, dry place, and should be turned once a day, great care being taken to handle them only with clean hands.

The Setting Hen.—The Asiatic breeds are the best setters. Leghorns, Minorcas, etc. are not good setters. Hens of gentle disposition should, if possible, be chosen. Setting hens should be provided with all the grain, grit, and green feed that they will eat. Water, too, should be available. If the setters are confined in nests, they should be let out for about fifteen minutes each day to eat and drink. They should be treated for and kept free from lice during the incubation period. Insect powder should be dusted into the feathers, making sure that it goes to the roots. If the nest becomes infested, put in a spoonful of the insect powder or a moth ball. A dust bath should be provided in the run or chicken-yard.



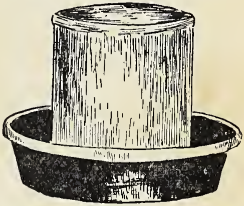
—Courtesy H. C. Andrews
An incubator.

The nests may be made in the poultry house, in coops, or in some unused building, and may be either on the ground or set up. Fine waste hay, short cut straw, or clean chaff, several inches deep, makes a good bottom for the nest. About thirteen eggs is quite enough to put into the nest for a setting. Coops with separate apartments, nests, and runs for each hen can easily be provided, and they save much labor in caring for the setters. If feed and water is kept before them, the hens can then leave and return to the nests at will, and the runs provide opportunity for dusting and exercise. The period of incubation for a hen is twenty-one days.

Artificial Incubation.—When *artificial incubation* is resorted to and incubators are used, it is well to follow carefully the instructions of the manufacturer. Even then, it requires great care and much experience to obtain the best results from the incubator. A little thoughtlessness, carelessness, poor judgment, or inattention is likely to undo everything. It would be useless to give detailed directions here for the use of an incubator, not only be-because full and detailed instructions accompany each but also because the machines themselves are made and operated differently.

Feeding and Care

Feeding and Care of Young Chickens.—After the chickens are hatched, they should be placed in a clean and well ventilated coop. The coop should be placed where the mother and her chicks may have plenty of room to move about. After the first day the chickens may be fed three times a day. A dry mash of bread crumbs, rolled oats, bran, linseed meal, etc., with some meat scrap, boiled egg, and skimmed milk, makes a good ration for the first five days. But, in addition, they should be fed fine grit, charcoal, cracked bone, green feed, and water. After five days, grain twice a day in litter and moist mash may take the place of the dry mash. After six weeks, on the range, they may be fed grain, dry mash, and beef scrap, with green feed, cracked bone, and grit. Water should always be available.


An improvised water fount. Hens require access to plenty of clean, fresh water.

Feeding the Hens.—There are some hens that will not lay many eggs, no matter how they are fed; they are not bred to lay, and they have not inherited the ability to lay. On the other hand, there are hens that have the breeding and the capacity to lay and will not lay simply because they are not well fed. A hen must not only have plenty of food, but she must also have food of the right kind. If she is allowed to run at large, and the kind of food which she requires is available, she will usually succeed in procuring enough of the kind that she needs. But if she is confined, she has no choice and has to depend on what her master gives her. If the hen cannot get in sufficient quantity the kinds of materials which are necessary for making eggs, it is impossible for her to make eggs. There is no cereal—wheat, barley, oats, corn, peas, or any other—that contains the materials required in the right proportions to make eggs. No hen can maintain herself in health and vigor and continue to produce eggs on wheat alone, no matter how abundant the supply. She must have a balanced ration, that is, a mixture of different kinds of foods composed of the necessary substances in different proportions.

Shell, bone, and grit.—What are the substances required to enable the hen to meet the needs of her own body and to produce eggs? Mineral matter is one of them. A hen cannot eat enough grain to give her more than half enough of the mineral matter that she requires. Hence, high egg production is impossible if she is fed on grains alone. The mineral matter in the hen's body is mainly calcium phosphate, and the food most easily obtainable for furnishing that mineral is ground bone. This mineral food is recommended for growing chicks that have to build up bone as they grow. The shell of an egg is chiefly carbonate of lime or calcium carbonate, and for supplying this mineral there is nothing better than ground oyster shells. They dissolve readily in the gizzard. Charcoal is a bowel regulator, and salt aids digestion; hence both should be supplied. Grit, in the form of fine gravel or sand, should be available to the hens at all times.

Animal foods.—It is supposed by many that the hen is a grain or seed eater only. This is not so. The hen is a meat eater as well, and must be supplied with some form of animal food to keep her in health and enable her to produce meat and eggs. When left to herself and free to range the fields, she will find the animal food that she requires—bugs, worms, grasshoppers, etc. are all a part of her animal diet. When the snow is on the ground, or when she is confined as in the winter months, she cannot gather her own animal food, and it must be supplied by the poultryman. Providing the hen with a liberal supply of meat has done more to increase the poultryman's profits than anything else in poultry feeding. Fresh, lean meat is the best form in which the necessary animal food can be supplied. Some fat along with it is not an objection, although it is the lean meat, because of the protein in it, that is most required. Fresh, cheap cuts of meat, with scraps of cut or ground bone, can readily be obtained from the butcher shop and cannot be surpassed for egg-making. If many fowl are kept, it pays to buy a bone-cutter and cut the meat and bone into scraps. The fowl eat this food greedily, and will soon pay for the bone-cutter in increased egg production.

Green feed.—Another food that fowl require is green feed. If the hen has no green feed, the poultryman will get few eggs. The lack of green feed is in large measure responsible for the scarcity of eggs in the winter months. The farmer who wishes to get a goodly supply of eggs during the winter will see to it that his fowl are provided with the same variety and kinds of food that they have in the summer months. Green feed is one of these. Alfalfa, clover, peavine, or vetch leaves, taken from the mow or haystack, make good green feed. So also do the leaves of many of the vegetables: turnips, lettuce, cabbage, mangels, beets, and kale. Sprouted oats are excellent for winter green feed and are greatly relished. It is only when the hen is starved for green feed and eats of some of these, such as kale, cabbages, or rape, to excess that the flavor of the eggs will be affected. All of these green feeds contain a greater percentage of mineral matter than do the grains, and this is precisely what the laying hen requires.

Other feeds.—To complete its ration, the hen needs in addition to the foregoing: grains of all kinds, ground or unground; vegetables, cooked or uncooked; mashes, wet or dry; milk, skimmed or unskimmed, or buttermilk; and water.

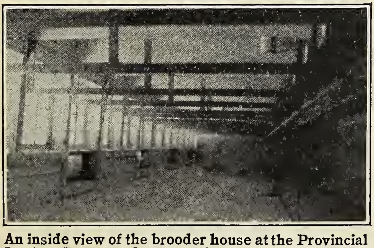
Housing and Care.—The conditions under which poultry are kept, and their surroundings, have much to do with egg yield. The kind of house that they have to live in, the size of the range, the character of the soil (whether favorable or unfavorable for scratching), the climate, freedom from frightening noises, as well as the size of the flock, all help to fix the returns from hens.

Of all our domestic animals the hen is the most sensitive to her surroundings. A stranger going into the poultry house, a stray dog running in among the flock, or even a change of yard or house will result in a decrease in the number of eggs.

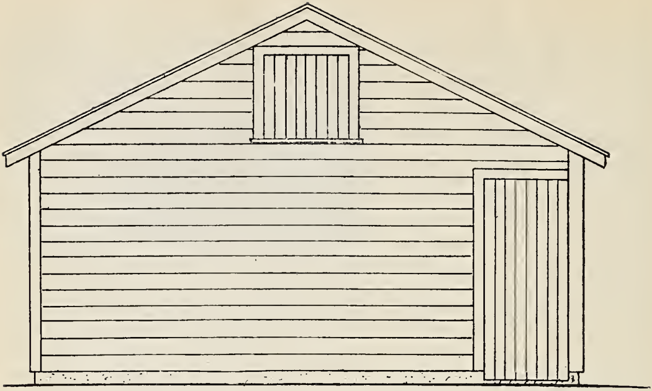
Warmth not the first consideration.—A tree was the hens original henhouse, and it is by no means the worst henhouse that was ever built. It was long supposed that warmth was the first consideration in building a henhouse. Houses were therefore built of logs, boards, and even bricks or cement, and were sometimes double boarded and lined with sheeting paper to make them close and warm. A few houses were built on the hothouse plan, with plenty of windows to admit the sun. As these were costly experiments and did not produce the desired results, poultrymen have come to realize that such houses are not the best kind for hens.

An outside view of a fifty-foot brooder house on the Provincial Poultry Plant at Oliver, Alberta. The small narrow runs are made with portable fencing. The fencing is taken down in the late summer, and the ground is dug up and sown to fall rye. In the spring the thickly sown rye provides tender green stuff for the earliest chicks. When the chicks are two or three weeks old, the small runs are opened up, and the chicks are given access to much larger grass runs.

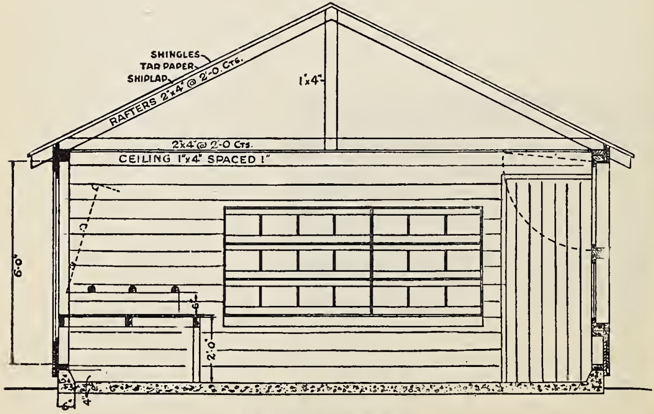
Ventilation more important.—More important to a hen than a heated house is a dry, well-ventilated one. If allowed to choose between one of these elaborately constructed houses and some rickety, open old shed to roost in, she will choose the shed. But in preference to either of these, she will choose a tree, feeling the need of pure air. In fact, in proportion to her weight, she requires more than twice the amount of oxygen needed by a man, a



An inside view of the brooder house at the Provincial Poultry Plant at Oliver. The brooder on the left is divided into sections and is heated by a continuous hot-water pipe underneath, extending from a coal-burning stove beyond the partition at the end of the house. The piping is encased in lumber, and from the encasement the heated air is conveyed up into each chamber of the brooder. An inside run for the chicks corresponds with each outside run and each section of the brooder.

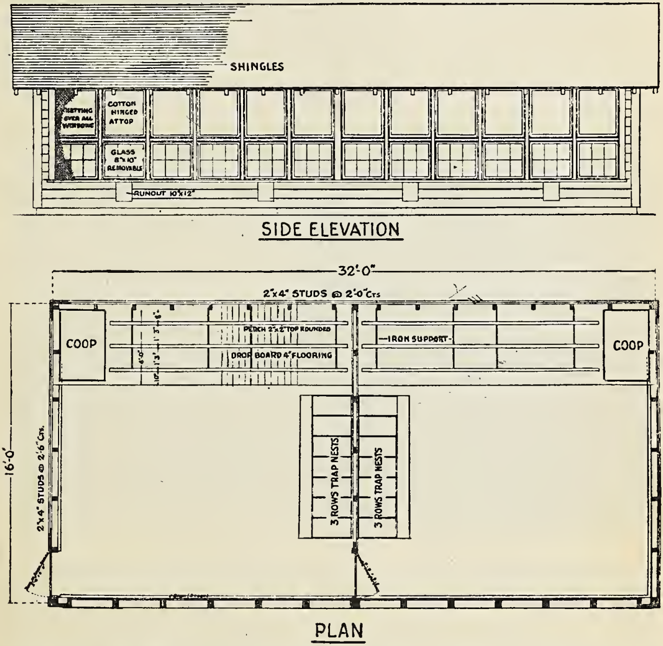


The end elevation of a henhouse.



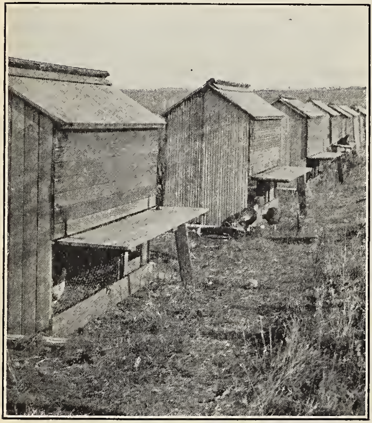
A section of a henhouse.

horse, or a cow. Close and stuffy poultry houses are injurious to the health of the fowl; and the first consideration for egg production, whether in summer or in winter, is to keep the hens in the best of health. Egg pro-



duction depends greatly upon the vigor, activity, and good health of the hens.

Construction of a suitable house.—Houses for poultry to-day are usually built with either an end or a side wholly or partly open. A wire mesh may cover the opening in order to give protection from night prowlers. In such a house the hens roost practically in the open air. Where the temperature does not go below zero, they thrive better and lay better in the open air than if more closely and warmly confined. Where the temperature is no lower than zero, the minimum of open space should be about one-half square foot per fowl, or twenty square feet for a house containing fifty fowl. Where the temperature goes lower, the curtain front is frequently used. In such houses, instead of the front being open, it has a curtain of muslin, canvas, or burlap, which may be closed when the temperature goes very low. During the winter the curtain is usually closed at night. Some poultrymen keep it closed all the time in winter, while others keep opening or closing it according to the temperature. This is troublesome, and the curtain is too frequently closed when it should be open and open when it should be closed. Many prefer the adjustable open front. With this front the size of the opening may be regulated according to the temperature. When it becomes extremely cold, the opening is decreased to about one-fourth its regular size. The most important consideration in building a henhouse, however, is the provision for an abundance of fresh air.



Housing young chicks.

TURKEYS, DUCKS, AND GEESE

Turkeys.—Raising turkeys has proved to be a highly profitable industry on western farms. Because of the light soil and unlimited range, they do especially well in the open prairie sections.

Breeds.—There are two breeds of turkeys commonly raised in the west. The *Bronze* is a large breed. It is bronze in color on the neck, back, and breast, and the wings are barred with black and white. The *White*

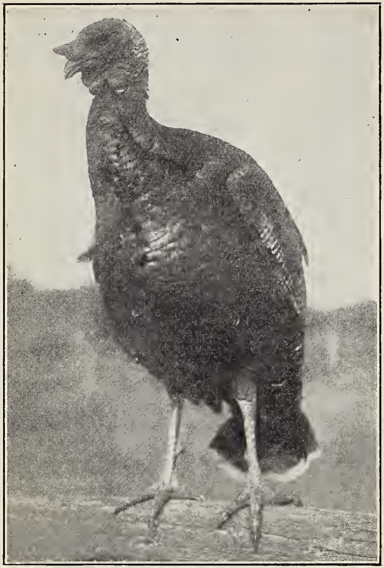
A model henhouse.

Holland is a smaller breed with a pure white plumage. The bronze is the more widely raised and by far the more popular breed.

Laying.—Turkeys prefer to lay in a concealed place. Boxes or barrels may be provided as nesting places, and, in order to prevent eggs being lost or destroyed, one nest should be provided for each fowl. After a turkey hen has laid from twenty-five to thirty eggs, she usually becomes broody.

Incubation.—The incubation period for turkeys is twenty-eight days. While setting, the turkey hen requires clean food, fresh water, and a chance to exercise herself.

Care of young.—Turkeys are delicate for the first few weeks. Shortly after they are hatched, the young turkeys should be placed, along with the mother, in a pen. No food should be given to them until they are two days old. The third day they may be given fine grit and sour milk. The following day they may be fed hard-boiled egg and bread crumbs. This diet should be continued for a week. Rolled oats and sour milk may be fed during the second week, and afterwards wheat may be given. Over-feeding must be avoided. After the second week the young turkeys will gather some food on the range and need be fed only twice a day. When a month old, they feed at large upon various insects and are thus of additional value to the farmer.



A Bronze turkey.

Turkeys need clean pens and clean food. Dampness is almost certain to kill young turkeys. Particular care is necessary to protect them against exposure.

Fattening.—It requires about three weeks in the fall to fatten the turkeys for market. Feeding should be begun gradually. Moist mash, consisting of ground grain moistened with sour milk, should be given in the morning and at noon, and whole grain, wheat, barley, corn, or oats at night. It is best not to confine the birds during this period, but roosting places which are free from draught should be provided.

A White Holland.

Ducks.—The principal breeds of ducks raised in the Prairie Provinces are the *Pekin*, *Aylesbury*, *Rouen*, and *Indian Runner*. As in the case of turkeys, young ducklings should not be fed until the third day. The first food should be stale bread soaked in milk. After several days a mash, soft but not sloppy, may be given. Cooked roots and vegetables are good. Ducks should not be allowed to swim until two weeks old. After the fourth week they may be given their liberty. Ducks require plenty of good water to drink.

In handling ducks care must be taken not to pick them up by the legs, as the legs are easily broken. They should always be picked up by the neck.

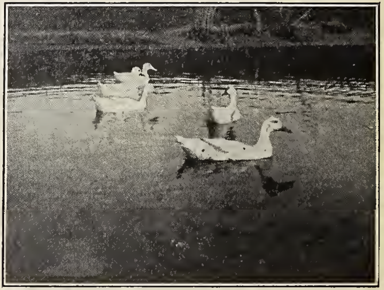
Fattening.—Ducks should be fattened for two weeks before killing. The ration should consist of equal parts of ground wheat, oats, and barley, with the addition of a small quantity of meat, meal, and cooked vegetables.


There are more ways than one of raising ducks.

Geese.—Geese subsist largely upon grass and so are profitable to raise where there is pasture and free range.

Breeds.—The most popular breeds are the Toulouse, Embden, and African. The *Toulouse*, the largest of the three, is gray on all parts of the body, except the belly, which is white. Its bill is yellowish. The *Embden* is pure white. The *African* is light gray, with a black bill which has a distinctive black knob at the base.

Care.—Many farmers find that the eggs can be most successfully hatched under a hen. Great care must be taken to protect young goslings against the cold and rain. After the second day stale bread soaked in milk, along with chopped boiled eggs, may be given the young goslings. In a few days they may be left to gather food for themselves, but, if rapid growth is desired, they should be fed wheat, bran, corn meal, and scraps. Geese require shade, shelter, pure water, and plenty of grass. They also need a good range to provide exercise.


Ducks and geese require a pond.

The feathers of ducks and geese are valuable for pillows and cushion fillings.

Questions, Problems, and Exercises

1. Visit poultry men and learn to distinguish the different types and breeds of chickens.
2. Visit the market or talk with egg producers or buyers to find out: (1) how eggs are classified; (2) how eggs are graded.

Key for Identification of Breeds of Chickens †

Type	Class	Breed	Ear-lobes	Legs and Feet	Comb	Color of Eggs	Remarks
Utility type. All clean-legged.	American	Plymouth Rocks	Red	Yellow	Single	Brown	Sitters
		Wyandottes	Red	Yellow	Rose	Brown	Sitters
		Rhode Island Reds	Red	Yellow	Rose or single	Brown	Sitters
	English	Orpingtons	Red	Light or dark	Single	Brown	Sitters
		*Cornish	Red	Yellow	Pea	Brown	Sitters
Egg type. All clean-legged.	Mediterranean	Leghorns	White	Yellow	Rose or single	White	Non-sitters
		Minorcas	White	Light or dark	Rose or single	White	Non-sitters
		Anconas	White	Yellow and black (mottled)	Single	White	Non-sitters
	Dutch	Hamburgs	White	Light or dark	Rose	White	Non-sitters
Meat type. All feathered legs.	Asiatic	Brahmas	Red	Yellow	Pea	Brown	Sitters
		Cochins	Red	Yellow	Single	Brown	Sitters
		Langshans	Red	Light or dark	Single	Brown	Sitters

*As yet no heavy egg-producing strain of this breed has been developed.

†From *Extension Bulletin No. 48, Manitoba*, by M. C. Herner.

Culling Charts *

Good layers have		Poor layers have
white	Legs	yellow
large deep soft thin skin	Abdomen	small shallow hard thick skin
large bright waxy plump	Comb	small dull dry shrivelled
fine lean clean cut	Head	coarse fat wrinkled
bright full bulging large oval	Eye	dull sunken flat small round
faded	Eye-ring	yellow
pale	Beak	yellow
white	Ear-lobe	yellow
thin fine loose	Skin	thick coarse tight

*From *Extension Bulletin No. 63, Manitoba*, by M. C. Herner.

CHAPTER XXI

DAIRYING

Economic Importance.—The economic importance of dairying is best understood when we consider the returns obtained from the cow in relation to the food that she consumes and to the labor involved in caring for her. Plants make food, but much of it cannot be used as food for man until it has been changed into some other form. A few animals, such as the horse or mule, are kept for work, but most domestic animals are kept because of their power to change food materials from one form into another. Man can use some of the grains, fruits, roots, stalks, and leaves of plants directly. It is estimated that about twenty-five per cent can be used in this way. But the remaining seventy-five per cent, consisting largely of leaves, stalks, grasses, hays, cobs, and straws, he cannot use directly at all. He prefers to have some of the grains which he might use directly changed first into other forms. Cattle change such plant foods into beef; hogs change them into pork; sheep into mutton; poultry into meat and eggs; and dairy cattle into milk, from which can be obtained other food products, namely, butter and cheese.

Of all domestic animals kept for the purpose of changing rough foods into food suitable for man's use, none is the equal of the dairy cow. In this respect she stands easily first. In feeding to stock what is grown on the farm, the greatest profit can be obtained from the dairy cow. The dairy cow has this further in her favor—the returns from her products are regular and constant.

In the case of the meat-producing animals, it is not until the animal itself is made ready for the market and sold that there is any money return. But, whether it is

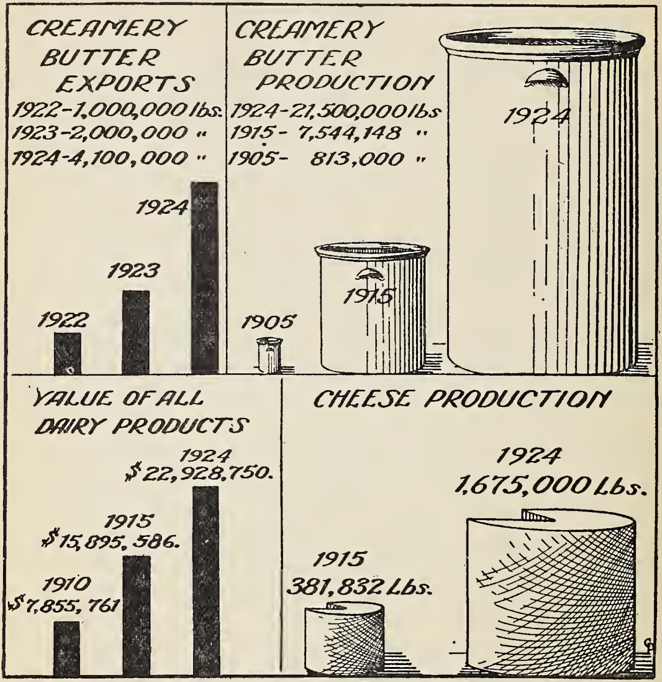
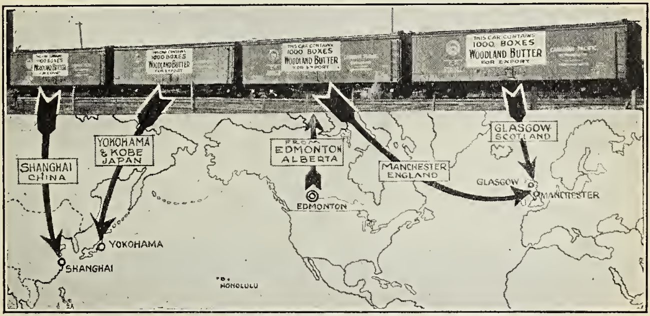


Diagram showing how milk products have increased in Alberta.

through the sale of the milk, the cream, or the butter, the money returns from the dairy cow come in at regular intervals. She is, moreover, with the possible exception of poultry, the only animal kept on the farm that will begin giving returns for her food within twenty-four hours after it has been eaten.

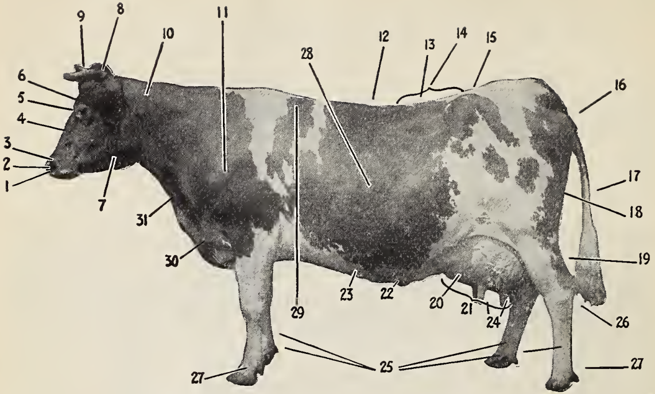
Returns.—If the dairy cattle are well bred, are heavy milkers, and are under efficient management, the returns will divide almost evenly in three directions: one-third going for feed; one-third for labor; and one-third for profit. The further the owner gets away from a high standard of efficiency in the cow and her management, the smaller do his profits become, until finally they



Alberta dairy products are shipped to all parts of the world.

disappear altogether; then the returns for labor diminish until they disappear. In fact, it is possible to get cows of such low milk-producing quality that the returns from them do not even pay for the food that they eat, to say nothing of profit or compensation for the labor.

Selecting and breeding the Dairy Cow.—To emphasize further the effect of breeding, compare the milk and butter yield of the average farm cow with that of some of the leaders among the high class dairy breeds as shown in the table on page 279. These are high records, although not the highest that have been made by certain individual cows of each breed. The records are for one year.



POINTS TO LOOK FOR IN A GOOD DAIRY COW

1. Nostril; large, clear, open.
2. Muzzle; broad, lips strong.
3. Nose; moderately short and broad.
4. Face; slightly dished.
5. Eyes; clear, full, mild, and wide apart.
6. Forehead; broad, full.
7. Jaw; strong, with deep cheeks, well muscled (inner skin yellowish).
8. Ears; thin, pointed, medium in size, fine hair outside, at edge longer.
9. Horns, if present; fine in quality, not coarse and shelly, waxy color.
10. Neck; long, thin, muscular; not short and thick as in beef type.
11. Shoulders; prominent, sharp, coming together at top, not meaty or coarse.
12. Back; either sway or slightly depressed, or else fairly straight and strong.
13. Backbone; large, vertebrae well spaced.
14. Loin; broad, strong, level.
15. Hip bones; broad, prominent.
16. Pin bones; far apart, prominent.
17. Tail; long, refined, not coarse, tapering, heavy brush.
18. Thighs; straight or incurving, not thick, but muscular, inside curved.
19. Rear udder; high, well supported.
20. Fore udder; coming well forward.
21. Udder; elastic soft skin, not meaty, hair fine.
22. Milk veins; large, crooked, elastic.
23. Milk wells; large.
24. Teats; of ample size, long, well spaced, cylindrical.
25. Legs; below hocks and knee smooth and refined.
26. Hocks; standing square turning neither in nor out.
27. Pasterns; upright and strong.
28. Ribs; long, well spaced, moderately arched, not short and flat.
29. Heart girth; deep, wide at bottom.
30. Breast; moderate width, with brisket rather narrow and sharp.
31. Throat; clean, not full.

		Produced in one year
Jersey	Milk, 17,500 lbs.	Butter, 1,200 lbs.
Guernsey	Milk, 20,000 lbs.	Butter, 1,253 lbs.
Ayrshire	Milk, 22,500 lbs.	Butter, 1,036 lbs.
Holstein	Milk, 27,000 lbs.	Butter, 1,250 lbs.

Twelve hundred pounds of butter sold at forty cents per pound would mean a return of $480 in a single year. The butter yield from many farm cows does not average

Dairy barns and cattle at the University of Alberta Farm.

more than fifty or a hundred pounds per year; in many instances not even that much. The price of pure bred stock, especially of stock of such quality as that indicated above, is so high that even well-to-do farmers cannot afford to buy such animals.

The average farmer must be content with making the best of what he has. He can improve the breed by selecting, year after year, the best milkers of the herd as mothers of the next generation, and by exercising judgment and care in choosing a sire.

Importance of a good sire.—A good sire should be masculine in appearance. He should be true to his breed type. This means that the characteristic points of the breed which he represents should stand out conspicuously. He should show alertness and thriftiness, and should possess a strong, vigorous constitution. The record of his ancestors should be investigated—was his mother a good milker? was her mother a good milker? and so on back through the line from which he came. If so, then it is very probable that he will pass on to his daughters the high milking qualities of his mother, grandmother, and other maternal ancestors. Such a sire can frequently be bought at a fairly reasonable price. He may have some slight defect which does not in the least prevent him from being an excellent sire for the herd, but which, none the less, prevents his registration among the pure breds of his breed.

Care for Milk Production.—The treatment and care given to the cattle has much to do with the success or failure of the undertaking. Like all other stock, the dairy cow responds to good treatment and more or less resents harsh or cruel treatment. The various breeds differ to some extent in this respect, and so, too, do individuals of the same breed or herd. The Jersey is sensitive and affectionate; so much so that a Jersey cow which was a complete failure in the hands of an abusive, rough, and boisterous owner, when sold to another, who understood her nature and treated her kindly, turned out to be one of the most profitable of all the herd.

The Holstein, on the other hand, though she appreciates kind treatment, is not so resentful as the Jersey if she does not get it. She is more cold blooded, quiet, and easy to handle, and neither her feelings nor her hide are so easily wounded as those of the Jersey. The Ayrshire is probably the most headstrong and contrary of any of the dairy breeds. She is inclined to retaliate if abused; in fact, rough treatment has been known to make some of these cows positively vicious.

The peculiarities of disposition are not confined to pure bred cattle. They can be found among the cows

A Holstein herd in the pasture.

of almost any herd and should be taken into consideration in handling them. It is senseless to abuse a cow because she chances to inherit from her ancestors a disposition different from that of some other cow. Moreover, abuse of stock always means a direct loss in dollars and cents.

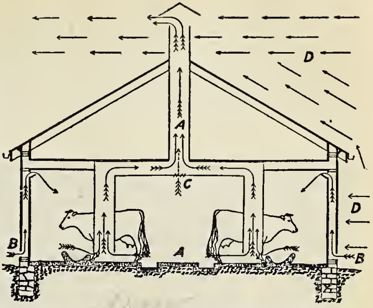
The milking should be done twice daily, at the same hours, and, if possible, by the same person each day. The milking should be begun slowly; for at the beginning, and occasionally during the milking, sharp pains will shoot through the udder, and the cow may jump or kick.

Rough handling, or abuse, at such times is unnecessary; it serves only to spoil the animal and make her worse. A young heifer is naturally more or less nervous at first, and only kind treatment will make her quiet and submissive during the milking.

As is well known, cows require a rest from milk-giving during a portion of the year. The period during which the cow is *dry* will vary somewhat with individual cows, but should be at least from four to six weeks. If the cow has a tendency to continue giving milk, she may be dried off by withholding the grain and feeding her roughage only. Also, leaving a little milk in the udder at each time of milking, and after a time reducing the milking to once a day, will tend to dry up the cow. During the rest or dry period she should be well fed, so as to fit her for the next strenuous period of milk-giving. If she is dry during the summer, she should, if possible, be put on good pasture. If the pasture is short or scarce, then green feed and a grain ration should be given. It will lessen the danger of milk fever developing later, if the grain ration is stopped a week or so before the cow freshens. In the winter time the cow should have a fair percentage of succulent feed and abundance of water.

Insufficient provision for lighting and ventilation.

The Dairy Barn.—*Location.*—The dairy barn should be located convenient to other buildings, such as the straw shed, granary, hay mow, and silo, since it will often be necessary to go from one to the other. For sanitary reasons, and because of odors and flies, none of these buildings should be too close to the house. The best site for a dairy barn is a side hill with a southern or western slope. As there is so much trampling around the barn, it should be so located that it will have natural drainage, as no system of artificial drainage will wholly remove the water and keep the place quite dry.



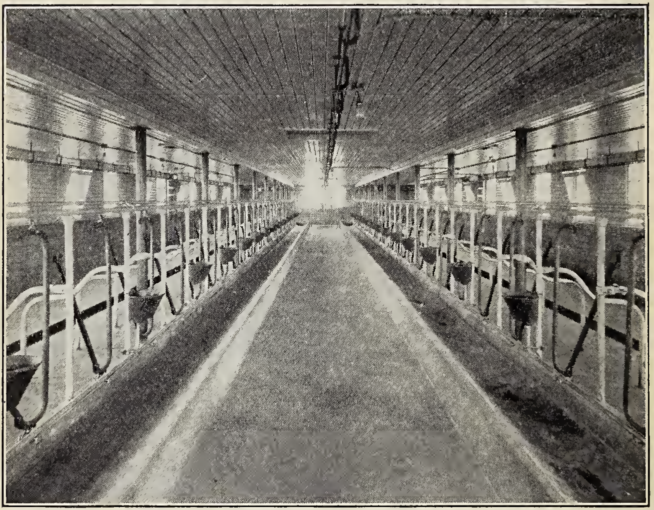
A section of a dairy stable showing the action of the wind at D D, forcing air into the stable by direct pressure at B B and out of it by suction at the top of the ventilating shaft A A. At C is a ceiling register in the ventilating shaft, to be opened only when the stable is too warm or when the draft is too feeble. (From "Ventilation for Dwellings, Rural Schools, and Stables," by F. H. King.)

Size.—The size of the barn will depend upon the number of stock to be kept in it. In planning it, fifty square feet should be allowed for each cow. This provides ample stall space and alley and passage ways. As each animal should have 450 cubic feet of air space, the ceiling should be at least nine feet high. This height of ceiling makes it possible to light the building properly.


This barn has abundance of light and is well ventilated.

Lighting.—The barn should have not less than six square feet of glass per cow. Light is cheap; it costs only the price of the glass to let it in;

and, as there is no better disinfectant and germ destroyer than light, buildings where animals are housed should be built so that their interiors may be flooded with sunshine. There should be plenty of windows along the walls. They should be high, hinged



The interior of a modern dairy barn.

at the bottom, and made to open on the inside at the top. In this way the wind is carried upward and does not strike directly on the cattle.

Ventilation.—If the stable is built close and warm, it must be provided with a special system of ventilation. Abundance of pure, fresh air is absolutely necessary. Close, damp, unventilated stables, with low ceilings and dark interiors, are, without doubt the principal causes of tuberculosis among dairy cattle. Yet the stable must not be too cold; a temperature of 60° Fahrenheit is considered about right. If it falls much below this, the cow must be provided with extra feed to keep up her body temperature; if it rises too high, she loses her appetite. Fresh air should be admitted through inlets in the wall near the floor. The size of these inlets should be regulated according to the weather. From eight to ten square inches of inlet is necessary for each animal. Two inlets, seven inches by eight inches, should suffice for ten or a dozen cows. There should be a tin shield on the inside to direct the incoming air upwards.

The air within the stable is constantly being poisoned. Moisture, particles of body tissue, ammonia, marsh gas, and carbon dioxide, that are always being poured into it, soon render it foul and unfit to breathe. These must be drawn off, and the best place to do this is near the ceiling. The outlets should be not less than fifteen inches square. They should be strongly made and should extend straight up through the roof of the barn and above the ridge. About twenty square inches per animal should be provided for in their construction. They should be located near the animals' heads and should be topped with cupulos to keep out the rain and snow. Of course, when the weather permits, the windows, too, should be opened.

Winter Dairying.—For winter dairying the cows are made to freshen in the fall rather than in the spring, so that the heavy flow of milk comes in the winter rather than in the summer months. This practice has a good many advantages. For one thing, in any case the cows have to be kept, fed, and attended to throughout the winter months, and it reduces considerably the cost of keeping them if they are giving milk.

The cow that freshens in the fall will, if well fed and properly housed and attended to, produce her greatest flow of milk during the winter, and, as the spring comes on, will naturally begin to slacken off. Then she is turned out on the grass, which again increases the flow of milk. The yearly production is thus much greater than when the cow is made to freshen in the spring, because in the latter case the change from the grass to the stable has the effect of retarding rather than stimulating the already slackening flow.

Moreover, in the winter the price of milk and milk products is higher than in summer, and, as the temperature is lower, they are more easily kept in prime condition. Labor, too, is more abundant, and wages are not so high in winter as in summer. Winter dairying also makes it possible to retain the summer help on the farm the year round. This works to the advantage of both employer and employee.

Feeding.—Feeding is one of the biggest problems in connection with dairying. It is one thing to feed an animal; it is quite a different thing to feed it scientifically. Scientific feeding requires study and experience, and it is difficult to understand and apply. There are, however, a few general principles to be followed. The feed should be palatable, that is, it should be such that the cow will like it; it should be succulent, that is, wholesome and juicy like the food of the pasture; and the ration should be properly balanced. Green grass is one of the most palatable and succulent of all foods for stock. Foods that may be supplied as a substitute for green grass during the winter months are turnips, potatoes, mangels, and silage. These are tasty foods; the cattle like their flavors, and their consumption aids digestion.

Balancing the ration requires study and care. The quantity of roughage, that is hay, straw, fodder, or silage, must be governed by the size of the cow; the grain fed must be in proportion to the quality and quantity of the milk produced. Speaking generally, the hay required will be two pounds per day for every hundred pounds of body weight. If silage is fed instead of hay, there will, owing to the greater proportion of water in the silage, have to be three pounds of silage in place of each pound of hay. That is, a cow weighing 1,000 pounds will require twenty pounds of hay; or, feeding less hay, ten pounds of hay and thirty pounds of silage. The grain ration is more difficult to understand and determine and requires considerable study. A general rule that will serve fairly well is to make a mixture of three or four different kinds of grain, and feed, in addition to the fodder, one pound of the mixture to every three to four pounds of the milk produced, depending upon the size of the animal and the richness of the milk.

Raising the dairy calf.

Raising the Dairy Calf.—*First three days.*—During the first three days the calf should be allowed to run with and suckle the mother. No other milk can take the place of that of the mother at this particular time—in quantity, quality, and temperature it is precisely what is required for the calf's digestive system.

First three weeks.—At the end of three days the calf may be taken from the mother and should be put where she cannot see it, in a place that is perfectly dry and clean. It should be taught to drink and should be fed three times a day, at regular intervals, on good, clean, wholesome, unskimmed milk. The milk should be warmed. From a quart to a quart and a half is sufficient at each feed. In no circumstances must the calf be fed cold milk, overfed, or fed out of a dirty pail.

This Alberta girl won first prize with her dairy calf at the Edmonton Spring Show in 1927.

These, together with keeping it in a damp, dirty place, give it scours, a disease that is fatal to calves of this age.

From three weeks to six months.—At the end of three weeks a little skimmed milk may be substituted for the whole milk. The proportion of skimmed milk should be increased gradually, until at the end of six weeks and from then on the calf is getting skimmed milk alone. The quantity may also be increased gradually until two or three quarts of milk are given at a feed. To take the place of the fat which skimmed milk lacks, a little flax-seed meal, boiled into a porridge, should be added to the milk. Beginning with a tablespoonful, the amount should be increased gradually, until at the end of two and a half or three months a cupful of meal is being added. Beginning also at the end of three weeks and continuing, a little chop—equal parts of oats and bran with a small amount of oil meal—should be fed. Clean, fresh, green hay or grass should now be kept before the calf at all times.

From six months on.—After six months the milk may be discontinued, but plenty of good food, along the lines suggested, is necessary to promote growth. The calf may be turned out on fall rye or some other suitable good pasture to gather part of its food, but it should be protected from flies and excessive heat. It should not be bred until two and a half or three years old.

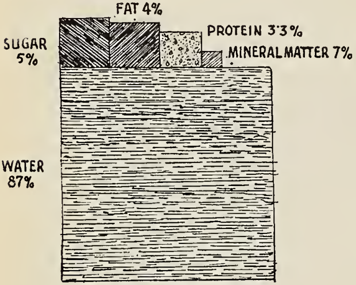
Questions, Problems, and Exercises

1. Certain farm animals are kept for the work that they do in changing rough foods into products required by man. Name these animals and explain their value in this respect.
2. In what respects is the dairy cow superior to all other animals of this class?
3. Discuss the time, care, and attention necessary in successful dairying.
4. Discuss the importance of breeding in the dairy cow. Find out the records of some champion dairy cows in yearly production of milk and butter. Compare these with the average farm cow.
5. What are some of the advantages of winter dairying?

CHAPTER XXII

MILK

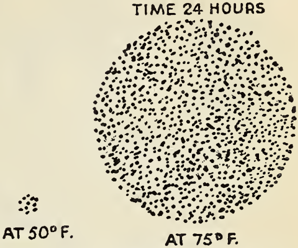
Composition of Milk.—Milk is one of the most important of all foods. It is the one food which for a time provides all that is needed for the young of all animals, including man. It is possible to live on milk alone, because it has in it ash for the bones, protein for the muscles, fats and sugar to supply energy, and water to slake thirst. Its composition and the proportions in which the various substances are found in it are as follows:



The composition of milk.

Water	87	pounds
Fat	4	"
Carbohydrates (sugar)	5	"
Protein (casein and albumen)	3.3	"
Mineral matter (ash)	.7	"
Total	100	pounds

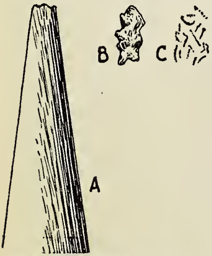
Of all these substances, fat is considered commercially the most valuable. The percentage of it in milk varies more than that of any of the other substances. Some cattle, such as the Jerseys, produce milk naturally rich in butterfat. Others produce milk that is naturally poor in butterfat. In fact, the butterfat may vary from two and a half per cent all the way up to seven per cent, depending upon the breed of the cow. Then, too, the last part of the milk drawn from a cow at a milking is richer than the first; and the milk that she gives as she approaches the drying-up period is richer than that given previously.



The effect of temperature on the rate of growth of bacteria. Time—24 hours.

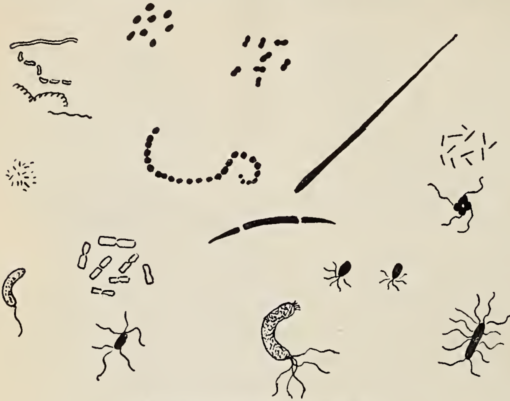
The fat found in the milk is in the form of little globules or drops of oil. In each of these globules there are at least ten different kinds of oils. The kind of food which the cow eats will affect the proportions in which these various oils are found in the globules. When, for instance, the cow is getting much green food, such as grass, the percentage of olein, one of the oils, will be increased, and the butter will be soft.

The size of the globules also varies considerably. Some are so small that it takes 20,000 of them to make an inch, while others are so large that 3,000 of them will make an inch. The feed has something to do with the size of the globules, but not all. The breed of the cow, and even the individual cow herself, has much more to do with it. Large globules separate from the milk more easily than do small ones, and cream composed of large globules of fat is much more easily and quickly churned than is cream composed of small fat globules.



The comparative sizes of: A, the point of a fine needle; B, a bit of dust; C, bacteria.

The protein of milk is in the forms of casein and albumen. Casein may be seen as curds when milk becomes sour, and albumen as a scum when milk is heated. The fat globules, being light, rise to the top and form the cream, which is removed when the milk is skimmed, but most of the casein and the albumen remain in the skimmed milk. Casein is the substance in milk from which cheese is made. About one-third of common cheese is casein. After the casein has been removed, the milk sugar (that is, the carbohydrates) still remains in the whey.


Forms of bacteria found in milk.

The mineral matters — lime, iron, potash, magnesium, sulphur, and phosphorus— are all in combination with the casein and the albumen.


A creamery at Peace River.

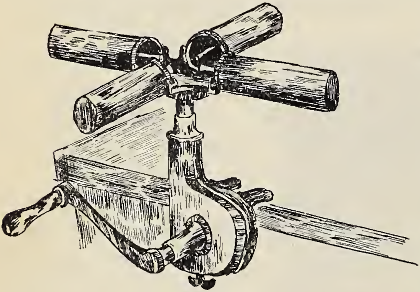
Keeping Milk Clean.—Milk is a great breeding ground for many kinds of harmful bacteria, or germs. If the cow is healthy, the milk, after the first few streams, as it comes from her will be pure; but any carelessness in the handling of it may cause it to become badly infested before it is used. Bacteria get into the milk in many ways. If the stables, stalls, pails, strainers, cans, bottles, or any of the utensils used are dirty, if the milker is unclean and has dirty hands, or if flies are allowed to get into the milk, it is almost sure to become unclean. When bacteria once get into the milk, they multiply rapidly and frequently render it unfit for food. Such milk is especially dangerous if fed to infants.

Good types of sanitary milk pails.

The barrel churn is still commonly seen upon the farm.

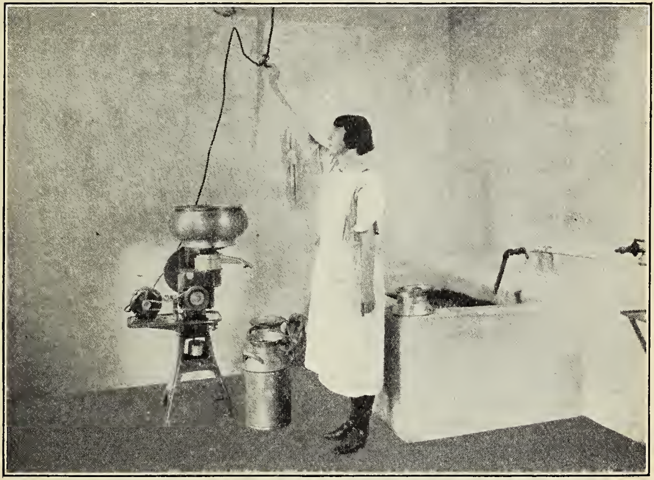
The importance of keeping milk clean cannot be exaggerated. All utensils used should be thoroughly scalded in order to kill any germs that may be present in them. The milker should wear clean clothes; he should have clean hands and should not wet them in the milk. The air should be free from dust; bedding or hay in the stable should never be stirred up immediately before milking time. The first few streams from each teat should be thrown away, as germs are usually present in the milk at the mouth of the teat.

Testing Milk for Butterfat.—As has been said, the percentage of butterfat in milk varies greatly. When milk is sold to the creamery, the price paid for it is not based on the quantity of milk but on the amount of butterfat that it contains. The instrument used for the purpose of testing the percentage of butterfat in milk is known as the *Babcock tester*. Before this apparatus came into use, there were many complaints by creameries that the milk offered for sale was thinned with water, or that it had been partially skimmed before being brought to the factory. After the Babcock tester came into use, all temptation to water the milk was removed.



A whirling machine. One of the less expensive forms of Babcock tester.

This instrument is useful, however, not only for the dairyman but for the farmer himself. By means of it he can keep a record of the value of the milk produced by each cow of the herd. A spring balance, a record sheet, and a Babcock tester are all that is necessary to enable him to keep a complete check on the value of his cows. The milk is weighed, say once a week, and a test is made for butterfat. Both facts are recorded on the record sheet. At the end of the season, the farmer has a fairly accurate milk record of every cow in the herd, and knows which ones are worth keeping and which should be disposed of. This will convince him, as nothing else will, of the great differences in the value of his cows. The Babcock tester is not very expensive. The makers supply full instructions for its use. Practice and experience, however, are very necessary before one can secure accurate and dependable results.



Cream at the turn of a switch. With electric transmission lines through country districts ever on the increase, farmers more and more are wiring their buildings for electricity. Electric operation of cream separators is easily accomplished; all the operator has to do is to connect the cord to any convenient lamp socket, turn on the switch, and let the motor do the work. The capacity of the electric cream separator shown in this picture is 75.5 gallons per hour.

Creaming Milk.—There are three methods in use for obtaining and removing the cream from the milk. They all depend for their success on the fact that the fat globules, of which cream is composed, are lighter than the remainder of the milk. The oldest method was to set the whole milk away in shallow pans. By allowing it to stand in a cool place the cream would accumulate on the top, after which it was skimmed off. A later method was to put the whole milk into deep cans and set these in water. When the cream had risen, the skimmed milk was then drawn off through a faucet at the bottom, after which the cream was drawn off in the same way. Still later came the centrifugal machine, or cream separator. In this machine the milk flows into a rapidly revolving bowl. The speed is very great, and the heavier skimmed milk is thrown to the outside of the bowl, where it runs out and is drawn off. The lighter fat globules flow to the centre and are drawn off separately. The cream separator is so much better than the former methods of removing cream from milk that now, wherever dairy cattle are kept in any considerable numbers, the separator is regarded as a necessity.

Questions, Problems, and Exercises

1. Visit a dairy farm or a creamery and ask the man in charge to show you how the Babcock tester is used in testing cream, buttermilk, and skimmed milk.
2. What precautions must be observed in the care and handling of milk?
3. Why is milk called the complete and perfect food?

CHAPTER XXIII

FARM MANAGEMENT AND RURAL PROBLEMS

As we have already said, the farmer, if he is to succeed, must be a good business man. He must plan wisely and must use sound methods in the management of his farm. He must determine the kinds of crops or live stock which he can produce most successfully, and study to find out how these can be sold to the best advantage. Cost of production, marketing, market demands, and market prices must be closely examined if losses are to be avoided and if the farm is to be made to yield the greatest possible profit. These, together with other considerations having to do with the business side of farming, are known as *farm management.*

SECTION I.—GENERAL PROBLEMS OF MANAGEMENT

Choosing a Suitable Location

The selection of a suitable location is of the very first importance. In choosing a farm, the climate, the soil, and all local conditions must be taken into account, because they will have an important influence upon all future operations of the farmer. If the farmer wishes to carry on successfully a particular branch of agriculture, he must choose a location where the conditions are favorable.

Conditions favorable to various Types of Farm Enterprise.—The Prairie Provinces offer opportunities for mixed farming, dairying, poultry raising, horticulture, and bee-keeping.

Ranching.—The foothills country, with its rather uneven surface, steep hills, small wooded areas, many mountain streams, and a soil adapted to grass production, is ideal for the raising of cattle, horses, and sheep. There are many other areas in the central and southern portions of the Prairie Provinces likewise suitable for ranching. It is to these areas that the rancher is naturally attracted.

A typical Alberta ranch.

Grain growing.—The prairies, with their chocolate loam soils, varying in depth from eight to twelve inches, with a fair percentage of sand which is favorable to early maturity of grains, have produced the finest hard wheats of the world. Generally, these areas are given over strictly to grain growing.

Mixed farming and dairying.—Broadly speaking, as we go northward in the Prairie Provinces we come into what is known as park country. The quantity of timber gradually increases until we reach the heavily wooded or forest regions in the north. In the park country the soil is black, and rich with leaf mold and other organic matter. Frequently, too, in northern areas there are muskeg and other peaty formations, which are of little value until thoroughly drained. The subsoil in these districts is usually of a heavy clay formation and occasionally of a gumbo nature, indicating poorer underdrainage, colder soil, later springs, and earlier autumn frosts than on the prairies, where the subsoil is more open. Such districts are best suited to mixed farming, because the grass grows abundantly and stays green from early spring

Grass, hay, and water in abundance.

until late in the fall, and because hay can be procured in quantities for winter feeding. The park and forest areas are well adapted to the raising of barley, oats, and other coarse grains, but not so well suited to the raising of high quality wheat as is the prairie. Because coarse grains are produced in large quantities in these districts, the hog industry, the raising of baby beef, the feeding of winter steers, and dairying are very profitable.

Poultry raising and horticulture.—In the districts near good markets poultry raising and horticulture are practised. Due to the rather dense population of our cities and the consequent good market for fresh eggs and new vegetables, poultry raising and vegetable growing are two well-established industries. These industries should grow as our population increases and our cities and towns become larger.

Local Conditions.—In every locality there are a great many factors which affect the usefulness and value of the land. In choosing a farm these local conditions must be carefully weighed.

The homesteader's shack, the first home on many prairie farms.

Soil. — Soils differ greatly in their composition and in their productive qualities. Very sandy, gravelly, and heavy clay soils do not yield well. A good soil should have a fair depth of loam, that is, of rich, black soil on its surface. If it is possible to obtain it, the loam should be at least six inches deep and is better to be from eight to twelve inches deep. The subsoil should not be too heavy or compact.

Surface.—The slope of the land also affects its value for farm production. If the land has too much slope, the rains that fall run off the surface, the water is carried away by coulees and ravines, and comparatively little remains to sink into the soil. On the other hand, if it has no slope and is low-lying, it is apt to be too wet. On such a farm spring operations are delayed, crops cannot be sown until the season is far advanced, and they are likely to be drowned out by the summer rains. It is also true that crops on low-lying land are more subject to injury by frost than are the crops upon the uplands.

Drainage.—The question of drainage is important. If the land has good natural drainage, the farmer will be spared the expense of providing artificial drainage. Artificial drainage, either by the open ditch or by tiles, adds very greatly to the cost of making the soil suitable for agricultural purposes, and should be taken into

Notice the arrangement of the buildings on this Alberta farm, and also the shelter-belt of trees in the background.

account in determining the choice of a farm and fixing the purchase price.

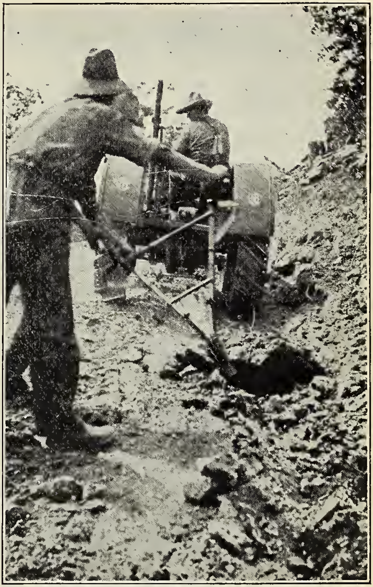
Water. — Water supply is essential. A creek or stream increases the value of a farm, because it furnishes an abundant supply of water for the stock. Even a slough or small lake, if it retains water throughout the summer season, is a very valuable asset on the farm. In some parts of the country the water table is so deep that wells have to be bored to a depth of two, three, or four hundred feet before water can be obtained, and the deeper one has to go for water the poorer usually is the quality. Water from deep wells very often contains a great deal of mineral matter and sometimes has in it so much alkali that it is scarcely fit for use. In buying a farm an effort should be made to find out how deep it is necessary to go in order to obtain water, and what the quality is likely to be when obtained. If a farm has no creeks, springs, or sloughs of a permanent nature on or near it, so that water has to be hauled long distances, its value and usefulness are considerably lessened.

This will do for shipping, but it does not furnish a local market for farm products.

Markets. — A farm which is near a flourishing town or city is worth much more than one which is not well situated. Such towns and cities create a local demand for many of the products of the farm, and this in itself adds value to the land. The farmer can bring in weekly many of his products, such as vegetables, eggs, poultry, butter, etc., and sell these directly to the consumer for practically the same price as is obtained by the retail dealers.

Roads.—Poor roads reduce greatly the value of all farm lands near them, because they make travelling difficult, and so force the farmer to make frequent trips over them with small loads. They are hard on horses; they are hard on people. The time that it takes to travel over them, the jolting and racking that they give to vehicles, horses, and drivers is often so great as to make the adjacent farms of very little value.

Good roads, on the other hand, have made possible the operation of motor busses for passenger service and trucks for quick delivery of farm produce to the markets. Good highways encourage sociability and add much to the comfort and enjoyment of country life. If the roads are good, the farmer and his family will go to church, to social gatherings, to political meetings, to lectures, and to concerts, at all of which they meet their friends and neighbors in a social way. Good roads are also great factors in education, since they make it possible for boys and girls to attend school regularly. Good roads and quicker transportation by means of the automobile have done much to enrich both country and city life by bringing nearer to each the advantages of the other.


Making a new road.

Community life.—In selecting a community in which to live it is always well to take into consideration the type of people who make it up and the kind of community life which it offers. The right kind of neighbors means more in country life than in town life. The church and the school are already fixed institutions in almost every community. The Community Hall also has come to

The radio brings the farm people into contact with the doings of the whole world.

occupy an important place in the life of the people in many localities. It affords a place to come together for social, political, and educational activities. The telephone has helped to bring the people of rural communities into closer touch with one another, so that they no longer feel cut off from their fellows. The radio enables the farmer, in his own home, to listen to speeches and concerts in far-off cities, and through market reports to keep in almost hourly touch with changes in the prices of his products. Farm life has been greatly enriched by the radio, the telephone, and free rural delivery of mail.

Local community organizations have sprung up rapidly in the last few years in the form of farmers' organizations, agricultural societies, women's institutes, debating and literary societies, Red Cross locals, etc. These organizations all add to the attractiveness of rural life and help to bring new settlers and immigrants to the communities where they are found.

Cost of Production

Ploughing and Cultivating.—An accounting system is just as necessary in operating a farm as it is in carrying on any other form of business. By reckoning the cost of production and comparing it with his revenue, the business-like farmer determines whether or not his methods of farming are profitable. His accounts show all details of expenditure and revenue connected with each operation, and enable him to trace any loss to the particular operation which is responsible for it. He knows whether ploughing and cultivating can be done more cheaply with horses or with a tractor, and whether large outfits or

The average prairie farmer finds it profitable to plough with an eight-horse team.

smaller outfits are the more profitable. The average prairie farmer finds it better, for instance, to drive a six or an eight-horse team on a two-furrow gang plough than to use two three or two four-horse outfits on single-furrow sulky ploughs. By the former method he saves the cost of the wages of one extra man. For seeding many of the prairie farmers have discarded the use of the tractor,

The farmer must keep account of the cost of production; teams, machinery, and men mean heavy outlays.

which pulls several seed drills and harrows, in favor of the single seed drill outfit. This is because heavy tractor machinery depreciates in value very rapidly, and more skilled and higher-priced labor is required to operate it.

Harvesting.—Similar problems arise at harvest time. The advantages or disadvantages of the tractor as compared with horse power, and of the small threshing machine as compared with the large, from the standpoint of cost and service, must be duly considered. With a small machine of his own the farmer can set his own time for threshing his grain instead of having to await the convenience of the custom thresher. With this machine, the regular farm staff, with the help of a few neighbors, can together do the threshing in season, and thus save the cost of feeding a crew of hired threshermen. Moreover, by using his own machine the farmer does not expose his fields to the danger of being polluted by weeds brought from other districts.

Cost of Marketing

Hauling Charges.—The cost of marketing grain has much to do with the profitable operation of a farm. Where farms are located close to the country elevators, the grain can be hauled direct from the threshing machine to the elevators at very little cost. But many farms are not so fortunately situated. Hauling grain long distances is very expensive. It involves the hiring of extra help, the provision of additional feed for horses, and considerable wear and tear on farm equipment.

An inexpensive, half-open shelter for sheep.

Using Grain on the Farm.—If the cost of taking the grain to market is very great, the farmer should consider whether or not it would be more profitable to feed the grain to live stock. When the price of oats is so low that the freight rate and other handling charges eat up the sum received, the farmer should find some way of using these oats at home at a profit. The feeding of winter steers, the raising of hogs, the keeping of dairy cows, and the raising of other kinds of live stock which will use up the grain may solve the problem. In those sections where mixed farming is practised exclusively, many farmers find it very profitable to feed all their grain to live stock. The stock can be driven to the

Some ranchers raise only high-class stock. The horses on this foothill range are all pure bred Percherons.

stock-yards and loaded. Creameries and cheese factories close at home manufacture the milk and cream into products which are in demand. High-grade wheat, however, is seldom fed to live stock; it is cleaned before marketing, and the screenings are used as feed.

Selecting Stock and Crops

Selecting Breeds of Cattle.—Certain breeds of cattle can be raised more profitably in one district than in another. Before selecting stock, each farmer must decide what breed is best suited to his conditions. If his farm is located among the foothills, or where there is abundance of open range, with a plentiful supply of good water, and where the area kept under cultivation is small compared with the grazing area, he will, no doubt, take up ranching and the raising of beef cattle. If, on the other hand, he has a farm of medium size, with a relatively large area under cultivation, and if it is located within reasonable distance of some good town or city, and near enough to the railroad so that he can ship milk or cream

A fine herd of pure bred Holstein cattle.

without too great expense or labor, he would probably do well with some one of the dairy breeds. For the average farmer, good "grade" cattle are best. They are hardy and can be bred up to increase either the beef or the milk strain by selecting pure bred sires of the strain desired. The breeding of pure breds is a highly specialized business, which requires long training and experience to ensure success.

Choosing the right Varieties of Grain.—Certain districts, also, are better suited to raising one kind of grain than another. Every farmer should study the varieties of wheat, oats, and other grains, and should select only those varieties which will thrive under the conditions prevailing in his district. He should, of course, as far as possible, aim to produce those tested varieties which have already established a favorable reputation and which are in sufficient demand to command a good price upon the market.

Questions, Problems, and Exercises

1. "The selection and value of a farm depend upon the kind of farming to be followed: soils; slope; drainage; topography; water supply; markets; roads."—Course of Study.

Explain carefully how each of these affects value and use.

2. Show how the life of the farming community is influenced by the character of the people, schools, churches, community halls, telephone, radio, mail delivery, etc.
3. What might be done by the people of your community to improve conditions and make farm life more interesting and enjoyable?
4. What work can the school, the pupils, and the teacher do to set a good example to the community?

SECTION II.—CO-OPERATIVE MARKETING

Agriculture is an industry of the first importance. More than half the people in Canada live and work upon the farm. The value of our agricultural products has now reached $1,700,000,000 dollars, or almost one and three-quarter billion dollars annually. This tremendous sum, when spread over all the farmers of the Dominion, shows that the average income of each is in excess of $2,000 per year. Farming is a vocation which offers independence and a healthful, interesting occupation.

Farming, however, is uncertain in many ways. Crops depend largely upon suitable weather conditions, and these conditions are often unfavorable because of too much or too little rain, or because of frost, hail, snow, or wind. In addition to the risk and the expenses involved in producing a crop, there are heavy marketing costs in the way of hauling, freight, and commission charges, which greatly reduce the farmers' returns. Then, too, the market prices for farm products vary so much that they are a cause of much concern to the farmer.

Grain crops are ready for market in the fall of the year, and generally at that time the supply of such food materials is more than equal to the world's needs until another crop is ready. Moreover, the need and the demand for food is limited to a quantity sufficient to satisfy our more immediate and actual needs. This is not always true of other commodities, such as clothing, houses, and those things which serve our amusement and recreational needs and wants. Consequently, the farmer frequently finds that the prices which he receives for his products may be low when compared with the prices which he has to pay for things which he does not produce, but which are necessary in his work or which minister to the comfort, convenience, and recreation of his family.

To make matters worse, all crops are marketed at the same time each year. You will readily see that, when a tremendous quantity of wheat is put on the market at one time, the supply may be greatly in excess of the immediate demand. We say that the market in these circumstances is *glutted.* The result is that the price falls. The farmer is forced to accept this low price, because he must realize upon his labors in order that he may pay for those things which he is forced to buy. The dealers who buy the wheat are, as a rule, more fortunate, for they are able to hold it until the market conditions improve, and the price returns to normal. The normal price of any commodity is fixed by the actual world supply as related to the actual world demand.

Pools

In recent years farmers have come to realize that many of the difficulties in connection with successful marketing have been due to the fact that each farmer has been trying to work out his problems alone, without the assistance of other people engaged in the same business. They have discovered that "in union there is strength," and they are learning to *co-operate*, that is, work together.

As a result, the farmers of many communities have organized themselves into associations called *pools*, for the purpose of selling their wheat, live stock, and other produce, as a group, rather than as individuals.

There are a number of local associations of milk producers, in which the dairy farmers of the community co-operate in this way. In addition, there are provincial pools, such as the *Provincial Dairy Pool*, *The Provincial Egg and Poultry Pool*, and *The Provincial Live Stock Pool*, all working to improve the quality and the marketing of the particular farm products in which they deal. But of all the pools, by far the most important are those which handle the wheat crop of the Prairie Provinces.

Advantages of Pools.—When farmers market their produce as a group, the cost is reduced for everyone. For instance, when poultry is to be sold, all the members of the association bring to a common centre the birds which they wish to sell. A large shipment is thus made up, and all expenses are lessened because of reduced handling and freight charges. Moreover, under this system the shipment is usually sold direct, and the middleman's commission is thereby saved. This system of marketing has taught farmers the advantages of keeping their produce up to a high standard. The best qualities are always in the greatest demand and consequently bring the highest prices.

Sometimes these associations also buy as a group, and in this way cut down the cost of many commodities to their members. This group buying is frequently employed in the case of coal, fruit, and binder twine.

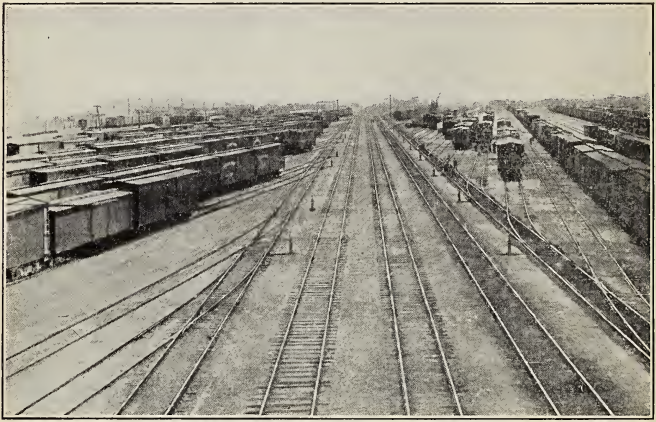
Operation of Pools.—When a co-operative association is formed, the members elect officers, usually a president, a secretary-treasurer, and a small board of directors. In some cases a paid manager, who understands the business of marketing, is employed. The expenses in connection with each shipment are distributed on the basis of the value of the produce sold by each member and are accordingly deducted from his returns.

The Wheat Board

During the Great War food products became scarce, and the price of wheat rose steadily. The governments of many of those countries involved in the war, including Canada, passed laws fixing the price of wheat. After the war, prices fell to such an extent that the agricultural industry was seriously threatened. Investigations followed. Co-operative marketing of farm produce was recommended as the means most likely to re-establish the industry on a proper basis.

Wheat Pools

In June, 1922, the various farmer organizations, the United Farmers of Alberta, the Farmers' Union of Saskatchewan, and the United Farmers of Manitoba, decided to proceed at once to organize a voluntary contract Wheat Pool in each of their respective provinces. The Alberta Wheat Pool completed its arrangements in time to market the 1923 crop, but in the other two provinces the operations of the pools did not become effective until the following year. In the fall of 1924 these three pools united to form a powerful agency for the marketing of grain. This central agency is known as The Canadian Co-operative Wheat Producers, Limited. It has its headquarters in the city of Winnipeg.



Grain cars in the Winnipeg freight yards.

Under the pool method of marketing wheat the farmer agrees to deliver his grain to the pool for a period of five years. The pool places the wheat on the market at times when it will command a fair price, and never allows the market to become glutted with wheat. The prices received at various times for any particular grade of wheat are all averaged, and each farmer receives for his grain the average price brought by all the wheat of the same grade delivered to the pool. This system has marked advantages: (*a*) The glut is prevented, and a better average price is secured. (*b*) The producer reaps the benefit of prices which are regulated by the fact that a steady supply is fed to the market over a long period. (*c*) The commission of the middleman, or commission agent, is largely saved to the farmer. (*d*) The farmer receives an initial payment which helps to meet his immediate needs, and receives further payments from time to time, and a final payment before the close of the year. He is not forced, through lack of funds to meet his obligations, to rush all his crop to market at once and dump it upon an already flooded market. (*e*) The producer receives expert marketing service at low cost.


A grain boat on Lake Superior.

The Alberta Wheat Pool. — The Alberta Co-operative Wheat Producers, Limited, or as it is more commonly called, the Alberta Wheat Pool, was incorporated in August, 1923, and commenced business the same year. The organization of the Pool is very simple. Alberta has now over 36,500 members, and each of these members has a voice in electing the representatives to the annual meeting of the Association, which is held in August of each year. The province is divided into seven main districts, and each of these districts is, in turn, sub-divided into ten sub-districts, making seventy sub-districts in all. Once each year the head office sends out to each member of the Pool a ballot and a list of the members in his sub-district. The member has the privilege of voting for some member in his sub-district as his choice of representative to the annual meeting. The member receiving the highest number of votes in his sub-district is declared elected as delegate for that sub-district.

The seventy delegates so elected are called together in convention to discuss and lay down policies for the guidance of the management. At some time during the convention the delegates meet in seven groups of ten each and elect from each group a director, who sits on the Central Board of the Association and is known as a *Director*. It will be seen, therefore, that the responsibilities for the government of the Pool, and especially for the policies followed by the Pool, are in the hands of the members themselves. This principle of direct representation is one of the strongest points in the whole organization.

Membership and acreage.—The following statement gives some indication of the strength of the Alberta Wheat Pool. The figures show the membership and acreage as at July 31st, 1926:

Total membership, July 31st, 1926	36,512
Total Pool acreage, July 31st, 1926	3,497,044
Average acreage per member	95.77
Less 34 duplicate contracts.	
Total wheat acreage for Alberta, 1925	5,719,749
Proportion of Wheat Pool acreage to provincial wheat acreage	61.14%

Elevators.—In Alberta the board of directors of the Alberta Wheat Pool, with the consent of the members, withholds a small amount per bushel. This sum is used to provide greater facilities in the way of local elevators and terminal elevators. To carry out this work a branch of the Wheat Pool, which is known as the Alberta Pool Elevators, Limited, has been incorporated, and this latter organization owns and operates all elevators which may be acquired by the Pool.

Three new elevators have been built at local points, while at some forty points the Company has purchased elevator facilities. In addition to all this, the Company has elevator agreements covering the handling of Pool wheat with over sixty elevator companies. Through these the Pool has control of the services of 1,100 elevators located at 500 different shipping points in Alberta.

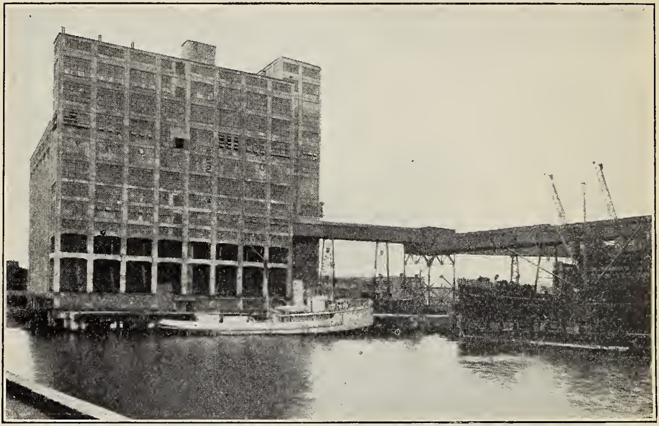
In acquiring these elevator facilities, reserve funds

At Fort William and Port Arthur the grain from the prairies is taken from the cars and transferred through the terminal elevators to Lake boats. The elevator in this picture has a capacity of over 7,000,000 bushels.

of the Pool are invested, as required, in shares of Alberta Pool Elevators, Limited. This means that the members of the Wheat Pool are really the owners of the elevator facilities controlled by the Alberta Pool Elevators, Limited. Directors of the Wheat Pool also act as directors of the Alberta Pool Elevators, Limited and so have full control of the elevator company.

The Alberta Pool controls more than sixty per cent of the wheat acreage of Alberta. Since it is almost exclusively Alberta wheat which is exported through Pacific ports, it has been decided that terminal elevators on the west coast shall be owned or controlled and operated by the Alberta Pool.

The port of Prince Rupert has not hitherto been used for the exporting of grain. But in view of the volume of Oriental business which is transacted, and its



This terminal elevator at Vancouver, under lease to the Alberta Wheat Pool, has a capacity of 1,650,000 bushels.

possible future development, the Board has leased from the Dominion government, for a two-year term, the terminal elevator which has been constructed by the government at this port. This terminal is being operated successfully. It may prove that, with the development of Prince Rupert as a grain port, the differential in ocean freight rates which now exists between Prince Rupert and Vancouver may disappear. In that event, it will doubtless be possible for the Pool to utilize Prince Rupert as a point from which to export wheat for the European trade. It is expected that the Board will have a Pool elevator in Vancouver ready for operation in the near future.

The Canadian Pool.—When, in the fall of 1924, all three Prairie Provinces had completed their wheat pool organizations, they decided to carry co-operation still further by uniting to form one central organization for the selling of wheat. This latter organization, incorporated under a Dominion charter, is known as The Canadian Co-operative Wheat Producers, Limited, and is commonly referred to as the Canadian Pool and sometimes called the Central Selling Agency. It is the business of this organization to receive the wheat from each of the provincial pools and place it upon the markets of the world in such a manner as will command a favorable price. The proceeds are returned to the provincial pools for distribution to those members who supplied the wheat. This scheme provides the means of handling a tremendous volume of grain through one agency and thus reduces the marketing cost to a minimum.

Government of the Canadian Pool.—The Canadian Pool is controlled by a board of directors composed of nine members, three from each of the provinces. Each of the provincial boards is responsible for electing its own three representatives. This board of nine members, in consultation with its sales managers, largely determines the selling policy of the Pool. The head office of the Canadian Pool is in Winnipeg. The Western Branch is in the city of Calgary. Sub-agencies are established at Montreal, Toronto, Vancouver, New York, and Paris (France), and connections have been established in practically all wheat-consuming countries of the world.

Strength of the Canadian Pool.—The Canadian Pool is the largest organization of its kind in the world. Its membership already exceeds 125,000, and it controls two-thirds of the acreage sown to wheat in the Prairie Provinces. It owns excellent elevators at Fort William and Port Arthur. In 1925 the Canadian Pool handled over 200,000,000 bushels of wheat. This represents more than half of all the wheat exported from Canada in that year. The Canadian Pool is now in a position to prevent large volumes of wheat from being rushed on the market, and thereby creating a glut, which always forces prices down. The strength of the Pool lies in its power to control the general price level, and this benefits not only the Pool member but the non-Pool farmer as well.

Questions, Problems, and Exercises

1. A man and team are worth 50 cents per hour. The team travels 3 miles per hour with a load of 60 bushels. Find the cost per bushel of hauling grain from a farm 4 miles from the railroad, and from a farm 12 miles away.

The elevator makes a charge for loading the grain. Visit the elevator to ascertain this charge per bushel.

The railroad collects a freight charge for hauling the grain to the terminal elevator. Find out the rate from the local station agent. Is the grain from your district shipped to Fort William or via the western route?

A commission agent or the Wheat Pool will make a charge for selling the grain. Ask a farmer how much this charge will be.

When all of these charges have been found, calculate the total cost of marketing a bushel of wheat.

2. Compare price quotations of wheat daily for a week and observe the rise and fall that occurs.

3. If there is a director of the Egg and Poultry Pool living in your district, invite him to explain its operation to the class.

How does the price received by one member of a pool compare with the price received by other members for the same grade of eggs or poultry?

Will the establishment of collecting centres and the shipping of eggs and poultry in large quantities reduce the shipping cost per dozen and per bird? Explain.

Will the consumers profit by the operations of a pool? In what way?

By reference to the discussion of "Co-operative Marketing" and the "Wheat Pool," make a summary of the advantages of pools of various kinds.

4. Is there a Dairy Pool or a Co-operative Creamery in your district? What are the advantages of these organizations to the farmer? Invite a director or one of the members of the Pool to come to the school and tell the class about the operation of the Dairy Pool and its advantages to the farmers.

SECTION III.—FARM ACCOUNTS

As we have already said, every farmer should keep business accounts. Errors occur, and disputes arise, and a written record of business transactions furnishes the best method of avoiding mistakes and settling misunderstandings. Moreover, it is of the utmost importance that the farmer should know the condition of his business from time to time. He should know, from records kept, which of his activities are profitable and which are causing a loss, so that he may extend or curtail his operations accordingly.

Single Entry System.—The farm accounts should, of course, be as simple as possible. The Single Entry System will serve the purpose of most small farmers. By the Single Entry System only *one* entry is made for each transaction. For example, if a steer is sold to Smith Bros. and is not paid for, it is simply charged to an account in their name. If it is paid for, the amount is entered in the Cash Book, among the receipts.

Inventory.—Every farmer should make a yearly *Inventory*, that is, a record showing all property, of whatever description, which he possesses. This statement will show his assets and his liabilities,—that is, his possessions and his debts.

Among the assets will appear:—

Land	$
Improvement on land, such as wells, fences, crops	$
Buildings, house, barn, silos, etc	$
Stock, horses, cattle, etc	$
Implements	$
Farm produce	$
Notes on hand	$
Accounts owing by other people	$
Money on hand	$
Money in bank	$
Total Assets	$

Among the liabilities will appear:—

Mortgages against his property	$
Notes owing	$
Bills and accounts unpaid	$
Total Liabilities	$
Net Worth	$

When the total liabilities are deducted from the total assets, the remainder is called the *Net Worth*. When this amount is compared from year to year, it gives evidence of a gain or a loss in the business. Great care must be exercised in fixing the values placed upon the different items in the inventory. It is customary to enter the value at the price that the article would bring in the open market. In the case of buildings and equipment, due allowance—usually five per cent per year—must be made for depreciation. If the inventory is to be reliable and of value as a record, honesty and good judgment must be exercised in making it.

Cash Book.—Next in importance to the inventory is the *Cash Book.* It furnishes a record of all cash transactions,—money received and money paid out. The difference between the two sides of this account always shows the amount of Cash on Hand. It is an excellent safeguard against mistakes and forgetfulness.

Bank Account.—In addition to the cash book, most farmers find it helpful to keep a *Bank Account,* because of the convenience and safety which it affords. The bank account in itself furnishes a good record of money paid out, because the cancelled cheques are returned, and these serve as receipts.

Other Records.—In addition to these general records, many farmers find it of the greatest advantage to keep close and accurate records in connection with the various branches of their business. For example, *Crop Records,* that is, careful accounts concerning each particular crop, are kept, charging against the crop such items as a fair rent for the land, cost of seed, cost of labor in ploughing, tilling, seeding, harvesting, and marketing. The selling price of the crop is credited against these charges. These records of costs and returns, kept over a number of years, are a valuable guide to the farmer. An example of a Crop Record will be found on page 324.

Likewise records may be kept for dairy cows, for poultry, and for swine. These records help the farmer to locate the sources of loss. He can then, as soon as possible, get rid of unproductive animals and discontinue or readjust unproductive branches of farming.

If the farmer begins to keep accounts and records in a simple way, he can soon work out a highly useful system. He can adjust his system to meet his needs from time to time, and by experience can gradually perfect it for his own purposes.

Year 1926

Record of 40 acres Oats West Field	Spent	Received
Preparing land	$ 130.00	
Seed—80 bushels at 55c	44.00	
Seed cleaning	8.00	
Seeding and harrowing	40.00	
Harvesting	72.00	
Threshing	120.00	
Rent and insurance	42.00	
Hauling	80.00	
Selling charges	98.00	
Sold—2,000 bushels oats at 55c		$1100.00
Profit	466.00	
	$1100.00	$1100.00

Questions, Problems, and Exercises

1. Find out from an experienced farmer: (a) the cost per acre of preparing the land for seed; (b) the cost of the seed wheat, and the cost of cleaning and pickling the same; (c) the cost of cutting and stooking an acre of wheat; (d) the cost of twine; (e) the cost of threshing; (f) the interest on the investment in an acre of ground; (g) the taxes per acre; (h) the cost of marketing.

From these find the cost of producing an acre of wheat, and the profit on it if the yield is 22 bushels per acre and is sold at $1.10 per bushel.

2. Find out the prices and the average life of different farm machines.
3. Discuss with farmers the cost of housing and feeding dairy cattle.

SECTION IV.—BIRDS

Value of Birds.—With a few exceptions, birds are among the greatest benefactors of mankind. There are some birds, such as crows, magpies, English sparrows, hawks, owls, and blue jays, that are considered more harmful than beneficial. While it is true that all of these do some damage, it cannot be said of any of them that they are wholly destructive. The harm that they do is seen and recorded against them; but the good that they do is too often both unknown and unrecognized. The very sight of a hawk sends most farmers scurrying for the gun. Because some hawks are known to prey upon chickens, it is concluded that all hawks should be destroyed. The state of Pennsylvania placed a bounty on hawks and owls a few years ago, and over 100,000 of these birds were slain. This was followed by such an increase in the numbers of field mice and other pests, upon which hawks and owls prey, that the damage done to field crops in the two succeeding years was estimated at nearly $6,000,000.

"It is hereby resolved and agreed that if the farmer will shoot all the owls, hawks, and crows, we will split fifty-fifty with him on his grain crop."

Even the much maligned crow, although he may do some harm, is capable of considerable good. The mischief which he does is confined mostly to a few weeks of the year, while at all other times he is working ceaselessly in our interests, destroying harmful insects and rodents. The English or house sparrow is another bird whose usefulness is often questioned. Though the adults live almost entirely on grain and weed seeds, the grain which they eat is gathered mostly from the barnyard or roadside, and much of it would be lost in any case. The young are fed almost entirely on insects of a harmful kind; grasshoppers are greatly relished and are consumed in large quantities.

Seed-eating Birds.—Seed-eating birds live almost wholly on weed seeds. *Cowbirds, meadowlarks, horned-larks, juncos, grosbeaks, blackbirds, snowbirds, redpolls, goldfinches*, and *sparrows* all consume immense quantities. Blackbirds are very fond of the seeds of bindweed and smartweed. Though goldfinches feed mostly on the seeds of thistles and dandelions, they are also quite fond of sunflower seeds, and there is no better way to attract them to a locality than by planting a few sunflowers. Juncos, redpolls, and snowflakes may be seen in the winter months feeding on the seeds of weeds that appear above the snow-covered fields. The snowbirds, or snowflakes, whirl through the frosty air like flakes of snow driven before the storm; then they all wheel towards the white earth beneath and run hither and thither over the snow, gathering their food from the projecting weeds.

Notice the square end on the tail of the sharp-shinned hawk. By this it can be distinguished from Cooper's hawk, which it closely resembles. The end of the tail on Cooper's is round. Both are small and are commonly called chicken hawks. They are the only ones that should be kept in check. Never shoot an owl or one of the large hawks. They are the farmer's friends. Be sure not to mistake the pretty little sparrow or grasshopper hawk for one of these.

Among all of the seed destroyers, however, the sparrow is easily first. A single sparrow will eat a thousand pigweed seeds for breakfast. The stomachs of many sparrows have been examined and have been found to be almost entirely filled with weed seeds. The quantity of these destroyed by even one sparrow in a single season is enormous. The variety of weed seeds eaten by sparrows is very great. They are known to feed upon the seeds of no fewer than eighty species of noxious weeds, some of which are among the worst pests with which the farmer has to contend. These few facts will give some idea of the value of birds as weed destroyers.

Insect Destroyers.—But birds are of even greater benefit as destroyers of insects. In order to live, man has to wage a constant war with insect foes. Were it not for the assistance which he receives from the birds, it is extremely doubtful if he could maintain his place in the world against insect ravages. Even with the assistance of the birds, and despite all his efforts to hold them at bay, insects live and thrive and feed at his expense. Insects were on the earth thousands of years before man, and are better adapted to live there than he is. Moreover, they have the power of increasing their numbers so rapidly that man is in constant danger of an insect plague.


A junco.

It cost thousands of dollars to fight the locust plague in the southern part of Alberta a few years ago. A year or two later there was in the north-central part of the province a plague of caterpillars. Myriads of caterpillars sprang into life in a single season, and miles and miles of forest trees were stripped of their foliage in a few weeks and stood as bare and leafless in the month of June as they had been in the previous December. Against this outbreak man could do nothing; he surveyed the ravages of the caterpillar and stood aghast before their numbers, but was powerless to check their progress or bring them under control.

These are but recent examples of what has occurred all too frequently in the world's history. There is no kind of vegetation, and nothing that man can grow, that has not its insect enemies; their species and their numbers are beyond computation.

Birds are insect destroyers. They are not the only destroyers, but they are benefactors of mankind to such an extent that one great naturalist has declared that, were it not for the assistance which man receives from the birds, he would be beaten in his struggle with the insect world, and the earth for him would soon become uninhabitable.

A goldfinch.

The insect-eating birds are of many kinds; they work in different ways, and each species performs a service peculiarly its own. *Robins*, *thrushes*, *sparrows*, and *meadowlarks* search the ground; they pry into every nook and corner, search out insects, and consume them. The *woodpeckers* listen for the gnawing of borers within, and then, with their sharp beaks they drill into the trunk with instinctive accuracy and drag out with barbed tongue the trunk-destroying grub. The *warblers* flit among the upper foliage of trees and pick insects from the blossoms and the leaves. The *chickadees* are more careful foragers; they hop about the branches of trees, and hang from leaf or twig in every conceivable position, examining them for insects with the minutest care, and will pick up a living on what has been missed by the more hasty warblers. *Wrens* scrutinize the foliage nearer the ground. These active little birds never cease from early morning until night in their good work. Ninety-eight per cent of their food and the food of their nestlings consists of injurious insects. *Swallows, flycatchers, king-birds, swifts,* and *night-hawks* are foragers of the air. They catch insects upon the wing, and consume flies, mosquitoes, gnats, and moths in enormous quantities.

Protecting Birds.—Birds should be given protection and should be encouraged in every way to come and make their homes among us, not only because of their importance as weed and insect destroyers but also because of the pleasant companionship which they offer.

A woodpecker's tongue, enlarged to show the barb.

Their habits and quaint ways interest and amuse us; their brilliant plumage delights us; and their charming songs captivate us.

Birds should be made to realize that we are their friends. A few crumbs scattered daily out of doors for the winter birds will often serve to tide them over some of the most trying periods. Bird-boxes can be made by the boys of the farm or town home. If set up on poles or fixed in trees out of reach of cats and other night prowlers, they will afford welcome nesting places for such species as delight to inhabit them. Holes may be cut into the gable ends of barns to admit the barn swallow. The eave swallow should be permitted to build its nest under the eaves unmolested. It takes toll of some of the most annoying pests that the housewife, the farmer, and his stock have to contend with. A colony of eave swallows would greatly reduce the plagues of flies and mosquitoes which make life miserable for stock, and which are an annoyance and a menace in the farm home.

Questions, Problems, and Exercises

1. What birds are harmful? What is the nature of the damage? How can harmful birds be destroyed? Are any birds, usually considered harmful, beneficial in some respects? Explain.

2. What some of the birds eat:*

Bluebird—68% insects, grasshoppers, beetles, caterpillars.

Kingbird—85% insects, flies, mosquitoes, locusts, blister beetles, crickets, cutworm moths.

Meadowlark—ground beetles, caterpillars, cutworms, army worms, grasshoppers, weevils, 24% weed seeds.

House Wren—grasshoppers, beetles, bugs, spiders, cutworms, wood ticks, plant lice.

Chickadee—70% insects, moths, caterpillars, beetles, ants, wasps, bugs, flies, spiders, and poison ivy berries and weed seeds.

Franklin's Gull—This is the gull that follows the ploughman. Its food is grubs, cutworms, dragon flies, beetles, ants, grasshoppers, wireworms, click beetles, May beetles, weevils.

Robin—58% wild berries, 42% worms and insects.

Song Sparrow and Chipping Sparrow—noxious weed seeds, beetles, weevils, ants, wasps, bugs, caterpillars, plant lice.

Hawks—With the exception of Sharp-shinned, Cooper's, Pigeon, and Goshawk, hawks do not maliciously attack poultry but destroy insects, mice, and gophers.

Owls—The Great-Horned or Cat Owl is the only one that destroys poultry.

3. Every school should have a copy of *Birds of Western Canada* by Taverner, Bulletin No. 41, Series No. 10, published by the Department of Mines, Ottawa. It is beautifully illustrated and gives very full information about all our Western birds. The price is $1.25 post paid.

SECTION V.—TREES

Benefits of Trees.—Trees are planted for ornament, for shelter-belts, for wind-breaks, and for groves or wood-lots. Posts, wood, and even lumber may be obtained from the latter. Trees conserve moisture, modify the climate, and purify the air. They protect the ground from the direct rays of the sun and keep it cool. As a consequence,

*From *Extension Bulletin No. 52, Manitoba, by V. W. Jackson.*

on hot days the air circulating over the ground and about the trees is cooler than elsewhere. At night the loss of heat from the ground is retarded, and the temperature is equalized. The atmosphere is thus kept cooler by day and warmer at night.

Where trees are growing, the soil, being more or less shaded, does not dry out to the same extent as in more exposed areas. Moreover, it is less beaten and is not so compact. The rains sink into it more readily. The fallen leaves act as a mulch; they check, too, the flow of water over the surface, and so prevent the washing away of good soil. Wind-breaks, by decreasing the force and effect of the wind, aid in retaining moisture in the soil. They also check the destructive force of high winds; they aid in preventing soil-drifting, and make it possible to grow crops with considerable assurance of success. Such shelter-belts, too, afford protection to stock in severe weather.

Government Aid to Tree Planting.—Tree planting on the prairies has passed the experimental stage. The experimenting has already been done by the *Experimental Farms* at Brandon in Manitoba and at Indian Head in Saskatchewan. Bulletins giving the results of these experiments and furnishing information on the kinds and varieties of trees to grow and how to plant and take care of them, etc., are now available and can be obtained by writing to The Publications Branch, Department of Agriculture, Ottawa. Anyone contemplating setting out wood-lots or shelter-belts on the prairies should write for Experimental Farm Bulletin No. 47. *Trees and Shrubs in the Northwest.* This bulletin was prepared by the late Dr. William Saunders, Director of Experimental Farms, after sixteen years of investigation and experimenting. It gives much valuable information, and all varieties of trees that may reasonably be expected to do well are listed. Forestry Branch Bulletins No. 1 and No. 72 are also very valuable. These bulletins should be in the library of every school, and they should be read and studied. The information that they contain should stimulate the teacher and school boards to beautify the school grounds by the planting of trees. This will encourage the children to similar effort on the farm lands at home.

The Nurseries at Brandon, Indian Head, and Saska-

Protected by wind-breaks of trees, sunflowers, and a willow-hedge.

toon distribute, free of charge, seedlings and cuttings for prairie tree planting, provided that certain conditions pertaining to preparation of the soil, the distance apart, the manner of planting, the care to be given the plantation etc., are fulfilled. From these stations approximately 5,000,000 trees are sent out annually for the planting of wind-breaks, shelter-belts, and wood-lots on the prairies. The results go to show that trees can be grown almost anywhere on the prairies, if the instructions are followed. Many farmers testify that tree planting has added from

$500 to $5,000 to the value of their farms. Tree planting is thus worthy of the farmer's serious consideration.

Planting.—During the season preceding that in which trees are to be planted, the ground should be well summer-fallowed in order to destroy completely all weeds and grasses. Native grasses, such as couch grass, sweet grass, and even brome grass, must be completely eradicated and kept from gaining a foothold, if the plantation is to do well. For wind-breaks and shelter-belts close planting is advocated. Four feet apart each way gives ample room for cultivation and makes a close, compact shelter. From five to seven rows is sufficient. Heavy drifts of snow may accumulate in the case of wider belts. Cultivation with a scuffler should be practised until the trees become well established. Planting is usually done with the plough. The furrow is ploughed, the seedling is set in the row, and the soil is filled in and tramped around it. Seedlings should be set about one inch deeper than they were in the nursery rows.

If trees for planting are to be selected from the woods instead of being obtained from the nurseries, care should be taken to choose only those that have been grown under conditions similar to those prevailing in the district where they are to be planted. The soil and moisture conditions of the two soils should be as nearly as possible alike, and the trees should be selected from those growing in exposed situations. A tree transferred from soil which is generally moist or wet to one which is usually dry, or a tree taken from a shady place and transplanted to a location where it is exposed to the full glare of the sun and the action of strong winds, is almost sure to die.

Trees for transplanting should not be too large; the larger the tree the more care it requires if it is to live in its new environment. From two to five feet, depending on the kind of tree, is quite large enough. It is very seldom that all of the root system can be lifted intact with the tree, and great care should be exercised in handling, so that too many of the fine feeding rootlets with their root hairs may not be torn off, or the roots be left too long exposed to the drying-out influence of the sun and air. The hole should be twice as large and deep as seems necessary to hold the root system. Fill up to the required depth with a rich loam, and set the tree about the same depth as it was before. If set too high, the roots will dry out overmuch; if set too low, they will be suffocated. The roots should be arranged in their natural position, the lower ones below and the upper respiratory roots above. The soil should be worked into close contact with the roots by means of the hands.

A wind-break of trees affords excellent protection.

If the soil is fresh and moist, water should not be added until near the end of the operation. When the hole has been filled to within two inches of the top, water may be supplied; after it has been allowed to soak in, the filling may be completed and the soil firmed by trampling. A light soil mulch may then be spread over this to prevent excessive evaporation. The tree should be staked to prevent swaying in the wind, thus causing injury to the root system before it has become established. If dry weather follows, the soil should be watered and cultivated.

Kinds of Trees.—Among the evergreens the white spruce has a leading place. But jack pine, lodgepole pine, and Scotch pine will all do quite well on the prairies. Among the broad-leaved trees the poplars, the aspen, the cottonwood, the Russian poplar, the Russian willow, and the Manitoba maple are some of the leading species successfully grown. The native birch, if it can be obtained, is a comparatively rapid grower and is a fairly hardy and comparatively long-lived tree. The cottonwoods grow rapidly, but are likely to die in about ten or twelve years. The Manitoba maple has a wide range and does well, except where it comes under the influence of the Chinook winds in the southern part of Alberta. Full information regarding all these and a considerable number of others suited to western conditions may be obtained from the Dominion Forestry Nursery Station, Indian Head, Saskatchewan.

Questions, Problems, and Exercises

1. There should be a wind-break of trees around your school and around the farm buildings at home. If you will write to Indian Head, Saskatchewan, you can get advice as to securing the trees for a wind-break.
2. Grass and weeds are enemies of trees. Keep this in mind in caring for a wind-break or shelter-belt.

SECTION VI.—PLANNING THE FARM

The well-planned farm is always a source of satisfaction and pride to its owner. Care in arrangement improves its usefulness and value. A convenient and attractive grouping of buildings should be studied.

The Fields.—In laying out the farm it is important to plan so that the fields are within easy reach of the buildings, as this means a saving in time and labor. Long fields are preferable to those which approach a square shape, because time is taken up in making the more frequent turnings necessary in working a square field.

The Farm House.—The size of the house and the arrangement of rooms must be determined by conditions, but health, convenience, and comfort must always be the first considerations. Adequate lighting and ventilation must be properly taken care of, because the two great essentials to health are fresh air and sunlight.

Only a place to dwell in.

The basement.—The basement deserves quite as much care in planning as does the rest of the house. If it is made to extend under the whole building, the rooms above will be kept warm and dry. The cellar must be well drained, and should have windows on all sides, so that it will be well lighted and aired. If possible, the furnace should be centrally placed, because this makes for economy in heating. Long smoke pipes in the basement are to be avoided. Arrangements should be made for fuel bins, for fruit storage, and for a soft-water tank. It is much better to have a root cellar outside the house, because vegetables create a dampness and a mustiness which may become disagreeable and unhealthy. A place in the cellar may be found for such conveniences as an electric light plant, a pneumatic tank, and power-driven machines for separating cream, churning, and washing.

Planning the rooms.—In planning the kitchen, good lighting and conveniences are most important. Every effort must be made to reduce the labor of the housewife. Approaches to the pantry, dining-room, basement, and upstairs must be carefully thought out, and the sink, stove, and work-table should all be conveniently arranged. If at all possible, the living-room should be large and comfortable, and should be provided with a fireplace and at least one large window. The sleeping-rooms should be well lighted and ventilated, and have good clothes closets. The house should have large verandahs and a sun-porch, if possible.

It may not look like an Alberta home, but it is! Do you know the nationality of its owner?

A Setting for the Farm Home.—There is a tendency to look upon the farm home merely as a house or as a place where the inhabitants may live, eat, and sleep, protected more or less from summer suns or winter storms. It should be that, but it should be much more than that. To be a real home, it should be not only a place in which to dwell but also a place of comfort and of beauty, a place where the weary eye may meet the restful view of tree, shrub, flower, and sky blended into a delightful picture. Trees or clumps of shrubbery surrounding the home, intermingled with the gay colors of summer flowers or the glorious tints of autumn leaves, add tremendously to its attractiveness. These are the things which elevate and enrich the lives of the people who dwell there.

Selecting the Site for the Farm House.—Such surroundings, however, can seldom be obtained without a wise selection of a location, followed by careful planning and designing. While it is true that some locations have much more natural beauty than others, it is usually possible to select for the home and buildings a location possessing a great deal of natural beauty and attractiveness. The selection of a site is of the utmost importance. Convenience to roads and to other parts of the farm is a consideration. But too often we find that this is the only consideration, and that a delightful, beautiful, and healthful location upon the farm is disregarded in favor of a dull, commonplace site that has nothing whatever to commend it except convenience. No amount of time, money, labor, or effort can ever make of such a site a place equal in beauty and attractiveness to the other. It is a mistake to allow convenience alone to determine the selection of a site. These other considerations are equally important and can frequently be provided for without much sacrifice even of convenience.

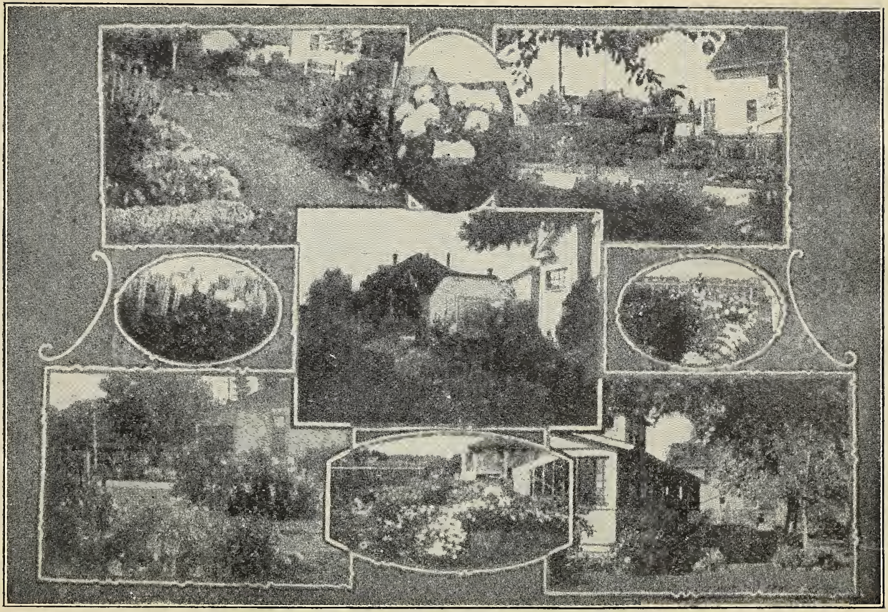
Trees, shrubs, and flowers will make a home of any house.

Arrangement of Trees, Shrubs, and Flowers.—When a location for the home and other farm buildings has been selected, there are two general methods that may be followed in adding to its beauty or improving it. There are two styles of landscape gardening. There is the geometrical style, and there is the natural style. In the geometrical, the drives, roads, and walks are all laid out on a definite plan, with regular curves or angles. The shrubs, too, and the flower beds are in regular patterns, and the trees are usually in straight rows. This style may be seen about public buildings and along city streets or boulevards. Although some farmers attempt to imitate this style, it is too formal on the farm and usually seems out of place.

For the farm the less formal style is the better. It retains as much as possible of the natural charm and

A farm home where the natural beauty has been enhanced and enriched.

beauty of the place, its lakes or streams, hills or valleys, clumps of bushes or trees. Any artificial features that are added, such as buildings, fences, lanes, drives, walks, and lawns, should be made to blend and harmonize with these. Trees should be planted so as to form shady lanes or to hide or shelter other features such as buildings or fences. Lawns should be laid out and flowers planted with the aim of beautifying the whole.



Beautiful farm homes and gardens in Alberta.

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