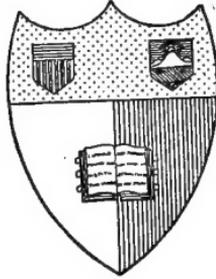


**NATURE STUDY
AND
AGRICULTURE**

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PREFACE

THIS book embodies a unified course in Nature Study and Agriculture for the common schools and for home reading. Teachers will find it a convenient manual to which they may go for information on such Nature lessons as they may wish to present. In the upper grades it should be in the hands of the pupils themselves. The various chapters need not be read consecutively, but the pupils should turn to such subjects as the course of study, the teacher, the season, or their interest may determine.

The chapters are not all designed for use in the same grade. While most of the book is suited to young and old alike, such subjects as plant diseases, soils, and farm management are of interest only to the maturer pupils, and they are therefore treated somewhat more technically.

It has long been the belief of the author that the beginning in the study of Agriculture should be made in Nature Study, in which is trained the power to see things in our physical environment as they actually are and to draw proper conclusions from them, and in which the learner acquires a good store of first-hand knowledge of plants and animals and other natural phenomena. In this book we make no attempt to draw an arbitrary dividing line between Nature Study and Agriculture. We shun the sentimental and essentially urban type of Nature Study that we have so often seen, and view Nature from the practical standpoint of those who live in actual contact with it. The aim has been to treat chiefly the topics whose study may yield knowledge of economic value. These may all be considered as belonging to a course in Agriculture. On the other hand, of the more technical subjects generally included in the comprehensive texts on general Agriculture designed for use in high schools, we present only those more essential ones usually prescribed in the modern courses of study for our common schools.

The Projects, Questions, and Experiments found at intervals throughout the book are provided in the belief that such studies are an indispensable feature of a course like the present one. Nature has the same relation to this course that the laboratory has to the study of physics and chemistry. By merely reading a book we cannot gain a genuine acquaintance with Nature any more successfully than we can learn chem-

istry and physics by that method. Our projects are designed to stimulate the all-important, direct study of Nature by personal observation and investigation. They give the definite problems and tasks that a pupil must have in order to work most effectively.

The suggestions for Oral and Written Composition deserve special attention. These exercises correlate the subject with language training in the most direct manner possible and will insure a more thorough study of the topic of the composition as well as afford a practical occasion to the learner for the clear and effective expression of his thoughts.

I am under obligation to several specialists in the North Dakota Agricultural College who read the manuscript and made many valuable suggestions. Professor H. L. Bolley read the chapter on Plant Diseases; Professor E. J. Thompson the chapters on Domestic Animals; Professor L. R. Waldron the chapter on Wild Flowers; Mr. O. A. Bartont, Assistant State Club Leader, read the chapter on Boys' and Girls' Clubs; and Dean C. B. Waldron read most of the remainder of the book. To Dean Waldron I am also indebted for the Introduction, which he has kindly written.

Although the larger portion of the illustrations are from photographs and drawings made expressly for this work by myself or under my immediate direction, it was manifestly impossible for me to cover the entire range of the book without assistance. I am especially indebted to the following: to the United States Department of Agriculture for photographs of about fifty birds, about half of the farm animals, and seven or eight of the wild animals; also for permission to reproduce from various Farmers' Bulletins many of the line drawings of insects; to the North Dakota Agricultural College for eight or ten photographs, and permission to reproduce several figures from its publications; to the Minnesota Agricultural College for permission to reproduce from its publications several of the insect figures, and to Dr. William S. Riley of the same institution for lending me the engraving of the Minnesota Fly Trap; to the Comstock Publishing Company for about a dozen illustrations; and to Little, Brown, and Company for permission to reproduce eight figures from Baird, Brewster, and Ridgeway's *Birds of North America*.

C. C. S.

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INTRODUCTION

THE old-time question as to what knowledge is of most worth is forever being asked anew, while the answers are as varying as are the ideas and experiences of those to whom the query is propounded. It belongs to that class of questions that cannot be answered in a dogmatic or categorical fashion, and yet those engaged in teaching must meet the question fairly and dispose of it in some practical manner. Speaking generally, we may say that that knowledge which makes us most effective and useful as citizens and at the same time enables us to appreciate and understand the part of the world with which we are likely to come into the closest contact is of the most worth.

We are not to understand from this that the useful citizen is he only who can produce most abundantly of material things; nor that our appreciation and understanding should not extend to the finer and more spiritual things of life. The point that should be kept clear is that the major part of one's education should center about the things that will be of direct value and interest in the life of the individual. Nor should he be compelled to go outside the schools to obtain all the knowledge and skill that will be demanded in later years.

The realization of this fact by the more progressive educators has led to the production of a type of school literature that we scarcely hoped for twenty years ago. Many of these publications are designed to be used wholly as textbooks by special students; while others, of which the present work is an example, are well suited for school use and for general reading by young and old alike. The author has succeeded in bringing together within a

small compass a large amount of most useful information, and has presented it in such an attractive manner as to make it interesting in itself and sure to create enthusiasm that will lead to further study. He has described in an elementary work the most recent findings of science — such as we usually expect to read about only in more advanced texts.

While not pretending to be exhaustive, the work has in a high degree the quality of accuracy; and the manner in which it seeks to arouse inquiry and develop originality on the part of the student should recommend it to those who are seeking to create an interest in nature study and relate it to the important business of agriculture.

C. B. WALDRON.

*Dean of Agriculture, North Dakota
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FARGO, NORTH DAKOTA

NATURE STUDY AND AGRICULTURE

CHAPTER I

PLANTS: IMPORTANCE, CULTIVATION, AND IMPROVEMENT

Importance of Plants. — The earth is the source of all wealth. From the earth's crust we get stone and clay for our building materials, coal for our fuel, and iron and other metals so necessary for our modern industries. But the plants produced by the earth are the most important source of all wealth, for without them all animals, including man, would starve.

Plants take from the earth and the air the inorganic substances on which they are nourished and make them into the organic substances on which animals feed. The vegetable kingdom thus serves as a connecting link through which the mineral kingdom indirectly supports the animal kingdom. Even if we live partly on meats, we must bear in mind that the animals from which these meats come are dependent upon a vegetable diet.

Moreover, we are not only indebted to plants for our bread, our fruits, and our vegetables, but also for lumber to build our homes, fibers to make our clothing, and drugs to make us well when we are ill.

Edible Parts of Plants. — All parts of the plant may contain nourishment capable of supporting animal life. Horses, cattle, sheep, and many other animals may eat the entire plant, either green or dried, and ordinarily they eat it in a raw state. The human palate and stomach, however, are more particular. It is usually necessary to cook food in order to develop the flavor and make it more digestible, and generally mankind uses for food only a small part of the plant. In a very few instances, as in beet "greens," we eat the whole plant; more frequently we eat the leaves, as in case of lettuce and cabbage. In many important cases it is the roots that we use, as sweet potatoes, carrots, turnips, parsnips, and radishes; while the common white potato is a form of underground stem called a tuber.

It is in the fruit, however, that the plant stores its richest food, for that contains the seed upon which it depends for the perpetuation of the species. By *fruit* we mean, here, the seeds together with the vessel which contains them. Sometimes it is the seed-vessel that we prize, as in apples and pears, melons and cucumbers, tomatoes and egg plants; but in our most important and most nourishing plant foods it is the seeds alone that are used. We refer to the cereals (wheat, rye, barley, oats, rice, and corn) and the legumes (peas, beans, and lentils). These seeds form the staple food of civilized man in practically all parts of the world.

Cultivation and Improvement. — Of the countless number and variety of plants which the land produces, many grow wild, cared for only by the hand of nature, while others have been domesticated and made more or less dependent on the care of man. To the latter class people have long given their chief attention, for most of our common food plants have been under cultivation from prehistoric times. For example,

wheat, barley, oats, beans, peas, radishes, beets, carrots, turnips, onions, lettuce, cabbage, apples, and pears were cultivated in Europe, Egypt, or southern Asia at the beginning of the Christian era, and most of them at least two thousand years before that time. These were brought to America by the early colonists.

On the other hand, Indian corn, potatoes, sweet potatoes, tomatoes, pumpkins, and squash were not known to our ancestors until the discovery of the western continent, where they had been cultivated for many centuries by the Peruvians and Aztecs, and in some cases by Indian tribes living farther north.

Modifications in these plants have been going on ever since they were domesticated, so that it is now difficult to tell what may have been their condition in the wild state. But we know that some of them were so inferior that we should hardly consider them fit to eat, and they would not be recognized by an untrained person as the ancestors of our rich food-producing varieties if placed side by side with them. Most of the improvements have been brought about very gradually by cultivation and selection.

Even at the present time every farmer and gardener, whether engaged in raising field crops, vegetables, fruits, or flowers, constantly aims to produce the largest possible



BARLEY HEADS

Showing result of seven years of breeding. The variety represented by the head on the right was developed from the one represented by the head on the left.

yield and the best possible quality, and may in that way gradually, though perhaps unconsciously, help to develop improved strains. Besides that, many specialists are devoting their knowledge and skill to the difficult task of producing varieties that shall serve our needs more abundantly.

It is perhaps needless to add that whatever may be our purpose in raising plants, — whether we want a good crop of corn or a fine display of flowers, or to develop more beautiful, more hardy, or more productive varieties, we must have a practical knowledge of the nature of plants and the laws of their growth. Not only is this knowledge of the utmost value, but the study of the subject is wonderfully interesting to every inquiring mind.

CHAPTER II

GARDENING

On the little farm in the state of Wisconsin where I grew up, the garden occupied a place of commanding importance. It furnished the fruits and vegetables that formed an important part of the family food supply, and to this day fond memory brings to mind visions of apple blossoms and roses and lilacs, and asters and pansies and poppies.

In this garden our parents assigned to each child a small patch of ground for his own flower-bed, which he himself planted and cultivated throughout the season. There was nothing said about Nature Study in those days; but no better introduction to the beauties and the wonders of plant life has yet been devised, and it is now commonly agreed that every boy and girl should have a garden.

The housekeeper looks upon the garden as a convenient source of supplies for the kitchen, the true gardener finds real pleasure in his plants, but the teacher values the garden as a means of educating the gardener, for the knowledge he gains in the course of his work is fundamental and of great value. Any one of these benefits alone is sufficient compensation, but as a matter of fact we may easily secure all of them at the same time.

We shall treat the subject under the two headings, (1) Flowers and (2) Vegetables.

FLOWERS

Annuals. — The most extensively planted flowers are the annuals. They yield the quickest returns. It takes several years to establish a good lot of perennials, but the annuals reward us with a rich harvest of bloom the same season that the seeds are sown.

Hardy Annuals and Tender Annuals. — The seeds of many annuals may be planted in the open ground as early in the spring as it can be worked, or at about the time when wheat is seeded on the farm. Such plants are usually distinguished in the seed catalogues as “hardy annuals.” Others are of tropical origin and are more tender. They cannot be planted out of doors till the ground is warm and danger of frost is past, — that is, at about the time for planting corn and melons and cucumbers. In many cases this is too late to bring them into bloom in good season, and they must be started in the house while it is still too cold for them outside.

Season of Growth. — This early planting indoors should also include some of the more hardy species. It must be borne in mind that the period of growth before a plant will bloom varies greatly with different species. Some will blossom in ten or twelve weeks; others require so long a period that they cannot be used at all in the northern states. Moreover, we do not want to wait for all our flowers till late in autumn.

Planting Annuals. — In the northwestern states the following plan is a good one :

1. In March, plant in shallow boxes in the house asters, pansies,¹ verbenas, petunias, zinnias, ageratums, stocks, and

¹ These pansies should begin to blossom late in summer, then live in the ground over winter, and resume their season of bloom early next spring. They may be regarded as biennials.

balsams. Transplant these into the garden when the ground is warm and danger of frost is over.

2. Plant sweet peas out of doors as soon as frost is out of the ground to a sufficient depth.

3. A little later, as soon as the ground is fit to work, plant nasturtium, sweet alyssum, candytuft, mignonette, annual phlox, annual poppies, morning glory, calliopsis, bachelor's button.

Perennials.—Perennials grow and blossom several years in succession,—some of them running out after two or three years, and others continuing to live for a practically unlimited period of time if the clumps are divided and reset. Plants of good size may be procured in the spring from dealers, and if they grow they should blossom the same summer. It is



CHINA ASTERS

much cheaper, however, to raise the plants from seeds; but that is a slower process, as most perennials do not bloom till the second year.

Some of the perennials, as the peonies and irises, do not "breed true" from seeds, and are started by the division of old clumps. Most perennials multiply each year, and the plants finally become so crowded that they are unable to secure sufficient nourishment. It is then best to take up the whole clump, cut it into pieces, and set these in fresh soil.

All herbaceous perennials die down to the ground in the fall, but their roots must be hardy enough to stand the winter freezing. There are a few tender perennials, however, such as the dahlia, canna, and gladiolus, that are among our most popular plants. These have fleshy roots or bulbs that are dug up in the fall and taken to a place of safety for the winter.



COSMOS



CALIFORNIA POPPY

Another requirement that a perennial must meet is that it shall blossom before the autumn frosts. Many kinds require too long a growing season for our northern states, and would not blossom here even if we could carry them through the winter.

Planting Perennials. — The most desirable perennials for the northwest are planted as follows :

1. Sow the seeds of the following early in the summer in a reserve bed, then early in the fall, or the next spring, transplant

to the place where they are to blossom the second summer and thereafter: hollyhock, larkspur, columbine, Iceland poppy, oriental poppy, golden glow, perennial flax, perennial phlox, baby's breath, sweet William, foxglove.

2. Irises and peonies are propagated by division of old clumps as explained elsewhere, and plants must be secured from friends or from dealers. They may be set out in early spring or in autumn.

3. Hardy bulbs are planted in the open ground as early in the fall as they can be procured from dealers. Those of easiest culture are tulips, tiger lilies, and crocuses.

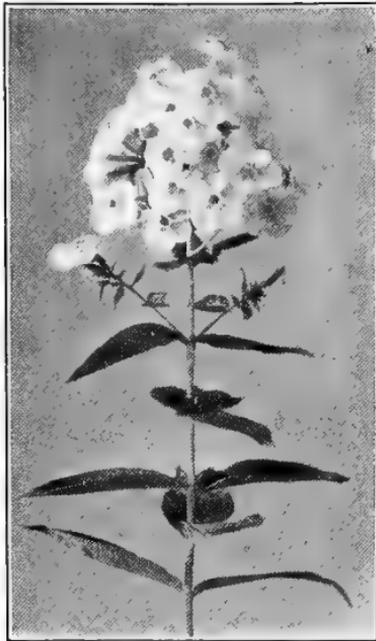
4. Gladiolus bulbs are planted in the spring as early as the ground can be worked — 6 inches apart and 3 inches deep. Dahlia roots should be laid on wet sand in a moderately warm place

for about 3 weeks to start the sprouts. Then plant them in the garden at potato-planting time — 2 feet apart and 5 inches deep. Dahlias may also be raised from seed like annuals, starting them in the house in March. In the fall, after the frost kills the plants, the gladiolus bulbs and dahlia roots are dug up and stored in a cool



PEONIES

cellar. Cover them with a little sand or earth so they will not dry out too much. Plant them again the following spring.



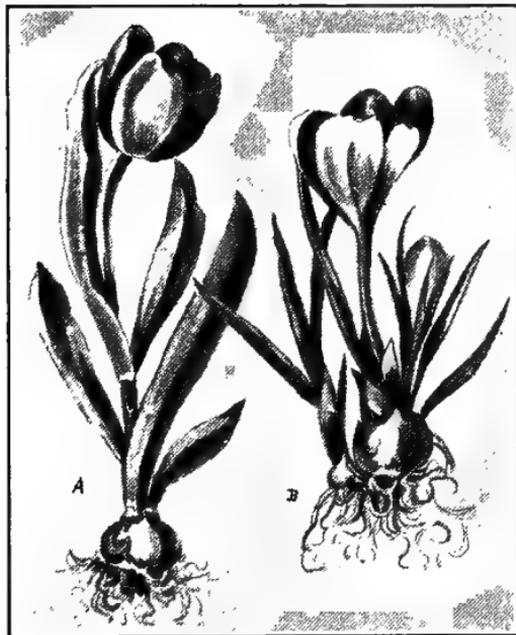
PERENNIAL PHLOX



IRIS

The Soil: Cultivation. — It is very important that the flower bed should have rich and mellow soil, for the finest blossoms are borne on the thriftiest plants. Of course all the principles of soil cultivation hold true in the case of flowers: (1) They must be kept free from weeds. (2) The hoe must be used at frequent intervals to preserve the dust blanket and conserve moisture. (3) The ground must not be cultivated when it is too wet. (4) In dry seasons it is well to water the plants, and it is best to do this late in the afternoon and then cultivate the ground the next morning.

Shelter. — It is desirable that the plants should be somewhat shielded from the wind, which is apt to break and mar the flowers, and the best way to secure this protection is by means of trees and shrubs. Flowers look best and thrive best when used as borders on the south or east side of shrubbery. If desired, some of them may also be planted close to the house.



A. TULIP. B. CROCUS



TIGER LILY

Suggestions for Beginners. — You will probably know people in the neighborhood who have flowers. Learn all you can from them. Let them show you their plants and tell you their names, and when and how to start them and care for them. Then begin your garden by planting those of easy culture that have already been found successful in your vicinity, and add a few new ones to the list from year to year, thus enlarging your acquaintance.

There are many enterprising dealers in seeds and flowers

who publish instructive illustrated catalogues, and it will help you to have a few of these and to study them. In making a selection we must bear in mind that plants do not grow equally



CACTUS DAHLIAS

well in all climates, and those that are highly recommended for one locality may not thrive at all in yours. Therefore, generally speaking, the catalogues published by dealers nearest to your home give more reliable information than those published at a great distance.

VEGETABLES

This topic may be treated very briefly, because a good part of what has just been said about flower culture is equally applicable to the growing of vege-

tables. The different kinds are planted as here suggested:

1. Start the following in the house in March: tomatoes, celery, cauliflower, cabbage. Set them out in the garden when the ground is warm. Bear in mind that tomatoes are easily frozen, but they need as long a season as possible.

2. Plant the following as early as the ground can

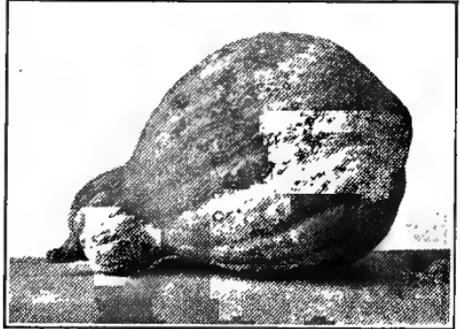


PARSNIPS

be worked: radishes, onions, lettuce, peas, spinach, beets, carrots, turnips, rutabagas, parsnips, salsify. For a succession of crops plant more of these later: radishes, peas, lettuce, spinach.

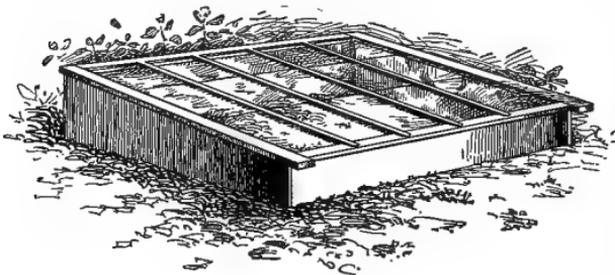
3. Plant when the ground is warm and danger from frost is over : beans, sweet corn, melons, cucumbers, pumpkins, squash.

4. Perennials. (a) One of the most valuable of all vegetables is asparagus, and every family that is fond of it should raise it. Two or three years are needed for the plants to acquire sufficient strength to yield a good crop, but once established the asparagus bed requires very little labor and lasts a lifetime. The roots may be secured from dealers and set out early in the fall or early in the spring. The chief requirement for success is an abundance of fertilizer.



HUBBARD SQUASH

(b) Rhubarb or pie-plant is usually started by division of old clumps. Very often a person can secure a clump for



A HOTBED

that purpose from a neighbor. Set the plants three or four feet apart in the row.

(c) Horse-radish is started by setting pieces of small roots in the

ground so that one end is near the surface. A few of the roots may be planted in an unused corner of the vegetable garden.

Hotbeds. — In the hotbed we may produce early vegetables for table use in the spring long before they could be raised in

the open garden. The hotbed is also a convenient place to grow a good supply of flower and vegetable plants for transplanting in the garden when the weather becomes warm enough. Directions for the construction and use of hotbeds may be found in any good book on gardening.

PROJECTS FOR THE HOME GARDEN

The gardening operations at home should include as many of these projects as possible. If more specific directions are needed, they may be found in the special works on gardening named at the end of this book. Some of those should be on the shelves of the school library.

THE FLOWER GARDEN

1. *Sow seeds early, indoors.* — Raise at least five of the annuals to be started in boxes as suggested in the first paragraph under "Planting Annuals," page 6. It is a good plan to raise more seedlings than you need, and when they are ready to transplant, exchange with other persons and thus get a larger variety.

2. *Sweet peas.* — Raise a 15-foot row of the finest sweet peas.

3. *Other annuals.* — Raise at least five of the annuals suggested in paragraph 3, page 7, for seeding in the open ground.

4. *Perennials from seed.* — Raise at least five of the perennials as explained in the first paragraph under "Planting Perennials," page 8. It is well to sow a large variety as some of them may fail to come up.

5. *Iris and peony.* — Secure roots of one or both of these flowers from friends or dealers. You should have several clumps of each, and it is well to have a variety of colors. Plant them in good, rich soil.

6. *Hardy bulbs.* — In early autumn secure 20 or 30 tulip bulbs from a dealer and as many bulbs as you desire of one or two other flowers of this class. Plant the tulip bulbs from three to five inches deep. Smaller bulbs are planted two or three inches deep.

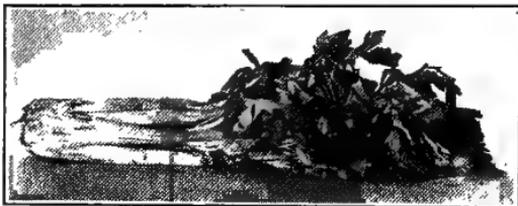
7. *Dahlia and gladiolus.* — Raise at least half a dozen dahlia and one or two dozen gladiolus plants. It will be more instructive and probably more interesting to have each of these flowers in several colors.

THE VEGETABLE GARDEN

8. *Sow seeds early, indoors.* — Raise a family supply of at least two of these: tomatoes, celery, cabbage, cauliflower.

9. *Plant in the garden, early.* — Raise a family supply of at least five of the vegetables suggested in paragraph 2, page 12, for early planting in the open ground.

10. *Plant later.* — Raise a family supply of at least three of the vegetables that are planted when the ground is warm, as suggested in paragraph 3, page 13.



CELERY

11. *Asparagus.* — Plant an asparagus bed, unless

you already have one. Probably from 100 to 200 plants will be sufficient to supply your family. Be sure to prepare the bed properly by digging a trench for each row and spading in plenty of manure to a depth of two feet, so that the roots will find very rich soil.

12. *Rhubarb and horseradish.* — If your place is not supplied with rhubarb and horseradish, secure plants and set them out.

ORAL AND WRITTEN COMPOSITION

13. The most original and profitable sort of exercise in composition is a good account of your own experiences; and a clear report of your gardening operations will be interesting and instructive to your classmates. The following themes are especially suitable.

a. *Sweet peas* (or other annual flowers). — Kinds selected, preparation of seed bed, when planted, subsequent care, blossoming time, cutting the flowers, beauty of the flowers, etc. Project numbers 2 and 3.

b. *How to raise perennials.* — Project 4.

c. *My experience with dahlias* (or gladioli). — Project 7.

d. *Our asparagus bed.* — When and how it was started, later care, tips cut when and how often, how they are appreciated, etc. Project 11.

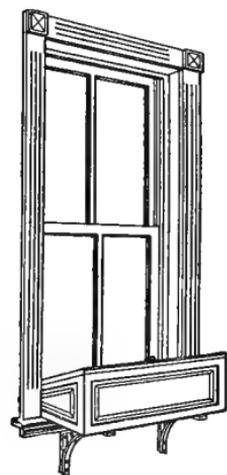
CHAPTER III

SCHOOL GARDENS

As the garden is so valuable a factor in education it is well to make the systematic use of it a regular part of the course of study. In our northern states, where a large portion of the growing season comes during the long summer vacation, the ordinary outdoor garden near the schoolhouse may not

always be feasible; but, even without that, the educational aim of the garden may be realized in good measure.

Many of the lessons in plant life that the advocates of the school garden have in view may be learned indoors, as explained in the following paragraphs.



A WINDOW BOX

Window Gardening. — This term designates the growing of plants in boxes and pots in sunny windows. The window garden has great possibilities for schools, because by this means plant studies may be carried on at all seasons of the year, unless the schoolroom is subject to freezing, and in

that case operations need to be suspended only during the coldest months.

Consolidated schools and all others of the better type should be provided with a small, well-heated conservatory, or a well-lighted alcove, on the south side of the house, where the possibilities of the window garden may be easily realized.

Such a feature of the schoolhouse would be of utmost value whether an outdoor garden is operated all summer, or part of it, or not at all. However, in the absence of this convenience we may make use of ordinary windows.

There are named below a few classes of plants that may be grown in the window garden and studied.

1. *Decorative House Plants.*

— Many lessons in plant growth may be learned from house plants if the pupils aid in starting them and caring for them. During the long vacation, if the school building is unoccupied, they may be taken home by pupils and returned again when wanted. This plan may also be followed during the coldest part

of the winter, if they are in danger of freezing in the schoolhouse. Among the plants most suitable for this purpose are the begonia, geranium, wandering Jew, fuchsia, heliotrope, English ivy, oxalis, cyclamen, and fern. The first six of these are started from cuttings, oxalis from bulbs, and cyclamen from seeds.

2. *Annuals and Perennials.* — Sow the seeds early in the spring in order to study their germination and growth. Use the seeds of vegetables and field crops as well as flowers. When the plants are ready, some of them may be transferred to the outdoor school garden, if there is one, and others may be taken home and set out there.



YOUNG TOMATO PLANT IN
FLOWER POT

3. *Bulbous Plants.* — The growth of flowers from bulbs is very fascinating and should be popular with teachers and pupils. Flowers of unrivaled beauty and great variety of color and form may be enjoyed from Christmas till spring



DUTCH HYACINTH

when other flowers are exceedingly rare. The cost is but nominal and the trouble but slight. Those of easiest culture are the Chinese lily, narcissus, and hyacinth.

Bulbs may be planted at any time from September to December, according to the time when they are wanted to bloom. The Chinese lily is usually planted in a shallow dish of water with pebbles placed around the bulb to hold it in place. Some of the hyacinths and narcissi may also be planted in this way. But most of the bulbs should be planted in pots of earth.

Trees and Shrubs. — The first step in improving the school premises is to fence the grounds and put the soil in proper condition by plowing and cultivating. Next should come the planting of trees and shrubbery and vines. At least this much should be done at every schoolhouse. It would make the surroundings more attractive and provide material for one very profitable line of Nature Study. Then, if conditions are favorable, perennials may readily be added to the permanent planting, and annuals may be put in from year to year.

Flower and Vegetable Garden.— In cities and towns, where the pupils live conveniently near the schoolhouse, a flower and vegetable garden may be operated successfully all summer, if a competent director is employed to supervise the children's work during the vacation. One of the chief aims of such an enterprise should be to stimulate more attention to home gardening.

In the ordinary type of rural school this sort of garden has not often been a success. The seeds may be sown in the



DUTCH HYACINTH BULBS

spring and about the time they begin to grow there comes the long vacation. Then the garden is surrendered to the weeds, and nothing else can be found when the pupils return for the fall term. This lesson in neglect is likely to offset such benefits as were derived from the planting operations in the spring.

Coöperate with the Home.— Whether or not the school has a flower and vegetable garden, its most important office is to coöperate with the gardening activities of the home. The school interests must be identified with the home interests, and in this matter it is especially easy to meet this requirement. From the various studies in plant growth the pupil should get practical and scientific knowledge that

will be a help to him whether he engage in raising field crops, or flowers and vegetables, or trees and shrubs. To the home garden the experiments in germination outlined in the next chapter should make a special contribution. Many of the plants started in the schoolhouse may be taken home when ready to set out, and in due time specimens of flowers and vegetables should be brought to school with instructive reports by the pupils who raised them.

The Projects which follow are the practical and more valuable portion of this chapter. The reader who is interested in the school garden is reminded that all of Part I of this book is devoted to plant life and, therefore, helps him to understand the principles and problems involved.

PROJECTS

1. *Bulb culture.* — As early in the fall as they come into the market, usually about the middle of October, secure some narcissus and hyacinth bulbs. Take flower pots, or tin cans with holes in the bottom for drainage, fill them with the best and richest soil you can find, and set the bulbs so that the top will be just covered with earth. In the case of hyacinths the tip of the bulb may be allowed to show above the dirt. After watering set the pots away in a cool cellar and cover them with several inches of earth or coal ashes. This favors the growth of a good root system before the top develops.

In six or eight weeks the bulbs should have good roots and the tops should begin to grow. Now transfer them to a warm, well-lighted room and give them plenty of water. Let them have some sunshine, especially when the flowers begin to open.

2. *Decorative house plants.* — Secure cuttings or slips of begonia, geranium, wandering Jew, and other good house plants and get some friend to tell you or show you how to plant them. Then keep them in the schoolroom and care for them. Whenever you have an opportunity, add to the collection and get as good a variety as possible. These plants will make the room more home-like and at the same time afford a means of increasing your knowledge of plant life.

3. *Flower and vegetable seedlings.* — About the first or middle of March plant flower and vegetable seeds in window boxes as suggested in this chapter and elsewhere. When the plants have developed four or five leaves, transplant them, giving them ample room to grow. As soon as danger of frost is over, take them home and set them out in your garden. If you have a school garden, some of them will, of course, be planted in that.

4. *Trees and shrubs.* — Study the subject of trees and shrubs for your school grounds. (a) If a good many are already found there, can



AN EGG-SHELL EXPERIMENT FARM

The plants from left to right are: cabbage, field corn, pop-corn, wheat, buckwheat.

you suggest any further improvements in the planting? Give details. (b) If a good start has not yet been made, then draw up a planting plan in accordance with the suggestions in this chapter and discuss it with the trustees and patrons of the school. Perhaps you can help to make your school grounds more attractive.

5. *Seeds, germination, and seedlings.* — The window garden affords a convenient plan for conducting the study of seeds and their germination as outlined in a previous chapter. In fact, those experiments are probably the most important thing for which the window garden may be used.

6. *Other exercises and projects* suitable for the school garden and window garden may be found at the end of the chapter on Soils, and many others may easily be devised by any teacher who is interested in investigating or illustrating the science and art of raising plants.

7. *Oral or written composition.* — Give a carefully prepared account, either oral or written, of your experience in carrying out some of the suggestions in this chapter. Be sure to make your report clear as well as interesting. Some of the preceding projects would be suitable; for example,

a. *How to grow hyacinths* (or other bulbous plants). Project No. 1.

b. *From slip to flower*, or the history of my geranium (or other house plant). No. 2.

c. *Ornamental planting on our school grounds* (illustrated with a map). No. 4.

CHAPTER IV

SEEDS, GERMINATION; AND SEEDLINGS; EXPERIMENTS

Germination is a most fascinating stage of plant growth and the following studies should be fruitful for students of all ages. Special care must be taken, however, to make them effective, for it is much easier to sprout seeds and leave them to be stared at aimlessly than to make sure of "getting the point." The observation must be definite. The student should note exactly what he is to learn in each experiment and he should not be satisfied until by trial and observation he has found out the facts from Nature herself. The teacher should always call attention to the practical use that the farmer and gardener make of the facts observed.

Oral and Written Composition.—The preparation of a clear report of an experiment will insure a good understanding of it, and it is also a profitable exercise in composition.

MATERIALS REQUIRED.—A handful of beans, peas, wheat, Indian corn, and squash or pumpkin seeds. To supplement these a few other large seeds are desirable, such as oats, watermelon, cucumber, flax, sunflower, morning glory, and box elder. Also some sand, earth, sawdust, blotting paper, flower pots, small wooden boxes, tin pans or cans, and other receptacles in which to plant seeds. Also some mosquito netting or coarse cheese cloth, small panes of glass, and glass tumblers.

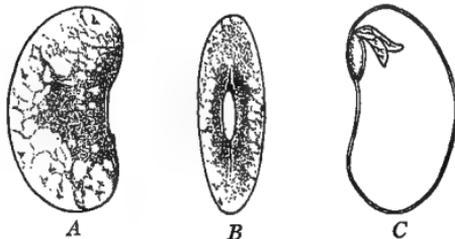
1. To learn: *How to make seeds sprout.*

Put different kinds of seeds on wet sawdust, sand, earth, blotting paper, cloth, or sponge. After the seeds are soaked, they must not lie in water, nor must they be allowed to become dry. To prevent

evaporation cover them with a piece of glass, an inverted tumbler, or other convenient object. Keep in a warm place.

2. To learn: *What are the first signs of germination?*

Watch the seeds in the preceding experiment and see (a) what change takes place in their size, and (b) what comes out when the seed coat is broken, — does the *plumule* (upper part) or *caulicle* (root end) appear first? To answer the last question, observe the growth of the young plants till you can recognize the root.



A BEAN SEED

A, as seen from the side; B, an edge view, showing the scar by which the seed was attached; C, with one half of the seed coat and one seed leaf removed, showing the plumule, radicle, and remaining seed leaf.

part or plumule of the baby plant. Now take a large bean that has been soaked in water only one day. You will find the embryo there also, but it is smaller. Dissect kernels of corn that have germinated for several days and try to find the embryo.

3. To learn: *To find the embryo or young plantlet in the seed.*

Take a bean that began to germinate several days ago as in Experiment 1. Separate the two halves and examine what you find between them. You should easily recognize the upper

4. To learn: *Will seeds germinate well without air?*

Take a small bottle, put some damp blotting paper on the bottom of it, and then fill it three quarters full of soaked seeds. Now close the bottle tightly with a rubber stopper, or with a cork well covered with melted paraffine or tallow.

Place a few other seeds of the same kind, and similarly soaked, in a second bottle with damp blotting paper on the bottom. Cover this bottle loosely to prevent evaporation but allow access of air. Place the bottles side by side so that they will have the same conditions of heat and light. Watch the results.

5. To learn: *How to test seeds.*

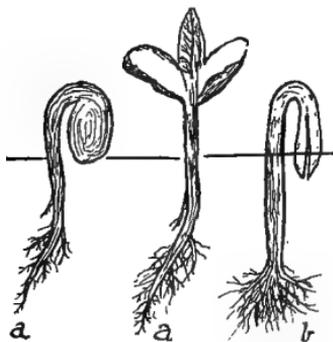
Take a deep pie plate, nearly fill it with sand, and cover the sand with a circle of unglazed paper. Wet the paper and sand thoroughly. Lay on the paper a hundred seeds of each kind to be tested, then cover it with more wet paper and another pie plate, or a board, or a pane of glass, to hold moisture until the seeds are germinated. Then count them out as "strong," "medium," "weak," or "dead."



A SEED TESTER

6. To learn: *How beans come up.*

Plant some beans in soil or sand, at least an inch deep, and when they come up, observe the process very carefully. What becomes of the cotyledons or seed leaves? Make two or three drawings showing different stages of this early growth of the bean.



a. Showing how beans come up.

b. Showing how squash, pumpkins, and melons come up.

7. To learn: *How squash, pumpkins, and melons come up.*

Plant these seeds in soil or sand and observe how they come up. Compare them with each other and with the bean. What becomes of the cotyledons in these cases? Watch them for a week after they are up and see if the cotyledons meet the same fate as those in the bean. Make a few drawings.

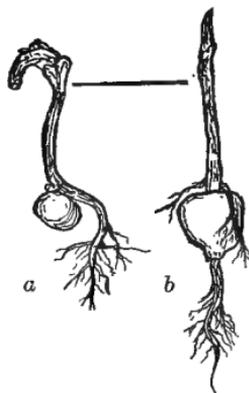
8. To learn: *How peas come up.*

Plant some peas in sand or earth and when they come up observe: (a) Does the tip point straight up as it comes out of the ground, or is it bent over? What advantage do you see in this? (b) Do the seed leaves come out of the ground, or what becomes of them? Dig up a

plant and see. Make two or three drawings showing how peas sprout and come up.

9. To learn: *How corn comes up.*

Plant some corn and observe the same points as in the preceding experiment. How many seed leaves in the case of corn? Do they come above the ground? Does the plant come out of the ground pointing straight up or is it arched over?



a. Showing how peas come up.

b. Showing how corn, the grains, and the grasses come up.

10. To learn: *The effect of too much moisture on germinating seeds.*

In a tin can or tumbler filled with soil, plant some flax seed and keep the soil saturated so that water may be seen upon the surface. Keep in a place warm enough for germinating. If the plants come up do they look healthy? Describe them. Have you ever observed the same appearance in fields that were too wet?

11. To learn: *The effect of drought on sprouting seeds.*

Sprout several kinds of seeds, as wheat, corn, and flax. (a) When the sprouts are about half an inch long, remove some of the seeds and let them become dry, then wet them and see if they will start growing again. (b) Dry some more seeds when the sprouts are an inch long. Then wet them and see whether they will grow again.

12. To learn: *Effect of drought on seedlings after they are up.*

Take two flower pots full of moist soil and plant about ten kernels of grain in each. After the kernels have sprouted, water one pot frequently, but give the other no water. Compare the condition of the plants in the two pots at intervals. How soon does the drought kill the plants in the dry pot?

13. To learn: *The effect of cold on plant growth.*

Have in a box or flower pot a few seedlings of beans, peas, wheat, and corn, and in another a duplicate set of seedlings. Keep one set in the warm room and the other in a cool place. Note the difference in rapidity of growth.

If you have this experiment in the spring when the weather is still cold enough, let one set of plants be nipped by the frost. Do all these species suffer alike from frost? How does frost affect the young wheat plant? Corn? Beans? Peas?

14. To learn: *The result of letting seeds get wet during winter.*

Take a dozen kernels of corn, and soak half of them in water for several hours. Then put these wet seeds as well as the dry ones in a cold place and let them freeze thoroughly. Then plant them and see which grow better, those that were dry or those that were wet when they froze.

15. To learn: *Is sunlight necessary for germination? Is it necessary for plant growth?*

Take two flower pots or small boxes and plant several kernels of corn in each. Keep one of them in good light, and keep the other in a dark place, or invert a box over it so as to darken it. Do the seeds that are kept in the dark come up as soon as the others? Watch them for a few weeks after they are up. What is the effect of darkness on growing plants?

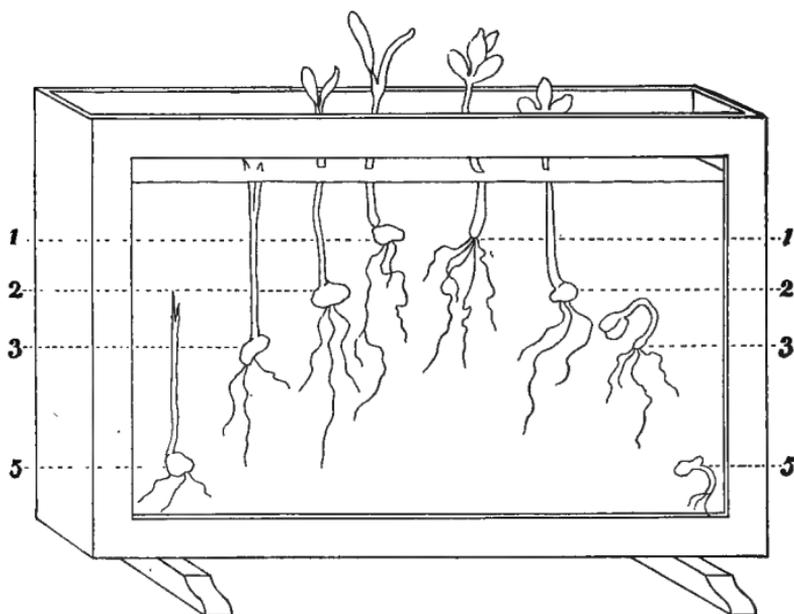
16. To learn: *Should various kinds of seeds be planted at the same depth?*

Take seeds of corn, beans, peas, cucumber, flax, wheat, and radish. Plant a few of each kind an inch deep, and a few of each kind two, three, four, and five inches deep. Observe results. Which came up first? Did all the seeds come up? Which grew the most vigorously?

17. To learn: *The effect of age on the vitality of seeds.*

Take some wheat or any other seed that is several years old. It is desirable to know just how old it is. Plant, say, a hundred kernels

and note how many germinate. Is this as good a proportion as would grow in the case of fresh seeds? If you can get several kinds of seeds of the same age, test them and ascertain whether some kinds have retained their vitality better than others. The seed testers described in Experiment 5 may be used.



PROPER DEPTH TO PLANT SEEDS

This box has a glass side and the seeds are planted next to that so their growth may be observed. To keep out the light the glass may be covered with black cloth or paper. A large, wide-mouthed bottle may be substituted for the box.

18. To learn: *Will a large, plump seed give a better plant than a small or shrunken seed?*

Plant several kernels of shrunken wheat and the same number of plump kernels. Keep the two lots under similar conditions and remember which is which. Note the results. Which kind came up first? Which produced the stronger plants? Try the experiment with Indian corn, comparing the kernels from the center of the ear with the small kernels near the tip. Try several other kinds, comparing large seeds with small ones of the same species.

19. To learn: *Are the cotyledons of the pea and bean of any use to the seedling?*

Sprout several peas and beans on blotting paper, or take some of those sprouted in Experiment 1. When the plumules appear, carefully cut away the cotyledons and set the plantlets, thus robbed, on mosquito netting or paper tied over the surface of a jar or glass of water, the roots hanging down in the water. Put with them some seeds similarly sprouted, but not mutilated. Let them grow for some weeks and note results.

20. To learn: *What is the relation of the number of cotyledons to the venation of leaves?*

Observe all the seeds you have been germinating in your experiments and arrange them in two lists. In one list include all that have but one cotyledon and in the other list place those that have two cotyledons. Then examine older plants of the same species and notice which have parallel-veined leaves and which have netted-veined leaves. Now answer the question, How is the number of cotyledons related to the venation of the leaves?

NOTES ON THE FOREGOING EXPERIMENTS

1. By a little experience the student will easily learn how to germinate seeds successfully. For the purpose of the first three experiments the seeds are not to be planted, but to be kept in full view so that the pupils may see exactly what takes place as they sprout. It is well to treat them by several of the methods mentioned.

2. (a) That the seeds swell as a result of absorbing moisture may be seen by putting some dry ones side by side with soaked seeds of the same kind. Or, fill a small cup with wheat or corn and pour on water enough to cover it. The water will all be absorbed and the grain will swell and run over. (b) The radicle or caulicle comes out from the seed coat before the plumule.

3. All seeds contain an embryo more or less perfectly developed. In many of them, such as the bean, pea, squash, and morning glory, this embryo constitutes the entire seed; while in others, such as corn and wheat, a good part of the seed consists of food that is stored outside of

the germ. Of course, in some seeds the embryo is better developed and more easily found than in others.

In case of the bean, the two halves are the seed-leaves or cotyledons. Between them, near one end, lies the plumule, which is the bud of that portion of the plant that will rise above the cotyledons. The little peg near the plumule, just outside the cotyledons, and attached to them and to the plumule, is the caulicle or radicle, the rudimentary stem which supports the cotyledons and pushes them out of the ground as it elongates, and from the lower end of which the roots spring.

4. This experiment will establish the very important fact that air is necessary for germination. Seeds planted too deep, or in ground that is packed too hard, or in ground that is water-soaked cannot sprout, because air cannot get to them.

5. When farmers or gardeners are in doubt about the viability of their seeds they test them before planting them and thus avoid disappointment afterward. This experiment gives a good way to conduct the test. Record the results in this form :

SAMPLE	TOTAL	STRONG	MEDIUM	WEAK	DEAD
No. 1	100				

6. In the bean the caulicle lengthens, and as one end is firmly anchored by means of the roots, the other end pushes or drags the large cotyledons with it to the surface, where the caulicle soon straightens up, the cotyledons part, and the plumule unfolds its leaves. The cotyledons may turn green and leaf-like, but in the course of a week or so they shrivel and die, the food stored in them having been absorbed by the growing plant.

7. Squash, pumpkin, cucumber, and melon come up in the same manner as the bean: the caulicle elongates and pushes the rest of the seed out of the ground. Notice that often the seed coats are not shed until the cotyledons expand after they reach the surface. In the case of these species the cotyledons grow, become green, and perform the

function of real leaves. They remain quite thick, however, and differ in that respect from the other leaves. In the morning glory the cotyledons are as thin as other leaves.

8. The pea comes out of the ground with the end arched over. This serves the purpose of protecting the delicate growing tip by making it unnecessary for it to keep at the front as it pushes its way through the earth. The cotyledons remain stationary in the ground because the caulicle does not elongate and push them upward. The roots spring directly from the short caulicle and only the plumule grows upward.

9. The growth of the germ in the kernel of corn is quite different from the cases we have studied. The seed remains underground and gives nourishment to the growing plantlet, which gradually absorbs it and leaves the husk of the kernel empty. Corn has but one cotyledon, and that remains inclosed in the grain. The plumule is erect, instead of arched, as it emerges from the ground. Wheat, oats, barley, and other species of the grass family come up in the same manner as corn.

10. The reason why seeds will not germinate when they have too much moisture is because they require air for the process, and if they are covered with water, or with soil that is saturated with water, the air cannot get to them. Seeds of some plants, as rice, can germinate under water by using the air within them and by absorbing air from the water.

11. This experiment will be very instructive as demonstrating the effect of a dry season upon seeds after planting. Of course, if the drought comes before the seeds have begun to sprout, no harm will be done except to delay their germination till they get moisture; but after they have begun to sprout drought will injure them. Vary the experiment in several ways and learn what is the nature and extent of the injury wrought by different degrees of dryness and at different stages of growth. You will find that sometimes the drought merely retards the growth, or perhaps kills a portion of the germinating seeds; under other conditions it may kill all.

12. It is intended that there shall be moisture enough in the earth to sprout the seeds in both pots, but if no water is supplied to one lot some of the young plants will lose their vitality before they reach the surface, while the rest will have their growth retarded, and finally they also will die. As soon as all the plants appear to be dead, dump the earth out and see how dry it is.

13. Spring wheat is put in much earlier than corn because it stands cold weather better, and for the same reason peas may be planted earlier than beans. Frost also injures corn and beans more readily than wheat and peas.

14. Seeds should be kept in a cool, dry room over the winter. To keep them damp is injurious, and if they are frozen while wet, the injury is often quite serious. If they are dry it does not harm them to freeze. To keep them over the winter in a well warmed room where the atmosphere is at the same time very dry also lessens their vitality. Try to demonstrate some of these points by experiment.

15. Seeds will sprout in the dark, else they could not come up when planted in the ground. But the growing plant needs sunlight. Plants grown in the dark never look green and can grow only by consuming the nourishment which is stored up within them or within the seed. The green coloring matter and sunlight are necessary for the production of new plant substance out of the raw materials taken from the atmosphere and the soil.

16. As a rule, seeds should not be covered deeper than is needful to insure sufficient soil moisture, but for the sake of this moisture it is often desirable to plant them as deep as their nature permits. Seeds that come up with thick seed leaves, as beans and radishes, should not be covered more than about five times their thickness; while those that do not push their seed leaves to the surface, as peas and corn, wheat and other grains, may be covered ten times their thickness. Of course, in a loose soil they may be planted deeper than in soil that is apt to become hard.

17. The vitality of seeds diminishes as they become older, and after a certain age they lose altogether their power to germinate. Thus, 90 per cent of cucumber seeds may germinate when they are a year old, 75 per cent when two years old, 70 per cent when three years old, and so on, — a small percentage germinating when they are as old as ten years. The age limit of the seeds of most cultivated plants is shorter than this. Thus, Indian corn and onion generally live but two years; turnip, radish, and cabbage, five years; bean, pumpkin, squash, and watermelon, six years.

18. Farmers are generally careful to clean their seed grain so as to reject all kernels that are under size or under weight. The plump,

heavy kernel contains a stronger embryo and a larger food supply upon which the young seedling draws for several weeks.

19. The seedlings that have been robbed of their cotyledons fail to grow as well as the others, because these cotyledons contain much food for the growing plant. In case of the pea the cotyledons serve no other purpose to the seedling than to supply it with nourishment. In the bean also this is no doubt their most important function, although they may be of some use as leaves.

20. It will easily be found that plants with one cotyledon have parallel-veined leaves, and plants with two cotyledons have netted-veined leaves. We do not know the reason for this coincidence; but it is a curious and interesting fact with which plant students should be familiar.

CHAPTER V

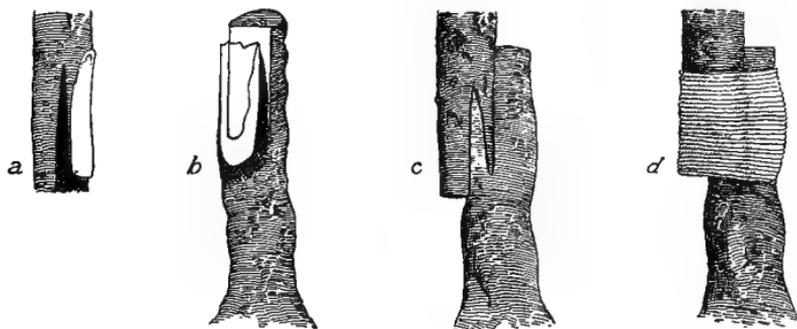
FRUIT GROWING

Meaning of the Term "Fruit." — The botanist means by *fruit* the part of the plant that contains the seed, the grown pistil, and applies the term to acorns and pea pods, tomatoes, and pumpkins, as well as to apples and peaches. In ordinary language, however, the word is used in a more restricted sense, and applied only to the grown pistil when it is distinctly juicy and either sweet or sour. It is in that sense that we employ the term in this chapter; and moreover, we are here interested solely in such fruits as we use for food.

Origin of our Fruits. — The fruits of our gardens and orchards have been obtained in various ways. Some of them were domesticated but recently and modified but slightly. Others have been cultivated since the dawn of history and their resemblance to their wild ancestors can be seen only by experts. Our native plums, strawberries, raspberries, and gooseberries have an excellent flavor, and many of our cultivated varieties were derived from them only during the last two or three hundred years. On the other hand, most of our apples, pears, and currants, and certain plums, were imported in early colonial times from Europe and Western Asia where they probably were among the first food plants brought under cultivation by primitive man. Peaches, apricots, and Japanese plums were brought from

China and Japan, and the Siberian crab, Duchess of Oldenburg and Hibernian apples, and many other hardy varieties came from Northern Russia.

Propagation. — Ordinarily cultivated fruit trees are not raised from seeds, for these do not “come true.” If you plant the seeds of your favorite apple, the chances are that when the seedling trees come into bearing no two of them will produce the same kind of fruit and that all of it will be very inferior. We therefore resort to another method of



GRAFTING A BRANCH ON THE ROOT OF ANOTHER TREE

a. Branch cut ready to be put on the root. *b.* Root cut ready for the branch. *c.* Root and branch put together. *d.* Waxed cord wound around graft, and the work is finished.

starting new fruit trees. Instead of a seed we use a bud, which contains all the possibilities of a full-sized plant and repeats the characteristics of the parent with perfect fidelity. Buds are employed for propagating by grafting and layering, and by the use of cuttings and suckers.

Grafting and Budding. — (1) From the tree we wish to multiply we take a section of a young twig with at least one bud. Then we take a hardy seedling of suitable size, cut off the stem just above the roots, and carefully fasten our twig in its place in such a way that it will grow upon the

stump and become the new stem of the tree. This operation is called grafting.

(2) If instead of a twig we use just a bud, we cut through the bark of our hardy seedling, slip the bud partly in under the bark, and tie it in place. When done skillfully, the bud will grow, and develop into a promising shoot, and after the removal of the foster tree's own stem this shoot takes its



GRAFTING A BUD ON THE STEM OF ANOTHER TREE

- a. T-shaped cut ready for the bud.
- b. The bud attached to the bark.
- c. The graft completed.

place and becomes the new stem. This process, called *budding*, is regarded as merely a special form of grafting. By either method we obtain trees in all respects like those from which the buds were taken, and bearing the same sort of fruit, though nourished by a root-system of different origin.

Cuttings and Slips. — We know that if we stick a willow shoot in the ground it will take root and grow, if the necessary conditions are observed. That principle is employed in multiplying currant bushes and grapes. The section of the stem used for the purpose is called a *cutting*. In geraniums and similar house plants, we usually call it a *slip*.

Layering. — Some bushes and vines will take root wherever they touch the ground, especially if partially covered by it. For example, (1) the end of a black raspberry cane is pulled down to the ground and covered with earth, letting just the tip stick out. It then takes root at that place and forms another plant which in due time is severed from the old bush and transplanted where it is wanted. (2) A grapevine covered at intervals with earth takes root and may

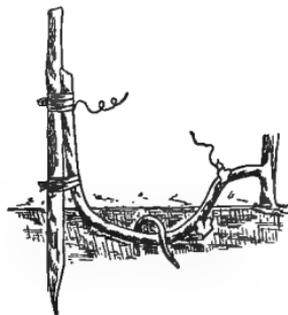
then be cut into pieces and each root used for a new plant.

(3) Again, if we heap up the earth around a gooseberry bush and thus bury the lower ends of the canes they form new roots in this mound of soil. Then each cane with all its roots is cut off and set out as a separate plant. These three cases are merely variations of the same principle, and are called *tip layering*, *vine layering*, and *mound layering*, respectively.

Suckers. — These are shoots which arise at various points on the roots of some plants, as plums, or from root-stocks, as in lilacs. When the plant is growing on its own roots, these suckers furnish the readiest means of propagation, as in red raspberries, lilacs, wild plums, and wild roses; but when the tree or bush is grafted, then the suckers, coming from the roots of the inferior stock, are usually worthless.

Origin of New Varieties. — While our choice varieties are carefully perpetuated by the foregoing methods of propagation, we are adding new varieties every year that are hardier, mature earlier, bear more abundantly, have better flavor, or excel the old varieties in some other particular. There are two methods by which these new varieties are produced.

(1) We have said that the seeds of our fruits do not “come true,” the generation grown from them showing great diversity and usually being quite inferior. But, as there is such great variation, the law of chance occasionally gives



LAYERING

A branch bent and pegged down and covered with soil. After adventitious roots have formed on the branch it is severed from its parent stock.

us a specimen that possesses some desirable quality in a high degree. Such a specimen, if discovered, is then kept and its characteristics perpetuated by propagating from its buds. Many choice varieties originated in this way. For instance, the Wealthy apple, a leading variety of the upper Mississippi Valley, was grown from a seed by Mr. Peter Gideon, at Excelsior, Minn., in 1864, and the many thousands of Wealthy apple trees now found in the country all descended from that one seedling.

(2) The second method by which new varieties are developed is by cross-fertilization. Two varieties are selected, each possessing certain characteristics that we should like to combine in a single individual. Then, at blossoming time we carefully fertilize some pistils on a plant of one variety with pollen from the other, and occasionally we succeed in getting just the result desired. The Transcendent and the Hyslop crab apples are examples of this kind of origin. They were produced by crossing the hardy but diminutive Siberian crab with a larger species. (See "Cross-fertilization," p. 65.)

The development of new strains and varieties, called *plant breeding*, is as important as it is fascinating, and has engaged the attention of practical students of plant life for many centuries. Some of the productions of such men as Mr. Luther Burbank are so different from their ancestors that they are often spoken of as new creations; and their value to mankind is so great that their originators should be ranked among the greatest benefactors of their time.

FRUIT GROWING IN THE NORTH

The northern states, for which this book is especially designed, are not regarded as lying within the fruit belt, and yet some fruits of the finest quality can be grown here as

easily as anywhere else, and other varieties can be produced if extra care is bestowed upon them. The suggestions given in the following pages are applicable even in the northernmost latitude of North Dakota, Montana, Minnesota, and Wisconsin.

Location, Shelter, and Soil. — In a level country we merely make sure to select a location that is well drained; but if the ground is hilly, then a south slope should be avoided, as it is apt to be too dry and the sun too hot. In the more arid sections of the West, we find the native trees growing best on the northern slopes and from this we may learn a lesson.

A shelter-belt is quite essential, being especially needed on the south side to give protection against hot winds. It is well to extend it also on the west and north side. As the snow drifts are apt to pile up among the fruit trees and break them down, this should be prevented by having the shelter-belt of considerable width, or else by providing a snow trap around the outside as described elsewhere in this book (see pp. 107-109). The space inclosed by the wind-break should be of ample size, and nothing should be planted close to the trees.

The soil for all fruits should of course be the best that the region affords. When the ground is about to freeze at the approach of winter, it is well to mulch it with straw to keep it from drying out to such a degree as to injure the roots.

Planting. — To make sure that all stock is adapted to the climate and soil, it is advisable to secure it from nurseries that are located as near by as possible. In planting fruit trees follow carefully the best practice of setting other trees. The ground should previously be well plowed, the holes

should be of ample size, the roots must not be allowed to become dry before planting, and if any of them are broken or have the bark torn off at the end, the injured part must be cut off so as to make a clean wound that will heal readily.

KINDS OF FRUIT

It is well to commence with small fruits, — as strawberries, raspberries, currants, and gooseberries, — and a few varieties



A FIELD OF STRAWBERRIES

of apples, plums, and cherry-plums. If some success has been attained with these, it is easy to enlarge the scope of operations by gradually adding other varieties of apples and plums, and also cherries and grapes in sections where their hardiness has been demonstrated.

Strawberries are undoubtedly the popular favorite among

small fruits, and they can be raised in our coldest climate without difficulty except in arid parts where hot, drying winds are apt to occur at the critical time between blossoming and the ripening of the fruit. A good shelter-belt of trees will afford some relief from the winds, and if water can be supplied from a well or reservoir, a dry season may be tided over in that way.

The plants may be secured from a nursery and are set out in the spring. Care must be taken to spread out the numerous roots in a natural way and yet have them pointing downward rather than sidewise. Strawberries must be cultivated throughout the season in order to keep them free from weeds and to preserve soil moisture. For this reason the rows should be about four feet apart, the plants in the row being set about two feet apart. At the approach of winter cover the whole bed with several inches of clean straw.

A strawberry bed bears its best crop the next year after planting, and after two crops it is usually of very little value. New rows should therefore be set out every other year. This is easily accomplished in the latter part of the summer by making use of young plants that have recently started from runners. Take them up with plenty of earth, water them after setting, and they should soon be at home in the new row.

There are, of course, many varieties of strawberries, and in making our selection we must remember that some of them bear flowers that have only pistils and no stamens. Such flowers are called imperfect. If any of these varieties are planted, it is necessary to set every fourth or fifth row with a perfect-flowered sort that blooms at the same time and thus furnishes pollen for the whole patch. The pollen

is then carried to the imperfect flowers by the bees or the wind. To avoid the necessity for this extra care we may simply use a variety with perfect flowers, as the Senator Dunlap.

The type of strawberries commonly known as ever-bearing, or fall-bearing, of which the Progressive is one of the leading varieties, is especially adapted to the home garden. It must, however, be provided with good soil and supplied with moisture throughout the growing season, that it may bear heavily in the late summer and fall.

Currants are about the hardiest fruit we have, and they require very little care and attention. It is not absolutely



GOOSEBERRIES

necessary even to give them any protection in winter, although a good mulching is an advantage. If rotten manure is used for the purpose, it can

be worked into the soil in the spring and will help to produce better fruit. To give room for cultivation, set the bushes four feet apart in rows that are six or eight feet apart. The bushes should not be allowed to become too thick, but all suckers except two or three should be cut out every fall or spring, and also all canes that are four years old. Thus we keep about eight canes to the bush and if well grown they will yield more and better fruit than a larger number.

As almost all of the varieties are entirely hardy, we can scarcely make a mistake in choosing. The London Market, Cherry, Red Cross, Perfection, and White Grape Currant are among the best, the white currant being sweeter than the red.

Gooseberries are as hardy as currants and require scarcely any pruning or other care. Set the plants in the same manner as currants. Some good varieties are the Houghton, Champion, Carrie, and Red Jacket.

Raspberries. — The canes or shoots of the raspberries are biennial; those that are formed one season bear fruit the next and then die. Each season large numbers of suckers appear, and these must be cut out, except the few that are wanted for fruit the following season. This pruning is best



RASPBERRY CANES READY FOR WINTER

done in the summer, after the fruit is gathered. At the same time remove the old canes that have borne fruit, thus giving the remaining young canes plenty of room. If the canes are apt to freeze back badly in winter or are broken down by snow, they may be bent over to the ground in the fall and covered with a few inches of earth or coarse manure. Cultivate the ground between the rows and keep out suckers and weeds.

Plums may be grown successfully everywhere if we take care to select varieties that are suited to the locality. Even those that can be grown in our coldest climate are valuable and profitable. The trees may be set ten feet apart in rows sixteen feet apart. This leaves good opportunity for cultivation. They need practically no pruning, but suckers should be cut out whenever they appear.

A thicket of wild plums in some unused corner is generally a source of pleasure and often of considerable fruit. It can be started from a few young bushes and will then spread from suckers if allowed to do so.

Some of the hardiest varieties of plums are the native or wild plum, De Soto, Wyant, Surprise, and Forest Garden.

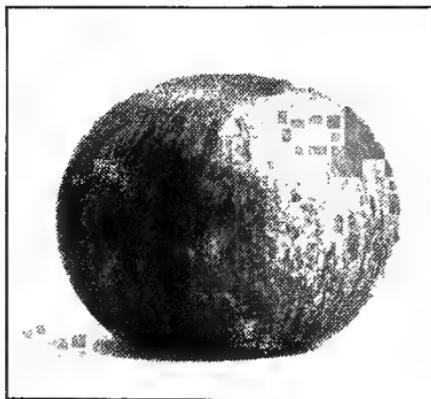


CHERRY-PLUMS

The Compass Cherry.

Cherry-plums. — This term designates a hybrid or cross between a cherry and a plum. The sand cherry, which is native of the cold, dry Northwest, has been used for one of the parents and a good hardy plum for the other parent. The breeding is effected by preventing the pistils of the cherry blossom from being fertilized with pollen from the same species and instead thereof carefully dusting on them pollen from the plum. The resulting fruit is a hybrid, the breeder hoping to combine in it the desirable qualities of the two parents. The

combination sought in this case was the hardiness of the wild cherry and the size and flavor of the chosen plum. Some hybrids of great value have been derived in this way, and they may now be procured from most of our nurseries. The oldest and best known is the Compass Cherry; but the Sapa, Opata, Sansota, and Cheresota are fast coming into prominence. Some of these should be planted in the North by every fruitgrower.



DUCHESS APPLE

The favorite fall apple of Minnesota.

Apples. — Apple growing has made considerable progress

in the North in recent years, and many good varieties are now produced. The trees are planted, cultivated, and cared for in accordance with the best practice followed in growing other trees. No special directions need to be given. In pruning we aim to develop a low-headed tree, rather than a tall one, and we thin out small branches to give the head a free, open growth.

The following are among the varieties that have proven most hardy in North Dakota: Duchess of Oldenburg, Okabena, Patten's Greening, Hibernial, Wealthy, Anisim Iowa Beauty, Whitney No. 20, Hyslop Crab, Florence, and Early Strawberry.

QUESTIONS AND PROJECTS

1. *Fruit produced.* — What varieties of apples are grown in your region? Of plums? Cherry-plums? Strawberries? Raspberries? Currants? Gooseberries? Are any grapes or cherries grown? If so, what varieties?

2. *Their characteristics.* — What are the merits and the faults of each variety reported in reply to the preceding questions?

3. *Difficulties in raising fruit.* — What particular difficulties do you have to contend with in your region in raising each of the different kinds of fruit mentioned in this chapter?

4. *Experience with strawberries.* — Find somebody who raises strawberries and get a full account from him, — where he got his plants, what variety, when and how he set them out, later cultivation and other care, amount and value of the crop, when and how he starts new beds, etc. Give a good report to your class.

5. *Experience with raspberries.* — If possible, follow the same plan with raspberries as suggested for strawberries in the preceding paragraph.

6. *A patch of your own.* — Plant and care for a patch of strawberries or raspberries.

7. *Fruit trees of your own.* — Persuade your parents to let you plant several different kinds of fruit trees and to let you have them for your

own and care for them till they come into bearing. You will find it interesting and instructive, and it should also prove profitable.

8. *Value of fruit crop.* — (a) If a dozen young trees yield an average of two bushels of apples each, what is the value of the crop at last season's price in your market? (b) What is the value of the fruit from a dozen compass cherry trees, averaging ten quarts per tree? (Allow the same price that was paid for plums in your market last season.)

9. *Grafting.* — Grafting and budding are very interesting operations

and require a high degree of skill. If you can find any one in your neighborhood who understands them, get him to show you exactly how each is performed.

10. *Insects and diseases.* — Are fruit growers in your vicinity troubled with any insect pests or plant diseases? If so, learn all you can about the nature of the trouble and the treatment for it.

11. *From flower to fruit.* — Study the structure of an apple blossom, and the development of the fruit as suggested in connection with the rose family on page 78.



CRAB APPLE TREE IN BLOOM

Grand Forks, N. D.

12. *Fruits compared.* — Compare various fruits and observe the different ways in which they are developed from the pistil. (a) The apple is developed from the "cup" of the flower; the pistil is the core. (b) The currant and gooseberry are simply the pistil containing several seeds. (c) Plums and other stone fruits are pistils with a single seed. (d) The raspberry is a cluster of tiny stone fruits, each of the grains that make up the berry being a pistil and containing a seed. (e) In the strawberry we eat the receptacle or end of the flower stalk, the

pistils being represented by the little dry seeds on the surface of the berry.

13. *Oral and Written Compositions.* — Oral and written reports on these projects make fine exercises in composition. The following subjects are especially suitable.

- a. *Fruits Raised in this Region.* — Projects Nos. 1 and 2.
- b. *Our Difficulties in Fruit Growing.* — No. 3.
- c. *How to Raise Strawberries or Raspberries.* — Nos. 4, 5, or 6.
- d. *How to Graft or Bud a Tree.* — No. 9.
- e. *Insects that Pester our Fruit Growers.* — No. 10.
- f. *Diseases Affecting our Fruit Trees.* — No. 10.

CHAPTER VI

SOME LESSONS IN BOTANY

The person who is surrounded by plants and yet does not seek to learn the many interesting facts about them is missing a large amount of enjoyment which he might have without cost; for when we have gained an acquaintance with the plants about us, and the conditions and laws that control their life, every trip across the prairie or field, or through the forest, has new interest and shows new evidence that the plant world is indeed a world of miracles.

All studies of plants involve applications of the science of botany, and in this chapter we present a few lessons that seem necessary for a thorough understanding of the other chapters on plants. Botany is merely the science, or the systematized knowledge, of the important things about plants. It teaches us the classification and names of plants, and the structure and function or use of all their parts, — as leaves, roots, stem, flower, and fruit. It enables us to understand the marvelous biography of the plant, — how it begins life, how it breathes, how it gets its food, assimilates it, and grows in stature, and how it reproduces its kind.

Botany is a practical science. Farmers and gardeners succeed with their plants in the same measure that their practice conforms to the laws of botany. It teaches us the best method of cultivating each useful plant and making it yield the richest harvest, and it helps us to understand the laws of heredity so that we may produce varieties that shall

yield even more abundantly. By the study of botany we learn to reason out why plants behave as they do under certain conditions, and how they would behave under certain other conditions. We may thus become investigators of the many problems about plants that are still unsolved.

As an aid in the study of this chapter it is well to have a good variety of house plants in the schoolroom where they may be under constant observation. A list of suitable kinds will be found in the chapter on School Gardens. House plants are often kept merely for their ornamental value, but they might also be of great help in our education if we would give them the necessary attention to get acquainted with them. The pupils should know the name of each plant, how it is propagated, its habits of life, its specific needs that must be satisfied in the care we give it, and all important characteristics of its leaves, roots, stem, blossoms, and seeds.

THE PLANT AS A WHOLE

Parts of a Plant. — All ordinary plants, with their many diversities of form and size, are constructed on the same general plan: they all consist of stem, roots, and leaves, and periodically develop flowers and fruit. Notice that this is true of grains and grasses with their slender, unbranched stems and long, narrow leaves; it is true of the great trees, and likewise of the little plants that lie prostrate upon the ground, as the common purslane and white clover. In all plant studies therefore we are largely concerned with these five parts, — stem, roots, leaves, flower, and fruit.

Woody Plants and Herbaceous Plants. — When the stem is composed of hard, woody tissue, it lives through the winter and from year to year, and we then have a tree or shrub.

Stems that are not woody either die entirely in the fall or at least die down to the ground. Such plants are said to be *herbaceous*.

Duration of a Plant's Life. — Some plants live but a single season and then die, others live two years, and still others live year after year for an indefinite time. Plants are accordingly classified as *annual*, *biennial*, and *perennial*.



CARROT

Blossoming and bearing seed the second year: a typical biennial.

An *annual* is a plant that completes the whole cycle of its life in a single year. It begins with the seed and dies, root and all, after ripening its seed. Corn, the small grains, and mustard are examples of annual plants.

A *biennial* is a plant that lasts but two years. It usually grows the first year without blossoming. In the fall the leaves may die, but the rest of it survives the winter and the next season

forms a plant that flowers, ripens its seeds, and then dies. Beets, carrots, parsnips, and cabbage are familiar examples.

A *perennial* plant lives year after year. If the stem is herbaceous, it dies down to the ground in the fall, and only the root with part of the stem below the surface survives the winter. Such a plant is called an herbaceous perennial.

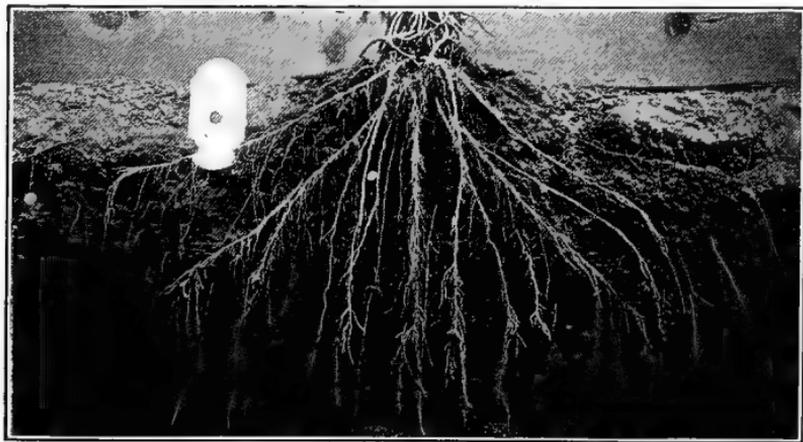
Rhubarb, peonies, and the common grasses are herbaceous perennials. If the stem is woody, it lives over the winter, and we have a tree or shrub, the only difference between these being in their size.

THE ROOTS

Tap Roots and Fibrous Roots. — Soon after the seedling stage of a growing plant is passed, the characteristic form of its root system becomes apparent, and then we generally find either one large main root, or merely a number of small, slender roots. In the first case we say the plant has a *tap root*; in the second case it has *fibrous roots*. Tap roots grow straight down into the ground, sending smaller, lateral branches in all directions. Beets, carrots, alfalfa, dandelions, and many other plants have tap roots. In some of them, as in alfalfa, this tap root reaches down to a great depth, which of course is an advantage in dry seasons. Fi-



TAP ROOT
Alfalfa plant.

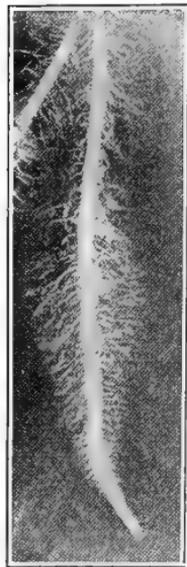


FIBROUS ROOTS OF A CORN PLANT

brous root systems we see illustrated in Indian corn, all the small grains, the grasses, and the clovers.

The Function of Roots. — The three most important uses of roots are to hold the plant in position, to absorb water from the soil for its use, and to store plant food.

1. *Roots hold the plant in position.* — The first of these functions is quite obvious, but it is interesting to notice the magnitude of the root system that is evidently required to hold a plant like a large tree in an upright position in a heavy storm. Roots of great strength reach long distances in every direction, and from them hundreds of smaller ones branch off. To blow the tree over, half of these roots must break off, or else it is necessary to lift the many tons of earth in which they are anchored.



ROOT HAIRS
Barley root.

2. *Roots take water from the ground.* — All the younger and fresher roots absorb some water from the ground, but the most active part of this work is performed by the tiny root hairs that cover the finest rootlets. These root hairs are most easily seen on young seedlings.

This water contains plant food. — It must not be supposed, however, that the water taken up by the roots is perfectly pure. We all know that well water is harder than rain water. The hardness is due to mineral matter that the water has dissolved in leaching through the earth. In the same way the water which the roots drink is charged with nourishment from the soil, and the richer the soil the more nourishing this water will be. This is the way the plant gets the benefit of the plant food in the soil. It can take nothing from it in any other way than in solution.

Large quantity of water required. — It may occur to the reader that this could not make a very rich diet for the plant, for at best the solution is very thin and weak. That is the truth; and, therefore, the amount of water that must be taken up to meet the needs of the growing plant is very large. It has been learned that 338 tons of water are absorbed by the roots of spring wheat to produce one ton of dry matter in the ripe plant, while growing oats require even more moisture. In other words, leaving the stubble and roots out of the account, a wagon load of grain bundles weighing a ton represents about 338 tanks of soil water, each weighing a ton. This water or sap is carried up into the leaves, where a small part of it, together with the dissolved materials, is used for the growth of the plant, and the rest of the water escapes into the air. There are very few parts of the world where rain falls in such abundance throughout the growing season (and yet never too much) as to enable a rich soil to produce the largest crop it is capable of producing. This ideal may be practically realized, however, by means of a good irrigation system; and it is easy to understand why irrigated land usually produces such heavy crops.

The soil must not be too wet. — Notwithstanding the large demands of plants for water, very few of them will thrive if the soil is excessively wet. It should be merely moist. This is most frequently shown in the spring of the year when yellow patches appear in wheat, corn, and flax fields. These are caused by the presence of too much water and too little air in the soil. In some sections of the country where crops suffer much from this cause, farmers go to a great deal of expense to put in a good drainage system for their land.

3. *Roots used for storage of food.* — Another use which the plant makes of its roots is to store food in them for future

use. In this practice, however, plants vary greatly. In annual plants like the grains, we have no such storage, for it would be sheer waste. The best illustrations are seen in such biennials as beets, turnips, carrots, and parsnips. These roots literally gorge themselves with food during their first year, and if allowed to grow the following season, this nourishment is used in the production of large seed-bearing plants. There are also many perennials, as rhubarb, asparagus, and peonies, whose vigorous growth in early spring is made possible by the abundant nourishment that was stored in their fleshy roots the previous year.



FLESHY ROOTS
Asparagus.

THE LEAVES

Function of Leaves. — Leaves are indispensable for the growth of plants, and in autumn, after they have died, the plant is dormant, that is, its life processes are suspended. A careful study of the work of leaves requires some knowledge of chemistry as well as of botany, and a very brief statement must suffice here. We may say that they serve (1) as the breathing organs, and (2) as the workshop of the plant.

1. As breathing organs they take in useful material (carbon dioxide) from the air and cast off waste material (water and oxygen) into the air.

2. The leaf is the workshop where the raw materials, taken from the air by the leaf itself and from the soil by the roots, are converted into starch, out of which all other plant tissues are made. This is a very complicated manufacturing process, and it is marvelous that it is carried on so silently

and in such a delicate organ as the leaf. Sunlight furnishes the energy for the process, and Nature has made the leaf thin and flat in order to expose as much surface to the sunlight as possible. In leaves that are kept in the dark by dense shade no starch is made, and, of course, the process is suspended in all cases at night. Another factor that is necessary is the presence of the green coloring matter of leaves. Leaves that are white or colorless cannot make starch.

The leaves are always a conspicuous part of a plant. They help to give the plant its characteristic appearance and are one of the chief features by which we identify it. If we wish to have a speaking acquaintance with a good variety of plants, it is necessary to be observing about a great many details, some of which we call attention to here.

Surface and Color. — The surface of leaves may be glossy, smooth, hairy, rough, etc.; and their shade varies from a very dark green or bluish green to light green, yellowish green, or even golden yellow.

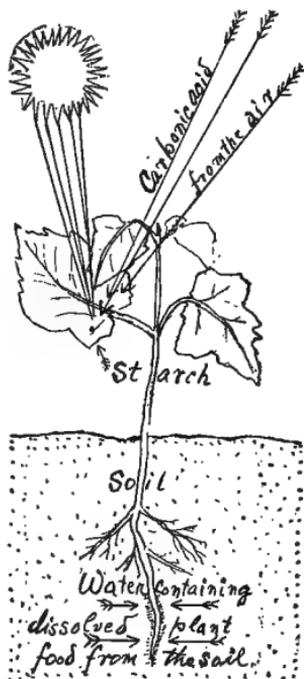


Diagram representing the office of the leaves.

Ribs and Veins. — These are the woody fibers that form the framework of the leaf and determine its shape. The leaf may be parallel-veined, as in Indian corn, the small grains, and the grasses, or it may be netted-veined, as in trees and shrubs and the majority of other plants. The details of the mode of veining are subject to infinite variation, each species having its own characteristic plan that

helps to make its leaf different from the leaves of other species.

Form and Size. — The shape of leaves varies from that of the needles of the pine and the narrow blade of grass to the circular leaf of a water lily and garden nasturtium, with an infinite number of intermediate gradations. A few of the typical forms are shown in the accompanying figures. Students of botany sometimes learn the names of a large number of these shapes, but that is not necessary for our purpose.



LEAVES

Indian corn, showing parallel veins. Basswood, showing netted veins.

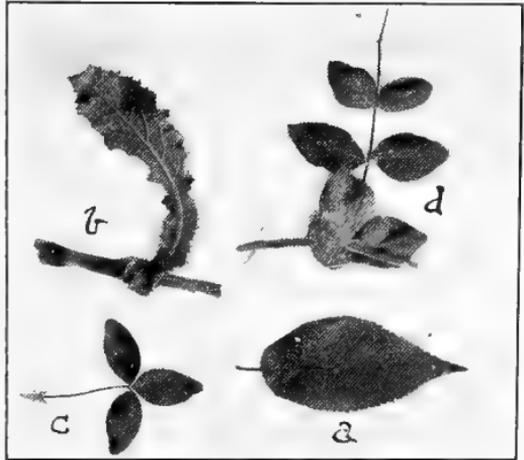
We merely wish to urge the reader to observe the shape and size of the leaves carefully so that the mental picture thus formed may aid him in distinguishing one plant from another.

The Margin of the Leaf. — This may be an even line, or it may be toothed, or wavy; there may be deep notches or indentations that cut the leaf into great lobes, or these notches may extend clear down to the midrib and make those lobes look like separate leaves. In the last case we have

Compound Leaves. — In these, the blade of the leaf has several entirely separate parts, each joined to the main leaf-

stalk just as that is joined to the stem or twig. These small parts of the compound leaf are called *leaflets*. Beginners and careless observers often mistake a compound leaf for a sprig on which each leaflet is taken for a complete leaf and the *midrib* or leaf-stalk for part of the stem. In case of trees and shrubs the true nature of the compound leaf becomes very plain in the autumn when the leaf-stalk falls off with the rest of the leaf. If it were part of the stem it would not fall.

Leaves with or without a Stalk. — The larger number of leaves consists of a broad part (the *blade*) and a little stalk (*petiole*), which joins the blade to the stem of the plant. But in others there is no such stalk, and the blade comes right up against the stem to which it is fastened.



LEAVES OF VARIOUS TYPES

a. Plum leaf, consisting of the blade (the broad, flat part) and the petiole or stalk.

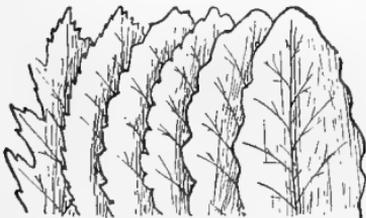
b. Annual sow thistle, has no petiole, but the blade comes right up against the stem.

c. Compound leaf of red clover, with three leaflets and two small blades, "stipules," at the base of the petiole.

d. Compound leaf of garden pea, with four leaflets, large stipules, and tendrils.

This also applies to the parts of compound leaves; the leaflets may be stalked or the little blades may come up close to the main leaf-stalk.

Opposite and Alternate. — In some plants, as the lilac and honey-



MARGINS OF LEAVES

suckle, the leaves are attached to the stem in pairs and are said to be *opposite*; but in the majority of plants they are attached singly and we say they are *alternate*. These two arrangements give a different appearance to the plant. They are especially



ARRANGEMENT OF LEAVES

Willow twig, showing alternate leaves. Syringa twig, showing opposite leaves.



WHITE SPRUCE

In winter.

important in trees and shrubs, as the position of the leaves determines the method of branching, because a new bud appears in the angle or *axil* of each leaf.

Evergreens and Deciduous Trees. — Most of our trees and shrubs drop their leaves in the autumn and new ones appear in the spring. We call these *deciduous* trees. The leaves of evergreens, however, last several years. New ones form every summer, and the oldest drop off so gradually that it is not noticed, and the tree remains green in winter as well as in summer.

THE STEM

This term not only refers here to the main stem of the plant, but also includes all of its branches down to the smallest twigs. We have seen that the important work of the plant is done by the leaves and the roots. The principal use of the ordinary stem, therefore, is to serve as a means of communication between these two organs, and to support the leaves and distribute them in such a manner as to expose them to air and sunlight to the best advantage.

The shape and habit of stems vary so greatly that it is well to notice some of the more interesting forms. A few of the chief types are shown in the accompanying figures.

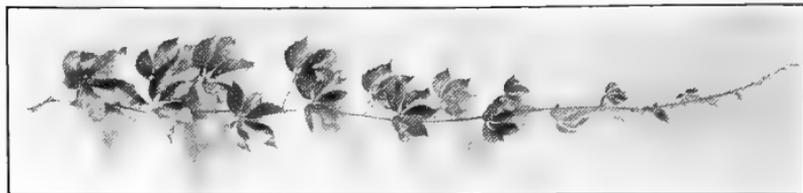
Type 1. In this type the main stem runs straight upward to the top of the tree. All the branches are much smaller. The head of the tree has a conical and symmetrical form. Examples: spruce, pine, and balsam.

Type 2. In this type the trunk divides into several large branches, and there is no straight, central stem extending to the top. This usually gives the head a broad or rounded form. Examples: box elder, elm.



ELM

Type 3. In the shrubs the stem usually branches below the surface or just above it in such a manner that no main



VIRGINIA CREEPER

stem is distinguishable, and the foliage extends almost or quite down to the ground. Examples: lilac, honeysuckle, spirea, buckthorn, etc.

Type 4. In vines the stem is very long and slender, and usually has several branches. It may climb by winding itself around its support, as the morning glory does; or by clinging to its support by means of tendrils, as the Virginia creeper and sweet pea do. Or the vine may be content to lie prostrate upon the ground, as we see in case of the pumpkin, squash, melon, and cucumber.



BROME GRASS

Type 5. Indian corn, the small grains, and the grasses have very slender, unbranched stems, with solid joints at intervals to strengthen them.

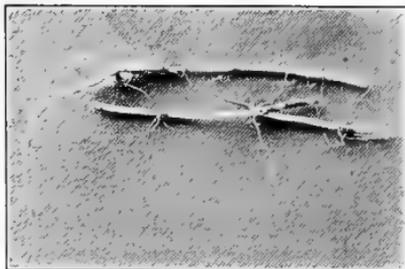
Type 6. Beets and carrots are examples of plants that are apparently stemless. But leaves will not spring directly from the root, and if the top of the beet is cut away the rest will refuse to grow. We therefore regard these tops from



CARROT

which the leaves spring as short stems.

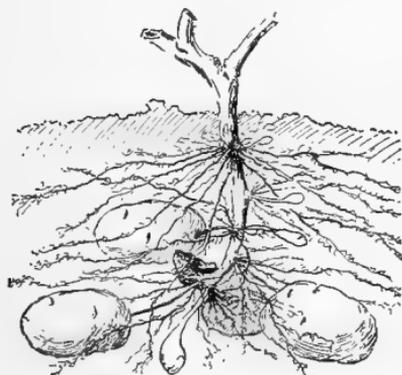
Type 7. Burrowing or underground stems have some resemblance to roots and are easily mistaken for them. The plant commonly uses these stems for the storage of food, and therefore they have capacity for vigorous growth. A small section of an ordinary underground stem or rootstock, if severed from the rest of the plant, will at once proceed to do business as a complete and independent



UNDERGROUND STEM OR ROOTSTOCKS OF QUACK GRASS

plant. Some of our worst weeds, as quack grass and Canada thistle, owe their persistence to their underground stems.

Type 8. The Irish potato is an abnormal enlargement of the end of an underground stem. Such a growth is called a *tuber*. The "eyes" of the potato are the buds.



POTATO AS AN UNDERGROUND STEM

THE FLOWER

The Purpose of Flowers. —

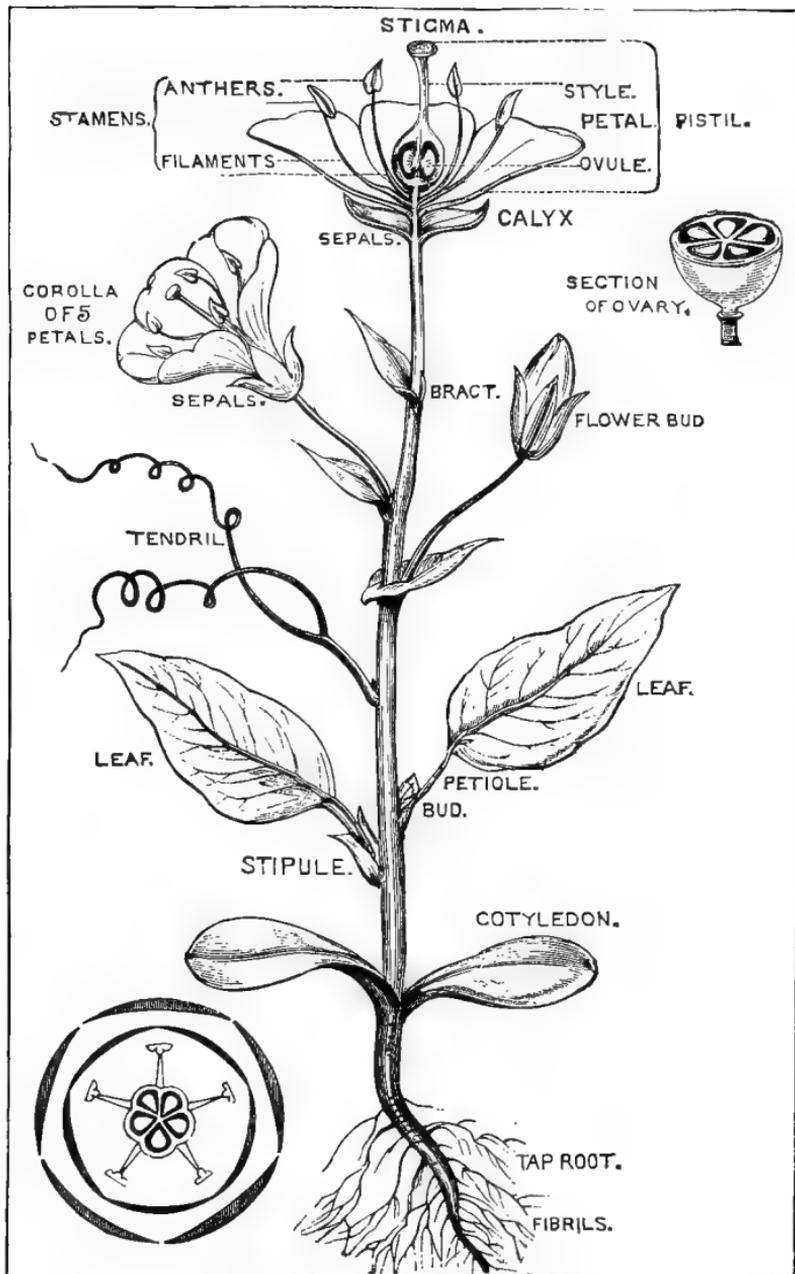
Flowers are the favorite objects in all nature. We prize them for their fragrance and delicate beauty, and we grow millions of plants in this country solely for the sake of their blossoms. When we cannot have the flowers themselves to please our sense of smell, we often make use of perfumes containing their precious essence. We are, therefore, apt to think that flowers grow for our special benefit, and this may in a sense be true of some cultivated varieties, like double roses and asters, that man's ingenuity has greatly changed by developing the size,

color, and odor that shall best please our fancy. But nature created flowers to serve certain purposes of the plant and not to please man. Without them the plant could not form seeds, and without seeds most kinds of plants would soon die out, for there would be no young plants to take the place of the old. Some flowers require the help of insects to produce seeds, and to secure that help they must be both bright and sweet. That is why nature has given them beauty and fragrance. Farther on in this chapter, under "Use of pollen," we shall learn more about this subject.

The Parts of a Flower.—*The Corolla.*—A flower, as we may see in the rose or the sweet pea, consists of several distinct parts. The colored part is called the *corolla*, and when composed of separate leaves these are called *petals*. In many flowers the corolla is not divided into separate petals, but may be funnel-shaped, as in the morning glory, or wheel-shaped, as in the potato, or of various other shapes.

The Calyx.—Below the corolla, or outside of it, is the *calyx*, which in the pea and rose and most other flowers is green. When it is composed of separate leaves these are called *sepals*. In many flowers, as in the rose and the apple, the calyx is not divided into separate sepals, but is a cup with the upper edge divided into lobes.

The Stamens.—Within the corolla we usually find two kinds of organs called *stamens* and *pistils*, the latter being at the very center of the flower. Let us notice the stamens first. They have very slender stems with knobs at their ends. The stems are called *filaments* or stalks and the knobs are called *anthers*. These anthers are very essential organs, for within them is produced the pollen. When the anthers are ripe they burst open and let the pollen grains escape. The stamens vary greatly in number with different flowers.



PARTS OF FLOWER AND PLANT

In mustard there are six; in peas, ten; in the rose there are several times as many.

The Pistil. — The *pistil* has three parts, but sometimes only two can be easily recognized. Good examples for beginners to study are the mustard, pea, and bean. The lower end of the pistil is somewhat swollen. This is the *ovary*, and within it are the *ovules* which are to develop into seeds. The stem arising from the ovary is the *style*, and at the end is a slight enlargement called the *stigma*. It may be recognized by its roughened and sticky surface to which the pollen adheres. In many flowers, as in the cultivated flax, we find a pistil with one ovary and several styles and stigmas. Other flowers, like the anemone and buttercup, have a large number of small pistils in which only the ovary and stigma are noticeable, the style being very short.

All these parts vary in number, shape, and relative size in different flowers, and in some flowers one or more of the parts may be wanting entirely.

The Use of the Parts. — *Pistil and Seeds.* — If we watch flowers until the petals fall off, and for a few weeks after, we shall see that the pistil of the pea and bean develops into a pod with seeds, and the pistils of all other kinds of flowers develop into various kinds of fruits, in each case containing one or more seeds. The production of seeds, then, is the office of the pistil.

Use of Pollen. — But the pollen-bearing stamens are equally essential to the production of seeds and fruit, for it is easily shown that the seeds will not grow in the pistil unless pollen from the same kind of flower has fallen upon the stigma. This is called *pollination*. Of course, the stigma must be at the right age so that it will be sticky enough to hold the pollen fast. The grain of pollen will then sprout, and

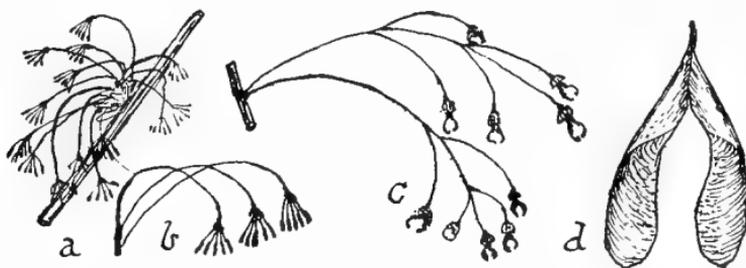
send a slender tube downward through the style and into the ovary, and add a tiny bit of its substance to that of the ovule. An ovule thus "fertilized" will at once begin to develop an embryo or baby plant, and grow into a seed endowed with the possibilities of a living plant like its parents. The life of the plant, therefore, originates with the fertilization of the ovule. The life of an animal begins in the same way. It may appear very simple, but the scientist and the philosopher regard the origin of life as one of nature's greatest miracles.

Now, nature has ordered that in most cases this fertilization of the pistil shall be brought about by pollen from some other flower. In such cases we speak of *cross-pollination* or *cross-fertilization*. Usually the pollen reaches other flowers without difficulty, being carried either by the wind or by insects. (1) There is so much pollen produced and discharged into the air that it settles upon all kinds of objects in the vicinity, and the pistils can hardly escape. Of course, the pollen grains are so small that we do not notice them, or if we do see them on our clothes or on our furniture we take them for ordinary dust. (2) Many kinds of flowers are visited by insects in search of sweets, and their feet and bodies become more or less dusted with the pollen, which is then rubbed off on other flowers visited. The stigma being right in their path and quite sticky is almost sure to be pollinated.

And here comes in the office of the *corolla*. That contains the nectar which invites the bees, and the bright colors serve to show them the way. The blossoms of wheat, corn, and many other plants that are without the sweet and bright-colored corolla, are dependent solely upon the wind for cross-fertilization.

Protection of Stamens and Pistil. — We have not yet mentioned the use of the calyx, but that is easy to understand. Before the flower opens we see the calyx covering and protecting all the other organs until they have reached their full development. Next to the calyx lies the corolla, which we now see serves another useful purpose, for within its soft and delicate folds are wrapped up the essential organs of the flower, — the stamens and pistils. In many plants, however, the calyx and corolla are wanting, and the growing stamens and pistil are protected in some other way.

Imperfect Flowers. — In many plants cross-pollination is the only method of fertilization possible, because the

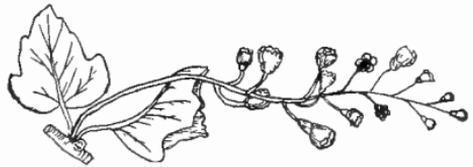


IMPERFECT FLOWERS OF BOX ELDER

a. Cluster of staminate flowers. *b.* Three of the same flowers enlarged. *c.* Pistillate flowers from another tree. *d.* The two ripened seeds from one of these flowers.

stamens and pistil are not found on the same flower but on separate flowers. Such flowers are said to be imperfect. Willows, cottonwood, and box elders produce only staminate flowers on some trees and only pistillate flowers on others. In popular language the former kind are said to be male trees and the latter female. There are many other plants in which the same arrangement is found. Still others, like the pumpkin, squash, melon, and corn, bear the two kinds of flowers, the staminate and the pistillate, on the same plant.

As all seeds and fruits come from the pistil, and its development is dependent upon the stamen, we see that a knowledge of the structure of flowers and their essential organs is of the highest practical value to intelligent farmers, gardeners, and other persons engaged in growing plants.



RACEME OF THE CURRANT

Flower Clusters. — Some flowers always grow in solitary fashion on the plant, but more commonly a number are produced close together and form some kind of cluster. With the principal types of these clusters the student should be familiar. One of the commonest is



PANICLE OF OATS

The Raceme. — Here the flowers grow singly from a common stalk, each flower having its own little stem and the lowest blossoms opening first. The currant, choke cherry, and lily



MILKWEED UMBEL

of the valley furnish good examples.

The Panicle. — If we modify the raceme by lengthening the little flower stems and putting several flowers on each instead of only one, we get a sort of compound raceme called a *panicle*. This is the kind of cluster we see in the oat and in most of the grasses.

The Umbel. — Here the little flower stems all spring from

the end of the main stalk so as to resemble the ribs of an open umbrella. All the plants of the carrot family have this sort of flower cluster, and it is also seen in the common milkweed and in some other plants.



COMMON PLANTAIN

Flower clusters in the form of spikes.

wheat, barley, and rye are spikes in which the flowers are not attached to the central stalk singly but in small clusters called *spikelets*.

Catkin is the name given to the flower cluster of the willow, poplar, cottonwood, and some other trees. It is a scaly sort of spike.

The Head.—Here all the flowers are attached to the end of the flower stalk, giving a compact cluster that is easily taken for a single flower by the untrained observer. Clover blossoms furnish a simple example. But the more common kind of head we find in the composites, as sunflowers, dandelions, etc. In these the summit of the flower stalk is flattened into a broad disk which bears the flowers upon its surface.

The Spike and the Catkin.—In the spike the flowers are close together and so close up to the central stalk that we cannot see their little stems, if they have any.

The plantain furnishes a good example. The so-called “heads” of



PUSSY WILLOWS

Left, pollen-bearing catkin. Right, seed-bearing catkin. Notice the tiny pods.



HEADS

- a. Red clover.
- b. Sunflower.

There are several other kinds of flower clusters, but these few types with slight variations embrace the blossoms of the large majority of our common plants, and will therefore be sufficient for our present purpose.

PROJECTS

1. *Drawings of leaves.* — Make drawings of the leaves of the familiar plants about you. Show carefully the general outline, the exact form of the margin, and the arrangement of the ribs and veins. If the leaf is compound, be sure to draw the whole leaf and not merely one of the leaflets. Write the name under each, as "Box elder leaf," "Pansy leaf." This exercise will help to fix in mind the form of the leaves of various plants, and thus to know one from the other.

2. *Drawings of trees.* — Make drawings showing the general outline of some fine trees that you know, as elm, linden, spruce. To represent the mass effect of the foliage it is well to use brush and ink, or crayons.

3. *Structure of the flower.* — Examine a variety of common flowers, as they come into bloom during the summer, and

(a) Identify the four parts, — calyx, corolla, stamens, and pistil. If any of them are absent, note the fact. If only one of the essential organs is present, try to find specimens with the other one.

(b) Describe each part in detail:

Calyx. — If there are separate sepals, give their number and form; if the calyx is in one piece, what is its form? Is the rim or border notched? Describe.

Corolla. — What is its color? Is it attached directly to the receptacle, or to the calyx? If it is in one piece, what is its shape? If the petals are separate, how many are there and what is their form?

Stamens. — Attached where, their number, and length.

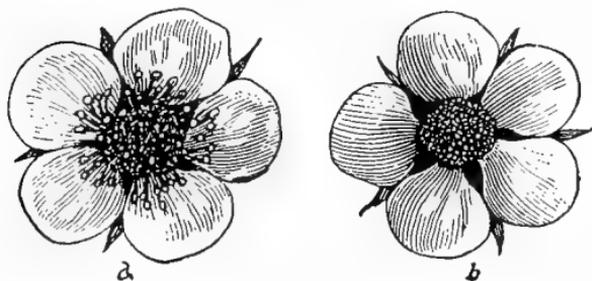
Pistil. — Number; form of ovary, style, and stigma; what sort of fruit does the pistil develop into?

4. *The strawberry.* — There are some varieties of strawberries that are very desirable, but their flowers bear only pistils and no stamens. If these are planted alone, the fruit will not develop. If we select one of these varieties, we must intersperse among the plants in the bed some variety with perfect flowers that open at the same time and thus furnish

pollen for the whole plantation. It is customary to plant every fourth or fifth row with the perfect-flowered kind.

If you have a strawberry bed, examine the flowers when in bloom and see whether all of them are perfect. If you find that many of them have only pistils, see what provision has been made to supply these blossoms with pollen.

5. *Indian corn*. — When the tassels on the corn are developed, examine them, find the stamens, and note the abundance of pollen that comes from them.



STRAWBERRY BLOSSOMS

a, perfect flower; *b*, imperfect flower. Note the prominent stamens in (*a*) around the pistils at the center, and the absence of these stamens in (*b*).

Note that no pistils are to be found in the tassels. Now examine the young ear. That is a cluster of pistillate flowers. Each kernel is an ovary. Note that one thread of the "silk" extends from each kernel to the outside of the husk.

That thread is the style and at its tip is the stigma. If any of these styles are too short to reach the outside so as to expose the stigma to the pollen that is floating in the air, their kernels will not develop and there will be gaps on the cob when the ear is ripe.

6. *Pussy willows*. — The "pussies" are the blossoms of the willows. A single pussy is composed of a large number of tiny flowers growing close together on a stem. A flower-cluster like this the botanist calls a *catkin*. This, you notice, means a little cat, a "pussy."

On the willows and the poplars, the stamens and pistils are in separate catkins and on separate trees, one tree bearing only staminate or pollen-forming flowers and another tree only pistillate or seed-forming flowers. The pollen-forming flowers make the prettier pussies.

These things should be learned directly from nature. Early in the spring gather a handful of twigs from eight or ten different trees, place them in jars of water, and put in a warm, sunny window. The warm temperature will hasten the development of the catkins before the

proper season and this makes it more interesting; but if preferred you can wait till the flowers develop outdoors. When your flowers are ready:

(a) Examine them and learn to distinguish the staminate catkins from the pistillate catkins. In the former the stamens are tipped with golden or purple anthers; the others are smaller and greenish-gray and not so soft and fuzzy.

(b) Draw (1) a staminate catkin; (2) a pistillate catkin; (3) an enlarged view of a small portion of a staminate catkin showing a few stamens plainly; (4) a similar view of a pistillate catkin showing a few seed pods.

(c) Later, note that when the pollen has all been shed the staminate catkins wither and die, but the pistillate catkins develop tiny pods, if they were fertilized by pollen, and when these pods are ripe they will open and set free the tiny seeds within them. These seeds are furnished with long, silky fuzz which enables them to float away upon the air.

7. *Other trees in bloom.* — (a) Find cottonwood trees that bear pistillate flowers, and notice the clusters of seed pods; open some of them and examine the seeds with the tuft of down that carries them on the air and often makes a nuisance of them. Find trees bearing staminate flowers. Would it be possible to raise only this kind and thus do away with the annoyance of flying cotton? At what stage of their growth could the selection be made? Make drawings of both kinds of blossoms.

(b) The box-elder is another good tree to study. It belongs to a different family from the willow and the cottonwood, and its blossoms look very different, but the stamens and the pistils are borne on separate trees as in the case of the others. Find both kinds of flowers and note the appearance of each. Make drawings of them. Later in the season notice that only a portion of the trees bear seeds, — namely those that had pistillate flowers.

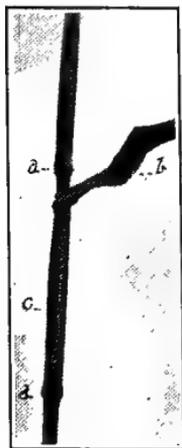
(c) Study the various other trees that grow in your neighborhood and note their blossoms and their seeds.

8. *Flower clusters.* — In the course of the season, as different flowers come into bloom, find illustrations of all kinds of flower clusters. It would be well to represent them by drawings, writing the name under each, as "A panicle, — oats," "An umbel, — parsnips."

CHAPTER VII

A FEW IMPORTANT PLANT FAMILIES

The Grass Family. — This is perhaps our most important family of plants as it furnishes us the cereal grains and much other food for man and beast. The plants have stems that are solid at the joints and usually hollow between; in Indian corn and a few other species the stem is not hollow, but pithy. The leaves are alternate and parallel veined; the basal part envelops the stem, forming a sheath that is open on the side opposite the blade.



SECTION OF
CORN STALK

- a. Solid joints.
- b. Part of blade of leaf.
- c. Enveloping sheath.

A good example for studying the structure of the flower is the head of wheat. This “head” is what botanists call a *spike*, and consists of two rows of spikelets attached alternately on opposite sides of a jointed stem. Each of these spikelets contains several flowers, but they are quite inconspicuous, as the showy calyx and corolla are absent and we have only the stamens and pistil, and these are inclosed within scales or chaff. There are three stamens, and when the wheat is in full bloom we may see the anthers dangling by their slender filaments. The pistil consists of the ovary or kernel and two styles and feathery stigmas.

In barley and rye the flower clusters have the form of a

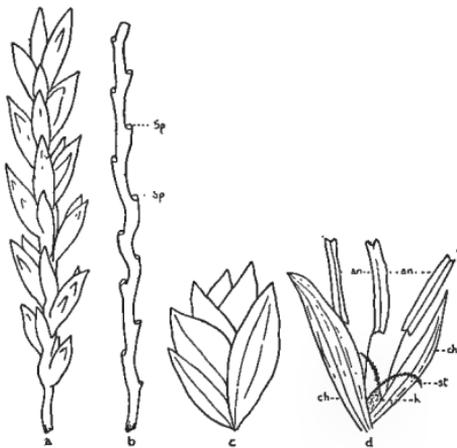
compact spike as in case of wheat, but in oats the little spikelets are arranged in a more open cluster, thus forming a spreading and drooping panicle.

In Indian corn this flower plan is modified beyond recognition. The two essential organs are entirely separate, the male or staminate flowers forming the terminal tassel at the top of the plant, while the female or pistillate flowers are found on the cob, surrounded by the husk.

The stem of grasses is unbranched, but several stems are produced from one seed by the process of stooling or tillering; that is, the root puts forth suckers and thus multiplies the stems. Many of the perennial grasses, like brome grass and June grass, also multiply and spread by means of rootstocks.

The principal plants belonging to this family are: (a) Those ordinarily called *grasses*, of which there are more than two hundred species in this country. The most important are described in another chapter. (b) Wheat, barley, rye, oats, corn, rice, sorghum, sugar cane, bamboo.

This family of plants should be carefully distinguished from the sedges, which closely resemble grasses, but whose stems are not jointed, and are usually triangular and solid instead of round and hollow, as those of the grasses are. As



SCOTCH FIFE WHEAT

a, complete spike or "head"; *b*, stem from which spikelets have been removed; *sp*, the points where they were attached; *c*, spikelet, enlarged; *d*, single flower, greatly enlarged; *ch*, chaff; *k*, kernel; *st*, stigma; *an*, anthers.

a rule the sedges grow in lower ground and most of them make inferior pasture and hay.

The Pea Family or the Legumes. — The legumes have a prominent place in agriculture for the twofold reason that they include many of our most valuable food plants and they



INDIAN CORN

Tassel, the staminate flowers.

Ear, the pistillate flowers.



STOOL OF RYE

Grown from a single seed.



A SEDGE

enrich the soil in which they grow. The characteristic feature which distinguishes these plants from others is the structure of the flower and the fruit. These are illustrated in the sweet pea. We may fancy that the general form of the flower resembles that of a butterfly. The corolla consists of five petals, the upper one being quite large, with two at the side of intermediate size and the two at the base much smaller. The last two are often fastened together so that they look like one piece. There are ten stamens, nine of

them being grown together except at the upper end. In some species all ten stamens are thus grown together. The pistil, when ripe, forms a dry pod containing a single row of seeds, as we see in the peas and beans. The leaves of this family of plants are alternate and are usually compound.

The great value of legumes is due to the nodules or tubercles that grow on the roots of the plants. These are tiny, whitish swellings not generally much larger than the head of a pin. They are the home of swarms of minute beings called bacteria that have the power of causing the ordinary nitrogen of the air to



SWEET PEA

The petals; the stamens and pistil; the ripened pod.

unite with certain sub-
stances of the soil and form what is called *nitrates*. These nitrates are then taken up into all parts of the plant, including the seeds, giving them a superior food value as seen in clover and alfalfa, and in peas and beans. The soil in which legumes grow is also greatly enriched by the nitrates in the roots and nodules. To appreciate the importance of all this the student must understand that nitrates are our most valuable food constituent. They form the basis of the proteids that are so essential for the support of man and beast. They are indispensable to the growth of plants, and plants must obtain them from the soil. But the supply



RED CLOVER ROOTS
With nodules.

of nitrates in the soil is easily exhausted, so that it must be replenished from time to time.

There are several thousand species of legumes, the most familiar examples being peas, beans, the clovers, alfalfa, sweet clover, prairie clover, the wild vetches, and the milk vetches. The family also includes several trees, as the Siberian pea tree and the locust.

The Family of the Composites.

— This is the largest family of our common plants and includes many of our most familiar flowers.

The term *composite* refers to the fact that what we regard as a single flower is really composed of a large number of flowers, thus making a sort of compound flower. The cultivated sunflower, on account of its large size, is perhaps the best example for studying the structure of composites, but the common thistle, the blazing star, or the wild sunflower will do very well.

Let us take the sunflower as our example. Upon careful examination we find that the "flower" consists of scores of tiny florets massed together in a compact cluster which botanists call a *head*. On the outside of this there are several overlapping rows of small, leaf-like scales that resemble a calyx and are called the *involucre*. Next within this green involucre



PODS OF LEGUMES
a, bean; *b*, alfalfa;
c, clover.

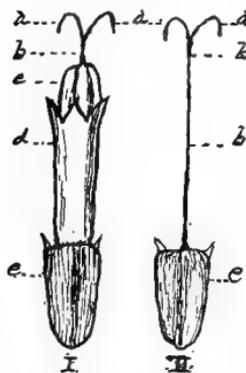
is a circle of yellow straps called *rays*. We might be disposed to call them petals, but each one is a complete corolla. In the sunflower and in some other cases the ray-flowers have neither stamens nor pistils, but in the daisy and certain other flowers they bear seeds.



SECTION OF SUNFLOWER

Ray-flowers and tubular flowers.

Within the circle of ray-flowers the entire space is set with perfect little flowers having a tubular corolla, five

TUBULAR FLOWER
OF SUNFLOWER

Greatly enlarged. *a*, two-cleft stigma; *b*, style; *c*, anthers forming a tube around upper end of style; *d*, corolla; *e*, ovary or seed. In II the corolla and stamens have been removed, thus showing the slender style the whole length.

yellow stamens set in a circle and forming a little tube around the pistil — which consists of the ovary, a long style, and a two-branched stigma projecting above the rest. In some other composites this sunflower plan is slightly modified; for example, the thistle and the bachelor's button have no rays, but only tubular flowers, while the dandelion, double aster, daisy, and chrysanthemum have only strap-shaped flowers.

The marked feature of the composites is the seed, which is simply a ripened ovary, each seed representing a floret. In many cases the seed is surmounted by a tuft of hairs by which the wind may easily carry it a long distance. The dandelion, thistle, and goldenrod furnish good illustrations of this ingenious flying machine.

Some examples of composites are :

(a) In our gardens — sunflower, aster, zinnia, dahlia, bachelor's button, marguerite, daisy, cosmos, coreopsis, calliopsis, marigold, golden glow, and lettuce.



SEEDS

a, sow thistle; b, dandelion, with their flying machines.

(b) Prairie flowers and weeds — wild sunflower, wild aster, goldenrod, coneflower, blazing star, ragwort, dandelion, thistle, sow thistle, and horse weed.

The Rose Family. — This is a large group of plants producing some of our favorite flowers and our strawberries, raspberries, and blackberries. The structure of the flowers is well illustrated in the wild rose. The calyx consists of five sepals united at the base and forming a deep cup. The five petals and numerous stamens are set on the edge or rim of the lining to this cup, and the many pistils on the bottom.

Some of the plants having a flower of similar structure, and belonging to related families, are the apple, pear, plum, cherry, June berry, and hawthorn.

It is very interesting to study some of these blossoms, then make subsequent observations, and learn the various ways in which our fruits are developed from the flower.

The Carrot or Parsley Family. — This group of plants may easily be distinguished by the form of the flower cluster, which is an *umbel* — usually a compound umbel. The individual flowers are very small, and those

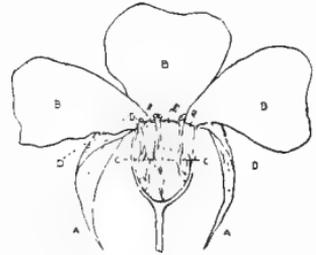


DIAGRAM OF A WILD ROSE

Showing how the petals and stamens are inserted on the rim of the cup and the pistils on the bottom; a, sepals; b, petals; c, pistils; d, stamens. Only a few of the many stamens and pistils are represented.

of garden carrots or parsnips are as good for study as any other. Five tiny petals and five stamens are set on top of the ovary around the two styles. The ovary develops into two seeds that remain grown together until they are ripe. In carrots the flower is white, and in parsnips, yellow. No other color is found in the flowers of this family.



PARSNIP

a, flower; *b*,
two ripened
seeds, *s-s*.

Most of the plants of this group are characterized by harmless aromatic properties which give parsnips, carrots, parsley, caraway, and dill their peculiar flavor.

The family also contains several poisonous

plants, as water hemlock; the garden parsnip becomes poisonous when allowed to grow the second year, and even the wild carrot is considered poisonous.

The Mustard Family. — The plants of this group have a pungent, watery juice, for which we relish horse-radish, mustard, and radishes. The flower may be studied in the common wild mustard. There are four sepals, four petals, and six stamens, two of these being shorter than the other four. The fruit is a pod, which is divided lengthwise into two cells by a thin partition, and has a row of seeds in each cell.

COMPOUND UMBEL
OF GARDEN DILL

WATER HEMLOCK

A common poisonous plant
very destructive to farm stock.

To this family belong many of our weeds, such as the common wild mustard, tumbling mustard, black mustard, pepper-



FLOWER OF WILD MUSTARD

a, Complete flower.

b, Parts shown in proper order: 1, sepals; 2, petals; 3, stamens; 4, the pistil.

grass, false flax, shepherd's purse; also such garden vegetables as the radish, turnip, rutabaga, and cabbage, and such flowers as the sweet alyssum and candytuft.

The Gourd Family.—

Plants of this family are vines with tendrils, and have two kinds of flowers, the male or staminate, and the female or pistillate, both kinds growing

on the same plant.

The pumpkin and squash are the most suitable for study. All the flowers have a funnel-shaped corolla.

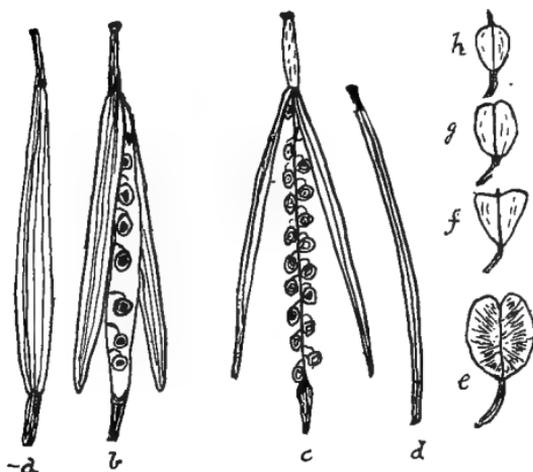
The stamens in the male flower are united into a single mass of irregular shape, and the pistil in the female flower consists of an

ovary with two or three stigmas. The seeds are comparatively large and

usually flat. The

group includes the pumpkin, squash, muskmelon, water-

melon, cucumber, gourd, and the wild or prickly cucumber.



TYPICAL SEED PODS OF MUSTARD FAMILY

a, Common wild mustard; *b* and *c*, the same pod as it bursts open to discharge the ripened seeds; *d*, Tumbling mustard; *e*, French weed; *f*, Shepherd's purse; *g*, Peppergrass; *h*, false flax.

EXERCISES AND PROJECTS

1. *A head of wheat.* — (a) Pull off the spikelets from a head of wheat, and note how they are attached — alternately, on opposite sides of the stem. Note the jointed form of the stem where the spikelets are attached.

(b) Examine a spikelet and see how many flowers or grains it contains. Compare with other spikelets and see which part of the head is least fruitful.

(c) When the wheat is in bloom, examine the flower. Note the scales of chaff that take the place of calyx and corolla. How many stamens do you find? Note the pistil, — the ovary or grain, and the feathery stigmas. Make a drawing of these parts.

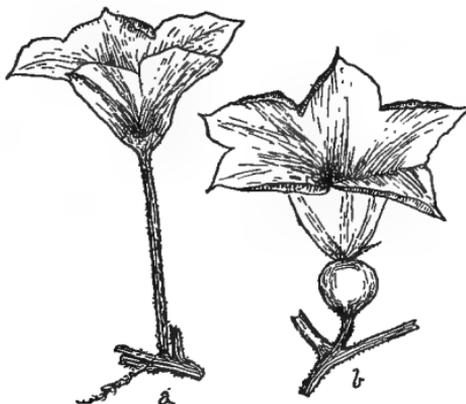
2. *Stooling or tillering.* — Pull up an entire plant of wheat or other grain and note the number of stems or stalks. Examine the root carefully and note how the stems are connected, showing that they belong to the same plant and came from one seed.

3. *Stem and leaf of grasses.*

— (a) Note the hollow stem with solid joints. This construction secures the greatest strength with the least expenditure of material. A solid stem made out of the same quantity of material would be very thin and weak.

(b) Tear a leaf and see how easily it splits, showing that it is parallel veined. Note how firmly the lower part of it clasps the stem and thus strengthens it.

4. *Grasses and sedges.* — Note carefully the characteristics of sedges as given at the close of the article on the grasses. Find some sedges in a wet meadow or by the water's edge and compare them with true grasses. Try to find several kinds of sedges and study them until you can distinguish the two classes of plants with ease.



FLOWERS OF THE SQUASH

a, staminate or male flower on its long slender stem; *b*, pistillate or female flower with young squash below the corolla.

5. *The flower of a legume.* — (a) Take the flower of a sweet pea, a garden pea, or a bean. Note the general form — the large upper petal, two smaller ones at the side, and the two smallest at the bottom fastened together into a boat-shaped object. Now observe the smaller flowers of clover, alfalfa, and other legumes, and notice that they have the same form. By a little practice you can become quite skillful in distinguishing legumes in this way.

(b) Remove the petals of the pea or bean and notice the stamens. How many are there? Are they all united? If not, how many are free from the rest? Note the form of the pistil — its resemblance to the mature pod.

(c) When the pea or bean is ripe, notice how the pod splits open on both seams and exposes a single row of seeds. Now find well-grown pods on clover, alfalfa, and other legumes and note that they have the same structure as the larger pods of peas and beans. The trained observer can safely classify a plant as a legume by the pod alone.

6. *The nodules on the roots of legumes.* — Dig up a well-grown garden pea, white clover, or other legume and look for small whitish growths on the smaller roots. By a little practice you will learn to find them very easily. Explain the part that these nodules play in the enrichment of the soil.

7. *The structure of a composite flower.* — Take either a cultivated or a wild sunflower and cut it as shown in the picture on page 77. You will easily see that the bulk of the sunflower is really made up of scores of perfect little flowers with a yellow, tubular corolla having five points on its rim. With the aid of a pin tear away this corolla and try to find the five stamens and the pistil with its long style, its two stigmas above, and its ovary or seed at the bottom. Examine the petal-like objects called “rays” on the margin of the sunflower. Notice that the ray has five little points at the end and is slightly rolled up at the base, indicating that it has been developed from a tubular corolla by splitting it down the side, flattening it out, and lengthening it. The remnant of the ovary at the bottom may also be recognized, though in the sunflower it cannot develop into a seed because there is no stigma.

Now examine other composite flowers and note resemblances and differences as compared with the structure of the sunflower. After a little practice you should be able to distinguish a composite flower at sight. What is the difference between such a flower and a clover blossom?

9. *Fruits.* — (a) Study the structure of the apple blossom and watch the subsequent development of the fruit. Notice that the enlarged ovary with the seeds becomes the core of the apple and fills a small space at the center. The remainder of the apple is developed from that part of the flower which we described as the "cup." (See page 78.)

(b) The growth of the fruit: it will help you to understand the development of the apple if you study the growth of the wild rose hip, which is simpler.

(c) A similar study of the strawberry and raspberry will show that each follows a different mode of development, the fleshy portion that we eat coming from a different part of the flower.

9. *The Carrot family.* — (a) Plant a few carrots and parsnips in the spring (the roots) and let them blossom. Observe the structure of the flower as carefully as possible. Make drawings to show the form of the cluster. Notice how two seeds come from each flower. They stick together and look like a single seed until ripe.

(b) At the water's edge in sloughs and roadside ditches you can probably find the water parsnip and water hemlock. Where one grows the other also is apt to grow. You should know them, because they are among the very few poisonous plants of the Northwest. They cause much trouble among cattle, especially when present in hay.

(c) Observe carefully all the plants you meet having this type of flower cluster until you can recognize at sight any member of the family. As far as possible you should also learn the specific name of each, but that is generally quite difficult unless you have assistance.

10. *The Mustard family.* — (a) Examine a wild mustard flower and note the structure as described elsewhere (see page 80).

(b) Examine a well-grown mustard pod, and note all the features mentioned in the description. Note how it splits open when ripe. Compare this type of pod with the pea or bean pod.

(c) Examine the pods of all the members of the family you can find. Note that, though the form and size vary greatly, the general structure is the same — all are divided lengthwise by a thin partition, making two cells for seeds. When ripe they split open to discharge the seeds in the same manner.

11. *Pumpkins, squash, cucumbers, etc.* — Study any or all of these vegetables when in bloom, and learn to distinguish the male from the female flowers. The latter may easily be recognized by the young fruit

at the base. Note that the pollen on the staminate flower is not in the form of loose dust which the wind may blow about, but sticks together in small masses. Nature therefore depends on insects to carry the pollen from the stamens to the pistils. If these workers do not visit the garden, the fruit will not "set," but the pistillate flowers wither and die just as the staminate flowers do. Do you find that this is happening on your vines? In such a case gardeners sometimes render assistance, — take a staminate flower, tear away the corolla, and rub it gently over the stigma to brush on a little of the pollen.

CHAPTER VIII

SOME PRAIRIE FLOWERS

If we compare a typical prairie flower like the goldenrod, aster, or coneflower, with a typical forest flower like the Canada violet, or with one growing in marshes like the dog violet, we see that the former is stronger and more robust. The stem is harder and stiffer and is usually more or less rough or hairy. This enables these plants to endure the drought and the strong winds to which they are occasionally subjected. With these hardy flowers the unbroken sward of our prairies is bedecked throughout the season. It would, no doubt, be appreciated by every lover of nature if we could help him to identify easily all of those that he may find in his neighborhood; but this is manifestly impossible, as in North Dakota alone, for instance, about 800 wild plants have been listed and the majority of them grow on the prairies.

We therefore describe only a few of the most characteristic species, arranging them approximately according to their season of blooming; and as a further help to the student in identifying specimens, we give color index at the beginning of the list.

SPRING AND EARLY SUMMER

1. **Pasque Flower.** — This is generally the most conspicuous of our early prairie flowers. The name means Easter flower. In their favorite localities the large bluish

COLOR INDEX FOR COMMON PRAIRIE FLOWERS

COLOR OF FLOWER	NAME OF PLANT AND ITS NUMBER IN THE DESCRIPTIONS FOLLOWING	
Greenish White	6 Meadow Rue	45 Zygadenus
White	2 White-flowered Parsley	5 False Solomon's Seal
	7 Pennsylvanian Anemone	16 Northern Bedstraw
	26 Wolf-berry	27 White Prairie Clover
	32 Yarrow	52 Aster
Purplish White and Bluish White	26 Wolf-berry	29 Beard Tongue
	35 Milkweed	40 Larkspur
Yellow and Orange	2 Hairy Parsley	3 Golden Violet
	9 Silver-berry	11 Squaw-weed
	12 Puccoon	14 Meadow Parsnip
	17 Ox-eye	18 Long-headed Coneflower
	19 and 20 Evening Primrose	24 Silver-weed
	25 False Dandelion	30 Prairie Rocket
	37 Yellow Flax	41 Golden Aster
	43 Black-eyed Susan	49 Gum Plant
	50 Goldenrods	51 Sunflowers
Red and Purple	4 Indian Paintbrush	21 Scarlet Gaura
	22 Prairie Mallow	33 Sticks
	35 Milkweed	38 Rose
	39 Lily	42 Purple Coneflower
	44 Gerardia	47 Thistle
Bluish Purple and Violet	1 Pasque Flower	8 Ground Plum
	10 American Vetch	23 Loco Weed
	28 Violet Prairie Clover	31 Silver-leaved Psoralea
	48 Lead Plant	53 Blazing Star
Blue	13 Blue-eyed Grass	15 Harebell
	34 Blue Lettuce	36 Wild Flax
	48 Lead Plant	52 Aster

purple blossoms adorn the prairie while all else is still brown, and proclaim to the world that the day of the resurrection of plants is at hand. After blooming, the fruits (seeds) develop long feathery tails. The leaves are close to the flower, forming a sort of cup that might be mistaken for the

calyx. The entire plant is covered with soft, silky hairs. It grows in dry soil, especially on knolls. It is often called the "crocus," but is really quite different from that well-known bulbous plant.

2. **White-flowered Parsley and Hairy Parsley** (*Peucedanum*).—These names apply to two plants that always attract attention on account of their extreme earliness, though they are usually less than six inches high and the flowers are not very showy. They



WHITE-FLOWERED
PARSLEY

bloom fully as early as the pasque flower. Their flower cluster is an umbel, showing that they probably belong to the carrot or parsley family, and the leaves are finely divided as we see in the garden caraway, dill, and other plants of this family. The hairy parsley has yellow flowers, and the plant is more hairy and the leaves more finely cut than in the case of the white-flowered species.

3. **Golden Violet: Nuttall's Violet.**—This golden-yellow violet of the prairies is not the same species as the downy yellow violet that forms the subject of Bryant's beautiful little poem, "The Yellow Violet," but it blooms even earlier in the spring. The golden violet is found on dry prairies, while the downy grows in woodlands.

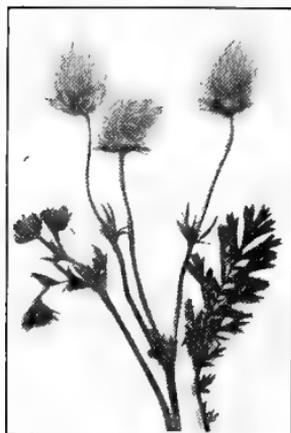


PASQUE FLOWER
Blossom and seeds
with plumes.



GOLDEN VIOLET

4. **Indian Paintbrush: Purple Avens.**—The stem of this plant is from six to eighteen inches high, and bears three pretty, bell-shaped flowers. Both corolla and calyx are purple. After blossoming, the styles become long, feathery plumes that form a soft, purple “paintbrush.”



INDIAN PAINTBRUSH
Flowers and plumes.

5. **False Solomon's Seal** is a tidy-looking little plant, bearing a row of narrow, parallel-veined leaves on each side of the stem and a raceme of small, star-shaped, delicate white flowers at the end. “Seal” refers to the marks on the underground rootstock.



FALSE SOLOMON'S
SEAL

6. **Early Meadow Rue.**—This plant does not have showy flowers, but always attracts attention on account of its neat



EARLY MEADOW
RUE

compound leaves, which appear very early in the spring. The blossoms are interesting, for the pistillate and staminate flowers grow on separate plants. There are no petals, and the sepals usually fall off early, so that the flower consists merely of a cluster of pistils in one case and of stamens in the other. When this species is known other meadow rues may be found later in the season and easily identified by their similar appearance.

7. **Pennsylvanian Anemone.**—A plant, 12 to 18 inches in height, bearing several attractive white flowers above

the three leaves near the upper part of the stem. There are also a number of leaves that come from the base of the stem. *Anemone* means wind, and there are several species of anemones or wind flowers. They were formerly supposed to open only when the wind blows.

8. **Ground Plum.**— This is named from the fruit, which looks like a green or purple plum of oblong shape. It is found lying upon the ground in clusters, and is sometimes collected and cooked like green peas and eaten. The flowers are violet purple and grow in a dense raceme at the end of a leafless stem. The plant shows all the marks of the Pea family to which it belongs.



GROUND PLUM
F, Fruit.

9. **Silver-berry.**— An attractive shrub growing in clumps in favorable spots on the prairie and at the border of copses and streams. It has oblong leaves and fragrant, yellow flowers. The leaves, young twigs, and berries have a beautiful silvery luster. The bush is quite ornamental and is worth planting on the home and school grounds.

10. **American Vetch** has very pretty, bluish purple flowers, four to eight in a cluster, growing on a slender and graceful vine. It is easy to see that the plant belongs to the Pea family. In some localities it is erroneously called "wild sweet pea." It



PENNSYLVANIAN
ANEMONE



SILVER-BERRY
Showing the
berries.

likes to grow in fairly moist places and is sometimes quite abundant among grass, forming a valuable part of the pasture and hay.



AMERICAN VETCH

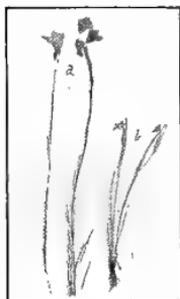
11. **Squaw-weed: Golden Ragwort.** — Has golden-yellow flowers of the composite family that are borne at the top of the plant in large clusters. The form of the plant, especially of the leaves, varies greatly. Usually 12 to 20 inches high.

12. **Puccoon.** — Here we have a pretty cluster of small, orange-colored flowers growing at the top of a very leafy stem. The flowers have a slight but very pleasant fragrance. The corolla has the form of a funnel, its spreading rim having five lobes. There are five stamens and one style. In another species the flowers are lighter yellow and the leaves narrower. *Puccoon* is the Indian name of this flower.

SQUAW-WEED (a)
AND PUCCOON (b)

13. **Blue-eyed Grass.** — This pretty little flower belongs to the

Iris family, but is very much smaller than its cousins, the irises. The plant is only a few inches high and grows on moist prairies among the grasses. The flowers are of a delicate blue color, and the leaves look like blades of grass.

HAREBELL (a)
AND BLUE-EYED
GRASS (b)

14. **Meadow Parsnip.** — A harmless plant of the Parsley family having yellow flowers and compound leaves. Height from one to two feet. Grows in fairly moist places.

15. **Harebell: Bluebell.** — A delicate plant with pretty blue, bell-shaped flowers, and rounded leaves at the base of the stem. It is famous in England and Scotland. It should do well in the flower garden among other perennials if properly sheltered.

16. **Northern Bedstraw (*Galium*).** — It is too bad that this pretty white flower has not a better name. The individual flowers are small, but a large number of

them are crowded together into a compact panicle that is dainty and attractive. The fruit or seed is covered

with minute bristles. The narrow leaves are arranged in fours around the stem. The plant stands erect and is from one to two feet high.



NORTHERN BEDSTRAW

17. **Ox-eye: False Sunflower.** — This showy, yellow-flowered plant resembles a wild sunflower, but blooms earlier in the season. It is usually two or three feet high and has large, broad leaves growing opposite each other on the stem. Sometimes found as a weed.

18. **Long-headed Coneflower: Prairie Coneflower.** — This is another "compound flower" having yellow mar-



MEADOW PARSNIP

MIDSUMMER



OX-EYE (a) AND LONG-HEADED CONE-FLOWER (b)

ginal rays. It is very fragrant, and the rays are only 5 to 8 in number and usually droop instead of standing out straight like those of the sunflower. The disk or center piece is a slender cone or column an inch long and grayish green in color. The plant is about two feet high and bears several flowers at the ends of the branches. Its



COMMON EVENING
PRIMROSE

leaves are deeply cut. This is a western flower, extending eastward into Minnesota and Iowa.

19. **Common Evening Primrose.** — A large, coarse biennial with a rather famous name. The pure lemon-yellow flowers are pretty enough, but the plant is so rank growing that it should be looked upon as a weed. The stems are several feet high and are not branched very much; the leaves are alternate. The flowers grow from the axils of the leaves at the end of the stem, opening in the evening and fading

the next day. They are a typical example of the Evening Primrose family and illustrate a very interesting flower structure that is worth careful examination. The calyx tube adheres to the ovary, is prolonged beyond it, and then terminates in 4 narrow lobes; the 4 yellow petals and 8 stamens are inserted on the summit of the calyx tube; the style is very long, reaching from the ovary through the calyx tube and terminating in a 4-lobed stigma. The cultivated Fuchsia belongs to the Evening Primrose family and its flowers have the same structure.

20. **Tooth-leaved Evening Primrose.** — A more dainty plant than the preceding, usually being only 5 to 10 inches

high. The leaves are narrow and slightly toothed. The flowers are yellow and reveal their relationship to the preceding species.

21. **Scarlet Gaura.** — Another member of the Evening Primrose family and having the same flower structure as the two preceding species. The flowers have a pleasant, spicy odor; they are rose-color, turning scarlet with age; their 4 petals are turned upward, and the 8 stamens and the long style are turned downward. The stems branch at the base and are 6 to 8 inches long; the flowers grow along the upper end, and the lower part bears numerous small leaves. The plant



SCARLET GAURA



PRAIRIE MALLOW

is found from eastern Minnesota to the Rocky Mountains and southward.

22. **Prairie Mallow or False Mallow.** — The flowers of this plant are bright, yellowish red, very showy and fragrant, about half the size of a small rose; they grow along the upper end of the stem. It is sometimes erroneously

called a "wild geranium," but it resembles a geranium only in the shape of its leaf. The Red River is the eastern limit of this flower.

23. **Loco Weed: Loco-Vetch.** — This name means *crazy weed*, and the plant is so called on account of the peculiar behavior of cattle, horses, and sheep that have been poisoned by eating it. It belongs to the Pea family, as indicated by the form of the flowers and the com-



LOCO WEED

pound leaves. The purplish violet flowers grow in a compact cluster at the end of an erect, leafless stalk, and at the base of this are the leaves.



SILVER-WEED

24. **Silver-weed: Goose Tansy.**— Receives its name from the silvery appearance of the under side of the leaves, due to the silky white hairs which cover them. The plant belongs to the Rose family, as shown by the structure of the flowers. These are yellow and form singly on short stems. The plant grows in moist places, lying flat on the ground, and creeping along by slender runners.

25. **False Dandelion (*Troximon*).**— This flower has the appearance of a dandelion and is often mistaken for it, but the flower stalk is longer, more slender, and rougher than in the dandelion, and the leaves—found at the base of the flower stalk—are smaller and fewer in number. This is a western flower.



FALSE DANDELION



WOLF-BERRY

26. **Wolf-berry.**— In many localities known as “buck brush,” and closely related to the snow-berry which is often found in cultivation. The wolf-berry is a low shrub common along the edges of groves and along streams, and is also found on the open prairies. The flowers are white, tinged with rose-color, bearded within, and fragrant. They grow in clusters at the end of branches and in the axils of the leaves. Later in the season the bushes are covered with small greenish white berries.

27. **White Prairie Clover.** — This plant stands more erect than our cultivated clovers and is a foot or two in height, the stems being terminated by flower stalks with dense spikes of tiny white flowers. It has compound leaves with 7 to 9 narrow leaflets. It belongs to the same family as the common clovers and serves to enrich the prairie soil, but the stems are too tough to be relished by stock.



WHITE PRAIRIE
CLOVER

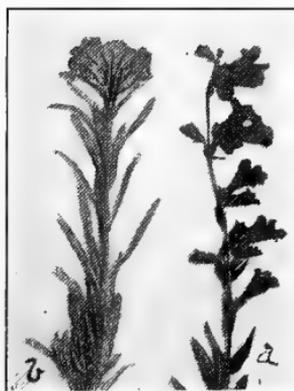


VIOLET PRAIRIE CLOVER

28. **Violet Prairie Clover.** — A somewhat larger plant than the preceding with purple flowers and smaller leaves; otherwise similar to the white prairie clover.

29. **Beard-tongue: Pentstemon.** — Bears a purplish white flower that is quite showy. The corolla is bell-shaped, but irregular and 2-

lipped, as in the snap-dragon; the upper lip is 2-lobed and the lower lip has three lobes. There are four ordinary stamens, the fifth one having been converted into a curious bearded tongue which gives the plant its name.



BEARD-TONGUE (a) AND
PRAIRIE ROCKET (b)

30. **Prairie Rocket: Western Wall-flower.** — Is a foot or two high, the unbranched stem bearing a large cluster of bright yellow flowers at the end.

These flowers and the pods which follow them are easily recognized as examples of the Mustard family. Grows in dry soil.



SILVER-LEAVED
PSORALEA

31. **Silver leaved Psoralea: Silver-leaved Prairie Clover.** — The whole plant is silky, silvery white, and quite decorative; bushy in form and 1 to 3 feet high. Flowers are small and purplish blue in color; leaves are compound, with 3 to 5 leaflets. Flower and leaves show that it belongs to the Pea family.

32. **Yarrow.** — A familiar plant, with feathery leaves and small white flowers in dense, flat-topped clusters. The plant is gray-green in color and has a strong aromatic odor resembling that of tansy. The stem is a foot or two high and is unbranched except at the top.



YARROW

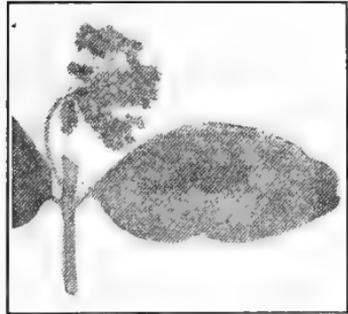


BLUE LETTUCE

33. **Sticks: Lygodesmia.** — A curious looking plant, all the lower leaves being so minute that it seems to be leafless, whence the name "Sticks." The plant is much branched and 10 or 12 inches high. The rose-purple flowers are composite, there being about 5 florets in a head.

34. **Blue Lettuce: Wild Lettuce.** — May be identified by its pretty blue composite flowers and milky juice, and its smooth stem and leaves. The plant is from one to two feet high, and is common on wild prairie sod as well as in waste places.

35. **Milkweed.** — The common milkweed may be known by its stout, unbranched stem (2 to 3 feet high); its thick, oblong, opposite leaves (4 to 8 inches long); and its milky juice. The dull purple flowers have a rich odor and grow in umbels from the axils of the leaves. Their structure is very complicated, and the stigma can be reached and pollinated by insects



MILKWEED

only with great difficulty, so that

from the many flowers only an occasional pod is formed. For the seeds in this pod nature has provided a generous supply of long silken hairs, able to carry them long distances on the wings of the wind.



WILD FLAX

36. **Wild Flax.** — A plant 12 inches or more in height, with blue flowers and narrow leaves, looking much like the cultivated

flax. This wild flax, however, is perennial. It is ornamental and is often found in the flower garden.

37. **Yellow Flax.** — Similar to the preceding, but a smaller plant, and with yellow flowers; easily recognized as a flax.

38. **Prairie Rose.** — This is a beautiful rose growing on a homely shrub, the stems being crooked and very prickly and only a foot or two high. The root is killed with great difficulty, and the plant is therefore



PRAIRIE ROSE

In fruit.

often abundant in fields as a weed. Though the flowers look alike, this is not the same species as the meadow rose found along the borders of copses and streams. That makes a handsome bush and is well worth planting near homes and school-houses. Nor is this species the same as the "prairie rose" native in the eastern part of the country and often cultivated.



RED LILY

39. **Red Lily.** — This is one of the handsomest prairie flowers, and is well worth transferring to our garden. It needs no description, as everybody knows a lily. Grows in fairly moist places.

40. **Azure Larkspur : Carolina Larkspur.** — The larkspurs of our gardens are familiar to most people, so that this wild species may be easily recognized. The name alludes to the spur which one of the petals bears and which contains the honey that attracts the insects needed for cross-fertilization. This species is almost white, tinged with purple, especially the spur at the base of the flower. The numerous flowers grow along the end of the unbranched stem. The leaves are few and deeply cut. This plant is said to be poisonous.

41. **Golden Aster.** — These showy flowers are light golden-yellow and about as large as a dandelion, terminating the numerous branches, which lean upon the ground. The whole plant is rough and hairy. It is most frequent in dry, sandy soil.



GOLDEN ASTER

42. **Purple Coneflower.** — In the "coneflowers" the center or disk is conical or rounded instead of flat as in the sunflowers

and many other blossoms of the same general type. The cone shape is best shown by the receptacle underneath the florets. The purple coneflower is distinguished by its rose-colored, drooping rays ("petals") and its dark, brownish purple disk which is quite sharp to the touch. The stem also is rough, from one to three feet high, bears a few narrow leaves, and is commonly terminated by a single flower, though sometimes by two or three.



PURPLE CONE-FLOWER



BLACK-EYED SUSANS

43. **Black-eyed Susan: Yellow Daisy.**

— Bears a

handsome flower of the sunflower type with about 14 dark yellow or orange rays and a rich purple-brown center. The plant is quite sturdy, from one to two feet high, has but few if

any branches, and only a few long, narrow leaves, and is covered throughout with rough, bristly hairs. It is quite harmless in the Northwestern states, but in the eastern part of the country it is a bad weed in hay fields.

44. **Gerardia: Rough Purple Gerardia.** — Bears pretty flowers, with large purple corolla that is shaped like a bell with an unsymmetrical, 5-lobed rim. There are 4



GERARDIA

stamens, one pair being shorter than the other pair. The plant is a foot or two in height and is covered with short, white hairs; the branches are nearly erect, the leaves, very narrow. Another gerardia, often found in the same places, is a smaller plant, has smaller flowers, and is smooth to the touch instead of rough.



ZYGADENUS

45. **Zygadenus: Swamp Camas.** — Bears handsome greenish white flowers at the end of a straight and slender stem that is a foot or two high. The leaves are narrow and parallel-veined; the entire plant is very smooth and has the structure and general appearance of a small lily. It grows from a bulb, in moist places.

A related species with yellowish flowers is poisonous to stock.

46. **Canada Milk Vetch.** — A sturdy plant of the Pea family, standing quite erect, 2 or 3 feet high, and bearing large racemes of greenish white flowers. These are not pretty, but usually attract attention as the plant is large and quite conspicuous. The pods remain on the old plants all winter.



CANADA MILK VETCH

There are many other, but smaller, species of milk vetches growing on the prairies. They were given this name in Europe because a certain member of the group was supposed to increase the yield of milk from goats that fed upon it. Our Canada milk vetch, however, is too tough for stock to eat.

47. **Thistle.** — The common wild thistle of our prairies is the wavy-leaved thistle with purple flowers. It is a harm-

less plant and easily killed, and it should not be called Scotch thistle nor bull thistle nor Canada thistle, for those are very different species and are not native of the prairies but have been introduced as weeds.

48. **Lead Plant : Shoe-strings.** — A plant of the Pea family growing from one to three feet high, densely covered with white hairs, and bearing bright, blue-violet flowers in large clustered spikes.



LEAD PLANT

The compound leaves have an unusually large number of leaflets (21-49). The silvery foliage and showy flowers make it a valuable plant for the shrubby border of the lawn, especially in dry places.

49. **Gum-plant : Rosinweed.** — Has yellow composite flowers and is easily recognized by the gummy substance that covers the heads, and by the strong, resinous odor. The plant is quite bushy in form and from one to two feet high. Often occurs as a weed in pastures.

LATE SUMMER AND AUTUMN

Among our wild autumn flowers yellow predominates, though white and blue are also common. Most of these flowers are composites, and more



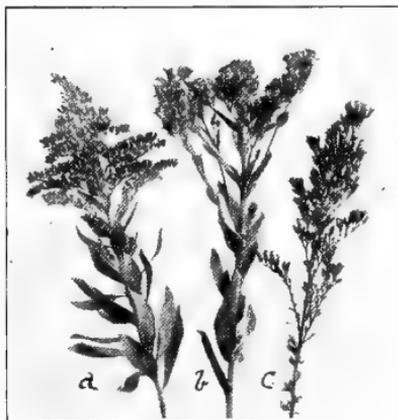
CANADA THISTLE AND
WAVY-LEAVED THISTLE



GUM PLANT OR RESIN PLANT

than half of them are goldenrods, sunflowers, and asters, there being many species of each of these.

50. **The Goldenrods.** — These popular plants have composite flowers in very small heads, and it requires close ob-



GOLDENROD

a, Canada; *b*, harsh-leaved; *c*, low Missouri.



WILD SUNFLOWERS

servation to discover that these little heads are really made up of five or ten tiny florets. In most of the goldenrods the flower cluster is gracefully turned to one side, as in *a*, but in a few species the stem is straight and the cluster presents a flat top, as in *b*. The latter form people often fail to recognize as a goldenrod, but the kind shown in the picture is quite common on most of our prairies.

51. **The Sunflowers.** — There are many species of wild sunflowers, all of which may be recognized by their resemblance to the cultivated species. The flowers, of course, are smaller, but they have the same sort of yellow rays at the outside of the head and the brown face in the center. The earliest species that comes into bloom has an unbranched

stem with but few leaves. In other species the stem is quite leafy and has many branches.

52. **The Asters.** — Many species of asters are found on the prairies, the smooth aster (*Aster laevis*) and the white wreath aster (*Aster multifloris*) being the prettiest, and in most sections the commonest. The first of these has very smooth leaves and stem, and large blue flowers. The leaves and stem of the second are grayish and hairy, and the flowers are white, very small, and very numerous. These two asters are fine enough for a place among the perennial flowers of the lawn or garden.



WILD ASTERS

a, smooth; b, white wreath.

53. **Blazing Star.** — Plants with very showy, composite flowers of bluish purple color. They are from one to two feet high, with unbranched stems and narrow leaves that are often twisted. There are several species, some of them being found under cultivation.



BLAZING STAR

PROJECTS

1. *Learn to know the flowers.* — If you like flowers you will, of course, want to know as many kinds as possible, and by going about it systematically you can extend your acquaintance greatly. Familiarize yourself with the descriptions and pictures of this chapter, and as soon as the flowers begin to appear in the spring try to identify them by the help of this book and of friends who know them. In a suitable

notebook enter a complete list of all the flowers that you know growing in your neighborhood. Then, as you become acquainted with others, add them, noting where they grow, a description of the whole plant, and especially of the flower, and any other points of interest. You will, of course, meet some kinds whose names you cannot learn at the time. If the plant is common and you become well acquainted with it, enter the description in your notebook in hope of learning its name later.

2. *A permanent collection of flowers.* — Make an herbarium embracing as many as possible of the flowers growing in your neighborhood. The collection may be made by a single student or by several working together. A good herbarium is valuable for the school, where it may be used year after year and additions to it made from time to time.

The specimen may include the whole plant, if it is small; otherwise, a piece of the stem with some leaves as well as the flower. Dry it as rapidly as possible between soft, unsized papers, under pressure, changing the papers occasionally as they become damp from the absorbed moisture. When dry, fasten the specimens on thick white paper by slips of gummed paper or by glue applied to the specimens themselves. There should be only one species on a sheet, and all the sheets should be of the same size. For large herbariums the standard dimensions are $11\frac{1}{2} \times 16\frac{1}{2}$ inches, but for small collections even 6×9 may be used.

3. *Oral and Written Composition.* — Many exercises in composition should be based upon such topics as are treated in this chapter. For example:

a. Give a clear, full, and interesting description of some flower with which you are familiar and which you have before you. The descriptions in this chapter have necessarily been made very brief and concise. Make yours several times as long, taking up similar points but explaining them more fully and also adding many other interesting details. Illustrate with drawings showing the form of flowers, leaves, and other features.

b. Give a general description of a particular group of flowers; as, your early spring flowers, your autumn flowers, flowers seen on the way to school, the flowers in your garden, etc.

CHAPTER IX

TREES AND SHRUBS

Ornamental Planting.—Every real student of nature is a lover of art out of doors. Such a person bestows the same degree of care and attention upon his yard or home grounds that he gives to the house itself. He regards it as a mistake for a home-builder to spend his last dollar in the erection and furnishing of the house, leaving the premises barren and unattractive. Ordinarily we can learn more about the character and taste of the owner from the artistic planting and care of the grounds than by looking at the size and beauty of the house. An architect and a full purse may account for the latter, but the former usually requires a labor of love.

The principle of ornamental planting is very simple; namely, that the trees and shrubbery shall give the house the setting necessary to form an attractive picture. In front of the house there should be an open lawn of smooth, velvety grass kept in trim condition and free from trees, shrubbery, or flower beds of any description. At the back and the sides of the house there should be plenty of tall trees, though most of them should be kept at a proper distance from the walls. The shrubbery may be massed in front of these trees, with the tallest in the rear. Low shrubs should also be placed against the foundations of the house to relieve the hard lines and connect the building with the ground in a natural way. Vines should cover at least a portion of

the veranda. The best place for flowers is at the border of the shrubbery. There they are protected from wind, and against such a background they appear to the best advantage. The general principle here outlined holds true in the country as well as in the city, and of schoolhouses



CORRECT ORNAMENTAL PLANTING ABOUT THE HOUSE

A frosty morning.

as well as of private homes, though the details, of course, will vary greatly with circumstances.

Hedges. — A hedge is a row of shrubs or small trees growing so close together as to form a more or less perfect barrier or fence. It may be allowed to grow up in a natural way or it may be cut back periodically to limit the height and give it the shape desired. The primary purpose of a hedge may be (1) to form a windbreak, (2) to mark off the boundary line of the premises and perhaps shut out intruders, (3) to inclose and protect the garden, (4) to shut off the barnyard from the dooryard, (5) to serve as a screen, (6) as a border along the driveway, and (7) for ornament.

Good taste requires that hedges shall be useful as well as

ornamental, and therefore even when ornament is the chief aim the hedge must be so placed that some other purpose is obvious. Ornamental hedges are often placed in situations where they cannot be allowed to obstruct the view, and unless made of shrubs that are naturally of very low



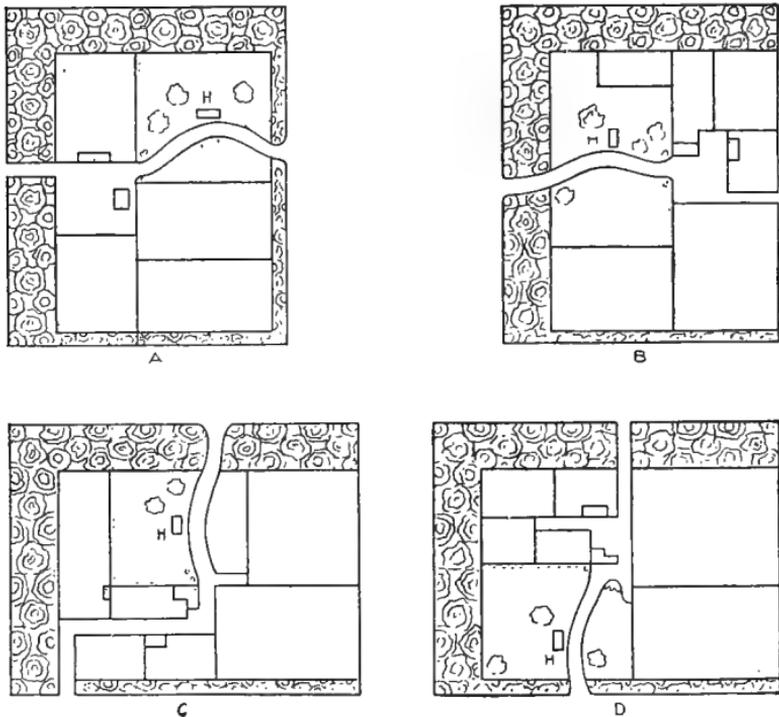
RUSSIAN OLIVE HEDGE — TRIMMED

growth, they are trimmed back about twice a year with hedge shears, a corn cutter, or some other suitable instrument. On the farm and at the rural school it is generally better not to trim the hedges.

The kind of shrub to be used depends upon the purpose and the location of the hedge. For windbreaks willows are commonly employed. For ornamental hedges the buckthorn is the favorite, as it has no superior either from the standpoint of beauty or utility. The Tartarian honeysuckle, caragana, Russian olive, and lilac are also employed, each having its own particular merits.

Windbreaks. — A good grove of trees near the farm buildings and the rural schoolhouse is both useful and orna-

mental, and its value is recognized by everybody. In this paragraph we are concerned with only one function of such a plantation; namely, to give protection against the wind. For this purpose a belt of trees is generally planted on the



PROPERLY LOCATED SHELTER BELT

For house situated on either side of the public road. In (a) the house is situated on the west side of the road; in (b) it is on the east side; in (c) it is on the south side, and in (d) it is on the north side. H denotes the house.

north side of the premises and sometimes also on the west and the south. It should have considerable breadth, not only to make it more efficient in checking the wind but also to insure a better growth of the trees. A solitary tree or row of trees planted on the open prairie cannot thrive so

well as the trees in a grove. In the latter case they protect one another and shade the ground, thus keeping it mellow and moist and preventing the growth of grass. To keep snowdrifts from forming among the trees and breaking them down, a row of willows should be set four or five rods to the north. This forms a trap and causes the snow to lodge between it and the windbreak proper.

For this shelter belt any trees may be used that are adapted to the climate, especially such as thrive in fairly close plantings. It is well to use several species in combination — some fast-growing and others of a more permanent character. The most effective windbreaks are formed by the evergreens.

Planting and Care. — A large proportion of the trees and shrubs set out annually fail to grow, and the commonest cause of such failure is that they were already nearly dead when planted. It may be that they came from a distant nursery and dried out too much on the way, but too often they are killed after arrival by exposure of the roots to wind and sun. It has been well said that a tree out of the ground is like a fish out of water; therefore, the roots must in some way be kept moist until they are restored to the ground. If allowed to become dry their diminished vitality may not be sufficient to start the growth, or, at any rate, not sufficient to pull them safely through the first season.

The ground should be well prepared before planting. If possible it should be plowed and cultivated in the same manner as for the seed bed of an ordinary field crop. The hole should be dug of ample width and depth to receive the roots without bending or crowding and to set the plant somewhat lower than it stood before. When nurseries sell trees and shrubs they usually furnish directions for their planting and care, and these should be diligently carried out.

When the trees and shrubs are young, they should be frequently cultivated and the grass and weeds kept away from them. After they shade the ground thoroughly, the grass usually does not thrive well enough to harm them. Unless the soil is quite rich, it should be well fertilized, that being just as necessary in this case as it is for farm and garden crops.

A FEW OF THE BEST TREES FOR NORTHERN STATES.

The person who does not admire fine trees must indeed be blind to the beauties of nature, for they are the grandest objects in the whole domain of plants and command our admiration even though we cannot tell their names. But if we become acquainted with them our appreciation is greatly enhanced, because each kind possesses charms that are peculiar to itself and that may easily escape observation. Moreover, a practical knowledge of trees makes it possible to raise them about our homes in greater variety and abundance and thus to increase this source of pleasure for ourselves and our posterity.

The species described in the following pages are readily transplanted and are fairly rapid growers, though they vary considerably in both of these particulars. We should, of course, not limit our studies to this list, but should aim to become acquainted with all the varieties found growing in our neighborhood.

The Cottonwood is a species of poplar, though it usually bears its own specific name, and when we speak of a "poplar" we mean one of the near relatives of this species, as the Norway or the Lombardy poplar, or the common native poplars or aspens. The cottonwood is the largest of the poplars, easily reaching a height of 100 feet. It takes its

name from the fluff of white hairs that cover its seeds. Many critics consider it and the box elder the most valuable trees of the Dakotas and adjacent territory. They grow rapidly and will survive more abuse and neglect than any other species. The cottonwood is a comparatively short-lived tree. We plant it for quick results, and we should at the same time set out more permanent trees that may eventually take its place.

The Box Elder belongs to the maple family and is often called the ash-leaved maple. Its great value is referred to



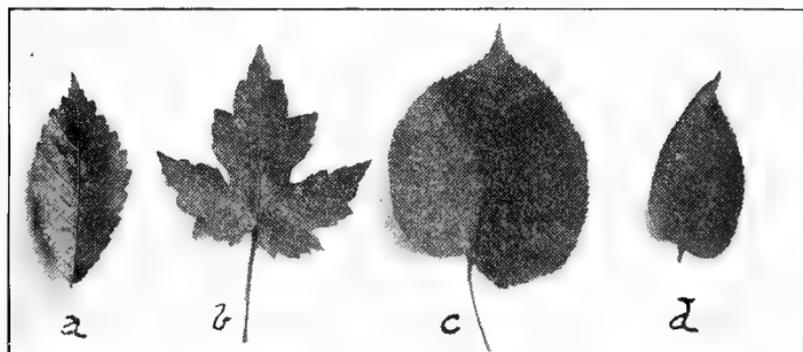
LEAVES OF TREES

a, Cottonwood; *b*, Box-elder; *c*, Green Ash.

in connection with the preceding species. It is not so tall as the cottonwood, and is more irregular in form.

The Green Ash does not keep pace with the box elder in its effort to get up in the world, but it is by no means a slow grower, and some even claim that after the first fifteen years, it will overtake the other tree. It withstands a dry climate remarkably well, it lives longer than the cottonwood and box elder, and it makes far more valuable wood. The white ash is also a great favorite, but it is not so hardy as the green ash.

The American Elm has been the favorite shade tree since the early settlement of the country. It was under the spreading branches of an elm in Cambridge, Massachusetts, that Washington first took command of the American army, and William Penn made his famous treaty with the Indians in the shade of an enormous elm which remained standing in the suburbs of Philadelphia until 1810. In the newer states of the Northwest this tree is equally popular. The easy curve of the larger limbs and the drooping branchlets give an outline that is distinctive and very graceful. It is some-



LEAVES OF TREES

a, Elm; *b*, Soft Maple; *c*, Linden; *d*, Hackberry.

what slow in its growth, but it will outlive several generations of box elders and cottonwoods.

The Soft Maple or silver maple is a handsome tree and a rapid grower, and is a favorite for any kind of place. It attains a height of 90 to 100 feet. The head is well formed and symmetrical, the foliage is light-green above and silvery beneath. It does not like a very dry climate and will not thrive farther west than the eastern part of the Dakotas.

The Linden or Basswood has a fine form and large, clean-looking leaves which make it a handsome and high grade

tree. It is hardy in a cold climate, grows fairly fast, attains a large size, and lives to a good age. This is one of the most famous trees of northern Europe, where there are certain specimens that are thought to be 900 to 1000 years old.

The Hackberry resembles the elm in general form and even in the shape of the leaves. It grows at about the same rate and is equally hardy. For the sake of variety it should be planted more extensively than it is, even though it is not distinctly superior to the elm. The dark purple berries are one-half to three-fourths of an inch long and are sweet and pleasant to the taste. If you are acquainted with elms and then for the first time come upon a hackberry laden with these berries, you may say, "Mr. Burbank must have played one of his tricks on that elm."

The White Birch makes a striking appearance on account of its chalky white bark, and its small leaves and slender twigs produce a light and airy effect. A clump made up of birches and evergreens is very attractive. The birch is hardy in the coldest climate and



WHITE BIRCH

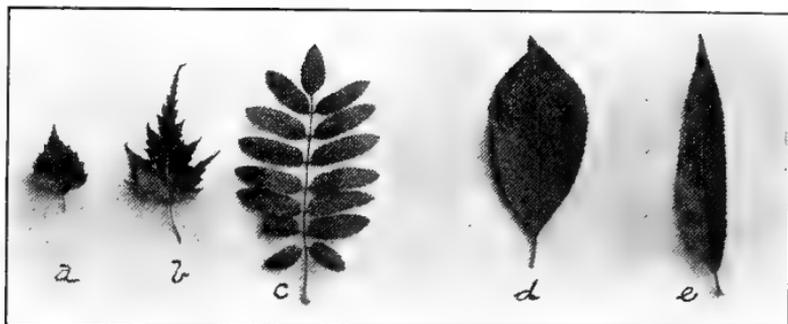
can withstand considerable drought. Many of the so-called white birches in the Northwest are the paper or canoe birch, which is native in this section of the country.

The Cut-Leaf Weeping Birch has slender and gracefully drooping twigs, delicately cut foliage, and white bark, that make it a beautiful lawn tree. It is very hardy, but is more easily affected by drought than the common white birch.

The Mountain Ash is another favorite for the lawn, being especially useful where a tree of small size is desired. It

produces attractive clusters of orange-red berries that hang on through the latter part of summer and until winter. They are so bitter that even the birds will not touch them as long as they can find anything else to eat.

Native Cherries. — The choke cherry and wild black cherry add interest to the premises on account of their white bloom



LEAVES OF TREES

a, White Birch; *b*, Weeping Birch; *c*, Mountain Ash; *d*, Choke Cherry; *e*, Golden Willow.

and their fruit. The black cherry in particular makes a handsome tree.

The Willows are often regarded as mere bushes growing in wet places, but several species thrive in dry soil and attain the size and dignity of trees.

The Russian golden willow is planted most extensively, being commonly employed for windbreaks and shelter belts. If properly trimmed and allowed room to develop, it makes a tree of good size and form.

The laurel-leaved willow has large, glossy, dark-green leaves and is the most beautiful of all the willows. It is particularly attractive as a low bush or hedge; as it becomes larger and older it loses its charm.

The Niobe willow is the only weeping willow that is hardy in the Northwest. Its graceful, hanging branches are much admired; and in winter the bright yellow bark makes an effective contrast with the dull color of other trees.

The white willow or gray willow is a favorite tree for shelter belts, and is superior to the cottonwood for that purpose, as it may be planted more closely. It does well upon all but the driest soil, attaining a height of 40 or 50 feet in 20 years. Its wood is especially valued for fence posts.

Evergreens require more skill and care in transplanting than other trees, and it is wise not to try them until some of the more common varieties have been established and some experience in tree culture is acquired. But as soon as possible a good number should be planted on every place. On account both of their beauty and of their value as a wind-



COLORADO BLUE SPRUCE

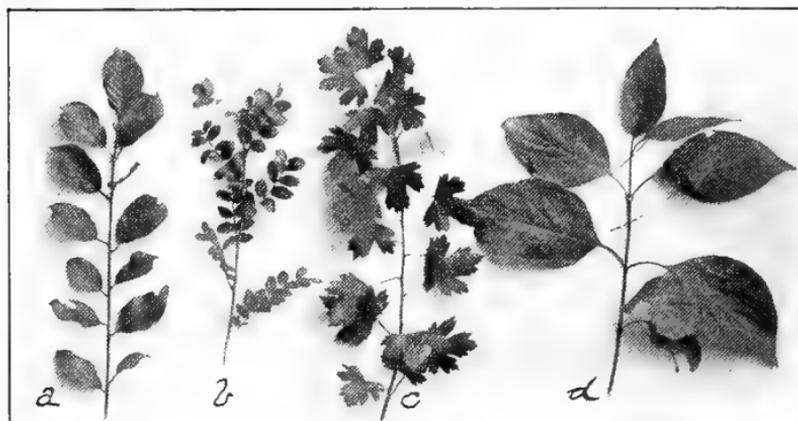
break they are especially appreciated in winter when other trees have lost their foliage. There are species that are well adapted to the soil and climate of the Northwest. Among the hardiest may be mentioned the Black Hills spruce, Colorado blue spruce, Scotch pine, Ponderosa pine and Jack pine. Of this list the first three are the handsomest.

A FEW HARDY SHRUBS

These brief notes will give some assistance in making a suitable selection of shrubs. We should not confine ourselves to two or three species, no matter how good they may be, for a greater variety gives more interest to the premises. The different kinds should be chosen (*a*) to meet the requirements

of the particular purpose or location for which they are desired, and (*b*) with a view to furnishing a succession of bloom throughout the spring and summer.

The Buckthorn has dark green foliage that looks healthy throughout the season and makes it a favorite bush. A few coarse thorns appear on the older plants. It stands pruning well and makes an excellent hedge.



SPRIGS OF SHRUBS

a, Buckthorn; *b*, Caragana; *c*, Flowering Currant; *d*, Dogwood.

The Caragana or Siberian Pea Tree thrives well in the north and is a favorite in the Dakotas, Montana, and northwest Canada. It is especially handsome in the spring, when its light green, feathery foliage is fresh. Toward autumn it takes on a somewhat rusty appearance. This plant is often used for hedges and may be pruned to suit the fancy.

The Flowering Currant or yellow currant produces racemes of fragrant yellow blossoms in the spring. It is a popular shrub and planted everywhere.

Dogwood. — There are several good varieties, such as the red-twigged and red osier dogwood. The former grows from

six to ten feet high, while the red osier is somewhat smaller. These dogwoods are especially prized for their showy red bark, which in winter and spring gives a bright note to the lawn when all else is dull.

Elder. — There are five or six kinds, varying considerably in size and habit; all of them bear large clusters of white blossoms followed by small red or black berries; several of them have yellow leaves. Perhaps the most common in



CARAGANA HEDGE — UNTRIMMED

Grown from seed and never transplanted. Experiment Station, North Dakota Agricultural College.

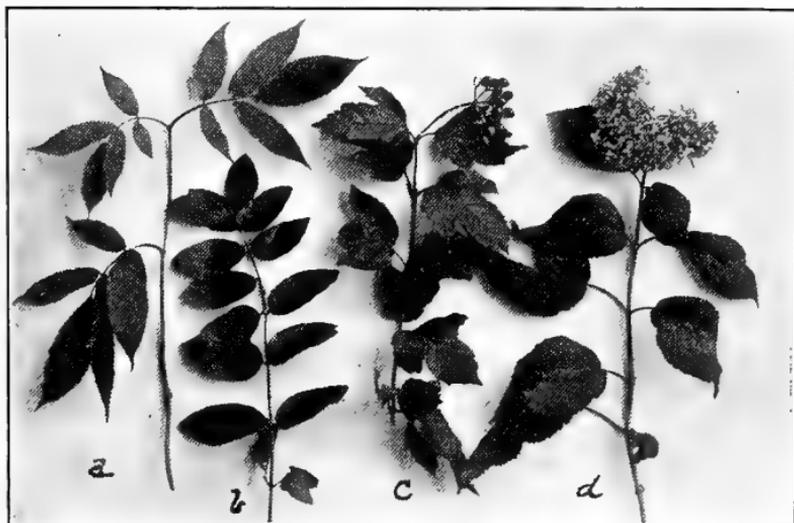
the North is the red-berried elder, which blooms early in the spring and matures its fruit in June.

The Tartarian Honeysuckle is a very popular bush, bearing a profusion of pink or white blossoms in May or June. Later in the summer and autumn these are followed by red berries that are quite ornamental. The honeysuckle is often used for hedges and may be trimmed back if desired.

The High-Bush Cranberry is prized for the large clusters of bright scarlet fruit which become conspicuous in early fall and hang on until winter and sometimes until spring. The foliage changes to a rich coppery tint in autumn.

The Hydrangea when in bloom is one of the most conspicuous shrubs to be found. It bears immense clusters of white flowers and is successful in all but the driest and coldest parts of the Northwest. There are several good varieties.

The Lilac is one of our most valuable shrubs and is found wherever there is any attempt made in ornamental planting. It has attractive foliage and a wealth of very fragrant flowers.



SPRIGS OF SHRUBS

a, Red-berried Elder; *b*, Tartarian Honeysuckle; *c*, High-Bush Cranberry with fruit; *d*, Hydrangea in bloom.

There are several distinct species and almost innumerable varieties, of which we can mention only three. (1) The common purple lilac is the most extensively used of all and needs no description here. (2) The common white lilac is similar to the preceding, but has pure white flowers and larger and coarser stems. Its bloom is not so abundant. (3) The Persian lilac is a smaller and more graceful bush, with more slender stems, narrower leaves, and somewhat paler flowers.

The Russian Olive has whitish, velvety leaves that make a pleasing and effective contrast with other foliage. It is a large bush, easily reaching a height of 15 or 20 feet. It will thrive in our coldest and driest climate, and makes a strong, compact hedge, especially when cut back.

The Snowball, as its name implies, bears large round clusters of white flowers. It is a great favorite and thrives



SPRIGS OF SHRUBS

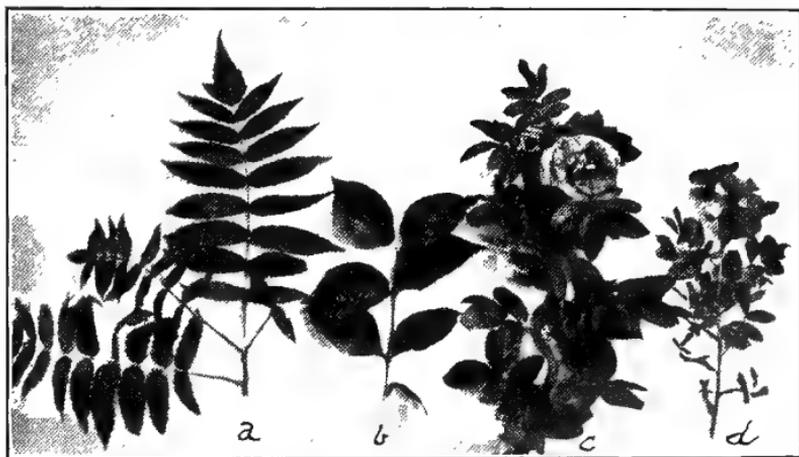
a, Purple Lilac; *b*, Russian Olive; *c*, Snowball; *d*, Van Houten's Spirea.

everywhere except in places where the soil is rather dry. In such regions the high-bush cranberry, which resembles it, is preferable. The blossoms of the cranberry are not so showy, but its ornamental red berries make up for that.

Spirea. — There are many species of spireas, but Van Houten's spirea or the bridal wreath is easily the best of them, and is one of the most popular of all shrubs. It is a graceful and dainty bush and in early summer is loaded with a mass of white blossoms. On account of its small size it is the commonest of the shrubs seen at the foot of foundation walls.

Sumac. — Several species of this bush are sold by dealers, but none of them is superior to the common smooth sumac which is a native of the northern states. Its foliage has a rich tropical appearance in summer and in autumn it turns to brilliant shades of red.

The Syringa or mock orange is one of our most famous shrubs, being prized for the delicate fragrance and purity and charm of its waxy white flowers. It blooms in midsummer.



SPRIGS OF SHRUBS

a, Sumac; *b*, Syringa; *c*, Rugosa Rose in bloom; *d*, Early Wild Rose.

Roses. — While a number of fine roses can be grown successfully in the North, nearly all require some special care to bring them safely through the winter. It is well to begin with those that can shift for themselves like other shrubs. The rugosa roses and the native meadow roses are able to meet that requirement most easily.

The rugosa or Japan roses and their hybrids are hardy in the coldest parts of Minnesota and North Dakota. There are single and double varieties, and they may be had in pure

white, pink, or dark red. They are a comparatively recent introduction and, for the northern climate, a most valuable acquisition. The name "rugosa" comes from the Latin word *rugosa*, which means wrinkled, and refers to the furrowed appearance of the leaves.

The meadow rose or early wild rose, which may generally be found wherever wild bushes of any sort grow, is readily transplanted and makes a fine addition to the home shrubbery. Its blossoms are among the earliest of the season, the foliage looks attractive all summer, and the red bark is an ornament to the premises in winter.

CLIMBING VINES

In ornamental planting, vines are used to adorn the porch and the walls, to cover trellises or screens for out-buildings, or to climb the trunks of old trees. Of the four vines described here, all but Engelman's ivy are natives of the North and therefore perfectly adapted to the climate. Engelman's ivy sometimes freezes back in the coldest sections.

The Virginia Creeper, American ivy or woodbine, is the most robust, the most generally planted, and the most satisfactory. In autumn the foliage assumes bright crimson tints. It is easily recognized by its compound leaf with five leaflets.

Engelman's Ivy is a variety of the Virginia creeper and resembles it in appearance. It has the advantage of being able to cling to brick, stone, or plaster walls by means of its tendrils, and without the aid of wire netting or other support.

Clematis. — There are many fine varieties of this vine, but perhaps the favorite is the Virginia clematis or virgin's bower. It produces quantities of greenish white flowers in July and August, which are succeeded in autumn by very conspicuous hair-like seed-plumes.

The Wild Grape is a strong climber, with healthy looking leaves that make it very ornamental. In the fall the bunches of fruit enhance its beauty and usefulness.



THREE HARDY VINES

a, Virginia Creeper; *b*, Clematis (Virgin's Bower); *c*, Wild Grape.

PROJECTS

FOR SPRING

1. *Tree Planting.*—Every boy should learn to plant a tree. In a dry and cold climate this is not so simple as some people who have not tried it think that it is. It is, of course, easy enough to set the young tree in the ground, but to plant it *so that it will grow*—there is the difficulty. We therefore suggest that from the time boys are strong enough to handle a spade they should plant and care for a few trees and shrubs every year until the art is thoroughly mastered. Study good printed directions for the process, and follow them, and also learn by watching successful planters. Try to find out the cause of every failure and to avoid that cause the next time. As success depends partly on the subsequent care which the tree receives, the same person who plants

it should also give it all necessary attention throughout the season. When you set out your specimens they may look puny and insignificant, but they contain the promise of stately trees, and in future years people will admire them and bless the man who planted them. Read William Cullen Bryant's "Planting of the Appletree" and learn what a great poet said on this subject.

FOR SUMMER

2. *Identification.* — As a true lover of nature you must try to become acquainted with every kind of tree, shrub, and vine growing in your neighborhood. The most favorable time for doing this is in the summer



VIRGINIA CREEPER ON MERRIFIELD HALL
University of North Dakota.

when the leaves serve as the best guide. Note, then, such things as the size and form of the leaf and the character of the margin, whether it is simple or compound, with or without stalk, the character of the surface, and the arrangement of the leaves on the stem (whether opposite or alternate). Of course, you will compare your specimens with the pictures on the preceding pages, and you should also read in this connection the entire chapter on Leaves, as it explains more in detail what

you should observe. It is a good practice to make a drawing of the leaf of each species.

Note the size and the general form of the plant. Quite likely most of the specimens you see are but partially grown, and you must try to learn what is the greatest height that the species ordinarily attains. Refer to the typical forms of trees and shrubs shown under the head of "Stems" in Chapter VI.

Find persons who are versed in this subject and get them to help you. You will find that everybody who knows and loves trees is glad to introduce them to his friends.

3. *A collection of leaves.* — Make a collection of the leaves of all kinds of trees, shrubs, and vines studied, as in the preceding project. Dry and press them between blotting papers; then fasten them to sheets of heavy paper and write their names by them. Use plenty of paper; usually only one leaf should be mounted on a sheet, with the name on the lower right-hand corner. The mounting papers should be of uniform size. Such a collection will be interesting and instructive to you and to your friends who may see it; and it would be very valuable to have in your school.

FOR AUTUMN

4. When the foliage develops beautiful autumn tints, take note of the characteristics of each tree, shrub, and vine, and make a list of those whose leaves turn red and of those that turn yellow. Does frost seem to be a necessary cause of these autumn tints, or do they often develop before the frosts come?

FOR WINTER

In the winter we may study the condition of trees with reference to branches, leaves, flowers, and fruit, noting the winter buds and comparing their form, position, and arrangement. This work is considered very profitable, but it is hard for the beginner in nature study to "see much to it." The bare branches of trees and shrubs in winter are not so attractive and promising as a bed of flowers or a flock of birds in summer. When we come to investigate, however, we find that these bare branches are not only full of promise, but that they have made all necessary arrangements to redeem those promises.

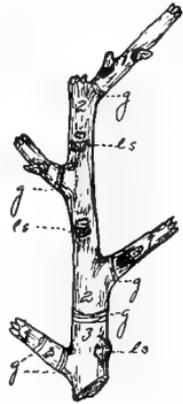
5. *Recognition in Winter.* — The first thing that most of us want to know when we approach an object to study it, is its name. There are many people who know the box elder, elm, lilac, spirea, Virginia creeper, etc., in the beauty of their summer foliage, but when they meet the same stem and branches in winter nakedness, they pass them by without recognition. Therefore all the species of trees and shrubs and vines to be found in the neighborhood should be scrutinized until you can identify them without the aid of their leaves. We must notice the general outline of the entire plant, with its branches; notice whether it is tall and slender, or low and diffusely branched; notice the mode of branching, and the shape of branches and twigs, whether straight or angular, slender or thickish; notice the bark, whether smooth, or furrowed, or roughened otherwise; and notice the color of stem, of branches, and of the smaller twigs. All these things and many more the experienced eye takes in at a glance, and they reveal the identity of the species at once.

6. *Annual Growth.* — Examine some branches and practice locating the rings that mark the stages in the annual growth. In the cottonwood, box elder, and many others it is easy to make out the growths of the last three or four years.

7. *Position of Leaves and Buds.* — Notice the relative position of leaves and buds. You can tell by the scars where the leaves were last summer, and you see that the buds are in the angle which the leaf made with the shoot. The leaf started first, and as the season advanced the bud formed in its axil, and it clung fast when the leaf fell in the autumn.

8. *Buds become Branches.* — Put some twigs of willow, or other tree or shrub, in a jar or large bottle of water and keep in a warm room, to "force" them. You will in this way be able to see that the buds are not merely leaves, but are really branches with many leaves. Note that the baby branch is usually covered with dry, waxy scales, which keep out snow and rain. In some species this cover is lacking and the bud is said to be naked. Can you find any of these?

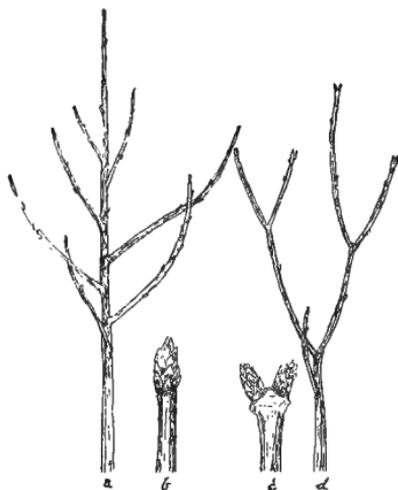
9. *Some Buds Remain Dormant.* — (a) Observe the buds on the



TWIG OF GREEN
ASH

The figures 1, 2, and 3 show the number of years old that each part is; g denotes the annual girdle on the bark; ls shows the leaf-scar.

portion of a branch which grew summer before last. There were more buds than were needed, and so these did not develop last summer. If the branch should be cut off just above these dormant buds, new shoots may spring from them. Certain of their mates did grow and became the last season's twigs.



DIFFERENT MODES OF BRANCHING

a. Cottonwood. At the tip of each shoot is a single bud, enlarged in (*b*), which continues the growth straight ahead. The central shoot with its bud makes the strongest growth and always keeps the lead, giving the tree a straight, upright axis.

d. Lilac. At the end of each shoot are twin buds, shown in (*c*), which, as they develop, form a fork so that the shoot does not grow straight ahead for more than one season (except perhaps the first few years) and there can be no straight central stem.

soming tree or shrub, look for buds others. They may be flower buds. If you think you find some of them observe them closely. An expert horticulturist can tell the fruit buds from other buds on his apple trees.

(*b*) The numerous buds on last season's twigs will share the same fate, — only a few will grow and the rest will remain dormant. Examine them and tell which you think look strongest and most likely to grow. Mark a twig on a tree or some shrub near the schoolhouse, make a drawing of it, showing all the buds, and mark those that you think will develop next spring. When the tree has leafed out compare the twig with your drawing. The struggle for existence is a case of competition, and the buds that have the most sunlight and room are the ones that grow. This struggle took place while the buds were forming last summer. The leaves engaged in the same competition. Do you see any correspondence between the size of a leaf as indicated by its scar, and the bud in its axil? Did the large buds grow in the axils of the larger leaves?

10. *Flower Buds.* — If you are able to make observation on a plum, apple, lilac, or some other early blooming tree or shrub, look for buds that are larger and less pointed than others. If you think you find some of them observe them closely. An expert horticulturist can tell the fruit buds from other buds on his apple trees.

11. *Arrangement of Buds and Mode of Branching.* — Compare the

position, arrangement, and growth of buds, with the mode of branching. Notice that buds are terminal — at the end of the twig, or lateral — along the stem. Again, in some species the growth is mostly from the terminal bud, in others, several lateral buds always develop and the terminal bud grows proportionately less. These factors, — terminal and lateral, opposite and alternate buds, — and the relative growth of each, and the direction of growth, whether upward or largely horizontally, — determine the mode of branching and general form of the tree or shrub and give to each species its distinctive character.

12. *Oral and Written Composition.* — This chapter furnishes many interesting themes for exercises in composition. For example :

a. How to plant a tree. — Detailed directions based on your own experience or observation. Project No. 1.

b. The elm (or some other tree with which you are quite familiar). — Detailed description of its characteristics, merits, etc. Project No. 2.

c. Rose growing in our district (or town). — Varieties grown, care necessary, etc.

d. Our hedges. — Description of a few that are found in your neighborhood, kind of shrub used, care required, their age, etc.

e. Our trees in winter. — Describe and compare the leading kinds in your neighborhood, mentioning points by which you know one from the other. Illustrate with sketches showing differences in branching, etc. Project No. 4.

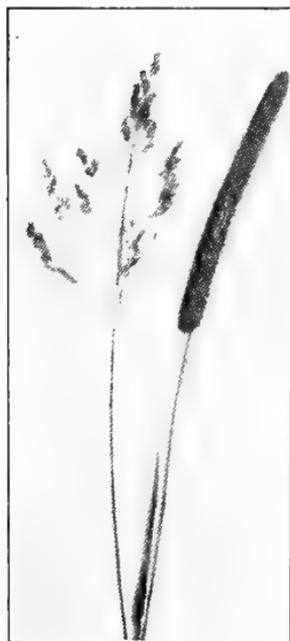
CHAPTER X

HAY AND PASTURE PLANTS

More land in the United States is devoted to hay and pasture than to any other crop. Most of the plants used for this purpose belong to the grass family, but the legumes also furnish some species of very great value.

The particular kinds to be preferred depend upon the special use in view, — whether for pasture or hay, and whether for horses, cattle, or sheep, — and also upon the climate and soil.

Nearly all these plants are perennial, the chief exceptions being millet, which is an annual, and sweet clover, a biennial. The description of the grass family and of the legumes forms a helpful introduction to this chapter and should be reviewed at this point. (See page 72.)



TIMOTHY (right), JUNE
GRASS (left)

CULTIVATED GRASSES

Timothy. — This is the most important hay plant in America. It makes hay of excellent quality, and when the soil is good and the rain ample, the crop is quite large. After the first two years, however, the yield diminishes, and when used in permanent pastures it is generally displaced in a few years by other grasses. It is not

adapted to regions where the rainfall is light. The name is derived from Timothy Hanson of Maryland, who imported the seed from England in 1720.

June Grass. — This is also known as blue grass or Kentucky blue grass. It is the most valuable grass for pastures, but the plant is too short for hay, most of the leaves being too close to the ground to be caught by the mower. It is also our most popular lawn grass, as it keeps green all the season except in midsummer and makes a fine, even sward. It has an abundance of rootstocks and will gradually crowd out most other plants, especially if the soil is good. It heads quite early in the season, hence its name — June grass. As it requires several years to become well established, it is usually seeded with other varieties that develop more quickly.

Brome Grass. — As there are several native brome grasses, this cultivated species is called *Austrian* or *smooth* brome grass. The plants are of large size and yield a good amount of very palatable hay. Brome grass also makes a good pasture. It is slow in making a start, but after it becomes established it will

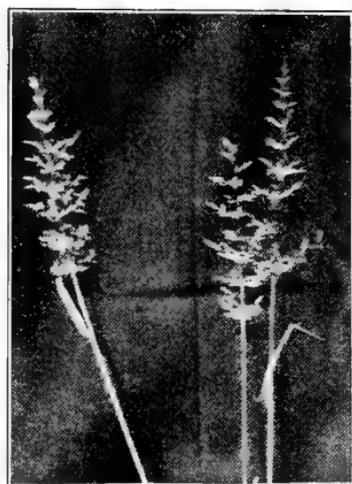


AUSTRIAN BROME GRASS

crowd out almost any other plant, even June grass. It is a good drought resister, as the roots often go down to a depth of five feet or more. It is therefore valuable where the rainfall is apt to be meager. In such regions it is a good substitute for timothy. The rootstocks are quite tenacious of life, but if care is exercised in breaking and backsetting the sod it is easily killed.

The head of all brome grasses resembles a head of oats; and the word "brome" was made by shortening *bromus*, now the Latin name of these grasses, but in ancient times the name of the oat.

Red Top. — In the eastern half of the country this is next to timothy in popularity. It is not only valuable for hay,



RED TOP

but also makes a good pasture. It grows especially well in damp ground; where the rainfall is light it does not thrive. It resembles June grass in appearance, but is taller and stands more erect; the heads have more numerous branches and have a purple tinge. It ripens rather early and then becomes hard and tough so that stock do not relish it.

Millet. — The millets, of which there are many varieties, are annual grasses and are of great value to farmers because when other hay is insufficient they may secure a supply from this source in a few months after seeding. A crop of millet is also helpful in cleaning the land of weeds, for it is seeded late in the season when weeds have started growing and are then killed by the cultivation. Millet makes a rapid and dense growth and smothers any weeds that attempt to compete for place. It stands dry weather pretty well and is well adapted to sections of the country where rain is not always abundant in summer. The different kinds of millets are usually arranged in three classes — foxtail millets, broom corn millets, and Japanese millets.

(a) *Foxtail Millets.* — These resemble foxtail or pigeon

grass, our most familiar weed, but they are larger and more valuable for hay. To this class belong common millet, Hungarian grass, German millet, and Siberian millet.

(b) *Broom Corn Millets*. — These are so named because the head resembles that of broom corn, from which brooms are made. It is in the form of an open panicle with long branches. Hog millet is a variety of broom corn millet that has become somewhat popular in the Northwest.

(c) *Japanese Millets*. — The principal variety of this class is the barnyard millet, which is derived from the common weed known as barnyard grass, and resembles it.



TYPES OF MILLET

Left — German Millet, a foxtail millet. Center — Barnyard Millet, a Japanese millet. Right — Hog Millet, a broom corn millet.

NATIVE PRAIRIE GRASSES

These are found chiefly on land that has never been broken, having established themselves there in the remote past in the same way

as the wild flowers and native trees. Plants that maintain themselves in a given locality for a long period of years, and without the help of man, must be particularly well adapted to the soil and climate. Good native grasses are therefore very desirable, and to a limited extent a few kinds have been used for seeding cultivated fields. Unfortunately, however, the seeds of most of these native grasses are so light or so few

in number that it is difficult to secure them in sufficient quantity for planting, so that after the wild land is once plowed we are obliged to rely on the tame grasses and legumes.

Wheat Grasses. — The head of these grasses resembles the head of wheat; that is, it is in the form of a spike. There



WHEAT GRASSES

Left — Slender Wheat Grass. Center — Awned Wheat Grass. Right — Western Quack Grass.

are several different species common on our prairies, slender wheat grass and awned wheat grass being the most valuable. Quack grass also is a wheat grass and a good forage plant. It is exceedingly difficult to kill its rootstocks, so that it often becomes one of the worst weeds we have. This is not a native but an introduced plant. There is a native variety, however, that is larger and stouter; it is a valuable hay and pasture grass in the West and its rootstocks are so short that it is not weedy in character.

Feather Bunch Grass. — This is a comparatively tall grass, distributed quite widely over our prairies. The seeds have rather long awns which are injurious to cattle when present in hay; for this reason it should not be cut until these “needles” have fallen to the ground.

Porcupine Grass. — This is related to the preceding species, but the awns are very much longer and are distinctly twisted and bent, and the stems are taller. The seeds are barbed and can work their way into a person’s clothing, or into the wool of sheep

and then into the body of the animal. In the latter case they may become quite harmful. These seeds, of course, should not be allowed to get into hay.

False Red Top: Fowl Meadow-grass. — In general form and color this resembles red top, but the entire plant is more



PORCUPINE GRASS (left),
FEATHER BUNCH GRASS
(right)



FALSE RED TOP

slender and the panicle is more elongated and weaker and has fewer branches. It is one of the most valuable native grasses, and is often the chief species in lowland meadows, where it produces a heavy crop of good hay.

Big Blue-stem: Forked Beard-grass. — In some sections this is also called “blue-joint.” The stem is distinctly purplish at the joints and bears from two to five spikes at or near the summit. It is a valuable grass for pasture and hay



LITTLE BLUE-STEM (left),
BIG BLUE-STEM (right)

and is found on prairies, ravines, and river bottoms where the soil is rich and moist.

Little Blue-stem: Broom Beard-grass. — This has a stem with purplish joints like the preceding, but is a much smaller plant. The “heads” are small, loose spikes, arranged singly along the stem. It grows in dense bunches, and, when headed out, the top of the clump has a fuzzy or hairy appearance. Cattle eat it early in the season, but it soon becomes too tough.

Wild Rye: Nodding Wild Rye. — This bears a close resemblance to ordinary field rye, except that it is not so

tall. It affords excellent pasture and hay.

Grama Grass: Muskit Grass. — In some sections this is also called “buffalo grass,” though that name belongs properly to the next species. It is an important pasture grass on the western prairies especially on the great ranges, where it “sun cures” and then continues to furnish forage for stock in winter.

Buffalo Grass. — This famous grass of the western cattle ranges is usually not over four or five inches in height. It resembles the preceding species and is often mistaken for it. Its curly leaves and creeping stems often form a dense mat on the ground. Stock is very fond of it, and it affords excellent forage in winter as well as summer.



WILD RYE

Cord Grass. — This very tall grass is common in sloughs and wet meadows and often makes a large proportion of the hay harvested in such places. The hay is coarse but nutritious, and is readily eaten by stock; but it must be cut before it becomes too tough and woody.

Prairie June Grass. — This is an early grass and is usually the first to head out and ripen, so that it may be recognized by this characteristic. It is quite abundant on dry prairies and furnishes excellent forage and hay.

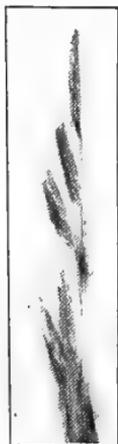
Wild Barley: Squirrel-tail Grass. — This is called "foxtail" in many localities, a practice that is confusing as that name has long been applied to common pigeon grass. It is easily recognized by its long, spreading awns. The nodding heads resemble those of ordinary barley, but they are smaller and



GRAMA GRASS (left), SIDE OATS (right)



BUFFALO GRASS



CORD GRASS



PRAIRIE JUNE GRASS



WILD BARLEY

the awns softer. Wild barley is regarded as a bad weed that invades pastures, meadows, and lawns. It is of no value, but, on the contrary, is injurious to stock, as the awns, when eaten, cause sores in the mouth and sometimes even in the stomach. The plant has short, fibrous roots and is easily killed by plowing.

LEGUMES

The legumes are of special value on the farm because they are richer in nourishment than the

grasses, and they restore the fertility of the soil instead of exhausting it as other plants do. The most important for hay and pasture are clover and alfalfa. On the wild prairies there also grow a great variety of native legumes.

Red Clover. — There are two varieties of red clover, the common red or medium clover and the mammoth clover. The former is smaller and matures earlier than the latter. Red clover is most commonly raised with timothy, making the famous timothy and clover hay. It will not thrive in poor soil or where the rainfall is scant. For horses



RED CLOVER

clover hay is not recommended, but it is very desirable for cattle and sheep.

White Clover. — This clover is very valuable for the pasture, being used to supplement Kentucky blue grass in the same way that red clover is used with timothy for hay. The stems of white clover creep along the ground and take root so that a single plant may produce many plants; in this way it spreads rapidly.



WHITE CLOVER (left), ALSIKE CLOVER (right)

Alsike Clover: Swedish Clover: Hybrid Clover. — The blossoms of this species resemble those of white clover but are tinged with red. In size it is between the white and the red clover. It thrives on poorer soil than red clover and is better adapted to a dry and cold climate.



ALFALFA

Alfalfa. — This plant looks somewhat like clover but is taller, stands more erect, and has smaller leaves. The common variety has purple blossoms. Although alfalfa has been known from earliest historic times, it has only recently become common in this country. In the last 25 or 30 years it has grown very rapidly in popularity. Where the season is long, four or five crops are cut, and sometimes even seven or eight. In the Northwest we harvest two or three. It yields richer hay and much more of it than other plants generally

used for the purpose. It has a longer taproot than any other farm crop and is a great resister of drought and heat as well as cold.

Sweet Clover has long been familiar as a roadside weed, but recently the variety with white blossoms has become popular in the Northwest for stock feeding. It begins growing very early in the spring, and when young furnishes excellent pasturage. At least one crop of hay may be cut from it the first season after planting and two or three the second season. Then the roots die, as the plant is a biennial. It should be cut before it commences to blossom or it will become too tough and woody. Sweet clover will make a good growth on soil that will scarcely sustain other vegetation, and it survives the severest climatic conditions.



WHITE SWEET CLOVER

Native or Wild Legumes. — There are growing on the unbroken prairies of the Northwest 30 or 40 species of legumes that have no doubt contributed much to the fertility of the

virgin soil. The large majority of them, however, are too hard and tough to be eaten by stock; a few are quite valuable. Special mention should be made of the American vetch, which grows in fairly damp ground; the wild vetch or prairie bird's-foot trefoil, an annual plant growing especially in dry or sandy soil; the marsh vetchling, growing among the grasses

in lowlands; and several of the milk-vetches that thrive on the drier prairies. In some sections these and a few other native legumes make up a good proportion of the wild hay taken from the prairie.

QUESTIONS AND PROJECTS

1. *Hay plants.* — (a) What are the leading grasses that are raised in your vicinity for hay purposes? What advantages are claimed for each? Have other varieties been tried? With what success?

(b) If wild hay is cut in your neighborhood, try to find out the principal species of plants in it.

(c) What clovers are raised? With what success? Is alfalfa raised? What difficulties are met in growing it? How many crops are cut during the season? Has alfalfa proved satisfactory?

2. *Pastures.* — Distinguish between a pasture and a field in which cattle are allowed to graze only for a time, as they often do in hay meadows during spring and fall.

(a) Are the pastures in your district made by seeding cultivated land or has the original sod never been broken?

(b) What plants can you identify in the wild land pastures? Has June grass or white clover been introduced? How?

(c) In pastures made from cultivated land, what plants are used? What is the advantage of mixing several varieties?

3. *A collection.* — Collect specimens of pasture and hay plants, press them and mount them on heavy paper; label each with its proper name. In case of the grasses, each specimen must show the "head" or panicle, because we rely upon that to distinguish one species from another. A careful study of this chapter and comparison of your specimens with the pictures should enable you to name most of the commoner species. In cases in which you cannot find out the name yourself, show your specimens to people who are informed upon such matters and learn the names from them. Making such a collection is very helpful as a means of extending your acquaintance with plants. The collection would be valuable for your school.

4. Make drawings of the heads of common grasses found in your vicinity — as June grass, red top, brome grass, timothy, slender wheat

grass, etc. This will be a good exercise in sketching and at the same time will aid in fixing in mind the forms of the different grasses. In each case the name should be written under the drawing.

5. *Oral and Written Composition.* — A well-prepared report on these themes will be instructive and interesting:

a. *The plants we use for hay.* — Project No. 1.

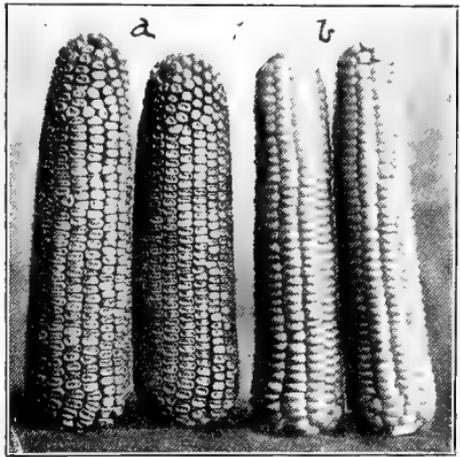
b. *Our pastures.* — Project No. 2.

CHAPTER XI

FIELD CROPS

Field crops are those of which we raise a relatively large acreage, as distinguished from garden crops, which are commonly planted in smaller "patches." It is evident that different methods must be followed in planting and harvesting a field of many acres from those employed with a patch of as many square yards.

One of the leading field crops, hay, we have already treated in the preceding chapter. We now have in mind more especially such farm produce as wheat, oats, barley, rye, corn, potatoes, and flax. In many sections of the country, the raising



TYPES OF CORN

- a*, Minnesota 13 (dent);
b, White Pearl (flint).

of these crops is the chief business of the farmer, and the subject is therefore one of such commanding importance that a large volume might be filled with its discussion. But we are obliged to limit ourselves to brief comments on the most important operations connected with the planting and cultivation of such crops.

Preparation of Seed Bed. — Generally it is best to plow the ground in the fall, so that it may absorb and retain as much moisture as possible. Fall plowing is also an advantage because it gets that much out of the way of the spring work. It is especially desirable in the case of wheat. For corn,



TYPES OF NORTHERN GRAINS

potatoes, and barley, spring plowing is quite common, though where the rainfall is deficient fall plowing may be better for these also. Ground on which corn has just been raised does not require plowing. Before seeding, fall plowing and unplowed corn and potato ground must be thoroughly disked to loosen it up, and spring plowing must be well harrowed. After seeding, the harrow may be used again as the earth should be made as fine as possible.

Selecting and Testing Seed. — The importance of planting good seed is well recognized by all practical farmers and gardeners. The kernels should be large and plump, and care should be taken that they have not lost their vitality

on account of age or by getting damp. Wheat, oats, barley, rye, and flax should be run through the fanning mill and all small and shrunken kernels removed, as these give but a feeble plant, if they germinate at all. Special care has to be exercised in the selection and storage of seed corn as it loses



A SMALL COLLECTION OF FARM AND GARDEN SEEDS

its vitality more readily than almost any other seed. In all cases of doubt it is well to test the seeds before planting them to make sure that they will germinate; otherwise much labor and material may be invested, only to find that they are wasted when too late in the season to replant. A simple method of testing seeds is described elsewhere. (See page 25.)

Planting. — The time of planting the seeds depends chiefly on the hardiness of the species. In the spring wheat region the earliest field crop to be planted is wheat. This grain will lie in wet and cold ground a considerable length of time with-

out injury, and the young seedlings will stand quite a hard frost. Oats and rye are even more hardy than wheat, but barley is less hardy, and flax and corn must be planted when all danger of frost is past, as the seeds will easily rot in the ground if too cold, and if frost strikes the seedlings after they are up it kills them.

Cultivating. — All such grains as wheat, oats, barley, rye, and Indian corn should be gone over with a smoothing harrow after planting and again after they are up. This last harrowing destroys such weeds as may be germinating near the surface or have already come up, and it restores the dust mulch and thus helps to conserve soil moisture. Corn and potatoes are also cultivated between the rows several times during the early summer for the double purpose of preventing weed growth and preserving the dust mulch.

EXERCISES AND PROJECTS

1. *List of field crops.* — Make a complete list of all the field crops raised in your section of the country with the varieties of each, as

Wheat: fife, blue stem, marquis, durum, etc.

Oats: Swedish, white Russian, etc.

Corn: (a) Dent — Northwestern dent, golden dent, Minnesota king, etc.

(b) Flint — Jehu, squaw corn, Will's Dakota, Longfellow, King Philip, etc.

Potatoes: Early Ohio, early rose, rural New Yorker, Burbank, etc.

2. *The permanent exhibit.* — Collect specimens of all the varieties of grain raised in your vicinity, as wheat, oats, barley, rye, etc. (a) A few heads of each variety and (b) a sample of the berry in a small bottle. The heads should be neatly mounted and the bottles should be of uniform size so as to make an attractive arrangement for a permanent school exhibit. Include in the exhibit also an ear of each kind of corn and a specimen of flax, millet, buckwheat, field peas, alfalfa, and any other kind of crop that can be kept in such a collection.

3. *A temporary exhibit.* — Bring exceptionally fine specimens of potatoes, carrots, beets, rutabaga, cabbage, cauliflower, salsify, and other vegetables produced in the vicinity.

4. *Description of exhibit.* — Each pupil should discuss the merits of his own contribution to the exhibit; for example, the advantages of his particular variety of wheat, corn, or potatoes as compared with other kinds.

5. *Harvesting corn.* — (a) Is corn husked in your vicinity without cutting the stalks? (b) If cut, is it bound, or is it shocked without binding? What machinery, if any, is employed? (c) Is it husked by hand or husked and shredded by machinery? (d) Is it put into a silo? Cornstalks have about as much feeding value as hay and should be utilized. Which of the above methods is the most wasteful? Give a full description of the various methods employed in your vicinity in harvesting corn, and explain the advantages claimed for each.

6. *The yield.* — What was the ordinary yield per acre of wheat, oats, barley, corn, potatoes, and other crops in your vicinity last year? What was the largest yield that was produced? Discuss these questions quite fully: (a) Why was the average yield so much lower than the best yield? (b) How could the ordinary yield be brought much nearer to the best record?

7. *Some problems.* — (a) What is the cost of raising 160 acres of wheat, counting the value of the seed and all labor and material from the plowing to the marketing? Figure the yield at 14 bushels per acre and use current prices for all items. (b) What is the profit of this crop at current prices? (c) What would it cost to raise this crop if the yield were 20 bushels to the acre? What would the profit then be?

8. *Plowing.* — When is most of the plowing done in your vicinity? Does fall or spring plowing produce a better crop of wheat? Oats? Barley? Corn? Is early or late fall plowing better?

9. *How much seed?* — How much seed wheat per acre is used in your section? Oats? How many kernels of corn are planted in each hill? How far apart are the hills? How much seed of other leading crops is used?

10. *Vitality of seeds.* — (a) Is wheat from an earlier crop than the previous season's good for seed? How long does wheat retain its vitality? (b) Answer the same questions for other important seeds of your section. (c) How do the farmers in your vicinity store their seed corn? Is the method satisfactory?

11. *Grading wheat.* — Obtain from your local grain elevator or other source a description of the wheat grades that are used as the standard in the markets. Name the various grades recognized, and note the chief points that determine the grading.

12. *Corn judging.* — A good farmer is an expert in judging all kinds of farm produce, live stock, and other things with which his business is concerned. Corn judging is an excellent practice and will help to develop a valuable ability.

Type. In judging an ear of corn we must know the ideal or type it is supposed to approach. It is important that it should conform to the characteristics of the type as closely as possible in such matters as the shape, length, and thickness of the ear, and color of kernel and cob.

Ripeness. The kernels must be ripe, hard, plump, and bright.

Tip and butt. Tip of ear must be well covered with uniform kernels and must not be too tapering. The butt must be neither open nor swelled, and the shank must be small.

Rows. Must be straight and close together, and there must be no spaces between the kernels in the row.

Corn and cob. The cob must not be too large. A selected ear of dent may easily yield as high as 85% of its weight in grain, leaving only 15% for the cob. In flint corn the proportion is not quite so high.

13. *Oral and Written Composition.* — These subjects are especially suitable:

a. *Our field crops.* — Project No. 1, with brief description of each kind of crop raised.

b. *Special merits of five wheat* (or other crop you wish to advocate). — No. 4.

c. *How we harvest corn.* — No. 5.

d. *How to increase the yield.* — No. 6.

CHAPTER XII

SOILS

As the life of all ordinary plants is dependent upon the soil, every practical cultivator of flowers, fruits, vegetables, or field crops must give attention to this all-important factor in their prosperity.

The soil is the loose surface layer of the earth's crust in which plants grow. Its depth varies from an inch in certain poorly favored regions to several feet in many of the prairie sections of the Northwest. It is more fertile and is usually darker in color than the ground immediately below it, which is called the sub-soil, but there is no hard and fast line dividing the one layer from the other.

Composition. — The chief part, or the basis, of the soil consists of small particles of rock or mineral matter. To this basis are added the remains of plants and sometimes of animals, this organic matter being called *humus*. Thus the nature of any soil depends simply upon the kind of rock from which it was formed, the size of the rock particles, and the amount of humus it contains.

The mineral matter in any given soil is practically permanent, varying only in a slight degree as some of the more precious elements are temporarily exhausted by growing plants. The mineral matter in one soil may differ from that in another soil (1) in respect to chemical composition, depending upon the kind of rocks from which the two were originally derived. The chemical composition, of course,

determines whether or not growing plants may obtain from the soil an abundance of food. (2) The mineral matter may differ greatly in respect to the size of the pieces or particles. They are smallest in clay; in sand most of the particles are a little larger; and in gravel they are larger still.

Humus is the part that makes the soil dark in color. Only a small proportion of ordinary soil is humus, but that is a very important part. It improves the physical condition of the soil, making it loose and mellow so that the roots of plants can live and grow in it. It increases its capacity to absorb water and to hold it. It is also the source of some elements which plants use for food. When land is farmed the humus is easily exhausted, and the supply must be replenished from time to time. Worn out lands usually suffer more from lack of humus than from lack of actual plant food.

Kinds of Soil. — As the materials that enter into the composition of soils vary greatly, there are many kinds of soil, the chief types being clay soils, sandy soils, and loams. Soils that are composed almost exclusively of fine clay are very compact. They do not admit water easily, and when they dry out they often “bake” and become hard. On the other hand, sandy soils allow the rain waters to run through and carry off the plant food that they may contain.

The best soils are loams, of which there are many grades. In all of them the mineral matter is intermediate in texture, being neither composed exclusively of coarse sand nor of a fine grade of clay. A sandy loam has sand for its basis, but it is comparatively fine sand, and a large portion of the particles are so fine that they rank as silt or clay. On the other hand, clay loams have clay for their basis, but the particles are not of the smallest size, and a good portion of them are large enough to be called grains of fine sand. A

clay or silt loam is considered the best kind of soil. Humus is an essential constituent of all loams.

Fertile Soil. — Let us now learn what are the factors that make a soil fertile. By this we mean a productive soil, one in which plants thrive. Many people have the idea that the only requirement of a fertile soil is the presence of enough plant food, but we must understand that several other factors are fully as essential.

(a) *Physical Properties.* — The growing roots of plants not only require food, but water, air, and warmth. Moreover, the soil must be so mellow that the roots can push their way through it without difficulty, and yet so compact that they shall press firmly against the particles and come in close contact with them. The degree of compactness of the soil, its power to absorb rain water from the surface, to bring up water from below, and to retain water depend upon the relative amount of sand, clay, and humus, and to some extent these qualities are the result of tillage. To a certain extent, therefore, we may control the physical properties of the soil and therefore its fertility by keeping it supplied with a sufficient amount of humus and by proper cultivation.

(b) *Soil Bacteria.* — Bacteria are among the smallest and simplest of all plants. Perhaps we hear of them most frequently in connection with epidemic diseases like diphtheria and typhoid fever, when they are often called germs or microbes, and hence we may easily get the idea that all bacteria are injurious. But while it is true that some of them cause diseases in animals and others produce them in plants, it should be understood that the harmful kinds are only a very small proportion of these lower plants, just as among the higher plants only a few are poisonous.

Bacteria are so small that they must be enlarged with a

microscope 500 or 1000 times before they can be seen, and an ounce of good garden soil may contain several billions of them and include many different kinds. What their real office in the soil is it is difficult to understand without some knowledge of chemistry. We must content ourselves here with stating that they make an important contribution to its fertility, are always much more numerous in good soils than in poor soils, and their number depends upon the amount of humus, for in that they make their home. -

(c) *Plant Foods*. — Chemists tell us that growing plants make use of about a dozen substances for building up their tissues. Only one of these, carbon, the leaves take from the air; all the rest are taken from the soil by the roots. The most important of all substances furnished by the soil is water, as it is not only used in making plant tissues, but it dissolves and takes along with it all other plant foods that come from the soil, none of them being used in a solid condition. An insufficient supply of soil water during some part of the growing season is the commonest of all the factors that limit the yield; in other words, we rarely have a year when the crops have all the moisture they need throughout the season.

The other plant foods that sometimes become too scarce in the soil are nitrogen, phosphoric acid, and potash. The first of these is mostly derived from the roots of legumes and from decaying humus, and the others from the mineral matter. Nitrogen is more liable to run short than the other substances, and we are therefore more frequently compelled to adopt some method of renewing the supply.

Cultivation. — When we explained the essential conditions of a fertile soil in the preceding paragraphs, we stated that good physical condition or texture is the first requirement, and that this is in a measure controlled by proper tillage.

This consists of plowing, harrowing, disking, or using some other form of cultivator. The plow is the implement upon which we chiefly rely for turning the ground to a sufficient depth for the deeper roots of the plants. Plowing loosens up the soil to the entire depth of the furrow, making it easier for the roots to penetrate, for the rain to soak in, and for the air to enter. It turns under manures, stubble, and other plant matter most thoroughly and buries them completely. The other tools are used merely for shallow tillage having for its purpose preparing a good seed bed, maintaining a dust mulch or blanket, or destroying weeds. By a dust mulch we mean a shallow surface layer of earth so loose and porous that moisture cannot rise through it from below and escape by evaporation. It is the farmer's most efficient means for the conservation of soil water.

Fertilizers. — We have learned that a productive soil must be mellow and warm and be well supplied with humus, water, air, and plant food. As a means of securing and maintaining these conditions, manure and other fertilizers are applied. On the ordinary farm we rely chiefly upon stable and barnyard manure. That contains all the necessary elements of plant food, and as it decays it produces gases that aid in dissolving the mineral matter in the soil and thus make it available for plants. But more important still, it adds organic matter to the soil and thus improves its texture, making it more mellow, porous, and warm, giving it more power to hold moisture, plant food, and air, and making it more hospitable to soil bacteria.

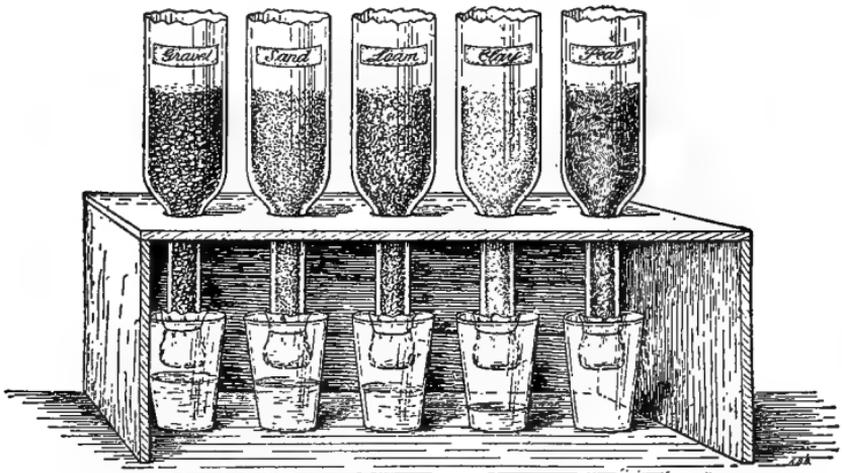
Almost all plant material serves the purpose of restoring humus to the soil. The roots and stubble of crops are of some value, but newly broken sod contains a great deal more vegetable matter and, therefore, it is very beneficial to grow

grass for a few years and then plow the field. Another farm practice sometimes adopted for restoring humus to the soil is to plow under a green crop. Any plants serve the purpose, even the weeds that are plowed under in summer fallowing, but plants with deep roots and heavy foliage are most helpful. By far the best of all are the legumes, as clover and alfalfa, for they not only restore humus to the soil, but are rich in nitrogen, which is the most valuable of all the plant foods and the supply of which is most liable to run short.

How Soils Are Impoverished. — When people began cultivating the rich prairies of the Northwest many of them made the mistake of assuming that the marvelous fertility of the virgin soil could not be exhausted, but experience in all parts of the country shows that 30 to 60 years of grain farming will “run down” the best land to such an extent that it will cease to pay. It is common to grow grain every year without replenishing the organic matter in the soil, which is therefore reduced to lower and lower proportions. Exclusive grain farming always implies that very few cattle are kept and but little farm manure produced. Even that which is formed is either allowed to remain in the barnyard or at least left there until half the plant food has been washed out of it by the rains. The straw and even the stubble are burned. Plant material is taken off the land every year, and none is returned to it.

The causes of the loss of fertility under these conditions may be summarized as follows: (1) Constant cropping diminishes the supply of available plant food. This does not mean that there is really no more plant food in the soil, but that it is not “available,” because it is not in soluble form so that plants can use it. To render it soluble is a very slow process even under favorable conditions. Commercial fer-

tilizers may be used to supply the deficiency, but in ordinary farming they are too expensive. (2) The nitrogen may have been carried away in drainage waters. Especially in sandy soils, the rain water as it sinks in carries with it the soluble matter, and the nitrogen compounds are the most readily dissolved of all the plant foods. (3) In some regions the land is impoverished because the richest surface soil is gradually carried away by wind or by running water from rains.



APPARATUS TO TEST THE CAPACITY OF SOILS TO HOLD WATER

There are sections where more fertility is lost in this way than is used up by crops. (4) Unproductiveness may result from bad physical condition caused by bad tillage, especially cultivation when the land is too wet. (5) The most prevalent and most fundamental cause of unproductiveness is the exhaustion of humus. That implies these specific faults: (a) The soil no longer holds the moisture supply so well as it did formerly. (b) It is less porous and otherwise less favorable to root growth, and it "bakes" more easily. (c) De-

caying humus produces nitrogen compounds, and that supply is now cut off, so there is a shortage. (*d*) The gases from decaying humus help to dissolve the mineral matter of the soil and thus make it available for plant growth. Such action is now diminished. (*e*) Soil bacteria that help to replenish the supply of plant foods now fail to thrive.

PROJECTS

1. *Kinds of soil.* — If several kinds of soil are found on the different farms of the vicinity, examine them carefully and note the difference. Try to name each kind. Find out from the owners the advantages and disadvantages of each kind.

2. *Samples of soils.* — Collect samples of as great a variety of soils as possible, preserving them in small bottles. They should include: clay, sand, loam, gravel, etc., and should be taken at or near the surface, 9 to 12 inches below surface, and from the subsoil still deeper. Each should be labeled to show kind of soil and exactly where it was taken.

3. *Soil and subsoil.* — If you see a post-hole dug, or a cellar or a well, notice the depth of the soil and the character of the subsoil. You may also make this observation at embankments along the road, but the cuts usually occur on hills where the soil may be shallower and the subsoil different from that on the general level. Ask a good farmer which is better, a clay subsoil or a sand or gravel subsoil, and why it is better.

4. *How much humus?* — Take a sample of very poor, hard soil and another sample of soil that is very rich and mellow, and after drying them thoroughly weigh an equal quantity of each and put it in separate flower pots. Then set the pots directly on the hot coals in a stove, and after the soil is thoroughly burned weigh it again. Some of the difference in weight may be due to further loss of moisture, but if the samples were well dried in the beginning, most of the loss will be due to the burning of the humus. A simpler method is to put half a pound of rich, dry earth on a coal shovel and place that on a good bed of coals. As the humus burns away we can see it glow.

5. *Humus and moisture.* — Take some soil that is rich in humus and some very poor, sandy soil and let the samples get thoroughly air dry.

Take two lamp chimneys or large tubes, tie a piece of muslin or netting over one end and into each of these receptacles put one of your samples, both of the same weight. Now pour water slowly upon each until it begins to drain from the bottom, measuring carefully the amount of water used. Note which soil has the greater power of absorbing moisture. Set the samples away to dry; weigh them every day to find out which has the greater power of retaining moisture.

6. *Effect of humus on the crop.* — Find fields that have been manured within the last year or two and compare the crop with that on fields that have been farmed for many years without having the humus replenished. Report the difference to the class.

7. *How corn affects the soil.* — Find fields on which corn or potatoes were grown the preceding year and learn about the yield. How do you account for the way corn or potatoes benefit the soil?

8. *Water rising in the soil.* — Take a wash basin and pile a small pyramid of sand in the middle of it. Then pour water into the basin and observe how rapidly it rises in the sand. We say this is due to “capillary action.”

9. *Surface mulch.* — Fill two large tin cans with moist soil, putting the same weight into each, and packing it firmly. Then stir up and loosen the surface in one of them daily to a depth of an inch, leaving the other packed. At the end of a week or two, weigh them to see whether the surface mulch helps to retain the moisture. By looking at the soil two or three inches below the surface you may be able to see the difference.

10. *Air in the soil.* — Drop lumps of earth into a pail of water and see the air bubbles rise; or immerse a small tin pail, can, or pot of earth in a larger pail of water and watch for the air bubbles. As the water penetrates the earth it crowds out the air.

11. *Need of air in the soil.* — Take two pots full of clay soil. In one pot plant seeds when the soil is loose, mellow, and moist, and at the same time plant seeds in the other after wetting the soil thoroughly and working or “puddling” it. Watch for results when the plants come up.

12. *Working soils when they are wet.* — Take a sample of heavy clay soil and another of sandy soil. Stir and work them thoroughly with a hoe or garden trowel, while quite wet, and then put them away to dry. If the two soils are very different, the effect of working them will be different, — the clay may become “puddled,” that is, the particles

may run together and stick together, forming a hard lump when dry; the sandy soil should not show so much injury.

13. *Oral and Written Composition.* — Suggested themes based on the preceding projects.

a. *Soils, — good, bad, and indifferent.* — Illustrated with samples from your part of the country. Projects Nos. 1 and 2.

b. *Subsoils and their importance.* — No. 3.

c. *Humus and its value.* — Nos. 4, 5, and 6.

d. *Effect of corn and potatoes on the soil.* — No. 7.

e. *Effect of the dust blanket.* — No. 9.

f. *Soil and air.* — Nos. 10 and 11.

CHAPTER XIII

WEEDS

What a Weed Is. — A weed is generally defined as a plant that persists in growing where it is not wanted. Sometimes we regard even a plant like wheat as a weed when growing in a flower bed or elsewhere out of its proper place. But wheat is a plant of highest value which usually attends to its own important business of filling the world's bread basket, and if by chance a few precious seeds get into the flower bed and spring up there they will readily yield to the argument of the hoe. True weeds are ordinarily useless, and unsightly or troublesome. Such plants are by nature adapted to growing in places otherwise unoccupied, and invading the fields to engage in competition with our cultivated crops. Farmers and gardeners properly look upon them as pests that often cause labor and expense; but some plants that are generally regarded as weeds may at times be put to good use. For example, the sweet clover is commonly found as a roadside weed, but of late years its value as a forage plant is being recognized in the northwestern states. Most weeds are homely plants, but in order to thrive under all sorts of hostile conditions they must be hardy and robust. Plants that pass muster as efficient weeds have one or all of these attributes:

1. They flourish in poor or rich soil, can stand drought as well as wet seasons, winter frosts as well as summer heat; the seeds may lie in the wet and frozen ground all winter without losing their vitality.

2. Many of them, as the thistle, dandelion, and tumble-weeds, have special means of scattering their seeds far and wide.

3. Many weeds are very prolific in the production of seeds. The Russian thistle will easily yield 20,000 seeds, and a single tumbling mustard has been known to produce 1,500,000 seeds.

4. Many of them, like the proverbial cat with nine lives, are exceedingly hard to kill. If we cut a purslane into a dozen pieces and leave them on the ground, each piece may take root and form a new plant, so that we make twelve weeds grow where only one grew before. Quack grass and Canada thistle are other examples of the great tenacity of life among weeds.

5. The ripening of the seeds is well timed to suit their particular method of propagation. Cockle ripens just in time to be harvested with wheat, and false flax with cultivated flax. Wild oats and mustard ripen before our grains, so that the seeds fall to the ground before they can be gathered up by the harvester, — self-seeding being their usual method of reaching the seed bed.

Native and Introduced Weeds. — Nearly all our weeds have been associated with cultivated crops for centuries and are the “survival of the fittest” for their particular mode of life. They have been introduced with our field and garden seeds, being among the evils that follow civilization, like rats and mice. The native plants of our prairies are generally lacking in the necessary attributes, and therefore do not make efficient weeds. Of the 35 or 40 species named in this chapter, the marsh elder, great ragweed, and wavy-leaved thistle are the principal ones that are natives of the northwestern states which they now infest.

Harm Done by Weeds. — It is easy to see that all weeds are more or less injurious in fields and gardens. We know that when plants stand too close they do not thrive, because the available supply of food and moisture is limited and all the leaves cannot get sunlight. When weeds compete in this way with cultivated plants, they take their full share of all the good things and will thrive better than the other plants because they are more robust. Weeds therefore do harm because (1) they help to exhaust the plant food from the soil, taking the nourishment that should go to the crops; (2) they use up equally valuable moisture; (3) they take up room and crowd other plants; and (4) they often tower above other plants and rob them of sunlight. For these reasons weeds are to be counted among the farmer's and gardener's enemies and should be studied with the view of learning the best method of combating them. That method varies with different weeds according to their nature and habit.

Annuals and How to Kill Them. — In the case of annuals the only thing necessary is to prevent the plants from bearing seeds, not only one year but for a number of years, until all the seeds in the soil have germinated and died. This is best accomplished by careful plowing and cultivating. We must also be on guard against bringing weed seeds upon our land from other parts. They may be carried by threshing machines or they may be mixed with seeds that we purchase for garden and field. The wind also brings many weed seeds to our farms, but the author cannot suggest any way to prevent this. Annuals are confined to cultivated and waste places. In grass lands they perish, for there they meet conditions with which they are not able to cope. If they do grow, it is because the sod is poor, and then spreading on fertilizer to produce a better growth of grass is the best treat-

ment. Annual weeds are more numerous than other classes. A list of the commonest may be found in the table that follows. (See page 162.)

Biennials and How to Kill Them. — Biennials do not thrive in cultivated fields as the annual visit of the plow destroys the plants before they can go to seed. In meadows, pastures, and waste places they may be exterminated by cutting them in season to prevent the formation of seeds for two years in succession. There are few biennials among our weeds. The commonest ones are the ordinary thistles, wild carrot, wild parsnip, and burdock.

Perennials and How to Kill Them. — In the case of perennials, as with annuals and biennials, the first necessity is to prevent the production of seeds, but this alone is not sufficient. The entire plant must be killed, and the plow does that effectually except in case of those that have underground stems. Perennials of this type are the only ones that can flourish in cultivated fields. From these underground stems new plants persist in growing. As soon as the young plant appears above the surface of the soil it begins to make plant food and to send it down to the rootstock and thus replenish its strength. It is therefore necessary to prevent this growth by cultivation or otherwise until the rootstock finally dies from starvation. It is so difficult to kill some of these plants that they are often considered the worst of all the weeds that we have. We refer especially to quack grass, Canada thistle, and perennial sow thistle. Other weeds of this type, though less harmful, are the wild morning glory, false sunflower, and common milkweed.

In uncultivated ground we also find types of perennial weeds that are not quite so tenacious of life. The commonest of these is the dandelion. That has a fleshy root which gives

vitality to the plant. This root may be starved by repeatedly cutting off or poisoning the green leaves, or we may cut out the crown (from which the leaves spring) and the upper part of the root. This latter method is only feasible when a comparatively small number of weeds are to be killed, as in the case of a few dandelions on our lawns.

Farm Management and Weed Control. — It must be borne in mind that the farmer has little time to hunt out individual species and prevent them from seeding or to cut them out at a certain season of the year, or to practice any other very refined method of exterminating them. The important thing to understand is that certain weeds flourish with certain crops and certain methods of farming, and that crop management involves weed management. A weed-infested farm is evidence of a poor farming farm. Good farm management involves systematic crop rotation, clean tillage, cleaning up unsightly waste places where weeds breed, and care in the selection of clean seed. Such management is the best system of weed control of which we know. As special measures to be employed when necessary, we may mention summer fallowing, seeding down to grass, pasturing with sheep, mowing at certain times of the year, burning the fields, and spraying with poisons.

Kinds of Weeds. — There are hundreds of plants that are known as weeds, and three or four scores of them may easily be found in almost any section of the country that has been settled for a generation or more. But the really important or aggressive kinds in any community will not exceed two dozen, and these the student should endeavor to identify. He will find most of them described in the following brief list. Generally assistance may also be secured from well-informed persons in the neighborhood.

BIRD'S-EYE VIEW OF OUR COMMONEST FARM AND GARDEN WEEDS

GENERAL TYPE	NAME	LIFE CYCLE	SPECIAL FEATURES
Very tall and coarse plants	<ul style="list-style-type: none"> 1 Great Ragweed 2 Marsh Elder 3 Annual Wormwood 4 Lamb's Quarters 5 Burdock 	<ul style="list-style-type: none"> Annual Annual Annual Annual Biennial 	<ul style="list-style-type: none"> { The tallest weeds by the roadside Has a very bitter odor Often called pigweed Round, hooked burs
Lie flat upon the ground	<ul style="list-style-type: none"> 6 Purslane 7 Spotted Spurge 8 Prostrate Amaranth 	<ul style="list-style-type: none"> Annual Annual Annual 	<ul style="list-style-type: none"> Thick, smooth leaves Milky juice Thinner leaves than Purslane
Vines	<ul style="list-style-type: none"> 9 Wild Morning Glory 10 Wild Buckwheat 	<ul style="list-style-type: none"> Perennial Annual 	<ul style="list-style-type: none"> Showy white flowers Flowers inconspicuous
Very prickly leaves; flowers composite, purple	<ul style="list-style-type: none"> 11 Common Thistles 12 Canada Thistle 	<ul style="list-style-type: none"> Biennial Perennial 	<ul style="list-style-type: none"> Flowers in large heads Heads much smaller than the preceding
Needle-shaped leaves	<ul style="list-style-type: none"> 13 Russian Thistle 	<ul style="list-style-type: none"> Annual 	<ul style="list-style-type: none"> Very bushy form
Flowers green; look like cluster of hairy chaff	<ul style="list-style-type: none"> 14 Red Root 15 White Amaranth 	<ul style="list-style-type: none"> Annual Annual 	<ul style="list-style-type: none"> Also called Rough Pigweed Plant is pale green
Grass family	<ul style="list-style-type: none"> 16 Yellow Foxtail 17 Green Foxtail 18 Barnyard Grass 19 Old Witch Grass 20 Wild Oats 21 Quack Grass 	<ul style="list-style-type: none"> Annual Annual Annual Annual Annual Perennial 	<ul style="list-style-type: none"> Heads form a dense spike Heads form a dense spike Flowers in a compact panicle Flowers in an open panicle Looks like cultivated oats Underground stems

BIRD'-EYE VIEW OF OUR COMMONEST FARM AND GARDEN WEEDS—*Continued*

GENERAL TYPE	NAME	LIFE CYCLE	SPECIAL FEATURES
Mustard family; bearing pods with two cells	22 Wild Mustard	Annual	Pods long and slender
	23 Tumbling Mustard	Annual	Pods long and slender
	24 French Weed	Annual	Pods short, flat, notched at end
	25 Peppergrass	Annual	Pods small, roundish, flat
	26 Shepherd's Purse	Annual	Pods heart-shaped, flat
	27 False Flax	Annual	Pods small, pear-shaped
Parsley family; flowers in umbels	28 Wild Carrot	Biennial	Looks like carrot, flowers white
	29 Wild Parsnip	Biennial	Looks like parsnip, flowers yellow
Red or pink flowers, 5 petals	30 Corn Cockle	Annual	Round, black seeds, flowers red
	31 Pink Cockle	Annual	Round, black seeds, flowers pink
Light yellow composite flowers	32 Annual Sow-thistle	Annual	Leaves with soft spiny teeth
	33 Corn Sow-thistle	Perennial	Leaves similar; milky juice
	34 Prickly Lettuce	Annual	Prickles on under side of leaf
	35 Dandelion	Perennial	Flower-stalk is hollow
Small, greenish white composite flowers	36 Horse Weed	Annual	Entire plant very leafy

BRIEF DESCRIPTIONS OF OUR COMMONEST WEEDS

Arranged in the same order as in the preceding table.

1. **Great Ragweed: Kinghead.**—This plant often attains a height of 6 or 7 feet. The form of the seed, with its

encircling row of projections, suggests a head with a crown — hence a “kinghead.” These seeds are so hard to remove from wheat that its grade is reduced if it contains many of them.

2. **Marsh Elder: Red River Weed.** — This resembles the kinghead in general appearance and size and is often

found in its company. But, though its leaves are about the same size, they are not 3-lobed like those of the other plant, and the flower is entirely different in form. The seed is also very different, being small, round, and black.



a, GREAT RAGWEED; *b*, LESSER RAGWEED; *c*, MARSH ELDER

3. **Annual Wormwood.** — The plant usually attains a height of from 2 to 4 feet; is more or less branched; quite smooth; the leaves are very much cut and divided. It has small, greenish white, composite flowers that are held on their slender stems in a drooping position.

Its bitter odor clings to the hands after touching the plant. Another wormwood, closely related to this, has been extensively used in medicine and is noted for its bitter taste.

4. **Lamb's Quarters: Pigweed.** — This plant is tender and juicy and pigs are very fond of it, but several other plants are called “pigweed,” and therefore the name is not much better than none. “Lamb's quarters” has reference to the shape of the leaves, which is supposed to suggest a leg of mutton. The plant grows in gardens and waste places.

5. **Burdock.** — This is a stout plant attaining a height of 2 or 3 feet and growing in pastures and neglected places.



ANNUAL WORMWOOD

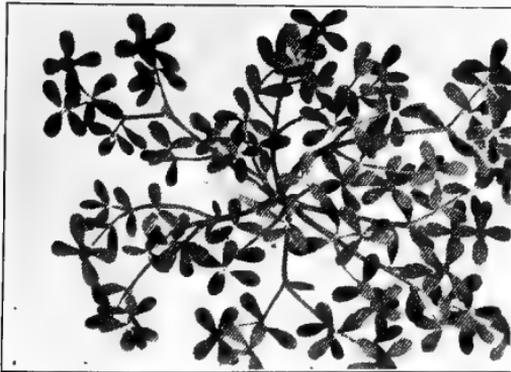


LAMB'S QUARTERS



BURDOCK

It has broad leaves and coarse flowers that are followed by burs which cling to the clothing or to the fur of animals.



PURSLANE



SPOTTED SPURGE

6. **Purslane: Pusley.** — This plant branches just above the root, the stems lying flat on the ground and radiating in all directions so as to cover several square feet when well

grown. The whole plant is of a reddish color, smooth to the touch, fleshy, and tender. The leaves are small but thick; the flowers are small, pale yellow, opening on sunny mornings.



PROSTRATE AMARANTH

A meek-looking plant, but a very bad garden pest, exceedingly difficult to destroy. Formerly much used as a pot herb for "greens."

7. **Spotted Spurge: Milk Purslane.** — In form, color, and habit this plant resembles purslane, but it is

smaller, and the stems and leaves are thinner; when bruised or broken a milky white sap comes out.

8. **Prostrate Amaranth.** — Another plant having a close resemblance to purslane and fully as large; but its leaves are thinner and the stem tougher. About all we can see of the flowers is a little cluster of green, chaff-like scales in the axils of the leaves. This weed, like purslane, prefers the garden to the field.

9. **Wild Morning Glory: Hedge Bindweed.** — This plant, with its vine-like stem, triangular leaves, and large white or pinkish bell-shaped flowers, is easily recognized by all who are familiar with the cultivated morning glory. It spreads by means of its white, fleshy, underground stems which are perennial and make it a persistent weed.



WILD MORNING GLORY

10. **Wild Buckwheat: Black Bindweed.** — The twining or trailing stem and triangular leaves of this plant make it look like a wild morning glory, but it lacks the showy flowers

of that plant. Its blossoms grow in small clusters from the axils of the leaves and are inconspicuous, but the triangular, dull-black seeds are quite distinctive; they resemble buckwheat and are difficult to remove from wheat.

11. Common Thistles. — The commonest thistle upon our northern prairies is the wavy-leaved thistle, which is native to the sod. It is covered all over with white, velvety fuzz, except perhaps on the upper surface of the older leaves. The height of the plant is from 2 to 3 feet. The bull thistle or Scotch thistle came originally from



WILD BUCKWHEAT



BULL THISTLE

Europe and is not

yet found in the more recently settled sections. It is taller than the wavy-leaved (3 to 5 feet high), is more prickly, and the white woolly fuzz is almost completely absent. The tall thistle or roadside thistle is still taller (3 to 10 feet); the stem is downy; the leaves are rough-hairy above and whitened with close wool beneath.

12. Canada Thistle. — This is one of the most pernicious weeds and is extremely difficult to eradicate. It is often found in dense patches, as it spreads from underground stems. It may easily be distinguished from

common thistles because the plant is smaller, the stems thinner, and not often over two feet high; it has more branches, and each branch has several flower heads; these heads are not covered with prickly spines, but the rest of the plant is more prickly than other thistles. The flowers are a paler purple and the leaves are darker green. This thistle, like so many other weeds, was introduced from Europe. It came by way of Canada, hence the name.



CANADA THISTLE

13. **Russian Thistle: Russian Cactus.** — This is neither a thistle nor a cactus, and it does not look at all like such plants. It is much branched and very bushy in form. When young it is dark green, and has soft, narrow, needle-shaped leaves. With age the whole plant becomes more rigid and the leaves develop formidable, prickly spines. After the frost has



killed it the wind easily breaks it loose from its moorings and carries it over the country, dropping seeds as it rolls along.

14. **Red Root: Rough Pigweed.** — This is one of the plants relished by pigs and bearing the name pigweed. It is more troublesome in gardens and potato grounds than in grain fields. It is somewhat hairy and rough; usually not much over



RUSSIAN THISTLE

2 feet high; the several branches point upward and terminate in a pyramid of green flowers. The flowers, however, may hardly be recognized by the inexperienced eye as we can see scarcely anything but a mass of green, hairy chaff. The bright red root helps to identify the plant.

15. **White Amaranth: Tumble-weed.** — This is related to the preceding species, which may be called the rough amaranth. The white amaranth is a smaller plant and has a paler green color, the stems are not so coarse and they spread out more, and the green flowers are found in small clusters in the axils of the leaves instead of forming a dense panicle at the top. In the fall the wind breaks this bushy plant off at the surface of the ground and uses it for a plaything. This is the original "tumble-weed," but since the



RED ROOT



WHITE AMARANTH

Russian thistle and tumbling mustard arrived on the scene they have also proved their right to this title.

16. **Yellow Foxtail: Pigeon Grass.**

— The foxtails are the most democratic of all plants, and though mere weeds they are perfectly at home in the society of cultivated plants everywhere. The blossoms grow in dense spikes like those of timothy and common millet. This species looks very much like the

next one, but its head or spike is more yellowish in color and its seeds are distinctly larger.

17. **Green Foxtail: Pigeon Grass.**— In some sections this is less common than the preceding, but in other localities it is even more abundant. It is easy to distinguish the two species if they are brought together for comparison.



a. YELLOW FOXTAIL
b. GREEN FOXTAIL

The two foxtails generally reduce the yield of wheat more than all other weeds combined, and we may therefore, with good reason, call them our worst weeds.

18. **Barnyard Grass: Cockspur Grass.**— This is often associated with pigeon grass, though it is fond of richer ground such as it would find in the barnyard. The beginner will find it hard to distinguish from pigeon grass until it heads out. Then the blossoms appear in a dense panicle like that of Japanese millet.

19. **Old Witch Grass.**— This is another annual grass, found wherever weeds grow. Until it heads out we distinguish it from pigeon grass and barnyard grass by the hairy sheaths, — the lower part of the leaf that clasps the stem. The blossoms are on slender stems and in a very loose or open panicle.



BARNYARD GRASS

20. **Wild Oats.**— This is easy to identify, but sometimes the name is erroneously applied to the native porcupine grass of the prairie in sections where the real villain has not yet become familiar. The grain of wild oats has a ring of hairs

at its base and bears on the side a blackish, twisted, and bent awn about an inch long. It is of light weight, shells easily, may lie in the ground many years and retain its vitality, and will germinate though buried to a depth of three or four inches. These attributes account for its rapid spread in a field after it once becomes established, and make it one of the worst weeds with which farmers have to contend.

21. **Quack Grass: Couch Grass.**— This is one of the wheat grasses and it is hard for one who is not familiar with



OLD WITCH GRASS



WILD OATS



QUACK GRASS

it to distinguish it from the native species. The wheat grasses, including quack grass, are useful for hay and pasture. But quack grass cannot be confined to grass lands. It invades our cultivated fields and it is exceedingly difficult to kill on account of its long, jointed, running rootstocks. Of course there are other grasses, as June grass and Austrian brome grass, that have these underground stems, but none of them are half so hard to kill as this one.

22. **Wild Mustard: Yellow Mustard.** — This plant with its yellow blossoms is familiar to all. It is one of the most troublesome weeds in our fields. Many farmers prevent it from getting a foothold upon their land by going through their grain fields every summer when it is in bloom and pulling all the plants. If this practice is begun before the weed is too common, the amount of labor required is not prohibitive.



WILD MUSTARD

23. **Tumbling Mustard.** — The flowers of this mustard are pale yellow or nearly white and not so showy as in the preceding species, the pods are longer and more slender, and the seeds smaller. If allowed room for growth, the plant becomes very bushy, and in the fall the wind breaks it loose from the ground and rolls it over the fields, distributing seeds along its path. It is one of the most abundant seed-producers known. A large plant may bear 1,500,000 seeds, and could seed down nearly 5 acres of ground giving 7 seeds to every square foot.



TUMBLING MUSTARD

24. **French Weed: Penny Cress.** — This may be recognized by its offensive odor, flat pods with a deep notch at the end, and its small white flowers. While most of the seeds do not germinate until spring, some of them come up in the fall, the young plants live through the winter, bloom early in the spring, and mature seeds soon after. It came to us from Europe by way of

Canada, and the name lays the blame for its introduction upon the Canadian French.

25. **Peppergrass.** — This is not a grass as the name implies, but a mustard, with small white flowers. The pods are small, flat, and circular, and are very numerous, often forming a raceme six inches in length. Each of the two cells of the pod contains a solitary seed.

26. **Shepherd's Purse.** — This looks somewhat like peppergrass, but there are fewer branches and fewer pods on a branch. The pods are heart-shaped and have 10 or 12 seeds in each of the two cells. Their shape is supposed to resemble that of a purse.

27. **False Flax.** — This is not related to ordinary flax and shows no resemblance to it until it is ripe. It is most common in flax fields, or where flax has been



FRENCH WEED



PEPPERGRASS



SHEPHERD'S PURSE



FALSE FLAX

grown. An upright annual, from one to three feet high, unbranched except near the top; has small yellow flowers; pods have several yellow, oblong seeds in each of the two cells.



WILD CARROT

28. **Wild Carrot.** — This eastern weed is not yet very common in the north-western states, but, when met, is easily recognized by its resemblance to the garden carrot — especially by persons who have seen the latter growing the second summer of its life history. The compact, flat-topped umbels of white flowers are very distinctive. This is the original of the cultivated carrot, but in its wild state it is reputed to be poisonous. It occurs in meadows, pastures, and waste places.

29. **Wild Parsnip.** — This is closely related to our garden parsnips and has the same appearance. It has a long tap root; the flowers are yellow; seeds broad and flat. It is said to be poisonous.

30. **Corn Cockle.** — This plant, most commonly found in wheat fields, attains a height of one or two feet, has but few branches, and those grow straight upward. It is quite hairy all over. The five calyx lobes are very narrow, and longer than the five purple-red petals. The pod appears swollen and contains many round, black seeds, which are poisonous. Flour made from grain containing much cockle is injurious to health; and therefore such grain is reduced in grade by elevator and mill men.



CORN COCKLE

31. **Pink Cockle: Cowherb: Cow Cockle.**— The seeds of pink cockle are similar to those of corn cockle, are also poisonous, and injure flour in the same way, but the plant looks quite different. It is bushy or spreading, is very smooth, and the leaves are broad and are opposite each other on the stem. The flower is pink.



PINK COCKLE



CORN SOW THISTLE

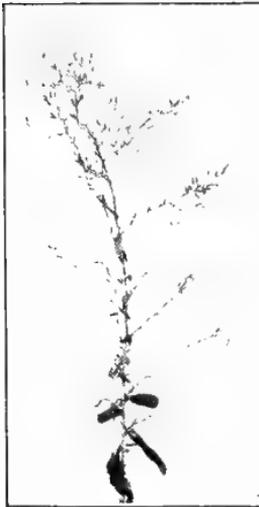
32. **Annual Sow Thistle: Common Sow Thistle.**— A coarse plant with fibrous roots and thick stem, mostly unbranched, one to five feet high, terminating in several clusters of pale yellow, composite flowers. All the leaves are margined with soft, spiny teeth.

The lower leaves have petioles (stalks) and are

deeply cut or notched; and the upper ones are much smaller, have no petioles, and clasp the stem by an arrow-shaped base. The tender leaves are sometimes used as a salad and as a potherb.

33. **Corn Sow Thistle: Milk Thistle.**— This plant resembles the preceding, but it springs from deep perennial roots and rootstocks like Canada thistle; is more branched and spreading; and its flowers are larger and of a brighter yellow color, suggesting those of the dandelion. Both of these sow thistles are considered bad weeds. Their seeds are provided with a tuft of hairs as is

common in the composite family, and by these the wind carries them over the country.



PRICKLY LETTUCE

34. **Prickly Lettuce.** — In general appearance this plant resembles the native blue lettuce or even the sow thistles, having the same smooth and fresh-looking foliage. It is easily distinguished, however, by the sharp prickles on the under side of the midrib of the leaf. There are also some scattered bristles on other parts of the plant, and the margin of the leaves is studded with soft spiny teeth. The plant may complete its life in either one or two years, and is considered a very bad weed.

35. **Dandelion.** — This weed needs no description here because everybody knows it. It is worth considerable study, however, as it furnishes a good example of a deep, fleshy, perennial taproot that is hard to kill; and of a composite flower with its numerous minute florets, followed by seeds that are provided with beautiful wings for their effective distribution. The name means *lion's tooth* and refers to the margin of the leaves and not to "dandy lion."

36. **Horse Weed: Canada Fleabane: Butter Weed.** — It is exceedingly difficult to identify this weed from any description that may be given, but it is so common everywhere in gardens, fields, and waste places that we should be able to name it. It is a hairy plant, somewhat rough to the touch, with



DANDELION

erect stem and branches easily reaching a height of two or three feet. It is quite leafy, most of the leaves being narrow and with even margins. The flower heads are very numerous but small, greenish white, and not at all showy. The flowers are composite, and the seeds have the tuft of hairs so typical of many composite flowers. "Horse weed" refers to the fancied resemblance of the full-grown plant to a horse's tail. It is also called colt's-tail.

PROJECTS

1. *Identify the weeds.* — Learn the names of the common weeds found in your vicinity. The easiest way is to let somebody introduce them to you, but if your friends do not know them either, you must identify them by the help of books, which can be done best at the time when they are in bloom. A good way to begin is to take a few that you know and see how they are classified in the "Bird's Eye View" or key, and further described in the pages that follow. Taking the dandelion, for example, you turn to the "Bird's Eye View," compare it with the "general types" in the first column, and, passing those types with which it does not agree, come to "light-yellow composite flowers." As this looks promising, you read the "special features" in the last column and notice that those of the dandelion are the only ones that tally with your specimen. You turn now to "No. 35, Dandelion," in the "Brief Descriptions" and all doubts you may have had are removed.

A little practice of this sort with plants you already know should make you so familiar with the key and the descriptions and pictures that you can identify others without great difficulty. Before going to the book with a new weed, observe a good variety of specimens and then select for the examination such as are typical and are in blossom. In some cases it is also neces-



HORSE WEED

sary to have plants that are mature enough to show the nature of the fruit (pods, seeds, etc.).

Bear in mind that the list in this book is quite incomplete, and you are apt to meet varieties that it does not include.

2. *Get acquainted with weeds.* — To be able to name a few weeds when you see them in bloom may not indicate any real acquaintance with them. (a) You must learn to recognize the different kinds in all stages of growth; know their form and general appearance, how large



A COLLECTION OF WEED SEEDS

Supplied by the Department of Biology of the North Dakota Agricultural College. Mounted specimens of the plants to aid in identification may also be secured from the same source.

they become, shape of leaves, kind of flowers and seeds, and how the seeds are distributed; where they are most common and what special harm they do, if any; whether domestic animals will eat them if found in pastures or if present in hay. (b) Learn whether they are annual, biennial, or perennial; what sort of roots they have; what characteristics they have that make them successful weeds; what appears to be the best method of controlling them.

3. *A collection of weeds.* — Take a specimen of each kind of weed that is common in your neighborhood — either the entire plant, or part of

the stem with leaves or flowers; hang it up to dry. As soon as you can learn the name, put it on a slip of paper and fasten it to the plant. This will assist everybody in the school in learning the names of the weeds. For a more convenient and more permanent collection the specimens should be properly pressed, mounted on stiff paper, and labeled.

4. *A collection of weed seeds.* — Get a small quantity of seeds of each kind of common weed and put them in a small bottle or an envelope. Small vials of uniform size are best for the purpose and can be purchased at trifling expense. Whenever it is possible to learn the name, the specimen should be properly labeled.

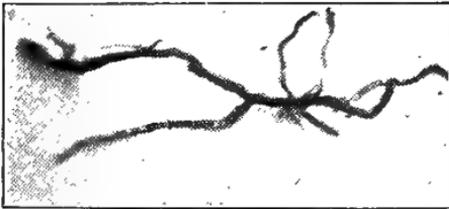
5. *How many seeds one plant bears.* — Take any weed with seeds large enough to be easily found and count those from a definite part of the plant. Then multiply by the number of such parts that the whole plant has. For example, in case of pigeon grass, count the number of seeds in an average-sized head and multiply by the number of heads. The plant stools, as wheat and oats do, and will have a number of stalks that are connected at the root. These stalks must all be included, as they come from one seed. The seeds of a mustard may easily be determined by making a count of those in several pods and then finding the average number of seeds per pod. Now multiply that by the number of pods to the plant. This number may be estimated by counting the pods on a portion of the plant, as a fifth or a tenth, and then multiplying.

6. *To tell whether a plant is an annual, a biennial, or a perennial.* — (a) The first season of a plant's growth from a seed we cannot distinguish these three kinds from one another by their appearance except that biennials and perennials do not usually bloom until the second year. (b) In subsequent seasons we can usually find dead remnants of the previous year's growth at the base of the plant in case of biennials and perennials. (c) When plants come up in the spring it is easy to distinguish the seedlings because they are comparatively tiny and weak while the biennials and perennials coming from old roots are coarser and stronger. (d) Biennials cannot be distinguished from perennials by their appearance. We must have actual acquaintance with the life history of the plant to tell whether it belongs to one class or the other.

It would be well to begin with familiar plants and observe the features just mentioned, then extend the study to less familiar species and continue it until a satisfactory degree of skill has been developed.

7. *A study of rootstocks.* — Dig up a wild morning glory and observe carefully the white underground stem, how it creeps along and spreads and how new plants spring from it; see how these rootstalks differ from real roots. Follow the same plan with other plants in your vicinity that have rootstocks, as June grass, Austrian brome grass, Canada thistle, sow thistle, quack grass. Find out which of these are difficult to kill.

8. *How to kill the dandelion by cutting off the top.* — Select a number of dandelions in a suitable spot where you can observe them from day to day for a few weeks. (1) From one of them cut off only the leaves, close to the ground. (2) From another cut off merely a thin shaving from the top of the root. (3) From others cut off $\frac{1}{4}$ inch, $\frac{1}{2}$ inch, and an inch. In this way find out how much must be cut off in order to kill the plant.



ROOTSTOCK OF WILD MORNING GLORY

variety that may sometimes be found in a small area.

10. *Oral and Written Composition.* — These topics are especially suitable:

a. *A common weed.* — Description of any weed with which you are acquainted. Give more interesting details than are found in the brief descriptions in this chapter. Project No. 2.

b. *A study of rootstocks.* — No. 7.

c. *My fight with the dandelions.* — Report on Project No. 8, and any other experience you have had in trying to kill them.

d. *My summer in a garden,* or a season's campaign against the weeds. List of all the weeds found in your garden, which were the most persistent, how often it was necessary to use the hoe, etc. No. 9.

CHAPTER XIV

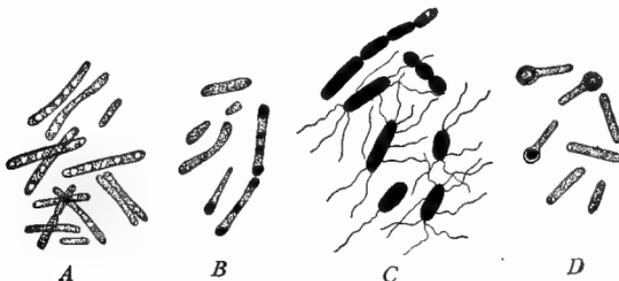
PLANT DISEASES

Plants, like animals, are subject to many diseases, and often these are due to similar causes. Infectious diseases, such as measles, mumps, and typhoid fever, are produced by germs or bacteria that get into a person's system; and practically all cultivated plants are attacked by similar parasites. These live in the body of the plant and feed upon its substance, causing the loss of health and sometimes of its life. As a farming, gardening, or fruit-growing district gets older, each crop becomes more and more liable to attack by its own particular enemy. These disease-producing parasites are low types of plants. Some of them are bacteria, but a larger number are fungi (plural of fungus). To enable us to understand more clearly the nature of plant diseases, we must learn something about the characteristics of bacteria and fungi.

Nature and Causes of Plant Disease. — Bacteria and fungi are not green, as the leaves of ordinary plants are, and this is a very important fact, for without the green coloring matter they are unable to manufacture their own food out of the elements taken from the soil and the air as higher plants do. They must, therefore, live upon food already prepared by higher plants.

Bacteria are the smallest of all plants — so small that we should have to place from 10,000 to 25,000 of them side by side to cover a line an inch long. Their form is extremely

simple: they are spherical, oblong, or cylindrical bodies having no roots, leaves, or flowers. They multiply in the simplest manner that we could imagine. Each individual simply splits in two, and in a very short time these parts are full-grown and ready to divide again. In some kinds this division takes place every 20 or 30 minutes so that two or three generations may be produced in an hour. Bacteria are found almost everywhere, but we are here concerned only with those kinds that grow in the tissues of living



DISEASE-PRODUCING BACTERIA

A, the tuberculosis bacterium; *B*, the diphtheria bacterium; *C*, the bacillus of typhoid fever; *D*, the bacillus that causes lockjaw; some of the cells are forming spores.

plants. An example of a plant disease due to bacteria is the fire-blight of pear and apple trees.

Fungi are much larger than bacteria, and with some of the most conspicuous kinds nearly all people are familiar. The largest fungi are the mushrooms, toadstools, and puffballs, but most of these live upon decaying animal and vegetable matter, and we are now interested only in those that infest living plants and make them sick. Fungi have no stems, roots, or leaves. Their main part usually consists of a mass of whitish threads that are sometimes finer than a spider's web. These threads lengthen with great rapidity and may extend

into all parts of the infested plant. Instead of seeds, fungi produce immense numbers of *spores* which serve the same purpose and are as tiny as grains of dust. These spores may be carried long distances by the wind, and if some of



a.

b.

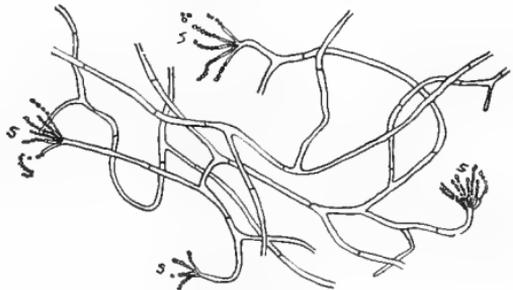
c.

a, PUFFBALLS; b, COMMON MUSHROOMS; c, SHELF OR BRACKET MUSHROOMS

them happen to lodge upon a tender part of the plant that is their favorite victim, they sprout and soon send their thread-like fibers into its tissues.

Some familiar plant diseases caused by parasitic fungi are rust, smut, flax wilt, mildews, potato scab, late potato blight, and bean-pod spot.

Parts Attacked. — Although a certain part of the plant may be the chief point where the disease shows itself, as, for example, the head in case of grain smut, yet the effect is general. All these diseases reduce the vitality of the whole plant.



BLUE MOLD

s, Spores.

Remedies. — Many of the most destructive plant diseases that afflict our crops, such as grain smut and potato blight,

can be prevented by methods that are now in general use; and many millions of dollars are thus saved every year. For other diseases, as grain rust, no such effective means of prevention has as yet been found.

Treatment with Chemicals. — For the preventable diseases two general methods of procedure may be briefly mentioned.

(1) The first method is followed when the germs of the disease, that is, the spores of the fungus, are found upon the seed that is planted. These spores germinate in the ground, and as soon as the host plant is well started, the young fungus enters its tissues and continues its growth there. To prevent this, we treat the seed before planting by wetting it



A CHEAP SPRAY PUMP

in some liquid that will kill the germs upon it. Wheat and other grains are treated in this way for smut, and seed

potatoes for potato scab. The favorite substance used for the purpose is formaldehyde.

(2) The second method is employed in the case of diseases that enter the plant by way of the leaves and tender stems. The spores are borne upon the wind and by insects, and when they fall upon the foliage they sprout, and soon the young fungus enters the tissues of the host plant and begins its ravages. To prevent this from taking place, we spray the plant with some chemical that will not injure the foliage but will kill the spores upon its surface. After the fungus has sent its filaments into the body of the plant it is out of reach of any remedy. The chemical must therefore be applied when the plant is still perfectly well. It is too late

when it has become diseased. Mildew, potato blight, and leaf spot are some of the common diseases for which we spray, and Bordeaux mixture, which is made from lime and copper sulphate, is the principal remedy employed for the purpose.

Disease-resisting Seed. — We know that some persons “catch” contagious diseases more quickly than others do. It is the same with plants — some of them become infected with a disease while others standing quite near them resist the attack. Scientists have therefore been trying to secure strains of disease-resisting seeds. The process is very simple, and any intelligent person can easily understand it. We need merely select the plants that have resisted the disease and save the seeds from those. Repeat this process of careful selection year after year, and the power of resistance will be developed more and more. Considerable progress has thus been made in developing a strain of flaxseed that shall be immune from flax wilt, cantaloupes that resist melon wilt, and cabbage that is free from black rot. Similar work with wheat and oats also seems promising.

SOME SPECIAL PLANT DISEASES

There is a very large number of plant diseases, each usually confining itself to one particular species of plant. Fortunately for us, a cool, dry climate is not favorable to the development of disease-producing bacteria and fungi, and such states as North Dakota have comparatively little trouble except from grain rust and smut, and flax wilt. The following brief list includes about all that are of much consequence in the Northwest.

Smuts attack wheat, oats, corn, and other grains, causing the black, powdery masses that are sometimes found in place



SMUT

a. Head of wheat affected with stinking smut. *b.* Head of oats affected with loose smut.

of the grain-heads or the ears of corn. Smut is a fungus growing within the body of the stem and leaves, and when the kernels form it enters them, fills them with its own tissues and soon with a mass of minute, black spores. When the grain is threshed, some of these spores adhere to the kernels and are planted with them to infect the next crop.

Rusts cause brownish spots on the leaves and stems of grain and many other plants, often doing great damage to the crops. The rusty patches on the surface are merely the spores, the rest of the fungus being within the tissues of the host plant. There are many species of rust, each having its own favorite plants upon which it flourishes. Often two different kinds of plants are used by a species in different parts of its life history. For example, the wheat rust may live in the spring upon the barberry, and later in the season the spores find their way to the wheat fields. We are therefore digging up all our barberry bushes in hopes of making it more difficult for the rust spores to develop. Grain rusts produce two different kinds of spores in different parts of the season. Those that appear just before harvest, called *black rust*, come from the same



CORN SMUT

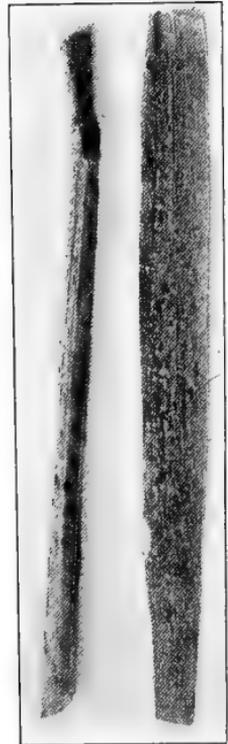
fungus that bears the red spores earlier in the season. The spores produced late in the season live through the winter and start life the next spring by infecting some host plant again.

The mildews cover the leaves of plants with a white substance either of a powdery or of a woolly form. The leaves of our lilacs nearly always show mildew except in early summer, and the grape, rose, woodbine, and willow are often affected. Of course, the larger part of the fungus is out of sight within the tissues of its host, and there it does its real harm to the health of the plant. To prevent mildew we may dust the foliage with dry sulphur.

The blights cause the leaves of plants to shrivel and blacken, looking as if overheated by the sun or by fire. Fire-blight attacks pear and apple trees, and when the disease appears the affected twigs should be cut off and burned. The potato blights belong to this type of disease and may be prevented by spraying with Bordeaux mixture.

The wilts are diseases that make their host plants wilt and droop as if suffering from lack of water. In a short time they die. This wilting is caused by fungi or bacteria that grow in the sap tubes of the plant and thus choke off the flow of moisture to the upper parts. Flax wilt is the most destructive disease of this type in

the Northwest. When a piece of ground has produced a crop or two of flax, it generally becomes infected with the germs of the flax wilt fungus, and we say it is flax sick. To control flax wilt

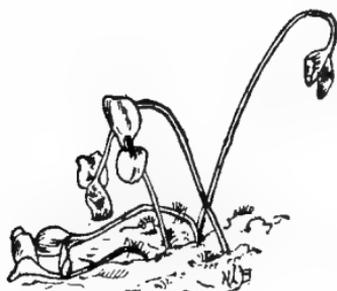


RUST

Leaf and stem of wheat affected with rust.

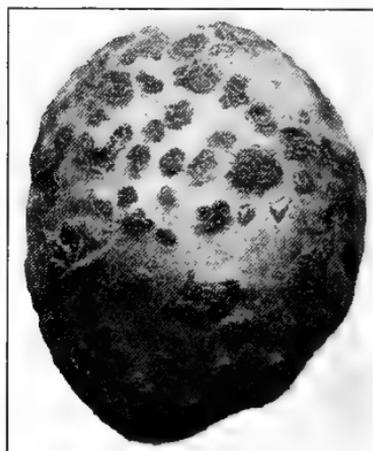
we should develop and use a strain of seed that resists the attack of the disease.

Potato scab shows itself on the surface of the potato in the form of irregular, rough patches. It is caused by a fungus that grows from spores on the seed potato or in the ground. (1) As already explained, to prevent infection from the seed potatoes we may soak them in a formaldehyde solution and kill the spores. (2) After potatoes have been raised in the



YOUNG FLAX PLANTS

Wilted, due to early attack of the wilt fungus from flax-sick soil. (After Bolley.)



POTATO SCAB

same ground a number of years so that the soil has become infected with the scab, some other crop should be grown on this land for a period of years and potatoes raised elsewhere.

Bean-pod spot manifests itself in the form of brownish or blackish patches on the pods of beans, which injure them greatly. Seeds from such pods are apt to contain the fungus, and if planted, this will infect the seedlings and in due time the pods. The best method of prevention, therefore, is to avoid planting infected seeds. Spraying the plants with Bor-

deaux mixture helps to control the trouble, but several applications are necessary.

PROJECTS AND QUESTIONS

1. *Mushrooms, toadstools, and puffballs.* — Bring several of these to school and tell your class where they were found. It should be easy to find them in the fall near barns, in meadows, or any damp place. They are large fungi. Notice the parts: an umbrella-like part or cap, a sort of stem, and some fibers running into the ground. Take the cap of one of your specimens, place it with gills down upon a piece of clean paper, cover with a glass or jar, and leave it for a day. Some spores will be set free and fall on the paper where you can see them very plainly. If the mushroom is one that has white spores, those will show best if colored paper is used.

2. *Mold.* — Moisten a piece of stale bread slightly, put it in a tumbler, and keep covered. In about a week the bread will probably have mold upon it. Mold is a fungus and affords a very convenient example for study. (1) Note the mass of fine white threads that take the place of stems, roots, and leaves of higher plants. Do any of the threads penetrate the bread? (2) Notice the black specks on the ends of some of the threads. These are spore cases and if you touch them gently with a pin they may burst open and a shower of minute spores come out. The unripe spore cases are white. A magnifying glass will enable you to see these things more plainly. (3) Moisten another piece of bread and with a small stick transfer some of the spores to that, planting them in rows. Invert a tumbler over this bread and after forty-eight hours examine it. Has the mold formed? This time you planted the spores on the bread, but where did they come from in the case of the first piece? Why do you think that stale bread is used rather than fresh bread?



BEAN-POD
SPOT

3. *Infecting with germs of decay.* — Take a rotten apple and a sound one. Stick a pin a third of the way into the rotten apple and then into the sound apple, repeating the operation in several places. Lay the

sound apple aside for about a week and watch for the result. How do you explain it? (Apple rots are caused either by fungi or by bacteria.)

4. *Different methods of infection.* — Find out in what different ways plants may become infected with disease-producing fungi.

5. *Multiplication of bacteria.* — It has been computed that if a bacterium divides once every hour, its offspring at the end of two days would number 281,500,000,000. What would be the number at the end of the first 24 hours? Notice that there will be twenty-four multiplications, giving us these products: 2, 4, 8, 16, 32, 64, etc. to the 24th.

6. *Plant diseases in your district.* — Find out what plant diseases are prevalent in your region. Which are the worst? How may each be controlled?

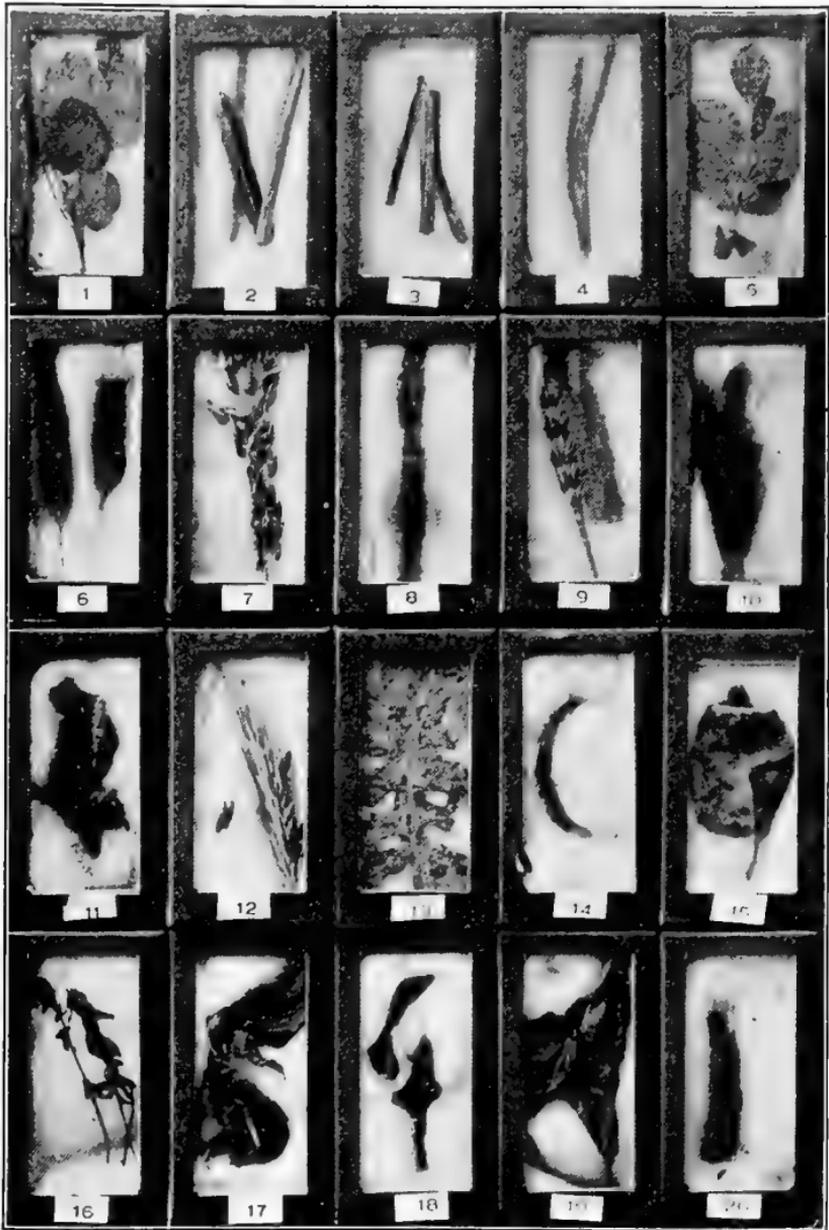
7. *Identifying diseases.* — (a) Try to find actual cases of all the plant diseases that are prevalent in your region, and to make yourself familiar with their appearance. (b) If you find some plants that look unhealthy, try to identify the diseases they are troubled with.

8. *A collection.* — Make a collection of leaves and stems showing rust, smut, mildew, bean-pod spot, or other diseases. Label the specimens and preserve them for future use.

9. *Fungicides.* — A fungicide is a substance used to kill, or to prevent the growth of fungi. Watch for an opportunity to see some farmer or gardener treat his seeds or plants with a fungicide. Give a clear description to your class — material used, seed or plants treated, method of application, etc.

10. *Grain rust.* — (a) If rust is found in any of the grain fields of your vicinity, examine the appearance of the plants and note how and where the disease manifests itself. Let a good farmer show you if necessary. The reddish or blackish spots on the surface of the leaves and stems are clumps of spore cases, the main part of the fungus being within. (b) Do you notice any difference in color between the rust spots in the later stage of the plant's growth as compared with the spots in early summer? (c) If there are any barberry bushes in your vicinity, go and see them and try to find rust spots upon them, in June or July.

11. *Smut.* — When grain is headed out in your district, try to find some smutted heads. Examine them and notice that the black mass consists of innumerable tiny specks. These are the spores of the smut fungus whose fibers extend through the body of the entire host plant. Mention all the grains in which you have found smut, — as wheat, oats,



PLANT DISEASE COLLECTION

Supplied by the Department of Biology, North Dakota Agricultural College.

barley, rye, and corn. It would be interesting to bring to school and show your class a specimen of smut from each of these.

Can you learn of any one in the neighborhood who treated his seed grain for this disease? If so, look for smut in the fields treated and compare with untreated fields. Get from the farmer a detailed description of his procedure with the fungicide.

12. *Flax wilt.* — If flax is raised in your vicinity, watch the fields for the development of flax wilt. If you find any diseased plants note their appearance carefully. Watch them for some days to see what becomes of them. How do you account for the origin of the disease in that particular field?

13. *Mildew.* — Find some plants with mildew upon them. You should at least notice it on lilac bushes in autumn. Does it seem to do any harm to lilacs? How does it affect roses or other plants?

14. *Potato scab.* — Examine potatoes when they are being harvested and see if you can find some that are affected with scab. How does it injure the value of potatoes? If there is danger of scab in your neighborhood, what is done to prevent its appearance?

15. *Fire blight.* — If this disease is found on apples in your district, try to see some trees that are affected by it. Learn to recognize it and to distinguish between healthy and diseased wood. Cut a twig lengthwise and see how far down the stem and how deep into the wood the disease extends.

16. *Oral and Written Composition.* — To prepare a good report on some of the preceding projects will be a fine composition exercise. It should usually be possible to show illustrative specimens to your audience (school or class) as you present the report, and in that way make it more instructive. These themes are especially suitable:

- a. *A study of molds.* — Project No. 2.
- b. *Infection by bacteria.* — Nos. 3 and 4.
- c. *Plant diseases of this region.* — Nos. 6 and 7.
- d. *How to kill fungi.* — No. 9.
- e. *Rust and its prevalence.* — No. 10.
- f. *Smut and its prevention.* — No. 11.
- g. *Flax wilt.* — No. 12.
- h. *Mildew.* — No. 13.
- i. *Potato scab.* — No. 14.
- j. *Fire-blight.* — No. 15.

CHAPTER XV

IMPORTANCE AND CHARACTERISTICS OF INSECTS

WHY INSECTS ARE IMPORTANT

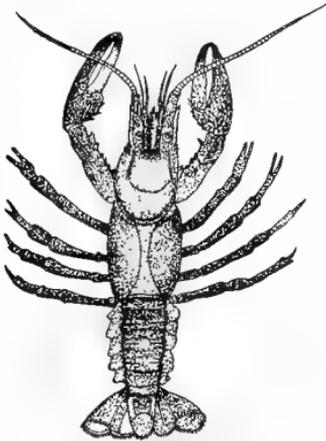
Damage Done. — There are about us on every hand — on the ground and on plants, in the air and in the water — numberless insects that are usually thought unworthy of serious notice. But our food supply often depends upon the presence or absence of some species of these tiny creatures. Practically all plants cultivated by farmers and gardeners are subject to insect attack. The potato beetle, chinchbug, Hessian fly, and grasshopper are familiar crop pests. The total damage to vegetation each year in the United States from insects has been estimated at \$700,000,000 to \$800,000,000.

It is often necessary for us to combat these foes of vegetation, and to do this intelligently requires a knowledge of their nature and habits. We should therefore consider it worth while to learn something about this branch of the animal kingdom.

Their Numbers. — The number and variety of insects is enormous. More than 300,000 species have already been named by specialists. No one person could ever become acquainted with all of these. If he studied ten new species every day, and worked 300 days a year, it would take him 100 years to go over all of them just once. But it is estimated that these 300,000 include only a fifth or possibly only a tenth of those living through the world. About 95 per cent of all the species of animals are insects. Moreover,

in many cases a single species numbers myriads of individuals. Certain kinds, as the grasshoppers, sometimes travel in such swarms as to darken the sky.

Their Rapid Increase. — Insects multiply at an enormous rate, and it is thought that they might often become so numerous as to devour every green thing in sight if they were not kept in check. The principal agency that nature has provided for keeping the numbers within limits is the birds that feed upon them. Our northern winters are also very unfavorable to insect life.



A CRAYFISH

Its shell is the only skeleton it has.

and their relatives, the skeleton is external; that is, it is on the outside of the body instead of lying within and being covered with flesh, as in the case of higher animals. This arrangement of the skeleton may be more easily seen in the common crayfish and the lobster, whose body is formed on the same plan as an insect's.

Parts of the Body. — The body of an insect consists of three distinct parts: head, thorax, and abdomen. In the wasp these parts are seen very clearly. Observe how

WHAT AN INSECT IS

To help us distinguish insects from other small animals let us note carefully their chief characteristics as given in the following paragraphs.

External Skeleton. — In insects

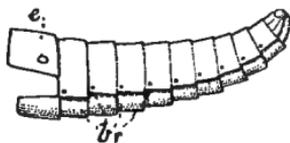


WASP

With head, thorax, and abdomen separated; *t*, thorax; *a*, abdomen.

different this is from the body of the higher animals, as a bird or a quadruped or the human being, where no sharp dividing line between the thorax or chest and the abdomen can be seen from without. Insects have six legs, and this feature distinguishes them from their relatives, the spiders, which have eight legs, and the centipedes and millipeds, which have a great many legs. An insect also has a pair of feelers and usually one or two pairs of wings. The feelers are attached to the head, and the legs and wings to the thorax.

Breathing. — Insects have no lungs but breathe air by means of a system of tubes which extend through the body and open at the surface for the admission of air. In large insects like the grasshopper a row of these openings may be easily seen along each side of the body.



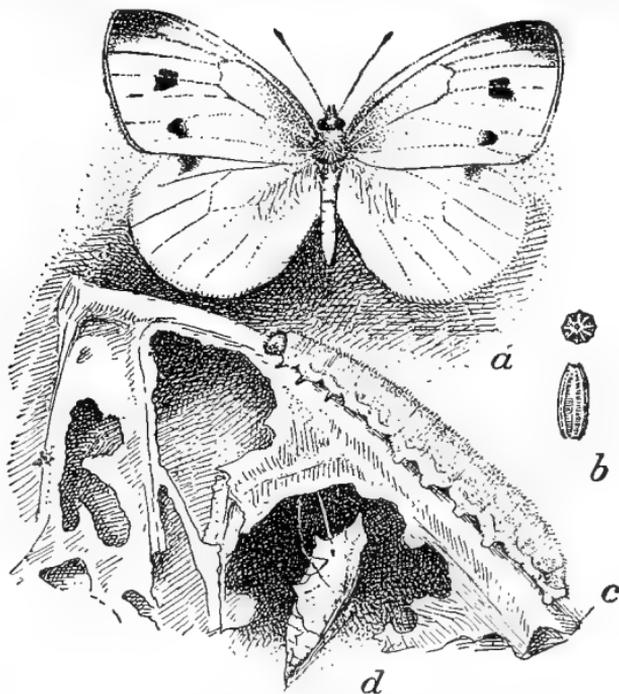
ABDOMINAL PART OF GRASSHOPPER

br, breathing pore; *e*, ear.

CHAPTER XVI

THE LIFE HISTORY OF INSECTS

One of the most interesting things about insects is their life history. Most of them during the period of their exist-



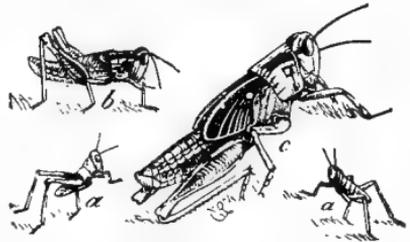
COMMON CABBAGE WORM

a, Female butterfly; *b*, egg, enlarged, — end view above and side view below; *c*, larva on cabbage leaf; *d*, suspended chrysalis.

ence pass through a number of changes that have no parallel in the life of higher animals. The appearance and habits

of an insect in one stage of its life may have no resemblance to its appearance and habits in another stage, and we may think that we have two distinct species. If we look at a caterpillar, for example, we can hardly believe that it will soon be a beautiful butterfly.

Egg, Larva, Pupa, and Adult. — Practically all insects lay eggs, and with those the next generation begins. The development of the young after hatching varies somewhat, but the complete series of changes as seen in flies, beetles, moths, and butterflies is as follows: (a) The eggs are laid by the adult on the plants, in the ground, or in the water where the young are to live and where they will find food. (b) The larva is the young hatched from the egg, and is called a caterpillar in the case of moths and butterflies, a maggot in the case of flies, and a grub in the case of beetles, bees, and wasps.



EARLY STAGES OF ROCKY MOUNTAIN LOCUST

Showing development of wings in *b* and *c*. The mature insect with full-grown wings is not shown.

Larvæ (the plural of larva) are worm-like in form, and they are often incorrectly called "worms." (c) The pupa. In due time the larva becomes entirely dormant or inactive, and while in this state it is usually inclosed in a case which affords protection against injury. During this period the animal undergoes great internal changes and when the adult comes forth it looks like an entirely different animal.

Simpler Changes. — In some insects, as the grasshopper, the young resemble the parent, but they are wingless, or they may differ in some other particular. These do not pass through the pupa state, but as they grow in size the wings

or other features gradually develop. It is very rare indeed for the young to have quite the same form as the adult, as is the case in higher animals.

Molting. — The outside of the insect is a comparatively hard, tough substance, and corresponds to the skeleton which the higher animals have internally. This skin or shell does not stretch much, and as the animal grows it soon becomes too small; in due time another skin forms underneath, and finally the old one splits open and comes off. This process is called molting. Some insects molt only three or four times during their growth, while others shed their skin twenty times or more before they attain their full size.



CAST-OFF
SKIN OF
YOUNG
LOCUST

The Adult. — The following facts about adult insects are of interest :

(a) The large majority of insects in this state have wings, though there are many exceptions.

(b) An insect never grows after it has reached this stage. Small flies, for example, do not grow into large flies. The adult insect therefore does not molt.

(c) Many adults eat more or less, but only to sustain life, not to grow. Indeed, some of them take very little food, while certain ones have no mouth parts at all. In some classes of insects, however, as in the grasshoppers and potato beetles, the adults as well as the young are ravenous eaters.

(d) The adult stage usually lasts a shorter time than the larva stage. In fact, the usual plan is that the mature insect shall live only long enough to lay eggs and thus secure the perpetuation of the species. Counting the whole period from the laying of the egg to the death of the adult, a year

is about the limit of an insect's span of life. There are, of course, many exceptions. For example, honey-bee queens live about three years, though the workers live only from five to seven weeks. The seventeen-year cicadas or "locusts" live in the larva state the greater part of seventeen years, and as adults only about a month. Mayflies live two or three years in the larva state, but as adults only a few hours or, at most, a few days; upon arriving at the adult state they immediately lay eggs and die.

How Insects Pass the Winter. — In cold countries it is of greatest importance to small animals that they should have some method by which they can successfully live through the winter. Besides escaping the enemies that are liable to attack them at all seasons, it is now necessary that they should be able to endure a freezing temperature for a long period of time. The different species of insects pass the winter in different stages of their life, — some of them (as the flies and potato beetles) in the adult state; others (as most moths and butterflies) in the pupa state; and still others, in the larva state. But the greater number of insects die in the fall, leaving eggs to perpetuate the species. These eggs are laid in the ground, as in case of grasshoppers, under the bark of trees in case of those that live upon the foliage, or in the water if the larvæ are to live there. Usually a given species follows either one or another of these methods, but in some instances the same species may hibernate in two or more of these conditions. A large proportion of every kind of insects perish during the winter, no matter in which stage of their life they attempt to live through this season.

If a search be made for insects toward the end of autumn, it will be found that they have become scarce. This is what has happened:

(a) Many have died of old age, one season being the natural period of their existence.

(b) The birds have been feeding upon them all summer and have consumed immense numbers of them.

(c) The rest have sought shelter in the ground, under leaves, grasses, and rubbish, in crevices of buildings, and elsewhere. Some of them will hibernate successfully in these places, and the rest will never wake up again.

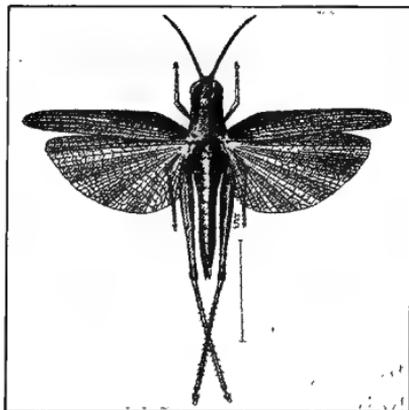
CHAPTER XVII

THE MOST IMPORTANT CLASSES OF INSECTS

If we wish to study insects, it is necessary to arrange them in groups, for it would be entirely impossible to consider separately more than a very small fraction of the various species. The classification of insects is based chiefly on the number and structure of the wings of the adults, though other things are also taken into account. The structure of the mouth, for example, is quite important because that determines the feeding habits of the creature. When the mouth parts are formed for biting, the insect may eat vegetation and other solid food, but if they are formed for sucking, then it must live upon the juices of plants or the blood of animals.

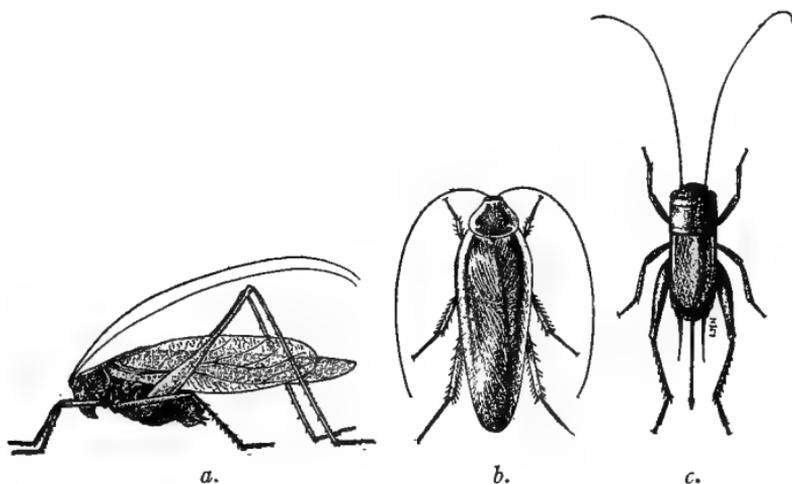
There are many other classes of insects besides the six orders which we shall describe here, but these are the largest, the most important, and the best known. We shall pay particular attention to the life history of each kind described.

Grasshoppers, Katydid, Crickets, and Cockroaches. — These have two pairs of wings, the front pair being thickened and lying flat upon the insect's back. The hind pair are



COMMON RED-LEGGED GRASSHOPPER
Showing unfolded wings.

thinner, and when not in use are folded underneath the others like a fan. The mouth is made for biting. These creatures are great eaters all their lives, the grasshoppers being very destructive to vegetation. Certain locusts or short-horned grasshoppers are a much-dreaded insect plague in various parts of the world, and in regions that are subject to their ravages it is sometimes almost impossible to carry on agri-



a, KATYDID; *b*, COCKROACH; *c*, CRICKET

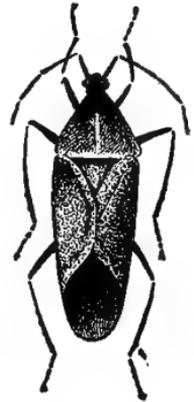
culture, as they may devour every blade of vegetation within their reach.

Grasshoppers lay their eggs in masses of 20 to 100 in the ground where they remain over the winter and hatch in the spring. The young resemble the parent, but are smaller and wingless.

Bugs, Lice, and Plant Lice suck the blood of animals or the sap of plants, and most of them are quite harmful to their victims. Some of them have four wings and others have none at all. The most important group belonging to

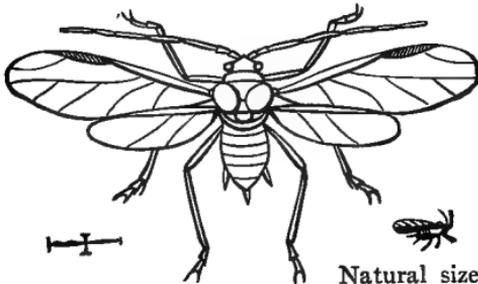
this order is the plant lice. They have a life history that is quite unusual. During the summer they are born alive like higher animals and in this way multiply with great rapidity, but in the fall a few eggs are laid that are preserved over the winter and from these the next summer's crop starts. They are minute creatures which live by sucking the sap from the leaves and tender stems, and thus they reduce the vitality of the plants and sometimes kill them. They are usually found in flocks huddled close together. Some have wings and others are wingless.

To this order also belong the famous 17-year locusts. It is remarkable that only this one species of the 300,000 or more should live so long, while all the others live from only a few days to not more than three years — comparatively few species more than a year. The larval stage, which is spent underground, usually lasts 16 years, and in the spring



SQUASH BUG
(Magnified.)

An example of a true bug.



Adult winged female.

Natural size.



Wingless larval female.

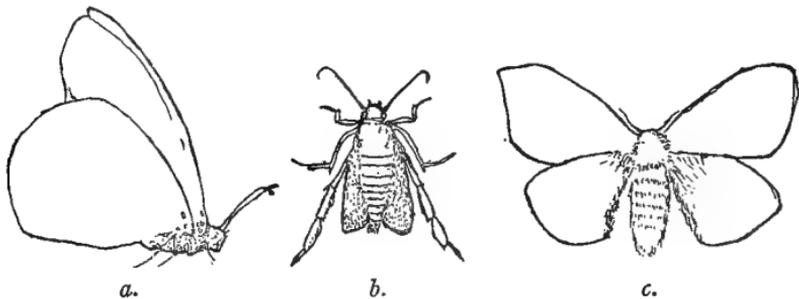
PLANT LICE

or early summer of the 17th year the creatures come to the surface and change to the adult form. Soon these adults lay their eggs, and the young, after hatching, burrow in the

ground and remain out of sight the next 16 years. In the southern states the warmer temperature hastens the development, and the life cycle is completed in thirteen years instead of seventeen.

Other well-known pests belonging to this class are the true bugs (the chinch bug, squash bug, and bed bug) and the several kinds of lice that live as parasites on man and other mammals and suck their blood. But *bird lice*, common on poultry and other birds, are quite different. These have mouth parts for biting and eat the feathers, hair, or skin of their victim.

Butterflies and Moths. — This class of insects is distinguished by the fine, overlapping scales which cover the four



RESTING POSITION

a, Butterfly; *b*, Moth with wings folded around the body; *c*, Moth with wings held straight out from sides.

wings. These scales appear like powder when they come off on our fingers as we touch the insect. The mouth parts of the adults are formed for sucking, but the larvæ eat solid food. Many of the moths are usually called “millers,” especially those that fly about lights at night.

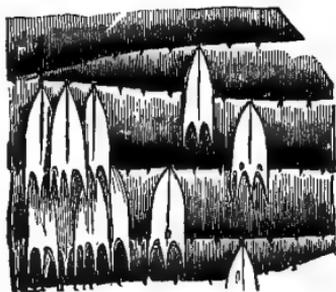
Moths and butterflies are distinguished from each other as follows:

(a) Butterflies usually fly in the daytime; moths in the evening and at night.

(b) When at rest, the wings of a butterfly meet over its back in a vertical position; the wings of a moth are spread out horizontally or are wrapped around the body.

(c) The feelers of a butterfly are thread-like and are thickened at the end. The feelers of the moth are formed like a feather or they are thread-like and pointed.

(d) The pupa of a moth is inclosed in a silken cocoon; that of a butterfly is in a chrysalis, which is a thin, hard shell and is most commonly of a brown color with golden yellow marks upon it.



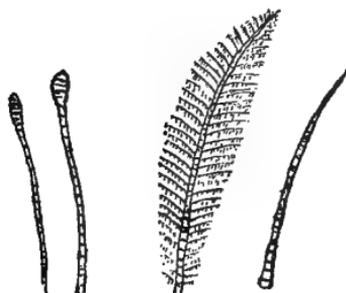
PIECE OF A BUTTERFLY'S WING
SHOWING SOME SCALES

The life history of moths and butterflies furnishes a fine example of the complete series of changes in insect develop-

ment. The eggs are laid on all kinds of plants and hatch in from twelve to fifteen days. The larvæ, called caterpillars, eat ravenously, grow fast, molt several times, and in the latter part of the summer change to the pupa state. This pupa, found in the cocoon of the moth and in the chrysalis of a butterfly, lives over the winter and in the spring the adult comes forth from it. A

few species, as the Isabella tiger-moth, pass the winter in the larval state.

Caterpillars vary greatly in size and appearance, but are



a. b.

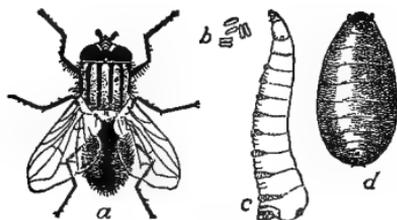
FEELERS

a, Butterflies; b, Moths.

wormlike in form and are usually provided with from 8 to 16 legs. They are of various colors, and some are covered with thick, short hair, while others are perfectly smooth. All caterpillars are great eaters and are destructive to vegetation. Some of our worst insect pests, such as cut worms, army worms, and measuring worms, are caterpillars. The adult moths and butterflies, however, are harmless. They can partake of no nourishment but a little nectar which they suck from flowers.

There are more than 6000 species of moths and butterflies known to occur in America north of our Mexican boundary.

Flies and Mosquitoes. — This class of insects is easily distinguished by the fact that they have only two wings.



LIFE HISTORY OF THE HOUSE FLY

a, Adult; *b*, Eggs; *c*, The larva or grub stage; *d*, The pupa.

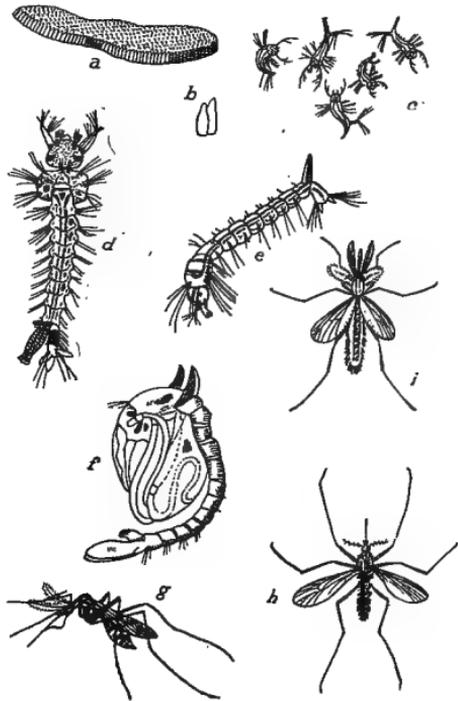
The mouth parts are formed for sucking. There are said to be about 8000 species of flies in North America, but as the house fly is the commonest and most important, we shall confine our attention to that.

House flies lay their eggs in all kinds of filth, most commonly horse manure, where the larva and pupa stages are to be spent. The eggs hatch in 24 hours or less. The larvæ, called maggots, are yellowish white in color and are footless. In a week's time they enter the pupa state, and in less than another week the full-grown flies appear. The females begin laying eggs in from nine to fourteen days after this. The length of all these periods varies with the temperature and other conditions, but generally the time from egg production by one generation to egg production by the next generation ranges from 16 to 25 days, and there may be

eight to ten generations or even more in a season. Most of the adults of each generation probably die in a few days or a few weeks after eggs are laid, but some of those produced in the fall live over the winter in quarters that are warm enough to keep them more or less active. The few females that survive in this way lay the eggs in the spring for the season's first brood.

Mosquitoes lay their eggs in a boat-shaped mass on the water. The larvæ, called wrigglers, hatch out in a few days. When at rest, they are at the surface of the water, head downward, to get air, as the opening to the breathing tubes is situated near the end of the abdomen. The pupa, which is but slightly different from the larva, lives for only about two days, then comes to the surface of the water, the skin bursts open, and the adult appears. This new creature is not able to live in the water as his

former self could an hour before, and as he sits upon the cast-off skin to dry his wings, he is apt to topple over into the water and perish. We are inclined to wish that the whole race might be shipwrecked some stormy day.

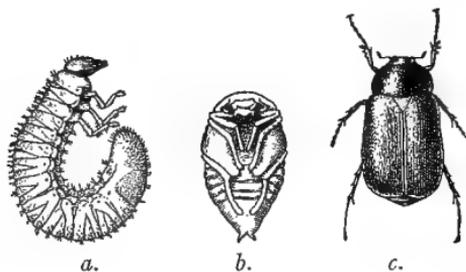


LIFE HISTORY OF THE MOSQUITO

a, Raft of eggs; *b*, Eggs enlarged; *c*, Larvæ or wrigglers; *d* and *e* are larvæ enlarged; *f*, Pupa; *g* and *h* are females; *i* is a male.

Beetles. — This class of insects has stiff wing covers which meet in a straight line down the back when folded, and are curved to make a snug fit over the body. Beneath these there is a pair of fine membranous wings. The mouth parts are formed for biting. Beetles live in all sorts of places — in the air or in water, on the surface of the ground or in the ground, and on vegetation. The eggs are laid in the place

where the larvæ are to live. These are worm-like creatures and are called grubs or grub-worms, a familiar example being the fat, white grub used for fishing bait. The pupæ are usually found in a sort of rude cocoon made of earth or bits of roots fastened together. While in this



MAY BEETLE AND WHITE GRUB

a, Larva or grub; *b*, pupa (under side);
c, beetle.

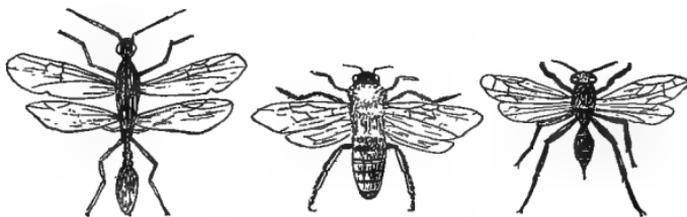
state, the insect is transformed into a full-fledged beetle.

There are more than 11,000 species of beetles. The adults as well as the larvæ vary greatly in size and in habits. Some of them are beneficial to man, but others do much damage, as, for example, the potato beetle, the cucumber beetle, the wire-worm beetles, and the wood-boring beetles whose grubs infest the stems of trees.

Bees, Wasps, and Ants have four very thin membranous wings, the hind pair being smaller than the front pair. Many of the insects of this class are highly beneficial. As they are fond of sweets they abound wherever flowers bloom and some plants are absolutely dependent upon them to bring about pollination and the formation of seeds. Moreover, among these insects we may find the most wonderful development

of instinct, and on this account they have always been a favorite subject for observation and study.

A good example is the honeybee. It lives in colonies, as so many species of this class do, and shows remarkable intelligence in the organization of the swarm and the pursuit of its industry. A study of the special duties of the



a. ANT WITH WINGS; *b.* BEE; *c.* WASP

queen, the workers, and the drones is very interesting, and we regret that we cannot give time to it here. The eggs are laid by the queen who, during the height of the season, has been known to produce as many as 3000 in a single day. They develop according to the typical method, the egg being followed by the larva, then by the dormant pupa, and finally the winged adult appears.

CHAPTER XVIII

SOME INSECT PESTS OF GARDEN AND FIELD

There are said to be about six hundred different species of insects that are more or less injurious to vegetation, and it is fortunate that they are not all found in one section. Those that are most common in any locality are the ones that should be selected for most careful observation. To assist in this work we briefly describe a few of the most important kinds that the student is apt to meet.

As these studies are to help us cope with insect pests more intelligently, and as frequent reference is made to poisons and sprays, let us first explain the principle that determines our procedure with these remedies.

Insect Poisons and Sprays. — When our potato patches, fruit trees, vegetables, or flowers are infested with insects, we usually spray them. To do this intelligently we must know whether the species is one that chews its food or sucks the sap of plants. Potato beetles and cabbage worms, for example, eat the leaves, and we may kill them by putting poison on their food. It is generally applied in a liquid form by spraying or sprinkling. Paris green has long been the standard remedy for this purpose, but arsenate of lead is also used extensively and is to be preferred for some purposes. For currant worms hellebore is commonly employed.

Plant lice are an example of sucking insects, and these are killed by spraying them with a contact remedy — one that kills when it gets on their bodies. Some of the remedies

used for this purpose act as a poison, and others are oily and soapy mixtures that stop up the breathing pores of the insects and smother them. Kerosene emulsion is one of the commonest remedies of this class and is made of soap suds and kerosene. Tobacco, another remedy, is used either by smoking the infested plants with it or by steeping it in water and using the liquid as a spray.

There are many other preparations sold by dealers, but each serves either to poison the food or to kill the insects by coming in contact with them.

The Colorado Potato Beetle. — This is often popularly called the “potato bug,” but the hard wing covers of the



THE COLORADO POTATO BEETLE AND ITS DEVELOPMENT

a, eggs; *b*, larvæ; *c*, pupa (underground); *d*, adult; *e*, wing cover; *f*, leg.

adult easily show us that it is a typical beetle. The adults are about half an inch in length, of a yellowish color, with ten black marks on the wing covers. These insects pass the winter as adults underground, and it would be easy to con-

trol them if every one in the neighborhood would spray his potato vines with Paris green for the first week or two after they come up in the spring. If this is not done, the "bugs" soon become very numerous, for each female lays from 500 to 1000 eggs, and there are from two to four broods a season. The eggs are deposited in clusters on the under side of the leaf of the newly started potato. They usually hatch in a few days into small brick-red grubs with black marks, and grow lighter in color as they increase in size. They devour the potato vines at a rapid rate and grow so fast that their skin becomes too small every four or five days, and they molt about five times during the three weeks that they take to complete the larval growth. Then they crawl into the ground and change to the pupa state. In ten or twelve days the adult is fully formed and comes forth to eat and to lay eggs for another generation.

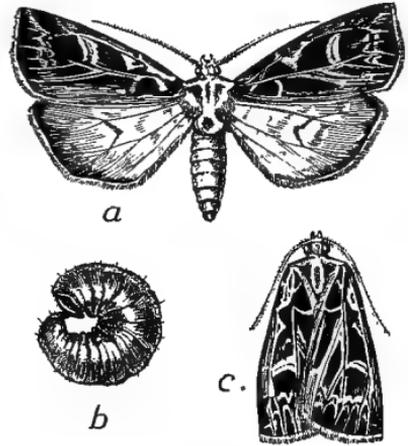
As both the adults and the larvæ eat the plants they may all be destroyed by applying Paris green or some other suitable poison.

The Cabbage Worm is the caterpillar of the cabbage butterfly, our commonest white butterfly, which may be seen flying about during the whole summer, and in the egg-laying season large numbers are sometimes found in the cabbage patch. The eggs are placed on the leaves of cabbage, cauliflower, and nasturtiums. The dark green caterpillars eat ravenously and do much damage. The remedy in case of cabbages and nasturtiums is to spray them with Paris green. As the cabbage head grows from within and we reject the outer leaves, there is no danger that the poison may harm us.

Cutworms cut off tender plants at the surface of the earth. They do this mischief at night, and whenever we see a plant in the morning thus destroyed we may usually find the cul-

pruit by scraping the loose earth away from around the roots. Plants may generally be protected from cutworms by folding a piece of stiff paper around the stem so that it will reach an inch into the ground and two or three inches above the surface.

Cutworms are the caterpillars of various species of moths that lay their eggs on plants near the ground during the latter part of the summer. The young at first feed upon the roots of grasses and other plants, but the tender seedlings of the garden and the field seem to please their appetite better.



DINGY CUTWORM

a, moth; *b*, larva or worm; *c*, moth with wings folded.

The Striped Cucumber

Beetle is a small, flat-bodied, greenish yellow beetle with two black stripes upon each wing cover. The adult feeds on the leaves of cucumbers, melons, squashes, and pumpkins, being especially injurious to cucumbers. It appears on the vines soon after they are up and at once devours them unless the attack is prevented. As the usual insect poisons are apt to injure these plants, the most effective way to protect them is to cover them while young with netting. If there are too many plants for this treatment, then coal ashes, or lime mixed with powdered charcoal or fine dust, may be sifted on the leaves while they are wet with dew or rain.



STRIPED CUCUMBER BEETLE
Enlarged.

The eggs of this little pest are laid about the roots of these plants. The larvæ, which are slender, white grubs with brownish heads, feed upon the roots and the underground part of the stems. There are two or three generations during the season. The insect hibernates in the pupa stage.

Plant Lice are among the commonest and most harmful insect pests. They occur in dense colonies on almost every



COLONY OF PLANT LICE
On the plum.

kind of plant, from the tenderest annuals to large trees, and are often very destructive, sucking the sap from the foliage and tender stems and thus weakening the plant. Some species even attack the roots. They are very tiny creatures and there are many kinds. Some are green and others are dark-colored. Some of them cause the leaves to curl up and form an inclosure in which they live. There is one species that attacks the cottonwood and forms for itself a peculiar house on the twisted leafstalk.

Many kinds of plant lice produce a sweetish fluid called honey-dew. This may often be seen on the leaves, and harms their appearance and attracts ants that feed upon it.

The remedy for plant lice is to spray them with some preparation that kills by coming in contact with the body. House plants that can be properly inclosed for the purpose may be fumigated with tobacco smoke.

The Currant Worm. — The adults are saw-flies about the size of house flies, but they have four wings and are related to the bees. They may be found about the time the currant leaves appear in the spring, and a few days later the white eggs are placed end to end along the veins on the under side of the leaves. The green “worms” that devour the foliage



CURRENT WORMS

Eggs on leaf; larvæ eating; adult fly.

are the larvæ that hatch out from these eggs. After a while these larvæ drop to the ground, and make their cocoons under dead leaves or just beneath the surface of the soil. In a few weeks the second generation of flies begin to lay eggs on the bushes and soon a second brood of worms attack the leaves. In due time these larvæ form cocoons under the

bushes the same as the first brood, and after passing the winter in that condition appear as adults the next spring to repeat the history.

The usual remedy is to spray the foliage with hellebore, applying it as soon as the worms begin to hatch out.

Measuring Worms or canker worms are familiar pests that devour the foliage of shade trees and fruit trees. They

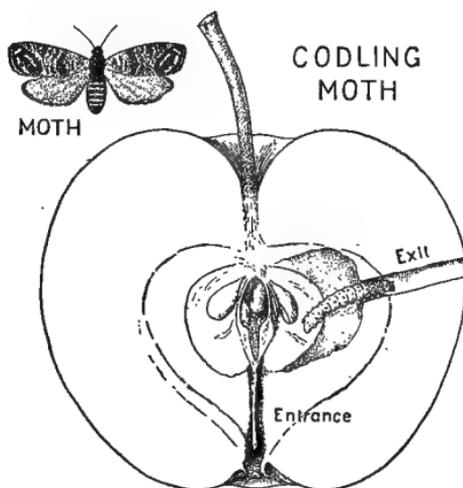


are called measuring worms on account of their peculiar mode of walking. They seem to measure off the distance in inches. These creatures are caterpillars — the larvæ of a moth. The adult female is wingless, but the male has wings like other moths. At the close of the eating season in summer the “worms” lower themselves to the ground by spinning a silken thread. Then they burrow in the ground a few inches and are changed into pupæ, and later into the adult forms.

SPRING CANKER
WORM OR MEAS-
URING WORM

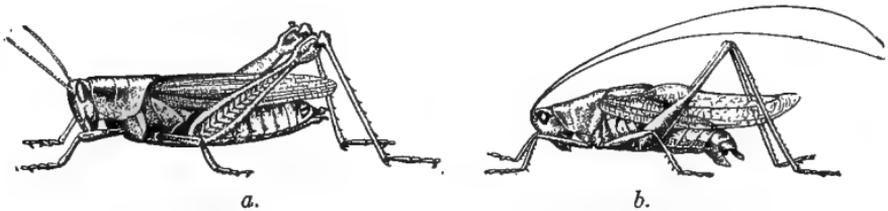
Early in the spring they come forth and return to the tree, the female being obliged to crawl up the trunk as she has no wings. There she soon lays her eggs, and by the time the leaves appear the young measuring worms are ready for the feast. If all this did not take place before the arrival of the birds they would prevent it. As it is, our few winter birds, especially the chickadees, do their best, and eat great quantities of the female moths and the eggs. It is easy, however, for a person to prevent the moths from climbing the trees by painting a band of coal tar and oil around the trunks at the close of winter, before the ascent of the tree by the female is begun.

The **Codling Moth** does much damage wherever apple-growing is an important industry, the annual loss caused in such states as New York, Ohio, and Illinois ranging from one to two million dollars and sometimes even more. This small, dark-gray moth lays her eggs in the spring on the surface of the young apple a week or ten days after the petals have fallen. A female has been known to lay as many as 85 eggs, usually one to an apple so that she may ruin a great many. As soon as the larvæ are hatched, they enter the young apple at the calyx, eat their way to the core, complete their growth in two or three weeks, and then eat their way out through the sides of the apple. They then crawl to the trunk of the tree and make their cocoons under the bark. In warm weather these complete their transformation in two or three weeks, and the adults come forth to start another brood on the late apples. We find some of these later larvæ in the fruit when we cut it; but some of them safely pass the winter in the orchard and then attack the next year's crop.



The treatment for the codling moth is to spray the tree in the spring just after the petals have fallen and before the calyx has closed. The larva then gets his medicine when he starts to enter the apple. Birds and beetles are the natural enemies of the moth.

Grasshoppers. — There are numerous species of grasshoppers and many of them are very destructive to vegetation. Early settlers of Minnesota, the Dakotas, and Nebraska still tell us how the Rocky Mountain grasshoppers or locusts devastated this entire region repeatedly between the years 1875 and 1880, devouring every green thing to be found. They came in the first place in great swarms from the eastern foothills of the Rocky Mountains. Smaller numbers have arrived once or twice in more recent years. The annual damage to our meadows and pastures from our common



GRASSHOPPERS

a, a locust or short-horned grasshopper; *b*, common meadow grasshopper or true grasshopper.

species, like the red-legged grasshopper, must be very large, though it is hard to estimate, as they generally eat only a portion of the plants which they attack.

There are two families of grasshoppers, the short-horned and the long-horned. The former, properly called locusts, have feelers that are much shorter than the body; in the second family the feelers are longer than the body and very slender. They are called meadow grasshoppers. The katydids belong to the same family and have similar antennæ, but they are larger insects. The crickets are closely related to the grasshoppers and have the same sort of powerful hind legs for jumping. They have long feelers like the meadow grasshoppers and katydids.

The grasshoppers are favorite specimens for the study of insect structure. With a strong magnifying lens we can see the appearance of the compound eye and may notice that the insect also has three simple eyes, one "right in the middle of his forehead," and one near each of the larger eyes. This arrangement enables him to see in all directions without turning his head; but even then the meadow lark gets him. Another feature clearly distinguished in grasshoppers is the three parts of the insect: the head with the mouth parts, feelers, and eyes; the thorax bearing the legs and wings; and the abdomen, which is the ringed portion. On each side of the abdomen may be seen a row of breathing holes looking like minute pin holes. These are the openings of the animal's breathing tubes.

The Chinch Bug is easily one of the most injurious insects of the Mississippi Valley. It is estimated that the loss it causes to our grain crops will average \$20,000,000 a year. Wheat is the principal crop attacked, but oats, rye, barley, and corn are also infested. After the small grains are ripe, great swarms of these creatures migrate to the corn fields if any are to be found.

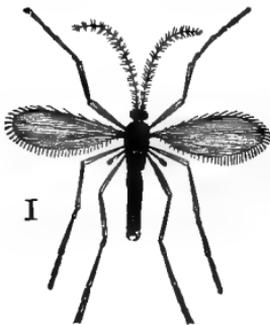


CHINCH BUG
Magnified.

They pass the winter in the adult stage under dead leaves, grass, and rubbish, and in the spring these adults lay eggs on the base of the plants to be attacked by the young. Usually there are not enough of these adults to do much harm, but as each female lays about 500 eggs, and as there are two broods during the summer, the fields often swarm with them in the latter part of the season.

The Hessian Fly is a serious wheat pest, being most destructive in winter wheat growing districts. It causes enormous losses some years, running into many millions of dollars

in the central states. In the spring wheat section the adults begin their campaign in May by laying their eggs on the young plants. The larvæ, which appear soon after, work their way in between the leaf and the young stalk, feed upon the sap three or four weeks, and then change into the pupa state. If very numerous, the plants become weak and sickly. In a few days the second brood of adults appears and soon these



HESSIAN FLY
Magnified.

lay their eggs, each brood being more numerous than the one before. The infested stalks break or bend over just above the second joint where the insects have been feeding, and the heads, which contain very little grain, are lost.

The adult Hessian fly has two wings and looks like a very small mosquito; the pupæ look like flax seeds but are smaller and narrower; the larvæ are white. The insects pass the winter in the stubble in

the pupa state, and therefore the remedy is to plow or burn all the stubble in the fall or very early in the spring. A few acres of infested stubble are sufficient to supply a large section with the pest the next season. In winter wheat sections the above history is somewhat different, as the insects make their first attack in the fall after the grain is up.

CHAPTER XIX

OTHER INSECTS OF SPECIAL INTEREST

Flies are the commonest insects we have, there being hundreds of different kinds of them. Tiny flies and gnats never grow larger, but all the different sizes and forms that we see are different species. Besides the house fly we may mention the stable fly, which we often see in great numbers around horses and cattle. It resembles the house fly, but it bites quite viciously, while the house fly does not. The blow fly or bluebottle fly is another kind that is of special interest. If we put a piece of fresh meat or fish where these flies can get at it, they are apt to lay masses of their whitish yellow eggs upon it.

But of all the different species the common house fly is by far the most important, and we must therefore consider it at greater length. Until recently most people have regarded house flies as merely a nuisance, but we have now learned that they are a constant menace to health. They may walk through any filth in the neighborhood and the next minute wipe their feet on the food we are about to eat and spread upon it not only filth but also the germs of typhoid fever, consumption, and other diseases. We have therefore adopted the slogan, "Swat the Fly," and practice it with more or less diligence in our homes, but it is easier as well as wiser to prevent their multiplication than to kill the flies after they are produced.

Only very few flies live through the winter, and when these

appear in the spring they should be destroyed wherever found, and the multiplication of the rest should be prevented by keeping the premises free from slop piles, barnyard manure, and other possible breeding places. In this way remarkable results have already been achieved, for in some communities, where the war has been waged persistently, they have been practically exterminated. If we consider the rate of increase, it is easy enough to understand why the flies are so numerous in the latter part of the summer. Starting with a single female fly on April 15, letting her lay 120 eggs, and continuing the multiplication in this manner until fall, we may have eight generations, as follows :

April 15	— 1
May 1	— 120
May 28	— 7200
June 20	— 432,000
July 10	— 25,920,000
July 29	— 1,555,200,000
August 18	— 93,312,000,000
September 10	— 5,558,720,000,000
Total	— 5,653,613,559,321 flies

Of course we cannot expect every fly to reproduce in this way without fail, nor can we be sure that none shall be destroyed, as here assumed, but on the other hand we have given each female credit for only 120 eggs, while she may lay many hundreds in her lifetime.¹

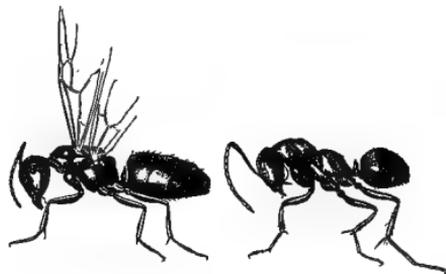
Ants have long been a favorite subject for the study of animal intelligence. They belong to the same order as bees and wasps, have the same remarkable powers of instinct,

¹ F. L. Washburn, State Entomologist of Minnesota, gives a much higher estimate of the possible offspring of one fly in a season. His figures are 214,557,844,320,000,000,000,000. See his circular No. 26, 1913.

and it is usually far more convenient to observe them. There are many kinds of ants, differing more or less in appearance and in habits, but all of them are social beings, living together in colonies like ordinary bees and wasps.

Each colony of ants, like those of the honeybees, consists of three classes of individuals: males, females or queens, and workers. The workers are by far the most numerous. They are wingless, while the males and females have wings and use them especially for their wedding journey. After this flight is over, the males soon die and the females tear off their own wings and lay their eggs, starting a new colony or being adopted by another colony.

The eggs of ants are so small that they usually escape notice. What are often called "eggs" are the cocoons; these are the whitish egg-shaped bodies that may



BLACK ANTS

The one at the left is in the winged stage.

be seen when we stir up an ant's nest. The larvæ are whitish also, but are readily distinguished from the cocoons, as they are smaller and are not motionless.

The workers are the most interesting. They do all the work and show wonderful intelligence—building and defending the nest, feeding the colony, caring for the eggs, the larvæ, and the cocoons, and showing the most tender devotion to the queen or mother. But the most wonderful of all is their relation to plant lice. As ants are fond of sweets and like to feed upon the honey-dew given off by plant lice, they often secure a colony of these lice and keep them and care for them as we do a herd of milch cows.

Silkworm Moths. — Our largest and most beautiful moths are the giant silkworm moths, which are closely related to the Chinese species that produces silk. From the study of these native moths we can get a good idea of the habits of the domesticated varieties that are employed in silk-producing countries.

We have various species of these silkworm moths, the largest and handsomest being the *cecropia* and the *poly-*



THE CECROPIA MOTH

phemus, one of which is shown in our picture. They measure five or six inches from tip to tip of wing. The general color of the polyphemus is yellowish brown, and of the cecropia a darker or dusky brown; both of them are beautifully marked with other colors. The body is thick and plump and quite hairy, and their feelers have the form of feathers.

The caterpillars may be found feeding upon the foliage

of shade trees and fruit trees. They change their color almost every time they change their skin, but when full grown (about three inches long) they are green and have many bright colored warts and bristles upon them. The two species differ in the details of these markings, so that they can easily be distinguished by the aid of some of the books devoted to the subject of moths and butterflies.

The cocoons of these moths may be found in the fall and winter, put into a box with a wire netting cover, and kept in a cool place until spring. In a warm room the moths are apt to perish or else come out before the proper time. When it is thought that they may come forth, they should be placed where they can be watched carefully, for the process is a very interesting sight. A scraping sound within gives warning of the coming event.

It is also a good plan to cut open one of the cocoons, being very careful not to hurt the inmate. Take it out and place it in a wide-mouthed bottle or fruit jar and watch for the change from pupa to adult. As the creature is much safer in the cocoon than out of it, this operation should be postponed until it is thought to be nearly time for the adult to appear.

It is easy to see that the cocoon affords protection from cold and dampness as well as from birds and other possible sources of danger. Notice the fine silk threads of which it is made. The polyphemus cocoon furnishes 800 feet of good silk thread when softened and unwound, and a very handsome and desirable silk cloth may be made from it. The only reason that these moths are not regularly employed for this purpose is that they are not so easily cared for as the Chinese species, which has been domesticated for many centuries.

Dragon Flies or darning-needles always attract our attention on account of their long, slender body, their four long, narrow, gauzy wings always spread out horizontally, and their large bulging eyes. They are excellent fliers and spend much of their time on the wing in pursuit of insects of which they devour large numbers. It is for this

reason that the name dragon is applied to them and that they are also called mosquito hawks.

The early life of the dragon fly is very interesting. The eggs are laid in the water, where the young live until the adult is ready to appear. There is no separate pupa stage, but the creature is active all the time, preys upon all other insects it can find, and finally, when ready to change to the adult, crawls out of the water, the skin bursts open along the back, and the winged form comes forth.



LIFE HISTORY OF THE DRAGON FLY

The young, wingless insect is seen in the water at *a*, the adult dragon fly is on the wing above the water, and the skin from which the adult escaped is on the plant just above the water.

Galls and Gall Insects.—

We often see on the leaves, stems, and roots of many kinds of plants, peculiar growths or swellings, termed galls or gallnuts. These tell an interesting story of certain insects and their relation to plants. The galls on the stems of goldenrods, at the tips of some

willow twigs, or on the oak (oak apples) are familiar examples. They are caused by small four-winged insects called gall-flies. These lay their eggs in the tissues of the leaf or stem, and when the larva is hatched out and begins to eat, the remarkable growth of the gall also commences. In many species of gallfly the larva changes to pupa and then to adult within the galls, while in other species the full-grown larva leaves the gall and makes these changes afterward.

Plant lice and mites also produce many galls, these being much smaller than the kind made by flies. These smaller galls always have an opening through which the residents may pass in and out, while those formed by gall-flies are closed until the inmates bore the tunnel to make their escape.



GOLDENROD WITH GALL-
NUT

CHAPTER XX

PROJECTS AND QUESTIONS: INSECTS

General Suggestions for Making Observations. — When you find an insect, try to learn such things as these: on what plants does it live? does it injure them? how — by eating the leaves or by sucking the sap? If it is a large biting insect, as the grasshopper, you may see that its mouth parts work side-wise instead of up and down as our jaws do. On the other class of insects you may see the sucking tube, — on moths and butterflies it is very long and when not in use it is rolled up like a watch spring under the mouth.

Notice the color, size, and form of the animal; the wings of the adult, the number and the structure; if there are two pairs, how the front wings compare with the hind wings; notice the mode of flying, of running, or jumping.

The life history: Where and when the eggs are laid; when the young appear; how they look; where they live and what they eat; try to see the molting process; if there is a distinct pupa stage, what is it like; when does the mature insect appear; what are its habits and how long does it live; how and in what stage does this species pass through the winter?

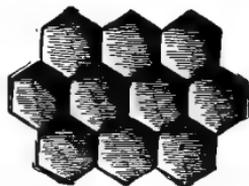
1. *An insect cage.* — For systematic observation of insects and their habits it is almost necessary to have a suitable box or cage in which they can be confined. A chalk box with a glass cover will serve for a small number and for a short time, but something as big as a cracker box is needed for a home in which their life will be more nearly normal.

Construction. — It is well to have the ends and top of wire netting in order to give plenty of air, and one side of glass so the inmates can be easily seen. The top should be on hinges so that specimens can be put in or removed whenever desired.

Furnishing. — The floor may be covered with a good piece of sod several inches thick with the grass closely clipped. Tall plants may be grown at the ends, a fresh plant or two suspended from the top, and a few sprigs thrown on the floor. The plants should be of several varieties, as thistle, goldenrod, and clover, all in blossom, aiming to give the insects something that they may like to eat and to live with. Keep the sod green by watering occasionally; renew the other things frequently.

Into this cage all sorts of specimens are placed, as caterpillars, cocoons, moths, butterflies, beetles, grasshoppers, flies, and ladybugs. All stages should be represented, — eggs, larvæ, pupæ, and adults, — and their habits and transformations observed.

2. *The structure of an insect.* — Catch a few large insects, as grasshoppers or dragon flies, and observe them carefully. Can you distinguish the three parts of the body — head, thorax, and abdomen? To which part are the legs attached? How many legs are there? How many joints have the legs? To which part are the wings attached?



PART OF INSECT'S
COMPOUND EYE

Greatly enlarged.

How many wings has each of your specimens? To which part are the feelers attached? Do they consist of a single piece or are they jointed? Find the row of breathing pores on each side of the grasshopper's abdomen. If you have a good magnifying lens observe the appearance of the compound eyes of the grasshopper or the dragon fly. Find the simple eyes. In the dragon fly they are located in the triangular space between the compound eyes and the projecting front part of the head. The description of the grasshopper on page 219 of this book gives their location for that insect.

3. *Insects in winter.* — Late in autumn, say between the middle of October and the first of November, make an investigation to ascertain what is becoming of the insects. Look for them under stones, boards, leaves, grass, and rubbish. The cocoon of the moth and the chrysalis of the butterfly you will find on bushes and other objects. You should discover a considerable variety of insects in this way. In what con-

dition are they? Have they lined their nests in any way as a protection against cold? Have they made any provision for food over the winter? Do they show signs of life? If some of them are motionless and seem to be dead, keep them for a short time in a warm room and note the results. Make a list of what you find, in each case noting whether it is the larva, pupa, or adult.

4. *Insects and flowers.* — We have learned in another chapter that insects play an important part in carrying pollen from the stamens of flowers to the pistils of the same or other flowers and that without this assistance the seeds or fruits of such plants would often fail to grow. Of course the insects render this service merely by chance, as they are visiting the flowers to get the sweets they contain. Various insects, but especially bees, are fond of the sweets. If there are honeybees in the neighborhood, they will find your blossoms; but at any rate there will be bumblebees and many other sorts of wild bees. These should be regarded as beneficial insects.

Watch your flowers and observe the visits of these insects. Note the different kinds; you may not know their names, but you can describe their appearance. See what they are doing and how they go from one flower to another. Watch especially such blossoms as those of the cucumbers, melons, squash, and pumpkins. They are said to be completely dependent on insects for pollination. At the end of your observations give a full account of them.

5. *The use of sprays and poisons.* — Watch a good gardener while he applies to his plants an insect poison or spray. Find out what the pest is, what remedy he is using, and how he applies it. Is it necessary for the spray to touch the insects, or how does it kill them? Give in your class a good account of the procedure.

6. *Plant lice.* — Find a variety of these on weeds (the marsh elder often has them), willows, rose bushes, sweet peas, plum trees, elms, etc. Some plant lice are green, some red, some almost black. Bring to the class some of them with the leaves that they are on and examine them. Do all the lice on one plant look alike or are there some very tiny ones without wings, others a little larger with the beginnings of wings, and some with quite large wings folded above the body, looking like small flies? How many wings have they? Hold the leaf on a level with the eye and look closely at the head of the animal. You may see the slender sucking tube inserted in the leaf.

7. *The cabbage butterfly*. — With the aid of the description given elsewhere in this book, try to identify this butterfly. If possible find cabbage or cauliflower leaves that are infested with the worms. They will probably also have some eggs upon them. On what part of the leaf are the eggs? Are they single or in masses? Notice how the worms attack the leaf. Put into an insect cage a leaf with some of the worms and watch for the change into the pupa state. How does the pupa look and how does it behave? If it is early in the season, it will change to a butterfly in about ten days. If it is too late, then the change will not take place until spring. Find out from some good gardeners how to treat cabbage and cauliflower for this pest.

8. *Currant worms*. — After the leaves are unfolded on the currant bushes, look for flies that are hovering around them. Catch a few, put them in a glass, and examine them. Are they ordinary flies or do they have four wings? If they have four wings, they are sawflies and are not related to the common flies, but to bees and wasps. Try to find some of their eggs on the leaves, also some tiny green worms that may have hatched out. Bring into the house a green twig with some of these larvæ, put the twig in a glass of water or an insect cage, and watch the insects eat and grow. In a cage you should be able to keep them until all the transformations take place and the adult flies are developed.

In a currant patch verify by observation as far as possible the life history of these insects as given elsewhere in this book. Also try the hellebore treatment as suggested.

9. *A fly trap*. — If you are troubled with many flies, construct a fly trap and place it at the kitchen door or in some other location where they are abundant. A successful device for catching them in large numbers, recommended by the Minnesota Experiment Station, is shown in these pictures. As high as 12,000 flies a day have been caught in one of these traps.

The trap is 24 inches long, 12 inches high, and 8 inches wide. Ordinary wire mosquito screen is used in its construction. The bait in the pan is bread and milk, frequently renewed; spoiling meat will attract still more flies. The flies may be killed by pouring hot water over them.

The trap is made in three sections that are held together by hooks at each end and may be readily taken apart to empty the jail or to refill the bait pans. (See p. 232.)

c, made of screen, serves as the jail.

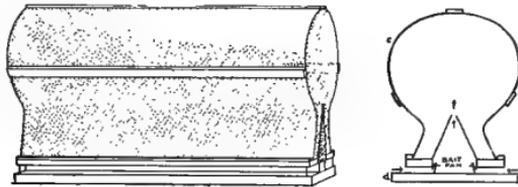
b, the middle part, also made of screen, shaped like the roof of a house, having holes in the peak through which the flies enter the jail.

a, the base, board upon which rest two tin bait pans.

The space between *a* and *b* is $\frac{1}{2}$ inch.

The space between *b* and the bait pan is $\frac{1}{4}$ inch.

10. *War on the house fly*. — Try a season's campaign against flies and see to what extent you can reduce their number. If you live on the farm and have no close neighbors, you can fight the war alone, but in a village or town the coöperation of the whole community must be secured. Some cities as large as Cleveland, Ohio, have conducted such a campaign and report a sweeping victory. The operations must follow



SIDE VIEW AND CROSS-SECTION OF FLY TRAP

along these lines: "In the early spring clean up all refuse heaps, filth of all kinds, manure piles, garbage heaps, old cans, trash of all sorts, and abolish as far as possible open vaults and earth closets. Screens should be used freely on all doors and windows. The prompt disposal of garbage should be arranged for and swill barrels and garbage cans should be tightly closed. Use some form of fly trap with the proper bait early, and continuously; place it where it will do the most good." (From circular No. 26, State Entomologist of Minnesota.)

11. *Ants*. — Nests of ants are often found under boards and stones and in the ground near plants. Others make little mounds of earth, "ant hills," that are several inches high and several feet across. They are especially interesting. Note the openings leading down into the ground; see whether the ants go in and out of these. Are they carrying things? With a stick dig up a portion of the mound; how do the ants behave now? Do you see some white objects looking like small grains of rice? These are young ants in the pupa stage. The pupæ themselves are in these tiny white bags or cocoons. Note the care taken of these

pupæ by the workers. Put a few of them into your insect cage and watch for adults to appear.

See how many different species of ants you can find and note how they differ in size, color, and habits. What harm do some of them do? Do any come into your pantry? In the fall a great many ants have wings. These are the queens and drones. Try to observe some of them. How many wings have they? The wings help to show the relation of ants to bees. At the end of the season give an account of what you have learned about ants.

12. *Oral or Written Composition.* — A good description of your observation or investigation of any insects, or experience with them, will form a valuable exercise in composition. The following are some examples of suitable themes:

a. Insects in winter. — If you make the investigation suggested in Project No. 3, prepare a full report of what you find.

b. Insect poisons. — Give the account called for in Project No. 5.

c. Plant lice. — Prepare an interesting account of your observation of plant lice on various kinds of plants during the season: what plants were infested, how the insects looked, how they affected the plants. Project No. 6.

d. Cabbage worms. — What the cabbage worms do to cabbage heads and how it may be prevented. Project No. 7.

CHAPTER XXI

POULTRY: CHICKENS, TURKEYS, DUCKS, GEESE, PIGEONS, AND GUINEA FOWLS

We are apt to underestimate the importance of poultry-raising because the industry, as most of us are acquainted with it, is conducted on such a small scale; but it is scattered over a large part of the country and in the aggregate it is really very large. Poultry and eggs rank among the first six or eight of the agricultural products of the country, their value being exceeded only by that of corn, beef cattle, dairy products, cotton, wheat, and swine. The principal domestic fowls are chickens, turkeys, ducks, and geese, — chickens being by far the most important.

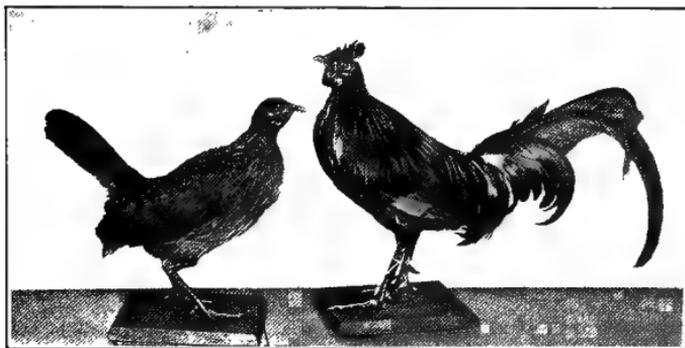
CHICKENS

Origin and Development. — Domestic chickens belong to the order of scratching birds, which includes also the prairie chickens, grouse, turkey, and guinea fowl. The remote ancestors of our chickens were wild birds; and it is probable that there were two distinct species, one of them being the so-called jungle fowl of India, and the other a much larger and more “blocky” bird that is no longer found in the wild state. The people of southern Asia tamed these birds and began breeding them many centuries before the Christian era, and the history of the earliest varieties is not known. But if there were two species in the first place, they were probably crossed in such a way as to develop breeds of two

distinct types, the one large, blocky, and awkward, the other smaller, more slender, and more active.

Some of these domesticated birds reached China as early as 1400 B.C., and soon after the people of southern Europe became somewhat civilized they also imported them. Those brought to Europe, however, belonged to the smaller type, and their descendants are known as the Mediterranean breeds, while those fancied in Asia are of the larger size and are known as the Asiatic breeds.

The chickens first brought to America were Mediterranean breeds, and by crossing these with the stocky eastern type, —



PAIR OF JUNGLE FOWLS

the Brahmas from the Brahmapootra in India, and the Cochins from Shanghai, China, — we have developed a general purpose fowl that is especially valuable to the farmer, who wants a hen that is a good layer as well as a good mother and a good meat producer.

Housing and Care. — Many people pay little attention to their poultry, but if it is to be made profitable it requires as much care as any other class of live stock. The poultry house should be warm and dry, and attached to it there should be a scratching shed where the fowls can feed and exercise

when the snow covers the ground. If not allowed freedom to range where they please, they should have a yard where they can run whenever the weather is favorable. They need plenty of sunshine, and for that reason the house, shed, and yard should have a southern exposure.

On the floor of the scratching shed there should be plenty of chaff or chopped straw, and into this the grain may be thrown to give the chickens exercise in scratching for it and picking it out. In a sunny corner there should be a box of fine dust scraped from the road in the summer time. The dust bath helps to keep the birds free from lice. They are also apt to be afflicted with mites that live in the nests and in cracks on the walls of the roosts, and at night come out and attack the birds by sucking their blood. To destroy these mites the poultry house should be cleaned at frequent intervals, and if necessary, washed with coal oil.

Feeding. — If we wish our chickens to do well, it is fully as important to feed them properly as in the case of horses and cattle. True, in the summer, if allowed their freedom, they will gather a good part of their rations themselves, and what they find needs merely to be supplemented with a certain amount of food from the granary. In winter, however, and at other times when confined in the yard, good methods of feeding require intelligence and care. The fowls must be fed such food and in such a manner that they will keep in the best physical condition. They must have some surplus fat in the body, for a poor hen cannot lay. On the other hand a very fat hen becomes too sluggish. We must therefore guard against these two extremes. The appetite must be kept good. They should come to breakfast hungry and eager, and not get too much then; but once a day, preferably at night, they should have all they can eat. The

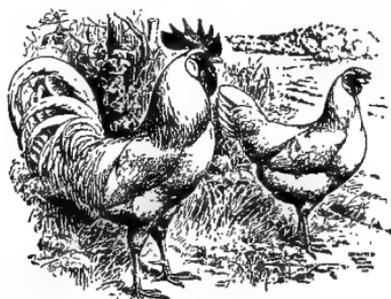
ration should consist of food which they like, there should be a good variety, it should be bulky enough, and should not all of it be highly concentrated. It should consist partly of whole grain and partly of ground feed; it should include some green food or vegetables, as cabbage, beets, or mangels, and some fresh meat scraps or other form of animal food. Fine gravel and sand or other form of grit should always be available, and they should have plenty of pure water.

Hatching. — The natural way to hatch all kinds of birds is to have the parent sit upon the eggs and keep them warm the necessary period of time. For the ordinary, small flock of poultry this is the simplest and best method. But wherever chickens are raised on a large scale, the incubator has become more and more popular, and is now employed almost universally. Having an incubator, if we want early spring chickens we are not dependent upon the pleasure of the hens, who have their own notions regarding the proper time to brood, and refuse to give up those notions just to accommodate us. In this machine the eggs are kept at the right temperature by artificial heat supplied by a lamp. After the chicks are hatched, they are put into another device, called a brooder, which serves as a substitute for the mother until they are well grown. A first-class incubator can easily be operated by any one willing to give it the necessary daily attention, if he follows the directions sent out with the machine.

Types of Breeds. — There are, of course, many breeds of chickens, and in choosing the one that we wish to keep, we are governed by the chief purpose that we have in mind. If we wish to specialize in egg production, not caring so much to realize large returns in the form of meat, we select an egg breed. If, on the other hand, we wish to give special attention

to the production of meat, we may forego the advantage of a large yield of eggs and choose one of the meat breeds. The large majority of people who keep chickens, however, do not specialize in either of these lines to the neglect of the other. They want a hen that lays well and also furnishes plenty of good meat and therefore they choose a general purpose breed.

The Egg Breeds. — These have a comparatively small and slender body, and therefore do not rank high as meat producers, but they excel as layers. They have a lively and



PAIR OF SINGLE-COMB WHITE
LEGHORNS

restless disposition and are not good sitters; but this disadvantage may be overcome by the use of an incubator. Most of them have large combs and wattles, as well as long, unfeathered shanks, and these features make them suffer from cold where the winters are severe unless they have fairly

comfortable quarters. The principal breeds of this type are the Leghorn, Minorca, Spanish, and Hamburgs, — the first being the only one that we meet very often except at poultry shows.

The Leghorn is the most popular of the egg breeds and is kept in large numbers. It has a large comb and wattles, and is a fine, trim-looking bird. The brown, white, buff, and black varieties are common, and all but the last of these may be had with single comb or rose comb. They are wonderful layers; flocks have made a record of an average of 200 eggs per hen in a year. This, of course, means that when properly cared for they will lay during both winter and summer.

The Meat Breeds. — These are large, heavy, and awkward-

looking fowls, furnishing a good quantity of excellent meat ; but they do not produce so many eggs as the other classes do. They have a quiet disposition, bear confinement well, and are good sitters. Their combs and wattles are small or of medium size, and their shanks are well covered with feathers. Therefore, they can endure severe cold better than the egg and the general purpose breeds. The Brahmas, the Cochins, and the Longshans are meat breeds, the first two being the most important.



PAIR OF LIGHT BRAHMAS

The Brahmas possess the characteristics of this type of fowls in largest measure and are, therefore, the most important and most popular of the meat breeds. The Light Brahmas are considered the largest breed of chickens in existence. The Dark Brahmas are about a pound lighter in weight.

The Cochins produce a fair number of eggs for a meat breed, and they are very hardy. There are four varieties — the Buff, Black, White, and Partridge.

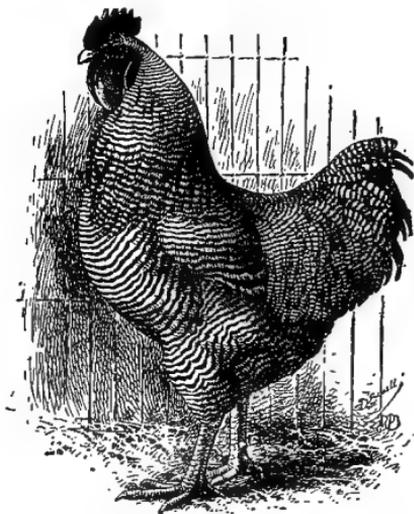


PARTRIDGE COCHIN HEN

General Purpose Breeds. — These are intermediate in size between the meat breeds and the egg breeds, and combine the advantages of these

two types in as large a measure as possible. Though they do not lay quite so many eggs as the egg breeds, nor yield quite so much good meat as the meat breeds, they are up

to a good standard in both particulars. They are therefore preferred by people who prize both products, meat and eggs, about equally. Their bodies are blocky and compact, their legs comparatively short. In disposition, they are fairly gentle, and although they will not sit quite so steadily as the meat breeds, they probably make just as good mothers; for they are more careful than the larger and more clumsy breeds, breaking fewer eggs and killing fewer young chicks by stepping on them. They are industrious foragers,



BARRED PLYMOUTH ROCK ROOSTER

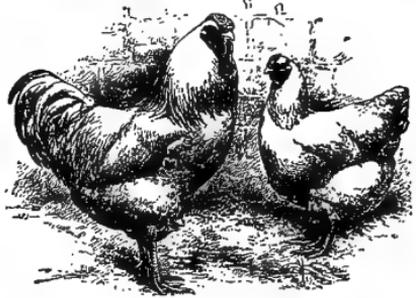
and if given their liberty they will roam over a considerable range in search of insects and other food, thus securing a good portion of their own living. This makes their keep more economical than the meat breeds, though they hardly excel the egg breeds in this respect. The chief breeds of this type are the Plymouth Rock, Wyandotte, and Rhode Island Red.

The Plymouth Rocks are the most popular chickens in the

United States, being kept in larger numbers than any other breed. In size they are not much below the meat breeds, and in egg production they come close to the egg breeds. There are six varieties, the Barred Plymouth Rock being the commonest, but many of the White and the Buff are also raised.

The Wyandottes are somewhat smaller than the Plymouth Rocks, their body being shorter and more blocky. But some critics think that the meat is better, that they lay better, that

they are more hardy, and bear confinement in a yard better. These people therefore consider them a better breed, and, of course, if these advantages were entirely demonstrated, most other people would agree with them. As it is, they are close to the Plymouth Rocks in popularity. There are eight varieties, the best known being the White and the Silver Laced.



PAIR OF WHITE WYANDOTTES

The Rhode Island Reds, as the name indicates, are red in color. The breed has been developed more recently than the two preceding, and is therefore not yet so well known. They are fowls of good size, their meat is of good quality, and they are good egg producers. They are giving good satisfaction, and it may be that their popularity will continue to increase. There are two varieties: the Single-comb and the Rose-comb.

SINGLE-COMB RHODE
ISLAND RED HEN

Fancy Breeds. — At poultry shows we often see many varieties of chickens that are seldom kept for practical use, but are bred as pets or fads of fanciers who admire the beauty of their plumage, the peculiarity of their form or other attributes. The most beautiful among these ornamental fowls are the *Polish* family, of which there are seven or eight varieties. Some of the Polish hens, it should be said, are good layers if they are kept under favorable conditions. Then there are a very large number of *Bantams*, or diminutive chickens. Many of these are exact counterparts of large breeds except in size. Other fancy breeds are the *Game* fowls distinguished chiefly for their fierce look and their fighting qualities. *Silkie*s, *Sultans*, and *Frizzles* are the names of still other fancy chickens.

TURKEYS, DUCKS, AND GEESE

Turkeys. — Of all our domestic fowls the turkey is decidedly the largest, well-grown gobblers ranging from 26 to



BRONZE TURKEY

Young male.

36 pounds in weight and the hens from 16 to 20 pounds. Not only is the quantity of meat which they yield quite large, but its quality is unexcelled; and considerable attention is therefore given to raising them for the market. Our domestic turkeys are descended from the wild turkey which may still be found in the eastern and southern parts of the North American continent. The roving disposition

of the wild bird survives in the domesticated fowls to this day and they often wander a half mile from home in search of a place to steal their nests. Moreover, it is desirable to give them their freedom, for if they are confined to limited quarters they become nervous and restless and fail to thrive. It requires more care to raise them than any other farm animal. There are six different varieties, the most common one being the Bronze.

Ducks. — These are raised chiefly for their meat, but their feathers are also valuable. Though they are

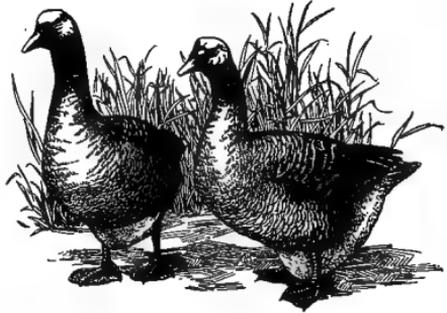


DUCK

water-fowls with webbed feet, they thrive very well without a swimming pool. Indeed, many people prefer not to let

them swim. They are easily raised on the farm, requiring little care and being generally free from the diseases and vermin with which chickens are troubled. It is best to have a good hen hatch them and mother them. There are about ten different breeds, the Pekin and the Rouen being the most important. The Pekin duck is white and the plumage of the Rouen is colored in beautiful shades of brown.

Geese. — These are like ducks in being web-footed water-fowls that are raised for their meat and feathers. They are much larger than ducks and chickens, how-



PAIR OF GRAY TOULOUSE GEESE

ever, being outranked in weight only by the turkeys. They should have freedom to range over a wider field than ducks need, and though opportunity for swimming is not absolutely necessary, they thrive better if they can have access to a stream or pond. There are at least five or six different breeds.

FANCY FOOD FOWLS

Pigeons and Squabs. — Pigeons have long been kept for pleasure, but in recent years the raising of squabs has become somewhat important, especially where there is a good market for them. *Squab* is the name given to the young pigeon as long as it sits in the nest. Well-grown squabs are in great demand among fastidious meat eaters, as they are noted for the superior excellence of their flesh.

Domestic pigeons are closely related to our wild mourning doves, but they did not originate from them. They are descended from the Rock pigeon, a wild species common in Europe and Asia; and as their ancestors were domesticated at least 3000 years ago, breeders have had plenty of time to develop the many varieties we now see.

The fancy pigeons kept for amusement are chosen for their ornamental appearance and are usually too small for meat purposes. For squab raising such varieties as the Homer are considered the most valuable.

Pigeons are quite hardy and are not subject to disease. Their blood being 50 degrees warmer than that of man, they can stand severe weather, and any building that is dry can readily be converted into a suitable house for them. If a special dove cote is built, it may be set on posts to raise it at least a few feet from the ground and put it out of reach of rats, weasels, and other enemies.

Pigeons are grain eaters, and are fed such things as whole corn, cracked corn, wheat, field peas, and millet. Their rations should be varied, as they easily tire of a monotonous diet.



PIGEONS

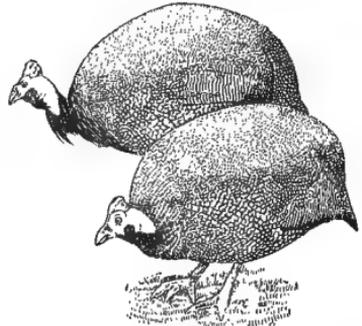
Their popularity as pets is well deserved. The beauty of their plumage can hardly be excelled in the whole realm of bird society; and their charming family relations cannot fail to command our admiration. In some breeds the male and female mate for life, a most exceptional practice among birds. Their affection for each other and for their young, so effectively expressed in their cooing, is a matter of common observation. The raising of a family, or of an endless succession of families, seems to be the great aim and object of their life and the source of all their joys. The female lays but two eggs for a sitting, but in some breeds a pair will raise from 7 to 12 broods in a year. The eggs hatch in from 16 to 18 days, and both parents share in the labors of incubation by taking turns in sitting on the eggs.

The feeding of the squabs is also very peculiar and interesting. In the crops of both parents there is prepared a cheesy substance which they pump into the mouth of the young. On this nourishing "pigeon milk" they grow with great rapidity, and in about five days it is replaced by grain which is softened in the parents' stomachs; this method of feeding is continued until the squabs are old enough to feed themselves. The wonderful control of the passage of food to the crop and back again shown in the feeding of the young, is also illustrated in the way pigeons take water. They are the only bird that can drink like a horse, that is, with the head downward.

Guinea Fowls. — These birds were originally found in the wild state in Africa, but have been reared by man since the days of the early Greeks and Romans, who kept them as table poultry. We often find a few of them on the farm, where they help to enliven the otherwise quiet situation with their penetrating cries. They are very watchful and are pretty sure to sound the alarm if the poultry yard is invaded by hawks or other intruders.

Although domesticated so long ago, they are still very wild and insist on making their nests in secret places. Nor do they like to have eggs taken from it, and they are apt to desert the nest if a hand has touched it. Guinea hens lay a good number of eggs that are about two thirds as large as an ordinary hen's egg and are more suitable for use in cooking than for the table. The meat is very wholesome and palatable, and the broilers are considered most excellent eating.

Guinea fowls thrive on the same food as chickens and generally eat with them. But they are great foragers, and if there are plenty of insects and seeds to be found, they will almost support themselves during the entire summer.



GUINEA FOWL

CHAPTER XXII

PROJECTS AND QUESTIONS: POULTRY

1. *Breeds found in the district.* — What domestic fowls are kept in your district? (Chickens, turkeys, ducks, geese.) If any of them are blooded stock, find out what breed they are. Find out why the owner prefers this breed. Visit some of the best flocks and note the breed and its characteristics.

2. *Food and feeding habits.* — Observe the feeding habits of a flock of chickens in summer, not confined in a small yard but allowed to forage.

(a) What food is given them? How many meals a day? How much is allowed for the total daily ration per chicken?

(b) What food do they find for themselves? Watch them for an hour or two and make an estimate as to the number of insects and other food each chicken probably finds in a day.

3. *Hatching, and the young.* — When some one in the district sets a hen or other domestic fowl:

(a) Make a careful note of the exact dates of setting and of hatching and compute the length of time between these dates.

(b) Observe the condition of the young when they come out of the shell, — to what extent they are feathered, how rapidly the little ones grow, how long before they eat, what kind of food is given them. Make a full report to the school.

4. *Confinement, freedom to roam.* — What benefits do chickens obtain from free range? Which breeds suffer most from confinement? Why? Why should chickens that are closely confined be provided with a scratching shed?

5. *Diseases and vermin.* — Find out what vermin or diseases afflict the poultry kept in your district and what treatment is most successful.

6. *Winter eggs; housing and feeding.* — Find out what are the most satisfactory flocks in your district in regard to winter production of eggs. Visit them and observe how they are housed and what feed is given them, also what care they receive.

7. *Arithmetical problems.* — Make up some problems about the poultry business and then solve them in the Arithmetic class. Here is an illustration :

(a) What amount is realized for labor, interest on the investment, and profit from a flock of one hundred hens, each laying one hundred eggs during the year selling at an average price of 25 ¢ a dozen, if each hen eats a dollar's worth of feed per year?

(b) What will be the results from a poorer flock of the same size laying only half as many eggs but requiring the same food and care?

8. *Charts showing various breeds.* — Let the pupils bring pictures of poultry which they clip from advertisements in farm papers and magazines. These pictures may be grouped and mounted on large sheets of stiff paper to make charts. Names of breeds and a few descriptive words may be neatly lettered beside or under each picture.

9. *Oral or Written Composition.* — Some suitable subjects:

(a) *My favorite breed of chickens.* Project No. 1.

(b) *Chickens as foragers.* Project No. 2 b.

(c) *The growth of young chickens.* Project No. 3.

(d) *Winter eggs.* Project No. 6.

CHAPTER XXIII

BIRD LORE FROM THE CHICKEN YARD: PROJECTS

[Lessons learned by direct observations of birds, using our chickens, ducks, and geese for the purpose. Adapted from Cornell Nature Study Leaflets for which due acknowledgment is hereby made.]

Our domestic fowls are well adapted for beginning the study of birds, because they give opportunity for continuous observation at any season when it may be convenient to teacher and pupils. When the pupil understands the habits of these common birds he will be better enabled to understand all bird life.

The pupils should make most of these observations at home and report the results to the class for discussion. Considerable material, however, should be brought before the class for examination. For example, when poultry is killed at home for the table, the pupils may bring some feathers for Lesson 1; the tail with the oil gland, for Lesson 2; some ornamental feathers, for Lesson 3; head with beak, for Lesson 5; feet, for Lesson 6; head showing ear, for Lesson 7.

LESSON 1

To learn the form and use of several types of feathers.

(a) Notice the down next to the bird's body. This serves the purpose of under flannels.

(b) The smooth outer feathers on the back and elsewhere. These serve as the outer coat.

(c) A breast feather with its fluffy base and smoothly webbed tip. This combines both of the preceding purposes.

(d) The large feathers of the wings and tail. These are the quills, and are the important feathers in the bird's flight.

LESSON 2

To learn what care the bird gives to its plumage.

(a) Oiling the feathers. The oil gland may be seen at the root of the tail, upper side, of a plucked fowl. It is largest in water birds, which have need of waterproof plumage. Birds press out a drop of oil with the beak and dress their feathers with it. The process is best seen in ducks and geese.

(b) The dust and sun bath. Lice are among the greatest pests of the chicken raiser. The bird's own treatment for this vermin is the dust bath and sun bath. Observe:

(1) How a hen takes her dust bath, — how she manages to get dust into the feathers.

(2) How she lifts the feathers so the sun may reach the body, and how she turns from side to side.

LESSON 3

To learn: (1) That the male bird is often more attractively dressed than the female. (2) That birds with beautiful feathers seem to know they are handsome.

(a) Observe the turkey gobbler. His strut and entire appearance indicate excessive vanity. Notice the pretty iridescence of his feathers as he shifts his outspread tail so that the sunshine may strike across it and show it off to the best advantage.

(b) The rooster. Notice the shape of the ornamental tail feathers, — how gracefully they curve. The proud, high-stepping manner of the rooster shows what he thinks of himself.

(c) The peacock is perhaps the most striking instance of the coloration of male birds, and of the pride that they seem to take in their fine feathers. If the pupils cannot observe this bird they can see pictures of it.

(d) Other common instances of beautiful colorings are seen in the male oriole, goldfinch, red-winged blackbird, bobolink, and mallard duck. In all these species the female wears plainer clothes than the male. This is the general rule in bird society, except when both sexes are dressed the same.

LESSON 4

1. To learn how a bird flies.

(a) Notice that when the wings are unfolded and folded the flight feathers open and close like a fan.

(b) The bird supports itself in the air by pressing down upon it with the wings as it flies. The principle can be demonstrated by holding an open umbrella in the hand while jumping from a chair. We feel buoyed up because the umbrella presses down upon the air, which is the same as saying that the air presses up against the umbrella.

(c) To explain why the hen cannot fly so well as the robin, for example, notice the length of the wings of the two birds as compared with the size of the body. In developing the hen from her wild ancestors her wings have lost efficiency because she does not need to fly much; on the other hand, her body has become heavier.

LESSON 5

To learn how the form of the bird's beak is related to the nature of its food:

(a) The Hen. Notice her stout, sharp, bony beak, and how well it is adapted to picking up seeds and insects.

(b) The Duck. Observe how her broad beak is adapted to finding insects and other food under water.

(c) The Canary. To compare these types with still another form of beak we leave the poultry yard and study a canary. It would be well if a bird in its cage could be brought to the schoolroom for the purpose. Notice how short and stout its conical beak is. Then see how it prepares its seeds for eating, — how it crushes and shells them.

(d) It would be instructive to compare with the above the beak of a typical insect eater, as a Wren, a Wood Warbler, or a Swallow. A picture may serve the purpose. See how difficult it would be for these birds to eat seed like a Canary.

LESSON 6

To learn how a bird's feet are adapted to its particular needs.

(a) The foot of the hen. Note the number of toes, their length, the strong claws; the horny scales covering the foot and affording thorough protection. All these features adapt the foot for its chief business, that of scratching the earth to find the seeds and insects which may lie hidden there.

(b) Observe the foot of the duck. How many of its toes are united by a web? It is easy to see that this web makes a good paddle of the foot.

(c) Now see what a good runner the hen is and how awkwardly the

duck waddles along. Note the reason: the duck is not fitted for a land bird, — its legs are short, set far apart and far back. This is the best arrangement for propelling the body through the water.

LESSON 7

To learn how birds hear and see and sleep.

(a) Observe that fowls have good hearing. Find the ears on a plucked bird; they are well developed, although hidden beneath the feathers.

(b) The hen's eyes being at the side of the head it can see what is happening in the rear as well as in front, and it is hard to come up to her and take her by surprise. Notice that when she wants to observe a thing closely the hen looks at it first with one eye, then turning the head looks at it again with the other.

(c) Observe that the bird's eye has no eyelids, but has the "film lid" which passes over the eye when the bird sleeps or winks. Notice also that when domestic fowls sleep they place the head beneath the wing.

LESSON 8

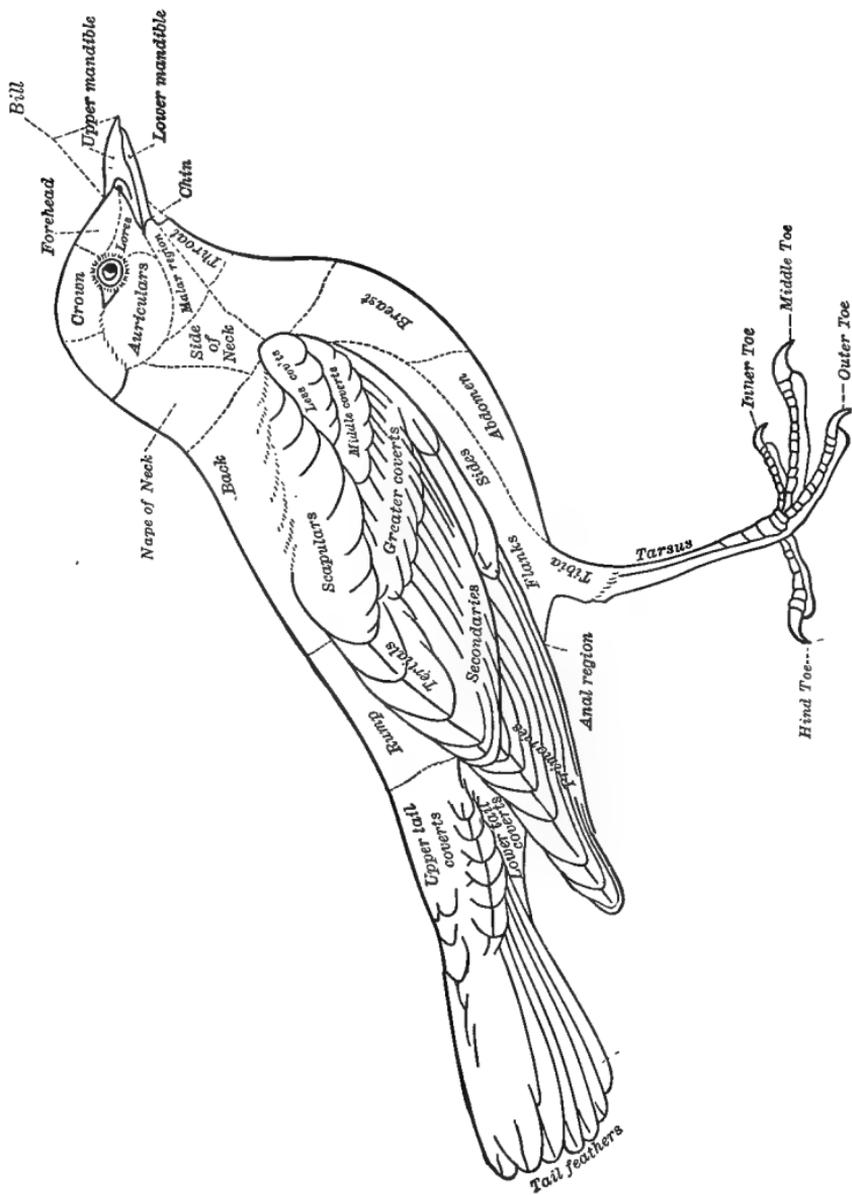
To learn the language of the poultry yard.

Barnyard fowls afford a fine opportunity to learn that birds can express quite a variety of feelings, and chickens excel all the others in this respect. Observe:

(a) The quiet gossip which goes on between hens when they are taking their sun bath; the song of the hen when she is happy; her cackle of triumph when she lays an egg; the short note of warning given by her or the rooster when a hawk is in sight; the way a sitting hen scolds when disturbed; the long, horrible squawk when she is captured; her clucking when she calls her chicks; the little questioning note she utters when she is curious about anything and looks at it carefully.

(b) The rooster crows to announce the dawn of day, to show his importance, or to assure his flock that all is well. When he finds some tidbit he makes a call which brings all his hens running to him, though he often changes his mind and swallows the morsel himself. He also gives a warning note when disturbed.

(c) If the pupil has the opportunity he may also study turkeys, ducks, and geese, and learn how they express displeasure and fright, and how they carry on amiable conversation. This will be a good training for the study of the call notes and songs of wild birds.



BIRD CHART

Showing the names of various parts of the body.

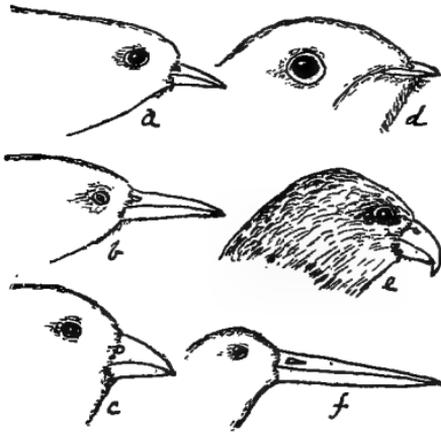
CHAPTER XXIV

THE BIRD: ITS PARTS, VOICE, AND COLOR

PARTS OF A BIRD

In the description of birds it is necessary to have terms that will designate precisely the part of the animal to which we wish to refer. Such terms are especially needed in describing the plumage when it has different colors on the different parts

of the body. The student should, therefore, study the accompanying bird chart and note the various regions and their names as here shown. There are many other terms which specialists employ, but for our purpose a few are sufficient. Whenever it is unnecessary to make sharp distinctions, the expressions *upper parts* and *lower parts* are employed in a general sense that needs no explanation.



BILLS OF VARIOUS FORMS

a, Yellow warble; *b*, house wren;
c, English sparrow; *d*, night hawk;
e, hawk; *f*, sandpiper.

THE BILL

Of the four organs, — bill, feet, wings, and tail, — the first is the most important. It is of greatest significance in the life and habits of the bird. Its size and form are fundamental

factors in classification, but in field work not so much attention can be paid to it, as the details of structure cannot generally be distinctly seen. A few points about the bill will therefore suffice for the present purpose.

(1) The two parts are called the upper and lower *mandibles*. They consist of projections of the skull bones covered by a horny material.

(2) The bill is said to be of *medium* length if it is about as long as the head; if longer than the head, it is considered *long*, and if shorter it is called *short*.

(3) A weak, slender bill shows that the owner must live on insects. A short, conical bill, fitted for crushing seeds, indicates the seed eater, and a stout, hooked bill indicates a bird of prey. Other interesting forms are the long, curved bill of the Curlew and the crossed mandibles seen in the Crossbills.

THE WINGS

Structure. — In the skeleton of the wing there are three joints, corresponding to the upper arm, forearm, and hand in human anatomy. Each of these is provided with a row of large, stiff feathers or quills. The largest and most important of these, the *primaries*, are on the last joint (the hand). The secondaries are on the forearm, and the tertiaries are on the upper arm. These quills form the spread of the wing and are the feathers on which flight depends. The others are smaller and serve to cover the bases of the quills and to dress the wing. They are called wing coverts.

The Form of Wing varies greatly. It is long and pointed in birds of easy flight, like Swallows, Hawks, and Terns, and those whose flight is more labored have short, rounded wings.

THE LEGS

Use. — There is a great and interesting difference in the use which birds make of their legs. The domestic hen uses hers for walking, running, scratching, and roosting. They are well developed and strong. The Chimney Swift never uses its legs except at night for clinging, by the aid of the tail, to some vertical surface. They are therefore small and weak. The majority of our smaller perching birds hop or jump instead of walk, while the other land birds and all the water birds walk, and do not ordinarily hop.

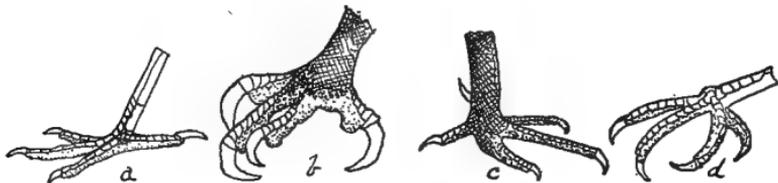
Structure. — In structure the leg of a bird is similar to the hind leg of a horse. The heel or hock is about the middle of the part of the leg that we see, the lower leg corresponds to the human foot, and the hoof to the toes. The knee is brought up close to the body and covered by the body skin, thus apparently making a part of the body the portion that corresponds to the thigh in human anatomy. In the bird all this is the same except that it has toes instead of hoof. The part above the heel, the “drum stick,” is usually well covered with feathers, so that the principal part we see is the naked joint below the heel. This is called the *tarsus*. Sometimes, as in most Owls and Grouse, the tarsus also is feathered.

THE FEET

Number and Arrangement of Toes. — The usual number of toes is four; but one of them, the hind toe, is often much shorter than the rest, and in some species it is entirely wanting, thus leaving only three. When there are four toes, the most common arrangement is to have three in front and one behind, as we see in the Sparrows. Another arrangement gives two in front and two behind, as in Woodpeckers and

Parrots. The Owls enjoy the advantage of another arrangement; although three of their toes point forward, one of them is reversible, so that in grasping an object the bird may put two toes on either side of it.

The hind toe is subject to the greatest number of variations. Sometimes it is as long as the other toes, and sometimes it is barely visible or entirely absent; between these extremes we find all possible gradations. All our domestic chickens have a short hind toe and, as in case of other birds



SOME TYPES OF FEET

a, Perching birds; *b*, birds of prey; *c*, domestic hen; *d*, flicker and most other woodpeckers.

with such a toe, it is attached considerably above the level of the front toes.

Webbed Feet. — Swimming birds usually have their toes connected by a web, or tough, flexible membrane, which makes of the foot a better paddle. In some families this web connects only the basal portions of the toes, as in the Grebes, in others it extends to the claws. Usually only three toes are connected, as in the Duck family, but in some cases all four toes are fully webbed (as in Pelicans and Cormorants). Sometimes the toes have only a stiff, spreading membrane or web along the sides, usually with scalloped edges (*e.g.*, Mudhens). The toes are then said to be “lobed.” When only the basal parts of the toes are connected with the web the rest of the toes may be lobed; that is the case with the Grebes.

Some shore birds, like the Sandpipers, have merely a narrow strip of webbing along the edges of the toes to help hold them up when walking over soft mud.

The Claws.—The toes of birds are provided with sharp nails or claws varying greatly in length and strength. On birds of prey they are especially large and strong and are



SOME TYPES OF WEBBED FEET

a, Membrane along the sides of the toes forming scalloped margins or "lobes." Example, the mudhen. *b*, Narrow border along the edges of the toes; sometimes a web also connects the base of the toes. Example, the snipes. *c*, All four toes joined by a web. Example, the pelicans. *d*, The three front toes joined by a web. Example, the ducks.

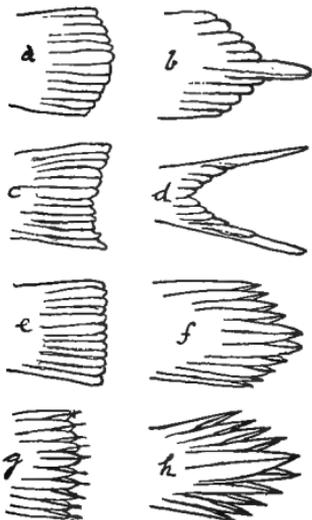
called talons. In case of the Longspurs and the Horned Lark, the claw on the hind toe is very long and almost straight.

THE TAIL

Use of the Tail.—The chief office of the tail is to serve as a rudder to steer the bird in flight, but Woodpeckers, Chimney Swifts, and Creepers also use it in climbing and in supporting the body while resting against the upright surface of trees and other objects.

Its Length has much to do with the manner of flight. Short-tailed birds like Prairie Chickens cannot make sharp turns, and they fly in a comparatively straight course, while long-tailed birds like Hawks and Barn Swallows can change the direction of their flight with ease and grace.

Shape of the Tail. — Most commonly the end of the tail is more or less rounded, but in some birds it is perfectly square. Again, the middle feathers may be shorter than the outer ones, and we then say the tail is notched, or slightly forked, or deeply forked, according to the depth of the indentation.



VARIOUS FORMS OF BIRD
TAILS

a, Catbird; *b*, prairie sharp-tailed grouse; *c*, bank swallow; *d*, barn swallow; *e*, nuthatch; *f*, flicker; *g*, chimney swift; *h*, brown creeper.

The main feathers of the tail are strong, stiff quills, like those of the wing, and the bases of these quills are covered by shorter feathers, called upper tail *coverts* and lower tail *coverts*. When the tail is used in climbing, as in the Woodpeckers, the ends of the feathers come to a sharp, stiff point; in case of the Chimney Swift, the stiff midrib or stem even extends beyond the web of the feather. The quills are set in a single row. The number varies slightly, but in all perching birds it is twelve.

THE VOICE

Call Notes. — These are the ordinary language of birds and are as worthy of our notice as their songs. All birds

have call notes, but some are very meagerly gifted, while others seem able to express alarm or give the signal to take wing, or on the other hand, to voice the spirit of contentment and sociability.

Song. — The power of song is limited to the Perching Birds, and not even all of these have it. Furthermore, it is generally restricted to the male of the species, and is employed

especially in the mating and nesting season as an expression of his happiness. Though some species begin to sing immediately upon their arrival and others continue their efforts till they leave us in autumn, the great concert season is in spring and early summer.

COLOR

Color and Environment. — Generally speaking, birds living on the prairies and elsewhere on the ground have dull or neutral plumage that harmonizes with their surroundings and protects them against discovery. In the foliage of trees and shrubs, we find the birds of brighter colors and, of course, also many of those in dull costumes.

Color and Sex. — In many species the colors of the two sexes differ. In these cases it is almost invariably the male that wears the gayer feathers.

Color and Age. — When both parents are colored alike, the young resemble them; but if they are unlike, the young of both sexes may resemble one of them, more commonly the mother, or they may resemble neither parent. Immature birds differing from adults usually acquire the adult coloring the next spring, though sometimes it takes several years to complete the change.

Color and Season. — Some birds undergo changes of color with the season. Thus, the male Bobolinks and Lark Buntings after the nesting season become streaked, sparrow-colored birds like their mates, so that we may not recognize them. In the spring and through the mating and nesting season all birds wear their most conspicuous costumes. However, among land birds, when both sexes are alike, there is little or no seasonal change in color.

It is impossible to note all the details about the plumage of

all the species, except in a large manual. When not otherwise specified, the descriptions of birds apply to adult males in their spring plumage. It will easily be seen that these variations and changes in color increase the difficulty of the observer immensely. In the fall, when a large portion of the birds we see are immature, it is difficult to recognize some of them except by the adults in the flock. By far the best way to simplify the problem is to make the acquaintance of new species upon their arrival in spring.

Color and Molting. — We are all familiar with the loss of feathers which domestic fowls suffer in the later part of summer. This is the molting process, and affects all bird life. That is, at the close of the breeding season all birds renew their entire plumage by molting. The following spring most birds again renew a portion of their feathers, while some birds have another complete molt. It is easy to see how a change of color scheme may be accomplished in this way, but in some cases the changes in the spring are brought about by wearing off the terminal fringes which covered and concealed the brighter colors during the winter.

CHAPTER XXV

THE MIGRATION OF BIRDS

The migration season is of especial interest. It brings to us for at least a short period many birds belonging in other regions, including some that raise their young within the arctic circle and spend the winter in the tropics. In this great movement all birds take part except some of the permanent residents, such as our Prairie Hens and English Sparrows.

How Far. — The length of these journeys depends upon the bird's food. Insect eaters are obliged to go far enough south for the winter to find insects in sufficient abundance at that season. This takes the majority of them to Mexico, while many go farther, — the Oriole, for example, to Central America, or the northern part of South America, and the Bobolink to southern Brazil. Birds like the Robin, that are willing to live on seeds and berries, merely go far enough south to get out of the heavy snowfall that covers their food, and beyond the range of severest cold. Generally speaking, birds that stay till late in the fall do not go far south and are the first to return in the spring, while those that leave us first go the farthest and return last. Some birds that live the greater portion of the year in arctic regions consider the Dakota winter quite mild. Thus the Snowy Owl and the Snow Bunting come south to spend the coldest part of the season with us. Again, some birds move but a few hundred miles, others go from arctic regions to the southern part of Argentina every fall and return

in the spring, accomplishing each time a journey of 8000 miles. Some Snipe and Plover belong to this class of tourists.

The Journey and its Risks. — These marvelous journeys are not accomplished without great hazard. In fact, migration keeps the bird population thinned; all the weak and the foolish perish by the way, and we have only “the survival of the fittest.” Most birds travel in the early part of the night — from about eight to eleven or twelve o'clock. They rest the remainder of the night, and feed and rest the next day. Geese and other birds with good wings fly either by night or day and can travel many hours in succession. The birds fly from half a mile to a mile or more high, following the direction of streams, mountain chains, and other landmarks. They usually travel in great flocks, the old ones leading the way, and they keep together by calling to each other as they fly. The instinct exhibited in migration is truly wonderful; but it is not infallible, and birds sometimes become separated from their companions and lose their way.

Cause of Migration. — It is popularly supposed that birds go south in the fall to escape cold weather. While this may be one of the causes of migration, especially in case of those who stay till cold weather really approaches, it does not explain why some species, as the Kingbird, start as early as July or August, — as soon as the young are hatched and grown strong enough. The fact is that the majority of the birds leave before the cold furnishes a reason. As soon as insects become scarce, the birds that do not relish other kinds of diet betake themselves to more sunny climes; and for this reason it is considered that food supply is a more fundamental factor than temperature.

But if we ask why they come north again in the spring, we have an even more difficult question. Probably we may

safely assert that the journey is undertaken principally for the purpose of nesting. Everybody is familiar with the way hens and turkeys like to "steal their nest," — that is, to go some distance from their accustomed haunts and make their nest in a secret place. The long journey to the North is supposed to be due to the same instinct. Moreover, here is where these birds were reared and where the older ones have already raised families in former years. This, no doubt, they regard as home, and the South merely as a place to spend the winter. So when the breeding season approaches they come home.

Return to Same Region. — Though a bird does not generally return to its former nest another year, it does come to approximately the same region where it was reared. But the changes incident to the settlement of the country also bring about a change in the bird life, and so the range of a bird may be gradually changed or extended. In such cases the route it travels remains the same that was followed originally. Thus, the Bobolink of Dakota comes from Brazil by way of Cuba and Florida. The ancient Bobolink of our eastern states traveled by that route, the knowledge of that route has been taught to each succeeding generation, and all American Bobolinks still go and come by it, although they have gradually extended their territory westward to Montana.

CHAPTER XXVI

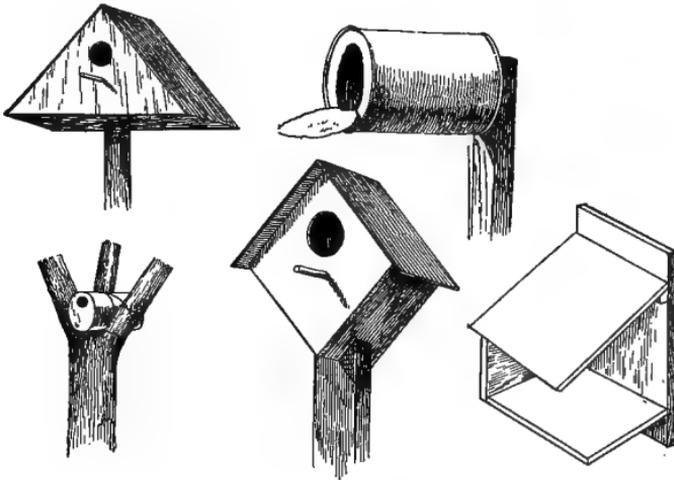
NESTING

The Nesting Season. — At this season birds are the most interesting. Their song, their plumage, and their traits and habits are then displayed at their best. Soon after their arrival from the south each bird chooses a mate, and the two then live and work together throughout the season. Nesting time comes in the spring and early summer when food for the young is most abundant and when there is ample time for the young to reach full stature and become strong enough for the long journey to the winter home in the south, or for the rigors of winter in case of those who do not migrate.

Nesting Sites. — Nests are built in all kinds of locations that afford concealment. Most birds build their nests at a distance from others, avoiding their own kind even more carefully than other species; but there are many interesting exceptions to this general practice. Our best example of the more sociable birds is the Cliff Swallow whose row of nests under the eaves of a barn might be compared to a great tenement house in which each family has a room. The other Swallows and the Blackbirds are also examples of species nesting in colonies that are compact or dense enough for convenient back door visits.

Birds that nest on the ground can find suitable sites without difficulty, and English Sparrows are willing to take almost any kind of place. But many others are not so easily accommodated. Unless we have trees, the Robins and Orioles and

scores of others will refuse to live with us. Birds that require some kind of crevice or hollow have still greater difficulty in finding accommodations. Hollow trees may be regarded as nature's provision for them, and in their absence we must



BIRD HOUSES

To be fastened to a post, tree, or building, in a shady location. The open house at the right is for robins, the others for wrens and bluebirds. The floor of the robin house is about 6 by 8 inches. Robins want their nest 6 to 15 feet from the ground; wrens and bluebirds, 6 to 10 feet. The entrance hole for wrens should be an inch in diameter; for bluebirds, $1\frac{1}{8}$ inch.

either supply proper boxes or do without Wrens, Bluebirds, and Martins.

Materials; Construction. — The nests vary greatly in many particulars. Generally speaking, the size is in proportion to that of the birds. The usual building materials are dead grasses, twigs, rootlets, plant-down and fiber, hair, and feathers. A number of birds, as Robins, Eave Swallows, and Barn Swallows, use mud, while Chimney Swifts get a gummy substance from their mouths to glue together little twigs and fasten them to the chimney wall.

Birds are far from being equally skillful builders. The hanging nest of the Oriole and the gourd-shaped mud nest of the Eave Swallow excite the admiration of all. On the other hand, the English Sparrow, though collecting plenty of material, throws it together in very loose and careless fashion, and the Mourning Dove uses such

a small quantity of sticks that we can sometimes see through it from beneath and count the eggs.



THE HANGING NEST OF THE ORIOLE

The Eggs. — The study of birds' eggs used to be more fashionable than it is now. It may be admitted that it is rather fascinating, but as our love for birds increases, the feeling also grows that it is bad manners to pry into their private family affairs. Of course, persons who

have sufficient interest in birds to read these pages would not think of robbing the nests, but we should bear in mind that the bird even resents the touching of the eggs or nest and often deserts them when we have intruded too closely.

Hatching. — The period required to hatch the eggs of a medium-sized perching bird is about twelve days (ten days in case of the Wren), while the Ostrich egg is said to require between forty and fifty days. In general, the length of the period is proportionate to the size of the egg. Domestic hens require 20 to 22 days, geese and turkeys about 28 days, ducks 28 to 34 days.

Usually the female is the sitter. In these cases the male generally takes her place on the nest for a time each day to let her get her food; but in some species he renders no such

assistance, our domestic chickens illustrating this practice. Again, in some species the male does about an equal share of this work, while in still others he does it all. This last practice — when the male alone does the sitting — is unusual. The best known instances of it are found among the Phalaropes, and curiously enough, in that family the female is the larger bird.

Care of the Young. — Birds are devoted parents, and they feed their young and watch over them, even after they have left the nest, as long as they can keep their brood together, and as well as possible, even after they are dispersed. The young of different species vary a great deal in the degree of maturity when hatched. If the egg is large for the size of the bird and takes a relatively long period to hatch, then the young at birth will be comparatively well developed,



BROWN THRASHER FEEDING HER YOUNG.
Birds are devoted parents.

being covered with downy feathers and able to leave the nest and run about or swim without further delay. This is what we see in our domestic chickens, ducks, and geese, as well as in the corresponding wild birds, and in the Gull and Snipe families and many others. On the other hand, all the perching birds and some others are practically naked when they come out of the shell and must remain in the nest for a considerable time to be fed by the parents till they are fully fledged and strong enough to fly. This is a good time to observe the remarkable intelligence of birds. They seem

to be well versed in the principles and practice of feeding babies, for they know that they must not give them starchy foods; and so, even if the parents are seed-eaters, we may see them gathering insects for their nestlings, and if these are too large, tearing them to pieces, before putting them into



THEIR FIRST AFTERNOON OUT
Young bluebirds.

their little mouths. Doves even bring up softened food from their crops and feed it to their young. The labor which the care of the young entails will be appreciated if the student observes a nest of fledglings for a day and keeps count of the number of visits made by the parents with food.

CHAPTER XXVII

HOW BIRDS MAKE THEMSELVES USEFUL

Seed-eaters and Insect-eaters. — Birds are roughly divided into two classes: seed-eaters and insect-eaters. But it must not be understood that the line of division is so sharp that birds belonging to one class never touch the food of the other class. Many birds that are essentially seed-eaters crave animal food for at least a small portion of their rations. Our domestic chickens illustrate this. Other birds that are quite strict vegetarians themselves will feed insects to their young.

On the other hand, some birds insist upon an exclusively insect diet, and when the supply is exhausted there is nothing for them to do but migrate. But many others adapt themselves to circumstances. Take, for example, the Robin. It is said that insects constitute 70 per cent of his diet the year round; and yet in the fall, when insects have become very scarce, he lingers with us many weeks longer, subsisting largely upon seeds and berries.

What Seeds are Eaten. — Most of the food that the seed-eaters find is the seeds of noxious weeds. In helping thus to check the multiplication of these pests the birds obviously do a great deal of good. But the service rendered in the destruction of insects, gophers, mice, etc. is more striking and it will be the chief subject of our inquiry here.

Quantity Eaten, and How We Know. — As a bird cannot be followed in its flight to see what it eats, we must get at the question indirectly. One way is to experiment upon birds

in captivity; another way is to observe the rations brought by the parent birds to a nest of young ones; still another method is to examine the contents of a bird's crop; and this has been done in hundreds of cases by government experts. Each of these methods independently establishes the fact that birds as a class consume an enormous quantity of food. Nor is this surprising. They are the most active branch of the animal kingdom. They are very busy creatures at all seasons of the year, — traveling long distances in search of food and in migrating. They rear large families, in many cases two or three broods in a summer. In short, for their size, they do a very large amount of work, and they require a corresponding amount of food to supply the energy.

The Food of Nestlings. — Nestlings will eat one half of their own weight of food per day, and even more if they can get it. A case is on record of a young Robin that was brought up by hand and was fed on cutworms and earthworms, of which he was allowed 50 to 75 a day. When three weeks old a test was made to see what quantity he really *could* eat. His own weight was then three ounces, and in the course of the day he ate just five and one half ounces of cutworms or 165 in number. To make room for so much food it is digested in a remarkably short time. The wonderful growth and development of young birds is accounted for by the satisfaction of their enormous appetite.

The writer once watched a nest of Wrens for a week and counted the number of trips per day that the old birds made with food for the young. They began at daylight and worked the greater part of the day till dark, bringing 250 insects. This gives 50 insects to each of the five young ones. Let us feed them at this rate till they go South, which will be in about 100 days, and 25,000 insects will be required for this brood.

Now, Wrens rear at least two broods a year, and the second will be here about 60 days and consume 15,000 insects. The hard-working parents will need at least the same rations during the five months they spend with us, and that will take 15,000 more. Adding these we have 55,000 to the credit of a single pair of Wrens for the season.

Chickadees and Cankerworms. — We are all familiar with the havoc wrought by cankerworms or measuring worms, for occasionally we have seen them strip our trees of their foliage. This would probably happen every year and our trees would be killed if it were not for the birds. The Chickadee will illustrate this point, for it is fond of adult cankerworms. The female cankerworms pass the winter in the ground and in the spring crawl up the trunk of the tree and lay their eggs, which soon hatch out and become the common measuring worms. It is estimated that each Chickadee may eat 30 of the adults a day during the 25 days they crawl up the trees, and the average number of eggs laid by each female cankerworm is 185. Thus one bird would destroy 138,750 prospective eggs of this noxious insect ($30 \times 25 \times 185$).

The Meadowlark as an Example. — Let us now go to the prairies and fields and see what the birds are doing there. We will take the Meadowlark for our first illustration. The principal insects here are the grasshoppers, and the Meadowlark will easily eat 50 of these a day. Now, if the number of birds breeding in one square mile is five pairs, and the number of young that reach maturity is only three for each pair, there will be 25 birds on one square mile, eating 1250 hoppers a day; and allowing them 120 days for the season's campaign, this amounts to 150,000 insects. The amount of grass and green grain these would consume is computed in this way: the average weight of a grasshopper is 15.4 grains, and his

daily food is fully equal to his own weight, so that our hoppers would eat 150,000 times 15.4 grains, which equals 2,310,000 grains or 330 pounds. As some of them are not destroyed till late toward autumn, let us assume that on the average their foraging season is shortened by only 60 days. Then, during that time they would have eaten 60 times 330 pounds, or 9.9 tons. But that is not all. If these insects were not destroyed, they would multiply and soon reach such numbers that they might devour all vegetation, as in former years they have repeatedly done over large areas.

Our Hawks and Owls. — Let us now consider our birds of prey. The prejudice against them is general, and is shared by those who should appreciate them best. This is of course due to lack of discrimination. It is true here that “a little learning” — on the part of the man with a gun — “is a dangerous thing” — to the bird. Simply because a few kinds of hawks like a chicken dinner, many people call half our species “hen hawks” and the rest of them “chicken hawks.” Now, there are 18 species of the Hawk family and 11 of the Owls recorded for North Dakota, and only three of these feed to such a great extent upon birds that they do more harm than good. They are the Sharp-shinned Hawk, Cooper’s Hawk, and the Goshawk. These are all inhabitants of wooded sections, and the last one is rare even there. So they are not of much interest in our prairie states.

As far as Hen Hawks or Chicken Hawks are concerned, these names belong to the Red-tailed and Red-shouldered Hawks, and are not deserved by these birds. About 90 per cent of their food consists of injurious mammals and insects, and only about $1\frac{1}{2}$ per cent of game birds and poultry. Besides, these hawks belong to the woods and not to great open fields. They are therefore not seen in our prairie sections. The case then

stands this way: many hawks are killed every year for Hen Hawks that are not Hen Hawks at all; and even those that do properly bear this name take high rank as public benefactors.

We have a few other Hawks and one Owl whose bad deeds may almost balance their good ones, but they are rare in our northwestern states. Most of them belong to wooded regions. We may lay down the general principle that the birds of prey dangerous to poultry are not prairie species.

Swainson's Hawk, and Grasshoppers. — As an example of the beneficent work of Hawks let us take Swainson's Hawk, one of the two most common on our prairies. He feeds upon insects and small mammals, chief among which are grasshoppers and gophers. He specializes in grasshoppers. As many as 130 of these insects have been found in his stomach after a single meal. If there were a hundred of these birds to the township, each eating 200 grasshoppers a day for a period of 120 days, then there would be 2,400,000 dead grasshoppers to their credit in that town, which, at 15.4 grains apiece, would weigh 2.64 tons. Now, a grasshopper, alive and with normal appetite, eats its own weight in produce every day; that is, the 2,400,000 hoppers would eat 2.64 tons a day. Assuming that on the average their foraging season is shortened by 60 days, we save 158.4 tons of produce that they would have eaten.

The Marsh Hawk and the Gophers. — Thousands of dollars have been spent in these states for strychnine and in bounties for gophers. Now, many of our Hawks and Owls wage a continuous warfare upon gophers or ground squirrels. The Marsh Hawk is a good example of these. He is the other of the two commonest Hawks on our prairies. A gopher a day would, of course, be a very stingy ration to allow him, but if

there are 100 of these Hawks to the township, living with us only 150 days during the season, they would dispose of 15,000 gophers.

The Owls will pass a similar examination. It is a well-known fact that they supplement the work of the Hawks, the latter hunting by day and the former in the dawn and twilight.

All the Birds Together. — Of course, no bird confines itself to just a single article of food; but if we allow it a mixed diet of grasshoppers, crickets, beetles, gophers, mice, etc. we shall not diminish the value of its services. Nor is there just one kind of bird in a given area, but many kinds. Estimating one and one half birds to the acre, as is considered a fair average, we have 34,560 to a township. If we allow each of these 25 insects a day for a period of 150 days, they would dispose of 129,600,000 insects in a season.

In fact, the work of the birds is so effective that the insects usually become pretty well cleaned out before the close of the summer, and the scarcity of their favorite food is the chief cause that drives the birds south in the fall.

CHAPTER XXVIII

PRACTICAL SUGGESTIONS FOR STUDYING BIRDS

Season for Beginning. — The best time of the year to begin bird study is the spring. The males, the more easily recognized, are then most in evidence, they then sing the best, their colors are brightest and most characteristic, and there are no young to confuse you. In the groves you can see them best before the leaves are out.

Locality. — Remember that some birds are to be found on the prairie and in fields, others in trees and shrubbery, some in marshy places, and others near the water or on the water. The best kind of place is one that combines several of these features. On the open, level prairie, far away from trees and shrubbery and water, the variety of birds is comparatively small.

Time of Day. — The best time of day is the early morning, beginning about sunrise. The next best is in the evening before sunset. Birds are wonderfully appreciative of a beautiful morning, and show their happiness by the greatest activity in song and movement.

Discovering Them. — The usual way is to walk along quietly, being constantly on the alert for call notes and songs as well as for a view of birds. Beginners usually make the mistake of depending too much upon their eyes. Especially among trees and bushes, we generally hear birds before we see them. In such a locality it is often a good plan to sit down and quietly wait for the birds to come near.

Mimicking the Birds. — It is helpful to imitate or mimic the call notes or song. It often brings into view birds that you did not see before. Even if you do not completely deceive them, they will want to know the source of the sound. If you can do no better, make a squeaking noise by kissing your fingers. A mechanical bird whistle is also recommended.



A GOOD PLACE FOR BIRD STUDY
Campus of the University of North Dakota.

Frightening the Birds. — Remember that birds are timid creatures, and that they generally see you before you see them. If you must get near them, approach very gradually and with easy, quiet movements. Even the color of your clothing should be quiet and not bright. One or two persons will succeed much better than a crowd. The larger the number, the greater the necessity for quiet behavior.

The Best Light. — You can see the bird best with the sun

at your back. Furthermore, it is often hard to distinguish the colors when seen against the bright sky. In such a case you must try to observe the bird with foliage or grass in the background.

What to Notice. — See your bird definitely, noting :

Size. — Estimate length in inches, using the English Sparrow ($6\frac{1}{4}$ inches), Robin (10 inches), and Meadowlark ($10\frac{3}{4}$ inches), as standards of comparison. Most beginners underestimate the length of a bird; it is taken from the tip of the bill to the end of the tail.

Bill. — Length as compared with length of head; stout and conical, or slender; straight, or curved.

Wing. — Length as compared with tail.

Colors and Markings. — Of head, back, rump, tail, wings, breast, belly, wing bars, if any; tip of tail, rounded, square, or notched.

Song and Call Notes.

Habits. — Of perching, flying, feeding, walking or hopping, etc.

Opera Glass. — Unless your eyes are particularly sharp, you will find an opera glass or field glass a great help. It will enable you to see the finer points on which identification often depends.

Notebook. — Immediately after an important observation make a note of what you have seen. If you are to write it down you will be more sure to see with exactness. Then, too, a written memorandum is far more reliable than memory.

The Bird Family. — If you familiarize yourself with the family characteristics as described in this book it will be easy to recognize the family to which your bird belongs, and it will be gratifying to know, at least, that it is a Wood Warbler, for example, or Vireo or Flycatcher or Sparrow. More specific identification may come later. It is sometimes very difficult.

CHAPTER XXIX

BIRDS OF THE NORTHERN STATES

This chapter is intended to give the student a clear idea of the different classes of birds and to help him get acquainted with some of the commonest species found in his vicinity. Those most apt to be found in ordinary localities are briefly described, and others are listed so as to make a fairly complete catalog for the northern states. It includes every bird that has been observed in North Dakota.

The student will, of course, meet many that are omitted from the descriptions and from the key, but the beginner cannot identify every bird seen even though he have a complete bird manual. It would be well, however, to have one or two such manuals in the school library to use for reference whenever desired. In using such manuals our catalog will be found very helpful, for it tells the student what birds he may expect to find in our region.

The Key includes only the land birds that we describe and is, therefore, quite incomplete. Its simplicity and brevity, however, will be appreciated by all who have but limited acquaintance with the subject and that is the class of people for whom it is especially designed.

The Numbers preceding the names are the standard check list numbers, usually found in larger bird books. They will be useful in referring to such books for further descriptions.

ABBREVIATIONS

- M. — Migrant, to be seen only on its spring and fall migrations.
 P.R. — Permanent Resident, found in our region throughout the year.
 S.R. — Summer Resident, breeds in our region and goes south for the winter.
 W.V. — Winter Visitant, comes to our region in winter from the North.
 S.R. and P.R. — Some birds of this species reside here only during the summer, but others are seen the year round.

Field Key for Identification of our Commonest Land Birds1. *Birds Usually Found Near Our Homes*CHECK LIST
NUMBER

- English Sparrow — most common of all birds. See p. 314.
 761 Robin — known by his rusty red breast.
 721 House Wren — small; olive brown; a tireless singer.
 560 Chipping Sparrow — likes bushes and vines.
 766 Bluebird — dull blue above; brownish beneath.
 456 Phoebe — dusky olive above; calls *Phæbe*.
 613 Barn Swallow — nests inside of barns.
 612 Cliff Swallow — builds nest under eaves.
 510 Brewer Blackbird — often walks around in our dooryards.
 611 Purple Martin — nests especially in martin houses.
2. *Birds of Open Fields, Prairies, and Pastures*
- 501, 501 *b* Meadowlark — yellow breast with black crescent.
 514-615 Many Sparrows — especially Vesper Sparrow, Grasshopper Sparrow, Tree Sparrow, Lapland Longspur, Smith's Longspur.
 474 *b* Prairie Horned Lark — black and white head.
 495 Cowbird — a brownish headed blackbird.
 604 Dickcissel — yellow on breast and near eyes; black throat patch.
 494 Bobolink — black bird with white on the back.
 605 Lark Bunting — a black bird with white wing patch.
 273 Killdeer — a shore bird found far away from water.
 378 Burrowing Owl — nests in badger holes, etc.
 367 Short-eared Owl — very tame; "ears" not usually seen.
 420 Nighthawk — usually seen on the wing.

CHECK LIST
NUMBER

- 331 Marsh Hawk — often flies low; shows white on the back.
 342 Swainson's Hawk — mottled; dark colored; dark tail bars.
 305, 308 Prairie Hens and Grouse — need no key.
 261 Upland Plover — a shore bird found far away from water.

3. *Birds Spending Much of Their Time on the Wing*

- 420 Nighthawk — flies high; white patch on wing.
 611-617 The Swallow — usually flies low.
 423 Chimney Swift — flies in companies; small.

4. *Birds that Climb Trunks and Larger Branches of Trees*

- 393-413 The Woodpeckers — red on the head; very large bill.
 636 Black and White Warbler — streaked black and white.
 726 Brown Creeper — streaked brown and white.
 727-728 The Nuthatches — head black and white; tail short and square.

5. *Birds Marked with Red or Orange*

- 393-413 The Woodpeckers — red on the head, very large bill.
 498 Red-winged Blackbird — red patch on bend of wing.
 507 Baltimore Oriole — orange-red, and black.
 761 Robin — rusty red breast.
 749 Ruby-crowned Kinglet — small red patch on top of head.
 608 Scarlet Tanager — scarlet except black wings and tail.
 687 Redstart — orange on sides, wings, and tail.
 595 Rose-breasted Grosbeak — rose-red blotch on the breast.

6. *Birds with Yellow as Prominent Color*

- 529 Goldfinch — all yellow except black cap, wings, and tail.
 652 Yellow Warbler — male is yellow all over.
 637-687 The Other Warblers — much yellow or yellowish green.
 501, 501 b Meadowlark — yellow breast with black crescent.
 447 Arkansas Kingbird — pale lemon-yellow below.
 604 Dickcissel — yellow on breast and near eyes; black throat patch.
 497 Yellow-headed Blackbird — as indicated by the name.
 748 Golden-crowned Kinglet — small yellow patch on top of head.

7. *Birds with Blue as Prominent Color*CHECK LIST
NUMBER

- 390 Kingfisher — back, sides, and breast band a grayish blue.
 477 Blue Jay — blue above, black collar.
 612-614 The Swallows — several of them have steel-blue backs.
 766 Bluebird — blue above, rusty brownish breast.
 727-728 The Nuthatches — ashy blue above, black and white head.
 655 Myrtle Warbler — back is blue, black, and yellow.

8. *Birds that are Brown, or Streaked Brown*

- 514-605 The Sparrows — brown and gray, streaked and mottled.
 715-725 The Wrens — small brown birds; faint cross bars.
 316 Mourning Dove — soft brown above, paler below.
 705 Brown Thrasher — bright reddish brown above, spotted below.
 387-388 The Cuckoos — brown above, gray below.
 555, 556 Wood Thrush and Veery are bright brown above.
 726 Brown Creeper — streaked brown and white.

9. *Birds Colored Black or Chiefly Black*

- 494-511 *b* The Blackbirds and Grackles.
 488 Crow — very large; black all over.
 494 Bobolink — black bird with white on back and wings.
 605 Lark Bunting — black bird with white patch on the wing.
 704 Catbird — grayish black; slender bird.
 611 Purple Martin — blue-black; notched tail.
 474 Magpie — very large; black and white.

10. *Birds Chiefly Dull-green or Gray*

- 444-468 The Flycatchers.
 624-633 The Vireos — greenish backs; dull white under parts.
 748-749 The Kinglets — olive-green backs; tiny birds.

11. *Birds Chiefly Grayish Black or Gray*

- 704 Catbird — grayish black, head and tail darker.
 567 Junco — grayish black, except white belly.
 444 Kingbird — blackish above; white under parts and tip of tail.
 735 Chickadee — gray back; black cap and throat; white cheeks.
 621-622 The Shrikes — gray above; white below; black on sides of head.

THE WATER BIRDS

DIVING BIRDS

This term refers only to our most expert divers, the Grebes and Loons, and is not applied to other birds that may have ordinary ability as divers, as, for example, many of the Ducks. The divers shoot through the water with greater speed and can remain out of sight for a longer time. Their feet have three webbed toes and are placed far back, near the tail, and they rarely venture upon land, where they are almost helpless. When alarmed they generally dive instead of trying to escape by flight.

They are the most ancient submarines in the history of navigation; the Grebes even employ their heads as periscopes.

Grebe Family. — The web does not completely connect the toes but forms scalloped flaps or lobes on them. On land they may scramble along by using their wings as fore legs. On the wing they resemble ducks.

6 *Pied-billed Grebe. Hell-diver.* Length $13\frac{1}{2}$ inches.

Occurs on all our lakes and smaller bodies of water, not in large flocks, but in pairs or in small families. Grebes and Loons are our champion divers. When disturbed the Hell-diver simply sinks out of sight and then swims almost any distance with only the tip of the bill above

the surface. In this way he sometimes seems to disappear, mysteriously and completely. Upper parts brownish black, belly white. Nest, a pile of decaying vegetation placed on the water. Common S.R.

1 Western Grebe. S.R.

3 Horned Grebe. S.R.

2 Holboell Grebe. S.R.

4 American Eared Grebe. S.R.

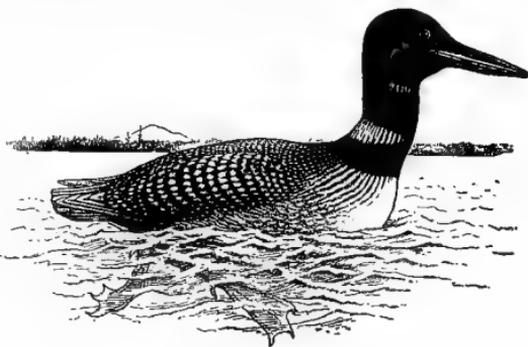
Loon Family. — Loons are much larger than the Grebes, and are their equals as expert divers and swimmers. On land not only the wings but also the bill assists the awkward legs. They have three toes completely webbed.



PIED-BILLED GREBE

7 *Loon*. Length 32 inches.

This is the largest bird of the Grebe and Loon families. It is seen only on fairly deep water and seldom flies if disturbed, but dives. Its commoner call is usually written *who, who, who, who*, "the syllables being so rapidly pronounced as to sound almost as the trembling of the voice—a sort of weird laughter." The bird is black above, beautifully marked with numerous streaks and spots and bars; belly, pure white. Eggs laid on the ground within a few feet of the water so it can easily slide from the nest into its true element. Common S.R.

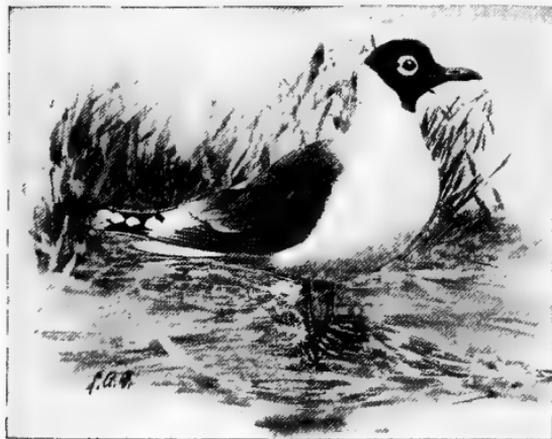


LOON

SWIMMING BIRDS

This class includes the Gull, Cormorant, Pelican, and Duck families. These birds are perfectly at home on the water, their feet being made

into efficient paddles by connecting at least the three front toes with a web. Many of them find their food either on the surface or by diving for it.

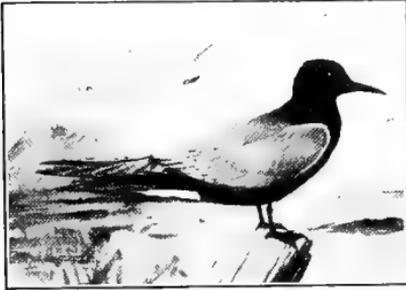


FRANKLIN GULL

Gull Family.—These are the large birds, mostly white in color, that are so common on our lakes; often mis-called "sea-gulls." They have long wings, and fly as easily as swal-

lows or hawks. The terns have long, forked or notched tails, while the gulls have square tails. The terns are on the wing much of the time;

the gulls spend most of theirs on the water. In flight the terns hold their heads pointing downward; gulls hold theirs in line with the body. The terns are more noisy and their voices are shrill. The gulls have hoarse voices. The terns are even more graceful than the gulls. As a rule, they are smaller and more slender.



BLACK TERN

59 *Franklin Gull*. Length 14 inches.

Mostly white with a black head; often visits prairies and plowed fields in search of hoppers and other insect food, and is a bird of great value.

77 *Black Tern*. Length 10 inches.

This swallow-like little tern often gets far away from the water and we may see it slowly skimming over prairies and fields. It is almost black, with a white patch under the tail. Very small for a bird of this group. S.R.

40 Kittiwake. M. and S.R.

47 Great Black-backed Gull. M.

51 *a* American Herring Gull. M. and S.R.

54 Ring-billed Gull. S.R.

58 Laughing Gull. M. and S.R.

60 Bonaparte Gull. M.

64 Caspian Tern. M. and perhaps S.R.

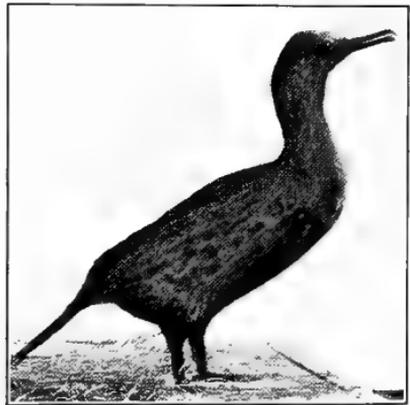
69 Forster Tern. S.R.

70 Common Tern. S.R.

71 Arctic Tern. S.R.

74 Least Tern. S.R.

Cormorant Family.— These are large birds with long necks, hooked bills, and short legs placed so far back that they must take an erect position when standing and use the tail for partial support. When swimming under water in pursuit of their prey of fish they make use of their wings as well as their feet. They have all four toes connected by webs. On the wing they look like large black ducks.



DOUBLE-CRESTED CORMORANT

120 Double-crested Cormorant. S.R.

Pelican Family. — These are very large birds, the White Pelican being five feet in length. Their most striking feature is their long bill with its peculiar pouch, that is used as a dip-net to catch fish. They have a long neck and short legs and tail.

125 American White Pelican. M. and occasional S.R.

Duck Family. — A large group of popular game birds which includes about 200 North American species and is divided into five subfamilies.

1. *The Mergansers* — live on fish which they dive for and catch under water. Only the Hooded Merganser is good to eat; the rest are too “fishy.” (Nos. 129-131 in the list which follows.)

2. *River Ducks or Pond Ducks* — do not dive for food but merely “tip up” the body and probe with the bill at the bottom of shallow water. All are good table food. Most of the ducks in our section belong here. (Nos. 132-146.)



AMERICAN WHITE PELICAN



HOODED MERGANSER



MALLARD

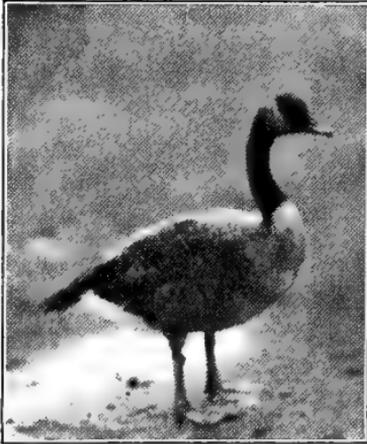


CANVAS-BACK

3. *Sea Ducks* — dive, often to great depths, for their food, consisting mainly of animal matter such as snails, crustaceans, etc., but not in-

cluding fish. The Canvas-backs are the only Sea Ducks that are very good eating; the flesh of some species is quite rank and coarse. (Nos. 147-167.)

4. *Geese and Brant* — vegetarians, and get a good portion of their food on land. When feeding on the water they "tip up" like River Ducks. Most of them are larger than the ducks and all are prized for food. (Nos. 169-174.)



CANADA GOOSE



WHISTLING SWAN

5. *Swans* — the largest birds of the family, have very long and beautifully curved necks and are distinguished for their grace of form and movement when on the water. In migration they fly at great height. Their food is largely vegetable matter. (Nos. 180-181.)

For a description of the many different kinds, this book cannot afford the space. When specimens can be secured from hunters, it will be instructive to examine them carefully with the help of a good bird manual and to identify the species.

129	American Merganser.	M. and S.R.	135	Gadwall.	S.R.
130	Red-breasted Merganser.	S.R.	137	Baldpate.	S.R.
131	Hooded Merganser.	Frequent S.R.	139	Green-winged Teal.	Common S.R.
132	Mallard.	Common. S.R.	140	Blue-winged Teal.	Common S.R.
133	Black Duck.	Rare. S.R.			

141	Cinnamon Teal. Rare. S.R.	167	Ruddy Duck. S.R.
142	Shoveller. S.R.	169	Snow Goose. Common. M.
143	Pintail. Common. S.R.	169a	Greater Snow Goose. M.
144	Wood Duck. Rare. S.R.	169.1	Blue Goose. M.
146	Redhead. M. and perhaps S.R.	171 a	American White-fronted Goose. M.
147	Canvas-back. M.	172	Canada Goose. Common M. and S.R.
148	American Scaup Duck. S.R.	172'a	Hutchins Goose. M.
149	Lesser Scaup Duck. S.R.	172 c	Cackling Goose. Casual M.
150	Ring-necked Duck. Rare. S.R.	173	Brant. M.
151	American Golden-eye. M. and S.R.	174	Black Brant. Rare M.
152	Barrow Golden-eye. Rare M. and S. R.	180	Whistling Swan. Casual M.
153	Buffle-head. M. and S.R.	181	Trumpeter Swan. Frequent M., formerly S.R.
166	White-winged Scoter. M.		

WADERS AND SHORE BIRDS

These include certain long-legged, long-necked, long-billed, and short-tailed birds, usually living in open places on the shores of rivers and lakes, though some of them are often found far away from water, in marshes or even on uplands. Their long legs are used for wading, and their long bills for probing for food in the mud on the shore or at the bottom of shallow water. The long-toed feet make it easy for them to walk over soft mud, but they are not webbed for swimming. The characteristics of the class do not hold true of every individual species; a few marked exceptions are noted under the different families. This order includes all the families on the following pages down to the Land Birds.

Heron Family. — Large birds with the long pointed bill, long neck, and long legs of typical waders. The herons are found near water, but the bitterns, which also belong to the family, occupy grassy meadows and marshes.

190 *American Bittern. Shide Poke. Stake Driver.* Length 24-34 inches.

A large, solitary, retiring bird often seen in marshy areas. He is like "patience on a monument" and will stand for an hour or two on one leg and wait for a frog or a snake to come within reach, when, like a flash, it goes into his crop. In spring, he produces the booming or

“pumping” sounds that we may hear a long distance from his haunts. The back is mostly brown; a velvety black streak on the side of the neck; under parts buffy with darker streaks; wings and tail short;



AMERICAN BITTERN



SANDHILL CRANE

bill large and pointed. A beautifully colored but clumsy looking creature. Common S.R.

191 Least Bittern. S.R.

201 Green Heron. Rare S.R.

194 Great Blue Heron. M. and S.R.

202 Black-crowned Night Heron.

196 American Egret. M.

S.R.

Crane Family. — Very large birds with very long neck and long legs, inhabiting prairies, and marshes. They are considered good eating, and are prized as game birds.

204 Whooping Crane. M. and S.R.

206 Sandhill Crane. M. and S.R.

205 Little Brown Crane. M.

Rail Family. — Legs only moderately long, bill rather short, toes long. The rails live in marshy places, but the feet of coots are partially webbed, and they have the swimming habits of ducks.

212 *Virginia Rail.* Length $9\frac{1}{2}$ inches.

Lives and nests in swamps and marshes and is seldom seen but often heard. The morning and evening notes are a succession of grunting sounds like those of a hungry pig, and during the breeding season, the

cry of the male, *cut, cutta, cutta, cutta*, may be heard after sunset or even at night. It is beautifully colored. Upper parts grayish brown, the feathers on the back having blackish centers; throat white, rest of under parts reddish. S.R.

214 *Sora. Carolina Rail.* Length $8\frac{1}{2}$ inches.

These are the Rails whose loud whistled *ker-wee* and penetrating whinny we often hear afternoons and evenings in marshy places. But we can seldom get sight of the birds themselves; they skulk among the rushes and grasses. In autumn they stray away from their haunts, even into towns; then many of them lose their lives,

and dead specimens are thus found. Upper parts olive brown, with dashes of black and fine whitish lines; forehead and throat black; and under parts slaty gray, changing to white near the tail, the flanks being barred with black and white. Common S.R.



VIRGINIA RAIL



SORA



AMERICAN COOT



WILSON PHALAROPE

221 *American Coot. Mud-hen.* Length 15 inches.

Often associated on the water with ducks and looks more or less like them, though it is darker and smaller than most ducks. May easily be distinguished by the bobbing motion it makes with its head when swim-

ming, and by the way it partly flies and partly runs over the water when disturbed. It has long legs, long toes with scalloped flaps, and a bill like a chicken's. Mud-hens are the most numerous swimmers on our lakes, but are very hard to get with a gun. If you ever try to eat one of them you will never long for another. Very common S.R.



AMERICAN AVOCET

215 Yellow Rail. M.

Phalarope Family. — Small wading and swimming birds with long legs and long, slender bills. On shore they appear like Sandpipers, but they have webbed feet like Coots and Grebes ("lobed") and are good swimmers. The male makes the nest and hatches the young. The female does the courting. She is the new woman in bird society.

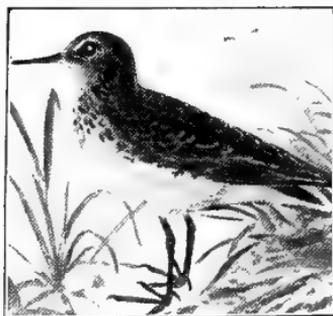
223 Northern Phalarope. M.

224 Wilson Phalarope. S.R.

Stilt Family. — Legs are extremely long, suggesting stilts; bills are long and slender and are bent upward. They find their food at the bottom of shallow water. The avocets are good swimmers as well as waders.

225 American Avocet. S.R.

Snipe Family. — A large family of shore birds generally long-legged, long-billed, and short-tailed, but varying greatly among themselves. Their toes have little or no webbing. Their colors are browns, dull yellows, and grays. The Woodcock and Snipes (Nos. 228-232) have very long bills, but their legs are comparatively short. They have plump bodies and are prized as game birds.



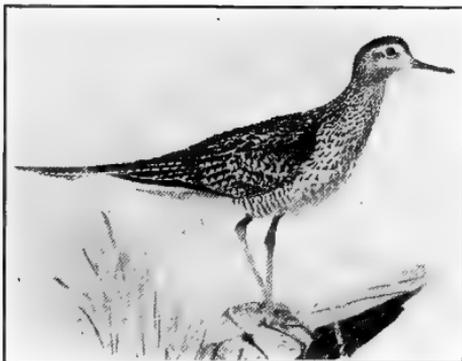
LEAST SANDPIPER

The Sandpipers have shorter bills, their bodies are more slender, and their movements quick and graceful. After a run, many of them have a characteristic habit of teetering the body in a see-saw manner. Most of the Sandpipers like to paddle in the

shallow water on sandy shores where their clear piping, *weet, weet*, or *tweet, tweet*, are very familiar sounds. Godwits have bills that are curved slightly upward, while the long bill of the Curlews is bent downward quite strongly. It is difficult for the amateur to identify the various species, but if he sees one of them he should at least recognize it as belonging to this group.

242 *Least Sandpiper*. Length 6 inches.

These are the smallest of our shore birds and are generally seen in flocks near our waters in spring and fall, but in the summer most of them go farther north to breed. The colors of the upper parts are browns and black; under parts white, the breast being streaked with brown. M. and S.R.



UPLAND PLOVER

261 *Upland Plover*. *Bartramian Sandpiper*. Length 11½ inches.

This bird lives on our prairies and is seldom found near the water. Its presence in the neighborhood may be known by its loud, prolonged, weird, whistling cry, — chr—r-r-r-ee-e-e-e-o-o-o-ee. May be recognized by its peculiar appearance when alighting: it stretches its wings high over its back as if to smooth every feather before gently folding them. A popular game bird. Is of great value as an insect destroyer, but has been almost exterminated by hunters. Colors, brown and buff above; creamy white below, much spotted with dark brown. Common S.R.



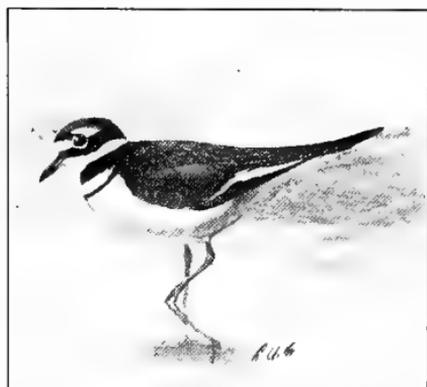
SPOTTED SANDPIPER

263 *Spotted Sandpiper*. Length 7½ inches.

In summer this is the principal sandpiper near our rivers, lakes, and ponds. A rapid runner and a comical teeterer. Its sharp *peet-weet* is given when flushed. Brownish gray back; white under parts much spotted with black. Very common S.R.

- | | | | |
|-----|--|------------------|---|
| 228 | American Woodcock. Very rare
S.R. | 249 | Marbled Godwit. M. and S.R. |
| 230 | Wilson Snipe. M. and S.R. | 251 | Hudsonian Godwit. Rare M. |
| 232 | Long-billed Dowitcher. M. and
S.R. | 254 | Greater Yellow-legs. M. |
| 233 | Stilt Sandpiper. M. | 255 | Yellow-legs. M. |
| 239 | Pectoral Sandpiper. M. and S.
R. | 256 | Solitary Sandpiper. Common
M. and S.R. |
| 240 | White-rumped Sandpiper. Rare
M. | 258 | Willet. S.R. |
| 241 | Baird Sandpiper. M. | 258 ^a | Western Willet. S.R. |
| 246 | Semipalmated Sandpiper. M.
and S.R. | 262 | Buff-breasted Sandpiper. Rare
M. |
| 248 | Sanderling. M. | 264 | Long-billed Curlew. S.R. |
| | | 265 | Hudsonian Curlew. M. |
| | | 266 | Eskimo Curlew. M. |

Plover Family. — Shore birds with bills too short to be useful for probing. They have round heads, short necks, plump bodies, long



KILLDEER



TURNSTONE

wings, and rather short legs for waders. The Killdeer and some of the others frequent uplands as much as shores and marshes.

273 *Killdeer*. Length 10½ inches.

The most abundant and most widely distributed bird of this group; found on uplands as well as near the water. Is quite noisy, and easily recognized by the shrill call-notes which he keeps repeating, "killdeer killdeer, killdeer," though often we hear only the last syllable. Back is brown; lower parts white; two dark bands across the breast, the upper

one extending around the neck. Bill rather short. Nest on the ground. Very Common S.R.

- | | | | | | |
|-----|-------------------------|----|------|-----------------------|------|
| 270 | Black-bellied Plover. | M. | 274 | Semipalmated Plover. | Rare |
| 272 | American Golden Plover. | M. | | M. | |
| | | | 277a | Belted Piping Plover. | S.R. |

Turnstone Family. — A small family of shore birds with short bills and (for shore birds) short legs, having the habit of turning over stones and shells in search of food. They are often associated with Sandpipers.

- 283.1 Ruddy Turnstone. Rare M.

THE LAND BIRDS

SCRATCHING BIRDS

From the standpoint of human food, this is easily our most important order of birds, for it includes not only some of our most popular wild game but also the principal part of our farm poultry. All the birds of this order have the habit of scratching the ground in search of food, a practice which is scarcely ever seen in any other birds. There are two great groups of scratching birds. One of these includes the famous Jungle Fowl of Southern Asia, from which our domestic chickens have descended, and the wild turkeys of America from which our tame turkeys have been developed, and it also includes the ancestors of the Guinea Fowl and the Peacock. This group receives attention in our chapter on Poultry. The other includes the Grouse family, of which we have a number of species that are native in the northern states.

Grouse Family. — These are birds with heavy bodies, and are fine game birds. Their similarity to our domestic chickens is quite striking, and like them, they scratch the ground to seek food. Hoppers, beetles, and other insects form a good portion of their diet, but they also eat seeds and other vegetable food. They stay upon the ground, depend upon their sober colors to escape observation, and are apt to hide rather than fly when danger seems near. Their flight is very swift and they use their short wings with such rapidity as to cause a whirring sound. They are not able to make long journeys, however, and do not migrate except, perhaps, from prairies to near-by wooded areas. Pheasant, Partridge, and Quail are popular names of some of these birds, but just which kind

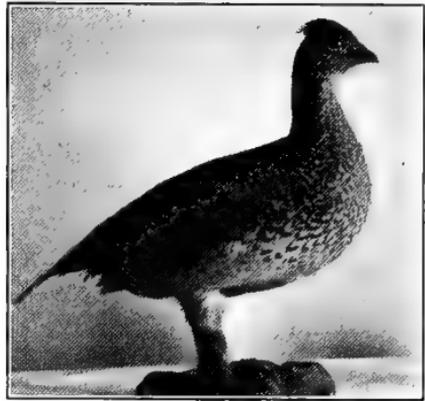
they designate depends upon the country where they are employed. For example, the Ruffed Grouse is often called "partridge" in the North and "pheasant" in the South, but in Europe both of these names refer to entirely different birds.

305 *Prairie Chicken. Prairie Hen.* Length 18 inches.

Has a broad tail, and the dark marks on its plumage form cross bars which are especially plain on the breast. In early spring the males make a loud booming sound which is very familiar in chicken countries. This



PRAIRIE CHICKEN



PRAIRIE SHARP-TAILED GROUSE

species was formerly found on all the prairies of the Mississippi valley, its range extending westward to the central part of the Dakotas and Nebraska, but it is no longer common except in the newer sections. A great favorite with hunters. P.R.

308 *b Prairie Sharp-tailed Grouse.* Length $7\frac{1}{2}$ inches.

A game bird similar to the preceding, both species being often called "chickens" without distinction. But this grouse's tail is pointed and the dark marks on the plumage are V-shaped; the legs are feathered more, and the general color is paler than in case of the Prairie Chicken. Its range extends farther west than that of the Chicken and east of the Dakotas it is becoming pretty rare. In winter it generally leaves the prairie and betakes itself to wooded or bushy regions. P.R.

- | | | | |
|-----|---|-------|--------------------------------------|
| 289 | Bob-white. Introduced in the Dakotas. Rare P.R. | 300 a | Canadian Ruffed Grouse. Rare P.R. |
| 300 | Ruffed Grouse. P.R. in very few parts. | 309 | Sage Grouse. P.R. in Western Dakota. |

Pigeon Family. — There are said to be about 300 species of pigeons and doves in the world, but we have only one of them in the northern states. This is not counting our domestic pigeons, which have been developed from the Rock pigeon found in the wild state in Europe. Pigeons live upon seeds; and when drinking they do not raise the head to swallow, as other birds do, but keep the bill immersed, and suck the water as horses and cattle do.

316 *Mourning Dove. Turtle Dove.*

Length 11 to 13 inches.

Looks like a small pigeon with a long tail, and walks and flies like one. Soft brown above, paler and more yellowish below; head and neck especially beautiful; a small black mark below the ear. The peculiarly mournful "coo-oo-coo-oo" of the male can be heard a long distance and gives the species its name. The nest is a frail

affair, built of a few sticks, usually on a horizontal branch, and is often blown down by the wind, — eggs or babies and all.

These doves are valuable helpers to the farmer and gardener, as they feed principally on weed seeds, and a single bird will easily consume several thousand of them in a day.



MOURNING DOVE

BIRDS OF PREY

These are large and fierce birds living exclusively upon animal food. They have very stout, hooked bills and their toes are armed with strong, curved nails or talons. To this order belong the Vulture, the Hawks, and the Owls.

Vulture Family. — Very large birds. Their appearance is repulsive and their habits are no better, for they live upon decaying flesh. Only one species occurs in the northern states.

325. *Turkey Vulture. Turkey Buzzard.* Length 30 inches.

About the size and appearance of a turkey; but looks more ugly, the head and neck being unfeathered and blood-red. "Distance lends enchantment," however, and when seen soaring high above you its easy flight is grace itself. S.R.



TURKEY VULTURE

Hawk Family. — The low form of the head and the way it is feathered, the way the eyes are set, and the hooked bill give these birds a characteristic and fierce expression. They grasp their prey with their talons and use their curved bill to tear it to pieces. They feed chiefly upon gophers, field mice, and grasshoppers and thus render a great service in clearing the land of these pests.

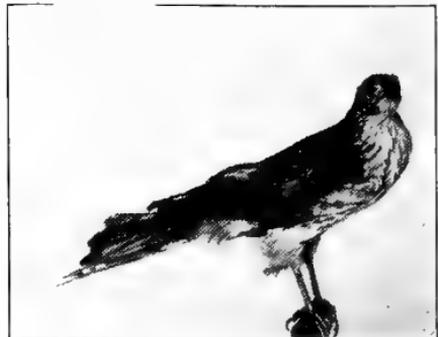
There are only a few species, namely: the Cooper hawk, the sharp-shinned hawk, the goshawk, and the eagles, that care for wild birds and poultry, and in many sections these are never seen; but they have given the whole family a bad reputation.

331 *Marsh Hawk.* Length, male, 19 inches; female, 22 inches.

A large, light-colored hawk easily identified by its white rump, which is especially conspicuous in flight. Wings quite dark, rest of upper parts



MARSH HAWK



SHARP-SHINNED HAWK

gray; most of lower parts white, spotted and barred with reddish; tail silver gray irregularly barred with blackish. This hawk flies low over prairies, fields and marshes; it perches low and may often be seen alighting on a slight elevation or in the grass. Feeds on insects, mice, gophers, etc. Nest, on the ground, in marshes. A good friend of the farmer. Common S.R.

332 *Sharp-shinned Hawk*. Length, male, 11 inches; female, 13½ inches.

This is a small hawk living in wooded regions, where it nests in trees. It flies swiftly and low; is very daring, and creates consternation when



SWAINSON HAWK



SPARROW HAWK

it comes among other birds. Lives on insects, mice and birds, including poultry when available. Grayish brown above, whitish, streaked with brown below; tail has blackish cross bars and a white tip; legs and tail especially long. S.R.

342 *Swainson Hawk*. Length, male, 19 inches; female, 22 inches.

A large, dark-colored hawk. Under side somewhat lighter, — a cinnamon-red or brown patch on the breast, the rest blotched and barred with brown and blackish and whitish markings; tail has numerous blackish bars. The color of this bird is very variable, sometimes the entire plumage is blackish. This is the most common hawk on the prairies of the Dakotas, also occurring eastward at least to the Mississippi River. Lives almost exclusively on gophers, mice, and insects, and is one of our most valuable birds. Common S.R.

360 *Sparrow Hawk*. Length 10 inches.

A very beautiful little hawk with much chestnut on back and tail; wings slaty blue, but the large feathers black and white; tip of tail white, a black band near the white; two conspicuous dark marks on the head; under parts buffy. This is our smallest hawk; lives in wooded regions; nests in hollow trees; feeds on insects and mice, and occasionally a small bird. Call is a rather high, rapidly repeated *killy, killy, killy*. Common S.R.

327	Swallow-tailed Kite.	Rare S.R.	348	Ferruginous Rough-leg.	S.R.
333	Cooper Hawk.	S.R. in a few localities.	349	Golden Eagle.	S.R. and P.R. Not common.
334	American Goshawk.	Occasional W.V.	352	Bald Eagle.	S.R. and P.R. Not common.
337	Red-tailed Hawk.	Rare S.R.	355	Prairie Falcon.	M.
337 a	Krider Hawk.	S.R.	356	Duck Hawk.	Rare S.R.
337 b	Western Red-tail.	S.R.	357	Pigeon Hawk.	Rare M.
339	Red-shouldered Hawk.	S.R.	358	Richardson Pigeon Hawk.	Rare M.
343	Broad-winged Hawk.	S.R.	364	American Osprey.	M.

Owl Family. — The owls are easily distinguished by their frank and open countenance. The face is so broad that the eyes look forward instead of sidewise as in other birds; furthermore, the eyes are surrounded by radiating feathers forming a large circular disk that makes them very prominent. They are not movable in their sockets and when the bird wishes to look in a new direction it has to turn the whole head. Many owls have tufts of feathers so placed as to look like horns or ears. The plumage of owls is soft and fluffy and their flight noiseless. All except the Great Horned Owl are very useful birds, as they feed upon gophers, rats, mice, grasshoppers, and other pests.

“A wise old owl lived in an oak;
The more he heard the less he spoke;
The less he spoke the more he heard,
Why aren't we all more like this bird?”

367 *Short-eared Owl*. Length 14-17 inches.

A common owl of our prairies, especially of marshy sections. Often seen in the daytime flying low over the ground and looking for gophers,

mice, and grasshoppers. Is not shy and will allow a person to come quite close, then it flies a short distance and lets him come up again. In this way the writer once caught one with his bare hands. The ear-tufts are scarcely longer than the other feathers, and one often fails to find the "ears." Upper parts brownish and buff, under parts whitish or buffy streaked with brown; tail has buff and brown bands or bars. Nest on the ground. Common S.R. and P.R.

373 *Screech Owl*. Length $7\frac{1}{2}$ to 10 inches.

May be known by its small sizes and distinct ear-tufts, and the weird whistling or screeching notes of its night call. It prefers orchards or tree plantings near our dwellings to dense woods. Nests in trees. Feeds on mice and insects. Color of upper parts varies from gray to bright rusty brown; below, gray marked with brown and black. Rare in the Dakotas but common eastward. P.R.



SHORT-EARED OWL

375 *Great Horned Owl*. *Hoot Owl*. Length 18-25 inches.



SCREECH OWL

This owl lives in the woods and nests in trees. Seldom seen in the daytime. A magnificent owl and a favorite for mounted specimens. It is the only owl that kills poultry and birds in any numbers, though even this one is more apt to dine on gophers and other small mammals. It is the owl that is famous for its deep-toned whōō, hoo, hoo, whōō-ō, whōō-ō. Ear-tufts nearly two inches long; upper parts finely mottled with buff and black; under parts reddish buff barred with black; a white patch on the throat; legs and feet feathered. P.R.

376 *Snowy Owl*. Length 20-27 inches.

A very large, beautiful owl often used for a mounted specimen. Color white, barred with dark grayish brown; legs and feet heavily feathered;

no ear-tufts. Females more heavily barred than the males. Breeds in Arctic regions and comes to enjoy our winter climate when we think we must go to Florida. Frequent W.V.

378 *Burrowing Owl*. Length 9-11 inches.

A prairie owl living in deserted burrows of badgers, foxes, and gophers, and nesting there. Easily identified by this habit. Has very long unfeathered legs, short tail, and no "horns." Mostly brown above, and



GREAT HORNED OWL



SNOWY OWL



BURROWING OWL

buffy and gray below. Feeds on gophers, mice, insects, small birds, etc. Common in the Dakotas and westward, but does not occur east of western Minnesota. P.R. and S.R.

366 American Long-eared Owl. P.R. 372 Saw-whet Owl. P.R.

370 Great Gray Owl. W.V. 375 a Western Horned Owl. P.R.

371 Richardson Owl. W.V. 375 b Arctic Horned Owl. W.V.

Cuckoo Family. — These are solitary birds inhabiting wooded areas, and are much oftener heard than seen. If you come upon them they glide silently by and disappear in the depth of a neighboring bush or tree. Their strange notes, the origin of their name, may be heard a long distance and are usually written *cow, cow, cow, cow, cow, cow*, or *tut-tut, tut-tut, tut-tut, tut-tut, tut-tut*. This lingo is supposed to prove that they are running the weather bureau and so they are often called "rain crows." They are long, slim, dove-like in form; have a long tail and a long, slender, distinctly curved bill; upper parts grayish brown with a greenish

tint, tail tipped with white; under parts dull white. Their nest of sticks is on low trees or in thick bushes. Our two birds are quite similar in these particulars. The points of difference are mentioned under each species.

387 *Yellow-billed Cuckoo*. Length 12 inches.

The call notes are separated by pauses, and are more harsh than those of the next species. Wings show reddish brown, especially in flight; under mandible is yellow except at the tip; there is much black on the tail. M. and S.R.

388 *Black-billed Cuckoo*. Length 11 $\frac{3}{4}$ inches.

The *cow, cow, cow, cow* is repeated quite rapidly. Wings are the same color as the back; entire bill is black; no black on the tail. Common S.R.

Kingfisher Family. — Medium sized, solitary, fish-eating birds found only near the water. When mealtime comes they hover over the water and on spying a victim make a plunge for it and capture it with the bill.



YELLOW-BILLED CUCKOO

390 *Belted Kingfisher*. Length 13 inches.

A large, conspicuous bird, which beginners often mistake for a Blue Jay; but the Kingfisher has a much larger bill, shorter tail, and more ruffled crest. Its haunts are the shores of wooded streams and ponds where it always perches near the water to watch for small fish and make a dash for it, — which the Blue Jay never does. It is grayish blue above and white below, with a bluish band across the breast. Has a harsh, rattling cry that could never pass as a song. Nests in a hole in a bank like the Bank Swallow; but its



BELTED KINGFISHER

eggs are laid five or six feet from the entrance, while the Swallow's are only two or three feet in. Common S.R.

Woodpecker Family. — Birds with sharp, chisel-like bill with which they can drill holes in tree trunks and posts in search of grubs that lie concealed beneath the surface, or excavate large tunnels for nesting places. As they cling to the side of an object their stiff, pointed tail feathers serve as a prop to help support them. They usually have a red patch on head or throat or on both.

393 *Hairy Woodpecker.* Length 9 inches.

A small black and white woodpecker that stays pretty closely within the woods. The ground color of the upper parts is black but this is



HAIRY WOODPECKER



DOWNY WOODPECKER



YELLOW-BELLIED
SAPSUCKER

marked with a white streak down the middle of the back, white spots or bars on the wings and much white on the side of the head. Below it is entirely white. The male has a scarlet band on the nape. Common S.R. and P.R.

394 c *Northern Downy Woodpecker.* Length $6\frac{1}{2}$ inches.

This is our smallest woodpecker and closely resembles the preceding species in the arrangement of its colors, the only difference being that the white outer tail feathers are barred with black in this species and without the bars in the Hairy. The Downy is a less retiring bird and frequents our orchards and shade trees as well as woodlands. We often hear his industrious *tap tap tap* as he patiently digs out from some tree the grubs that form his bill of fare. P.R.

402 *Yellow-bellied Sapsucker*. Length $8\frac{1}{2}$ inches.

This is the small woodpecker that makes rings of holes around the trunks of small trees. He does this to secure the sap and the flies and bugs which it attracts, but he sometimes drills so many holes that it injures the tree. Back irregularly barred with black and white; red crown and throat; breast black; rest of lower parts pale yellow. Female has white throat instead of red. S.R.



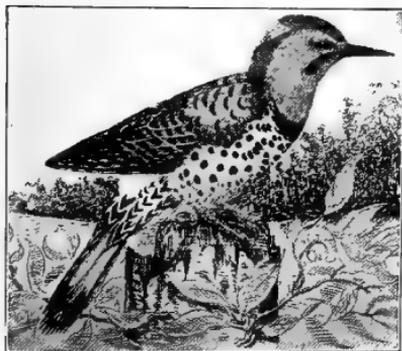
RED-HEADED WOOD-
PECKER

405 *Red-headed Woodpecker*. Length $9\frac{3}{4}$ inches.

One of our most conspicuous birds. Head, neck, and breast red; back and wings black; white patches on the wings; white on rump and other parts. Common S.R.

412 a *Northern Flicker*. *Yellow Hammer*. *High-hole*. Length 13 inches.

Our commonest woodpecker, and wherever he occurs his shrill cry is a very familiar note in early spring. Often feeds on the ground, digging for insects with his bill if that is necessary to get them. Brownish gray above barred with black; red band on the nape; black crescent on breast. In flight he shows a white rump, and yellow under wings and tail. Rest of under parts white, thickly spotted with black.



NORTHERN FLICKER

400 Arctic Three-toed Woodpecker.
Occasional W.V.

408 Lewis Woodpecker. Rare S.R.

Whip-poor-will and Nighthawk Family. — Nighthawks and Whip-

poor-wills have a small bill, and the mouth opens very wide, a great convenience in catching insects on the wing. Their wings are long and pointed and they fly with great ease; but their feet are small and weak so that they sit lengthwise upon their perch.

620 *Nighthawk*. Length 10 inches.



NIGHTHAWK

Not a very good name, for this bird is not a hawk at all and he is active in the afternoon and evening, seldom at night. He flies with great ease and at quite a height, not merely for exercise, but to get his supper, which consists of mosquitoes, moths, and other insect pests. No bird could do more useful work. In wooded regions he passes the day perched lengthwise on a limb, but on the prairies he roosts upon the ground; in either case he is not easily seen because his colors harmonize with his surroundings. Nighthawks make no nest, but the female lays two eggs on

the bare ground or on the flat roofs of large city buildings. Common S.R.

417 Whip-poor-will. S.R. westward to eastern Dakota.

418 Poor-will. Rare S.R.

420 a Western Night Hawk. S.R. in western Dakota.

Swift Family. — These birds have the same small bill, large mouth, long wings, and feeding habits, as the preceding family. The tips of the tail feathers are provided with spines, used in supporting the birds when they cling to the brick walls of chimneys.

423 *Chimney Swift*. Length 5½ inches.

Dusky black, seen only on the wing; fly quite high, looking like a black bow and arrow against the sky. Their nervous twitter is heard at frequent intervals as they course about over head, feasting on mosquitoes. Nest, a bracket-like basket of small twigs glued to the inner walls of chimneys with their own saliva. Sometimes large flocks make their home in a disused chimney to which they return in a body every evening. They cling to the side,



CHIMNEY SWIFT

using their spine-pointed tails as Woodpeckers do, for support. They are frequently miscalled "Chimney Swallows." Common S.R.

Hummingbird Family. — Very small birds with exceedingly long and slender bills and small mouths. They live on insects and the nectar of flowers, securing their food while on the wing. They fly “like a streak of lightning,” their wings moving so rapidly that they make a humming sound which is usually the first thing to attract our attention when we come across them. These brightly colored birds are often confounded with the sphinx or humming moth, and it is well to be skeptical about reports of “hummingbirds” seen near flower beds in the evening or late afternoon. Hummingbirds visit the flowers in the daytime.



428 Ruby-throated Hummingbird. S.R.
Not common in prairie sections.

RUBY-THROATED HUMMING-
BIRD

PERCHING BIRDS

This class is the highest and by far the largest order of birds, and contains over half of all the species known. All our songsters belong to this order, and the term “Song Birds” is sometimes employed as synonymous with Perching Birds. But this practice is confusing, as many of these birds (including the entire Flycatcher and Crow families) do not sing at all. In size they range from very small birds (Kinglets, 4 inches long) to medium, — the Crow family being the only one with species much larger than the Robin. The legs are comparatively short and slender and so set as to give the body a horizontal position when resting on a perch. All these birds have four toes, the hind one being about as long as the other three and on a level with them, and when these clasp the perch and the bird sits down the automatic action of certain tendons locks it to the perch and holds it there during sleep. None of the toes are webbed for swimming.



KINGBIRD

Flycatcher Family. — These are distinguished from other birds by their peculiar feeding habits. They take a position on a perch that



ARKANSAS KINGBIRD

affords a good lookout and watch for passing insects. When one is spied they make a dash for it with wide-open mouth, seize it, and return to a perch, often their former station. Their plumage is generally olive green or grayish. The family is without musical talent.

444 *Kingbird*. Length $8\frac{1}{2}$ inches.

Upper parts grayish slate color, darker on the head and tail. Under parts and tip of tail white. Has a habit of perching in an exposed position watching for insects. If a victim is seen the kingbird suddenly darts after it, seizes it, and returns to the

same perch. Spreads its tail like a fan when it alights. Nests in bushes and trees. Its calls and cries are loud, unmusical, and make us think that it is quarreling with its mate. If you molest their nest you may wish you hadn't. Very common S.R.

447 *Arkansas Kingbird*. Length 9 inches.

A yellow bellied Kingbird having the same habits and notes as the common Kingbird. Upper parts and breast light gray; lemon yellow below; tail black; outer side of the outer tail feathers white. Not found very far east of the Dakotas, but in its region a very common S.R.



PHOEBE

456 *Phæbe*. Length 7 inches.

Name is derived from its notes, *pewit phæbe*, *pewit phæbe*. May also be identified by its nest, which is bulky, largely of mud and moss, lined with grass and hair, placed on a beam of a building or under a bridge.

The birds are dusky olive above, darkest on head and tail; under parts white, washed with yellowish. Drops and jerks its tail and dashes from its perch after passing insects. Phœbes are ideal boarders: the more they eat the better for the landlord. Their trustful ways make them favorites with bird lovers. Arrive everywhere early in the spring. S.R.

461 *Wood Pewee*. Length $6\frac{1}{2}$ inches.

Occurs in woodlands. More frequently heard than seen. May be recognized by his call or song, a plaintive, sweet, slowly sounded *pee-a-wee*. Upper parts dark olive-brown; two dull white wing bars; lower parts whitish. Nests in trees. Westward to central part of the Dakotas. S.R.



WOOD PEWEE

467 *Least Flycatcher*. *Chebec*. Length $5\frac{1}{2}$ inches.

Most easily distinguished by its note, which is a well-pronounced, snappy *chebec*. An inhabitant of shade trees and orchards. Like other flycatchers he spends much time sitting dreamily on a perch and making an occasional sally after a passing insect. Dull olive above, wings and tail more brownish; two whitish wing bars, and whitish under parts. Nest, neatly made, generally placed in a crotch. This is our smallest Flycatcher. Common S.R.



LEAST FLYCATCHER

452 *Crested Flycatcher*. S.R.

457 *Say Phœbe*. S.R. Central Dakota and westward.

462 *Western Wood Pewee*. S.R. Central Dakota and westward.

463 *Yellow-bellied Flycatcher*. S.R.

465 *Acadian Flycatcher*. S.R.

466 *Traill Flycatcher*. S.R.

Lark Family. — The Horned Lark and its several subspecies are the only American members of this family to which the famous European Skylark and many other Old World species belong. They are ground birds, have rich voices, and deliver their song on the ground, from a slight elevation, or on the wing.

474 *b* *Prairie Horned Lark*. Length $7\frac{1}{4}$ inches.

When met with in our path, this lark often runs before us after the manner of the Vesper Sparrow, from which bird it may be distinguished by its chocolate back, the black shield on the breast and black patch on the cheek, giving it a striking appearance.



HORNED LARK

When it takes wing, it usually utters a sharp whistling note, whereas the Vesper Sparrow flies off in silence. The "horns" are tufts of elongated feathers on either side of the head of the male, but they cannot be distinctly seen except when the bird holds them erect. A charming singer, and may be heard especially just before dawn and after sunset. Utters the first bird song of the season; the writer has heard one sing on the North Dakota prairie the first day of March. Begins nesting

when the snow is still on the ground. His diet consists of prairie insects and seeds. P.R. and S.R.

474 *c* *Desert Horned Lark*. S.R. Central Dakota and westward.

Crow Family.— This is not a commonplace family. In point of intelligence its members rank among the cleverest birds, in size several of them excel all other perching birds, and in musical ability no bird could be less gifted. They are omnivorous feeders, eating almost any vegetable or animal food in almost any condition. They inhabit wooded regions, though the Crows often wander into open fields.



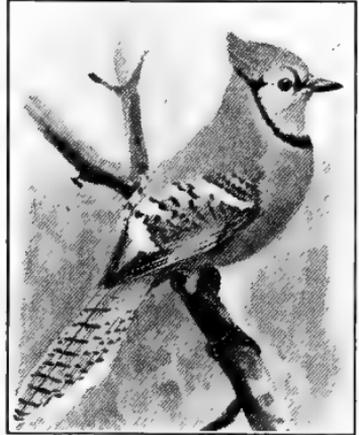
AMERICAN MAGPIE

475 *American Magpie*. Length 15-22 inches.

A large, long-tailed, black bird with white shoulders, belly, and tips of wings. Nest very large (sometimes as big as a bushel basket) placed in bushes or trees. Magpies are easily tamed and become mischievous and interesting pets. They are only occasionally seen farther east than the Missouri River. P.R.

477 *Blue Jay*. Length $11\frac{3}{4}$ inches.

A large, beautiful bird; but notorious as a robber of birds' nests. Upper parts grayish blue; under parts dull white; wings and tail have bars and spots of black and white. Wears a collar, which, however, is too high up on the back of the head and rather too low in front. Has a conspicuous crest and a very long tail. Call, a loud, screaming *jay, jay, jay*. Nests in bushes and low trees. Very rare west of central Dakota. S.R. and occasionally P. R.



BLUE JAY

488 *American Crow*. Length 19 inches.

A common, large, black bird, usually found in flocks. Noted for its intelligence and notorious for its bad conduct. May be recognized by its call notes of *caw, caw*.

Nest is bulky, placed high up in trees. Crows arrive very early in the spring and remain till very late in the fall. Common S.R.



AMERICAN CROW

486 American Raven. Rare S.R.

484 Canada Jay. Rare P.R.

486 a Northern Raven. Rare P.R.

491 Clark Nutcracker. Occasional in Western Dakota.

Blackbird Family. — Black is the characteristic color of all these birds except the Meadowlarks. Bobolinks have considerable white on the upper parts, the Cowbirds have a coffee brown head, the Yellow-headed and the Red-winged Blackbirds are well described by their names, the plumage of Meadowlarks is gray and brown, Orioles add orange or chestnut to their black, and the rest are black all over. The

female often lacks the brighter colors and shining black of the male, and in several species she is much smaller. Most of them are of medium size, but, with the exception of some species in the Crow family, the

Grackles are our largest perching birds. The family includes some of our finest singers, as the bobolink, meadowlark, and oriole; but some species have no voice for music. With the exception of the orioles they live in flocks after the breeding season; some of them even nest in colonies. They feed on seeds, worms, and insects, and the small amount of grain they take amounts to nothing compared with the good they do.



BOBOLINK

494 *Bobolink*. Length $7\frac{1}{4}$ inches.

A wonderful singer from time of arrival in spring till July. Renders his bubbling, frolicsome song from a tall weed, a bush, or on the wing. He inhabits low, marshy areas, but is occasionally found in uplands for a short season. Many birds are lighter on the under side than above, but Robert of Lincoln has his clothes on the wrong way, for his black suit is marked with white on shoulders and lower back, and golden brown on the nape of the neck. Female (also male in autumn) looks much like an olive colored, streaky sparrow. S.R.

495 *Cowbird*. Length 8 inches.

A small blackbird commonly seen in pastures near cattle but also in woods and elsewhere. The male is glossy greenish black, with brown head and neck. Female, dark brownish gray. Cowbirds have only a feeble, guttural note. They live the life of hoboes, and are outcasts in bird society, the only birds we have that neither build nests nor take care of their young. The female lays her eggs in the nests of other species and these usually hatch and rear the



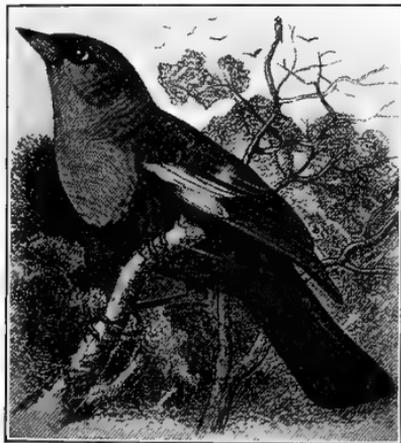
COWBIRD

young cowbirds, who crowd out the rightful occupants of the nest. What conduct could be more contemptible! No doubt their keeping company with cattle is due to the same lazy disposition: they find

that the easiest way to get flies and mosquitoes to eat. Thus, by their feeding habit they incidentally do some good.

497 *Yellow-headed Blackbird*. Length 9 to 11 inches.

Is well named. The male is easily identified by his deep yellow head, neck, and breast; white patch near the bend of the wing; the rest is black. The female is a grayish brown bird with most of the head and breast a dirty yellow. Found in marshy places; nest fastened to reeds,



YELLOW-HEADED BLACKBIRD



RED-WINGED BLACKBIRD

2 or 3 feet above the water. These birds usually gather together in companies. Notes harsh, not in the least musical. S.R.

498 *Red-winged Blackbird*. Length 9½ inches.

The male is very easily identified, being a jet black bird with a distinct red patch on the shoulder. The female is blackish above, streaked with rusty; under parts streaked with black and white. A common bird of sloughs and marshes; also often seen in fields and on trees. Nests in rushes or low bushes, often surrounded by water. His song is rich and clear and is usually translated *kong-quer-ree*. In the fall they assemble in large flocks and give blackbird choruses that are worth hearing. Blackbirds arouse the farmer's ire by stealing his corn, but he should give them credit for the tons of bugs and worms they destroy in a season. Common S.R.

501 *Meadowlark*. Length $10\frac{3}{4}$ inches.

One of the most conspicuous birds on the prairies, open fields, and pastures. His ringing song can be heard a good distance, being a clear, metallic whistle; he often delivers it from post or stone or other elevation. The nest is placed on the ground. The upper parts of the bird are mottled grays and browns; the breast is bright yellow with a black crescent; he displays white outer tail feathers in flight. Arrives early in spring and remains till late autumn. A great favorite.



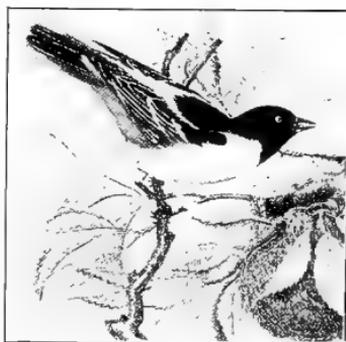
MEADOWLARK

The range of the eastern meadowlark extends westward to the Dakotas, where that of the western variety begins, the two overlapping somewhat. The description in this paragraph applies to both

forms equally well. The western is somewhat paler in color than the eastern and his voice is considered clearer and more varied.

507 *Baltimore Oriole*. Length $7\frac{1}{2}$ inches.

One of the most beautiful birds, the male being brilliantly dressed in black and orange. Black is seen on the head, wings, and part of the back and tail; a rich reddish orange on the rest of the body. The colors of the female are more sober, being brownish above and dull yellow below. Its notes are loud, clear, and agreeable. It sometimes seems to say, *Peter, Peter*. No bird can build a better nest nor put it in a safer place. Common S.R.



BALTIMORE ORIOLE

510 *Brewer Blackbird*. Length 10 inches.

These are the blackbirds that often visit our dooryards, especially in the fall. Not found east of western Minnesota.

They are entirely black, but with purple sheen on the head, and greenish or bluish on the back. Head and neck of female brownish gray. The

male looks like the Grackle but is smaller. They build their nests in bushes and on low trees and from such places they like to give their after-dinner concerts, but their music is neither sweet nor soft. M. and S.R.

511 *b* *Bronzed Grackle. Crow-Blackbird.* Length 12 to 13½ inches.

A very large blackbird, with a bronze sheen on the back, and a purple, bluish green or steel-blue sheen on head and neck. Female, much duller than the male. Grackles live in colonies. We may often see them near their homes, walking about in search of grasshoppers,



BREWER BLACKBIRD



BRONZED GRACKLE

crickets, and other destructive insects. Their note is a harsh *grack*, or *grackle*. Nest bulky, in trees, about thirty feet above ground. S.R.

501 *b* Western Meadowlark. S.R. in the Dakotas and westward.

503 Audubon Oriole. S.R.

506 Orchard Oriole. S.R.

508 Bullock Oriole. Occasional S.R.

509 Rusty Blackbird. M.

Sparrow Family. — This is our largest bird family and offers the greatest difficulty to the student. The birds vary in size from small to medium, the English Sparrow being about the average; none are quite as large as the Robin. They are very beneficial on account of the great quantities of fowl seed they consume; and, to vary the diet, they

also eat a great many insects. They have short, conical bills adapted to crushing seeds. Some of the larger species have very heavy, stout bills and are called Grosbeaks; two of them, the Crossbills, have the mandibles crossed in a peculiar way. Several have a very long nail on the hind toe and are called Longspurs. Many of them have plain colors (browns and grays) arranged in a streaky pattern, and these are called Sparrows; others have brighter colors. A good portion of the plainer birds are found on prairies and in open fields; the brighter colored species more generally stay among trees. Musical ability is quite common in this group, and some of our favorite cage birds, as the Canary, belong to the family; others, however, hardly sing at all.

English Sparrow. Length $6\frac{1}{4}$ inches.

If we wish to know the birds, it is well to begin our course of study with the English Sparrows. They are our commonest birds and are found in abundance in all our towns and villages and around many farm



ENGLISH SPARROW

buildings. Every student must know them so thoroughly that he will never confuse them with other birds, for we have many other sparrows that are quite similar in general appearance. They are not migratory and live in the same locality the year round. They are a great nuisance for several reasons, not the least of which is that they occupy our premises to the exclusion of other birds.

Their plumage shows the color scheme that is typical of the sparrows. They are brownish above, streaked and mottled with gray, and the males have a conspicuous black patch on the throat and breast. The bill is conical in shape and rather stout, being fitted for seed eating. The birds pick up grain in the street and in the barnyard, eat kitchen scraps, and everything else that birds can eat. They are noisy and pugnacious; their notes are harsh chirps and it is by these notes that they are most easily distinguished from other sparrows. They do not sing. They build their nests in all convenient places about buildings and also in trees. The nest is bulky and poorly constructed out of all kinds of material.

This species is not native to this country but its ancestors were originally introduced from Europe in the belief that they would destroy certain insects. This they failed to do and their introduction has proved to be a mistake. They are found all over Europe and in parts of Asia and are the same species of sparrows which the Bible mentions in several places.

529 *American Goldfinch*. Length 5 inches.

A very common, small, yellow-bodied bird with black cap, wings, and tail. The female is brownish above, and whitish washed with yellow below, and she is without the black cap of the male. Except when nesting, these birds are often seen in small flocks. In flight they describe a wavy path, singing *per-chic-o-ree*. Their call, when perching, is *sweet, sweet*.

The song of the American Goldfinch is very lively; it reminds us of the canary's, though it is less varied. The nest is built in bushes or trees. Common S.R.



AMERICAN GOLDFINCH

534 *Snow Bunting*. *White Snowbird*. *Snowflake*. Length 7 inches.

May be readily known by the fact that its predominant color is white.



SNOW BUNTING

The under parts are white; also much white on the head, wings, and tail. Upper parts rusty brown, parts of wings and tail black. These snowbirds come in flocks in winter, feed on seeds, and come to barnyards when the fields are entirely covered with snow. They are strictly ground birds and never perch on a tree. As soon as the snow melts at

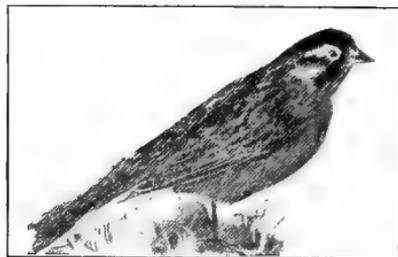
the approach of spring, they betake themselves again to the north to build their nest in the Arctic regions. Common W.V.

536 *Lapland Longspur*. Length 6 inches.

The back is streaked in the characteristic style of sparrows; head, neck, throat, and breast are black; a buffy line behind the eye; lower parts white; hind toenail very long. Generally found in flocks, often associated with Snowflakes. Has a habit of squatting behind some



LAPLAND LONGSPUR



SMITH LONGSPUR

clod, where it will remain till almost trodden upon; then it will run a little distance and again attempt to hide. M. and W.V.

537 *Smith Longspur*. Length $6\frac{1}{2}$ inches.

A winter bird of our western prairies; habits similar to that of Lapland Longspur; but its color is more buffy. M. and W.V.

540 *Vesper Sparrow*. Length $6\frac{1}{4}$ inches.

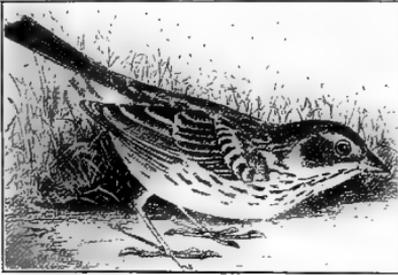
A rather pale sparrow; the under parts white with dark streaks; white outer tail feathers; pale russet shoulder patches. We often find him on the road running rapidly ahead of us, waiting for us to catch up, and then running ahead again. He has a high-soprano voice and his song, which is loud, clear, and ringing, can be heard at a distance of several hundred yards. He is generous with it, too, and delivers it at frequent intervals, morning, afternoon, and evening. The evening song gives him the name, "Vesper Sparrow." Nest, on the ground. Common S.R.



VESPER SPARROW

546 *Grasshopper Sparrow*. Length 5 inches.

Best identified by his singular song, a feeble, insect-like effort that gives him his name. It might be written *pit-tuck*, *zee-e-e-e-e-e-e-e-e*, the chief part being the prolonged, hissing *ee*. But he holds up his head very



GRASSHOPPER SPARROW

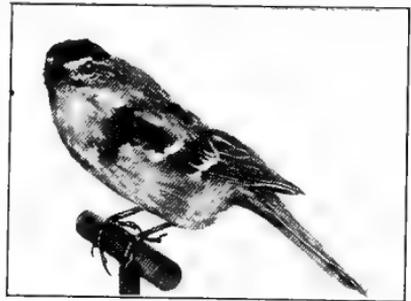


WHITE-THROATED SPARROW

proudly and sings with apparent satisfaction. Lives quietly on or near the ground and is easily overlooked unless you know his song and are quite near when he renders it. He has a streaky back, buffy breast and sides, whitish belly, and yellow on the bend of the wing. Common S.R.

558 *White-throated Sparrow*. *Peabody Bird*. Length $6\frac{3}{4}$ inches.

Most common in early spring when large companies visit us on their way north. They then attract us by their song, which is a loud, sustained, plaintive whistle. Very commonly we may notice only one prolonged note; but they often add two short ones in an undertone making *Peabody*, whence one of their names. In fall, numbers of them come again but not to sing so much. The head has two black and three white stripes, two of the latter changing to yellow in front; throat white, contrasting sharply with the gray breast; two white wing bars. Common M. and occasional S.R.



TREE SPARROW

559 *Tree Sparrow*. Length $6\frac{1}{2}$ inches.

These are birds of prairie and field and their name does not seem appropriate. They come in flocks, often associated with *Juncos*. The

back is streaked like that of so many sparrows; their best badge of identification is the small black dot on the center of their otherwise unmarked grayish white breast. Cap reddish brown, two whitish wing bars. Common M. and W.V.

560 *Chipping Sparrow*. Length $5\frac{1}{4}$ inches.

Common about our dooryards in trees, bushes, and vines; in these it builds its nest, which is a neat basket of grasses, fine twigs, or rootlets, thickly lined with long hairs. Is quite trustful and readily feeds on the crumbs at our doorstep. Has a streaky, sparrow-like back, chestnut brown cap, whitish under parts and line under the eye. Call, *chip*; song an unmusical, insect-like trill, sounding like the noise made by drawing a knife across the teeth of a comb, and conceived to be a rapid repetition of its name, *Chippy*. Its range extends westward into the eastern part of the Dakotas. Common S.R.



CHIPPING SPARROW

561 *Clay-colored Sparrow*. Length $5\frac{1}{4}$ inches.

Easily identified by its resemblance to the Chipping Sparrow. Its song is even more insect-like than Chippy's, that is, the notes are run together more closely and rapidly. Novices would easily mistake it for some unknown insect. Unlike Chippy, this bird does not come near our homes but is found in fields and pastures where there are plenty of bushes, in which it builds its nest and from the tops of which the male renders his "songs." This is a pale-colored sparrow with much gray in its plumage, giving it its name. The head has irregular black and white stripes with brown at the sides; under parts white, soiled with gray. Common in the Dakotas and westward, rarer eastward. S.R.



SLATE-COLORED JUNCO

567 *Slate-colored Junco*. Length $6\frac{1}{4}$ inches.

A bird of genteel appearance coming in flocks in spring and fall. Upper parts, throat, and breast slate-color; belly and outer tail feathers white. Female similar, but upper parts browner, throat and breast paler. The slate color of the breast changes very abruptly to the white of the belly, and this, together with the white outer tail feathers, makes it easy to recognize the Junco. Breeds from the northern part of the United States northward. Call note, *tsip*; song, a sweet tinkle or jingle. Common M. and occasional P. R.

581 *Song Sparrow*. Length $6\frac{1}{4}$ inches.

Distinguished by an abundance of blackish streaks on the sides of the whitish under parts and a large blotch in center of breast. Upper parts as in typical sparrows but rather dark. Considered one of the sweetest singers of all our birds. Its refrain is short, the first part consisting of

about three notes that might be written *oleet, oleet, oleet*, and these are followed by an untranslatable little warble. Most common in shrubbery near the water, but it never has much company. Nest, on the ground or in bushes. Is with us and sings all summer. Common S.R.



SONG SPARROW



DICKCISSEL

604 *Dickcissel*. Length $6\frac{1}{2}$ inches.

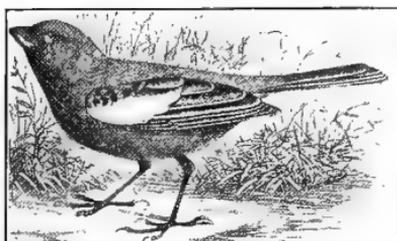
Back of bird streaky, sparrow-like; breast yellow; a conspicuous black patch on the

throat and, above that, a white chin; a yellow line over the eye. The colors of the female are duller; no black mark on the throat. The Dickcissel is found only in an occasional section, and then in weedy

fields. Likes to render his little song from a tall weed stalk. It is pleasing, but not at all loud: *dick, dick, cis-cis-cis-cisste*. S.R.

605 *Lark Bunting*. *White-winged Blackbird*. Length $7\frac{1}{4}$ inches.

Male all black, except a clear white patch on the wings; this white patch disappears later in the summer. The female (also the male in autumn and winter) is a streaky, brownish, sparrow-like bird. A fine singer; often renders his song on the wing like the bobolink and is



LARK BUNTING



ROSE-BREASTED GROSBEEK

sometimes mistaken for that bird. Common on the prairies west of the Red River Valley. S.R.

- | | | | |
|-------|---|-------|-----------------------------------|
| 514 | Evening Grosbeak. Occasional W.V. | 538 | Chestnut-collared Longspur. S.R. |
| 515 | Pine Grosbeak. W.V. | 539 | McCown Longspur. S.R. |
| 517 | Purple Finch. M. or S.R. Rare. | 540 a | Western Vesper Sparrow. S.R. |
| 521 | American Crossbill. Occasional P.R. or W.V. | 542 a | Savanna Sparrow. Common S.R. |
| 522 | White-winged Crossbill. Occasional P.R. or W.V. | 542 b | Western Savanna Sparrow. S.R. |
| 527 a | Hoary Redpoll. Occasional W. V. | 545 | Baird Sparrow. S.R. |
| 528 | Redpoll. W.V. | 546 a | Western Grasshopper Sparrow. S.R. |
| 528 b | Greater Redpoll. Occasional W.V. | 547 | Henslow Sparrow. S.R. |
| 533 | Pine Siskin. S.R. Eastern Dakota and eastward. | 548 | Leconte Sparrow. S.R. |
| | | 549 | Nelson Sparrow. S.R. |
| | | 552 | Lark Sparrow. S.R. |
| | | 553 | Harris Sparrow. Common M. |

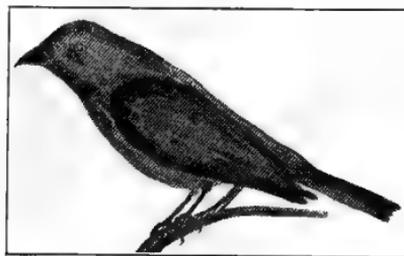
554	White-crowned Sparrow. M.	588	Arctic Towhee. S.R. West of Central Dakota.
	and occasional S.R.		
563	Field Sparrow. S.R.	593	Cardinal. Casual S.R.
563 a	Western Field Sparrow. S.R.	595	Rose-breasted Grosbeak. S.R.
566	White-winged Junco. S.R.	596	Black-headed Grosbeak. S.R. West of Central Dakota.
	Western Dakota.		
583	Lincoln Sparrow. M.	598	Indigo Bunting. S.R. Rare.
584	Swamp Sparrow. S.R.	599	Lazuli Bunting. S.R. Western Dakota and westward.
585	Fox Sparrow. M.		
587	Towhee. S.R.		

Tanager Family. — A large family of tropical, tree-living birds remarkable for their brilliant plumage. Only one species, the Scarlet Tanager, is common in the northern states, though another, the Louisiana Tanager, occurs in Southwestern South Dakota and westward.

608 *Scarlet Tanager.* Length $7\frac{1}{2}$ inches.

The male is a very conspicuous bird, his general color being bright scarlet and his wings and tail black. The female is olive green above and yellowish below. The song is similar to that of the robin. S.R.

Swallow Family. — The swallows are to be admired for their swift and easy flight, their long and powerful wings enabling them to spend most of their time in the air in pursuit of their food, which consists almost entirely of mosquitoes and other insects. No birds can be of greater service.



SCARLET TANAGER

They search for their prey near the ground, skimming low over the fields with ease and grace. The bill is short, flat and broad, and the mouth opens conveniently wide. They have small, weak feet, and when alighting they select a perch which they can easily grasp, — a small twig, or preferably, a telegraph wire. The Barn Swallow has a deeply forked tail, and that of the others is more or less notched. The chief color of all but the last is blue-black or steel-blue; the under parts are mainly white; the Cliff and Barn Swallows also have chestnut on neck and breast. None of the family can take rank as singers, but their voices are very pleasant and their merry twitter is expressive of their

happy disposition. Their genial nature also manifests itself in their fondness for the society of their kind which leads them to nest in colonies and after the breeding season to collect in still larger flocks. From every standpoint they merit their popularity. Every observer should be able to find at least three species, the Cliff, the Barn, and the Bank Swallows. These are most easily distinguished by their nesting habits.

611 *Purple Martin*. Length $7\frac{3}{4}$ inches.

A large, shining, blue-black, swallow-like bird with a notched tail. The female is duller on the back; her throat, breast, and sides are brown-



PURPLE MARTIN



BANK SWALLOW

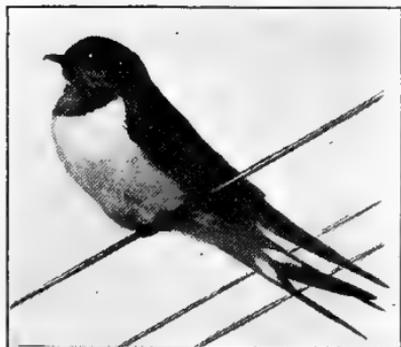
ish gray, and her belly white. Nest in boxes or in the hollow spaces under the roof of store buildings which they may enter through a knot-hole or chink. We may hear their pleasant guttural twitter on the main streets of almost any of our towns. They spend much of their time on the wing catching insects as their cousins, the swallows, do. S.R.

612 *Cliff Swallow*. *Eaves Swallow*. Length $5\frac{1}{2}$ inches.

Easily identified by the gourd-shaped or jug-like nests of mud placed close together under the eaves of buildings, never inside. Back steel-blue, forehead white, much chestnut on the neck, belly white. End of tail almost square. S.R.

613 *Barn Swallow*. Length 7 inches.

Identified by its nest, which is placed on beams in barns and under bridges; may also be known by its deeply forked tail. The bird is steel-blue above; forehead and throat a rich brown. S.R.



BARN SWALLOW



CLIFF SWALLOW

616 *Bank Swallow*. Length $5\frac{1}{4}$ inches.

Identified by its nest, which is always in a horizontal hole in a steep or vertical bank near a stream or a road; generally nests in colonies. Brownish gray above, white below. Tail is slightly notched. S.R.

614 Tree Swallow. S.R.

617 Rough-winged Swallow. Occasional S.R.

Waxwing Family. — Birds of medium size and wonderfully rich grayish brown color. The name "waxwing" refers to the bright red tips on some of the wing feathers, suggesting sealing wax. Both of our species have a stylish crest, though the Bohemian does not always keep his raised.

618 Bohemian Waxwing. M. and W.V.

619 Cedar Waxwing. S.R.



CEDAR WAXWING

Shrike Family. — The shrikes are gray-backed birds with black wings and tail and white bellies. The sides of the head are marked with a conspicuous black band extending from the bill backward far beyond the eyes. They are about the size of robins. Their strong bodies and hooked bills indicate their hawk-like character. They feed on mice, insects, and small birds and have a villainous habit of impaling their prey on thorns and barbs. Their practice of killing even much more than they can eat has earned for them the name *butcherbird*.

621 *Northern Shrike. Butcherbird.* Length 10½ inches.

Distinguished from the Loggerhead by its larger size and the wavy dark lines across the white underparts. They breed in the far North.

In northern Minnesota and North Dakota they are more frequently seen in the spring. Elsewhere they are considered winter visitants.



LOGGERHEAD SHRIKE

622 *Loggerhead Shrike. Butcherbird.*
Length 9 inches.

Smaller than the preceding and without the wavy cross-bars below; otherwise the same. An occasional summer resident, nesting in bushes or trees, five or ten feet from the ground. In the northwest we have the variety of the Loggerhead known as the Migrant Shrike.

622 a *White-rumped Shrike.* S.R. from central Dakota westward.

Vireo Family. — The Vireos or Greenlets are very common little birds, but not well known, because, though we hear them singing often enough, we seldom see them. They keep within the foliage of trees and patiently glean insects from the under surface of the leaves and crevices in the bark. With plenty of vireos to protect them our trees would always be safe from pests. Their color is green, as indicated by their name. They are considered good singers. The beginner will do well if he recognizes a bird as being a vireo, even though he cannot tell its specific name.

624 *Red-eyed Vireo*. Length $6\frac{1}{4}$ inches.

Most easily distinguished by his song, which is so broken up by pauses that he has been called the Preacher. We might fancy his saying, "You see it? — you know it? — Do you hear me? — Do you believe it?" Olive green back, top of head slaty, with a white line over the eye and a dark one above that; under parts white. Nest a well-made, deep-hanging basket, resembling the Oriole's but much smaller. Common S.R.

627 *Warbling Vireo*. Length $5\frac{3}{4}$ inches.

Song, as indicated by the name, is a pleasing warble, not broken or interrupted like the Red-eye's but continuous. Passes the greater part of his time in the upper branches of trees and is especially hard to see. Upper parts ashy olive green; under parts white, slightly washed with yellowish, especially on the sides. Nest, the same as the Red-eye's. Common S.R.



RED-EYED VIREO

625 Philadelphia Vireo. S.R.

631 White-eyed Vireo. Rare S.R.

628 Yellow-throated Vireo. S.R.

633 Bell Vireo. Occasional S.R.

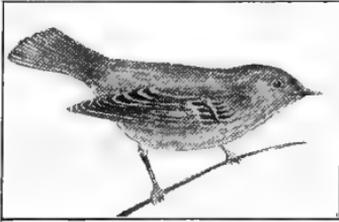
629 Blue-headed Vireo. Rare S.R.

Wood Warbler Family. — This large group of birds is at once the delight and despair of the young bird student. Most of them have brilliant plumage, yellow and olive green being the characteristic colors; but a few species are dressed in a different color scheme. They are small birds, most of them smaller than an English sparrow. They are inhabitants of woodlands, shade trees, orchards, and thickets, many of them keeping so well out of sight that to the uninitiated their existence is unknown. They live upon insects captured on trees and bushes, and have no bad habits to offset the services rendered. Their bill, as this feeding habit would lead us to expect, is slender and sharply pointed. Several have good vocal talent, but, generally speaking, the Warblers have weak voices and the name applied to the family is inappropriate. This brief statement should help students to identify a bird as a Warbler

when one is seen, and this is worth while even though the species may be difficult to determine.

652 *Yellow Warbler*. *Summer Yellow-bird*. Length 5 inches.

This bird is well named indeed, for the larger portion of the plumage is a bright yellow; but the back has a greenish tinge and the wings and tail are darker and streaked with brown. The female is darker above, being a yellowish olive green, instead of a greenish yellow. This is a common inhabitant of bushes and small trees near our home and elsewhere, but not in forests; is especially fond of the bushy banks of small streams. It is more frequently seen than other warblers; novices often take it for an



YELLOW WARBLER

escaped Canary. If they would merely compare its bill with the Canary's, that alone would prove the mistake. Its pleasing, high-pitched little song has been translated *wee-chee, chee, chee, cher-wee*. Common S.R.

655 *Myrtle Warbler*. Length $5\frac{5}{8}$ inches.

No warbler is more easily identified than this one with its four distinct patches of yellow, on crown, rump, and either side of breast. The rest of its color scheme is also distinctive: upper parts bluish gray streaked with black; two white wing bars, white spots on the tail, and white throat and belly; breast and upper belly heavily marked with black. A handsome bird, frequent in early spring on its way north. M.



MYRTLE WARBLER

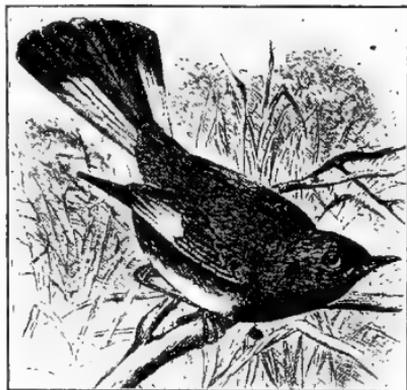
681 *d Northern Yellowthroat*. Length $5\frac{1}{4}$ inches.

Easily identified by a very conspicuous black mask across the forehead and over the cheeks, making him look like a little bandit. Upper parts are olive green, but next to the mask whitish; lower parts a deep yellow. This is a bush-living bird more frequently heard than seen; he will inform you of his presence by his energetic little song, which may

be written *wichity, wichity, wichity, wichity, wichity*. It may be heard all summer. S.R.

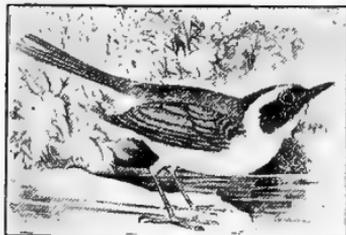
687 *American Redstart*. Length $6\frac{3}{4}$ inches.

Though the Redstart has the habits and tastes of the Warblers, the male is without the yellow and green that are such a family characteristic. But his attire is no less brilliant. Upper parts, throat, and breast shining black; bright orange at upper half of the tail, middle of wings, and under the wings; belly nearly white. Redstarts are very active, and as they dart about after insects they have a peculiar habit of turning somersaults and spreading their wings and tail as if to show off their fine clothes. These charming little birds are most frequently seen during the spring migration. M. and S.R.



AMERICAN REDSTART

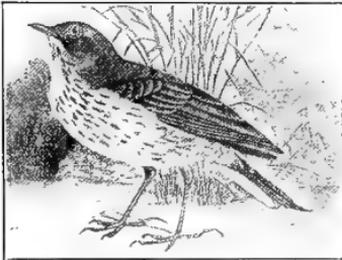
- | | |
|---|--|
| 636 Black and White Warbler. M. and S.R. | 647 Tennessee Warbler. M. and S.R. |
| 637 Prothonotary Warbler. S.R. | 648 Parula Warbler. S.R. |
| 642 Golden-winged Warbler. M. and probably S.R. | 650 Cape May Warbler. M. and probably S.R. |
| 646 Orange-crowned Warbler. Probably S.R. | 654 Black-throated Blue Warbler. Rare S.R. |
| | 657 Magnolia Warbler. M. |
| | 659 Chestnut-sided Warbler. S.R. |
| | 660 Bay-breasted Warbler. M. |
| | 661 Black-poll Warbler. M. |
| | 662 Blackburnian Warbler. M. and S.R. |
| | 667 Black-throated Green Warbler. S.R. |
| | 671 Pine Warbler. M. |
| | 672 Palm Warbler. S.R. |
| | 674 Oven-bird. S.R. |



MARYLAND YELLOWTHROAT

675	Water-thrush. S.R.	683	Yellow-breasted Chat. Rare
675 a	Grinnell Water-thrush. S.R.		S.R. Commoner south-
679	Mourning Warbler. S.R.		ward.
681 a	Western Yellow-throat. S.R.	685	Wilson Warbler. Casual M.
	Western Dakota and west-	685 a	Pileated Warbler. M.
	ward.	686	Canadian Warbler. M. and
			S.R.

Pipit Family. — Birds about the size and appearance of Sparrows, usually found in open fields and pastures. They have a very long tail which they are in the habit of wagging up and down, as if to balance themselves. The Sprague Pipit has a wonderful song, considered superior to the Bobolink's.



AMERICAN PIPIT

- 697 American Pipit. M.
700 Sprague Pipit. S.R.

Wren and Mockingbird Family. — Birds living chiefly in bushes and small trees, having a long tail and a moderately long bill which in the Wrens and Thrasher is distinctly curved. The family embraces two widely different groups,—the Thrasher, Catbird, and Mockingbird forming one, and the Wrens the other. The first group have remarkable control of their voices, and their songs seem like interminable medleys in which we may fancy they are mocking various other birds. The Wrens are small, brownish birds with indistinctly barred wings and tail and a very active, nervous manner. They are very musical also but their performance has no resemblance to that of Catbirds and Thrashers. All the birds of this family are insect eaters of the first rank.

704 *Catbird*. Length 9 inches.

A common, slate-colored bird with almost black crown and tail; rusty



CATBIRD

brown patch under the tail. Its form is slim and graceful. Lives in bushes and small trees, and is a tireless and accomplished singer, though novices often know him only by his occasional cat-like mews. In his song he mimics the notes of many other birds and he likes to deliver it from the thickest bush he can find. Nest well hidden in bushes or vines. Common S.R.

705 *Brown Thrasher. Brown Thrush.*

Length $11\frac{1}{2}$ inches.

Easily identified by its bright reddish brown upper parts, its large size, very long tail and long bill. Under parts white with many dark brown spots and streaks. This is a thicket-haunting bird, ordinarily shunning observation, but when the musical impulse seizes him he takes a prominent position — generally in the upper branches of a tree — and gives his entire attention to song for a considerable length of time. His performance is delightful. It has a similarity to that of the Catbird but the tones are stronger and richer, and it is free from the Catbird's occasional harsh notes. Nest, in bushes or on the ground. S.R.



BROWN THRASHER



HOUSE WREN

721 *House Wren.* Length 5 inches.

Sings at frequent intervals and with great energy, its head raised, tail dropped, and the whole body trembling with the exertion. The bird is dark brown; wings, tail, and sides cross-barred with faint dark lines; dusky white below. Of all birds the wrens are the most certain to accept our bird boxes for a home, but they will also nest in all sorts of holes and cavities about buildings and trees. Common S.R.

715	Rock Wren.	M.	722	Winter Wren.	W.V.
719	Bewick Wren.	S.R.	724	Short-billed Marsh Wren.	S.R.
721 b	Western House Wren.	Com- mon S.R.	725	Long-billed Marsh Wren.	S.R.

Creepers Family. — Only one American species belongs to this family.

726 *Brown Creeper.* Length $5\frac{1}{2}$ inches.

A very interesting little bird with mottled brown back, white under parts, a long tail with stiff pointed feathers, and a slender, distinctly



BROWN CREEPER

curved bill. If you meet him, you will recognize him easily, for he will be very busy in climbing a tree, using his tail to assist as woodpeckers do. When the top is reached he suddenly drops to the bottom of the same or another tree and patiently repeats the process. He generally

makes the ascent by going around the tree in a spiral. Needless to say he is searching for insects, eggs, and grubs in the crevices of the bark and as he succeeds in supporting himself that way it is evident that he knows his business. You are most likely to see him in spring or fall. M. and occasionally P.R.

Nuthatch and Chickadee Family. — These are hardy little birds with a nasal voice that make their living by gleaning insects from the trunks and branches of trees and bushes.

727 *White-breasted Nuthatch.* Length 6 inches.

Easily identified by its habit of running up and down the trunks of trees, searching for grubs and insect eggs hidden under the bark. His tail is short and square and does not assist in climbing as in case of the Brown Creeper and the Woodpeckers. His nasal *yank, yank* often tells us of his presence before we see him. General color ashy blue; cap and neck almost black; whitish below. S.R. and P.R.

728 *Red-breasted Nuthatch.* Length $4\frac{1}{2}$ inches.

Similar to the preceding but smaller. Throat white, rest of under parts brownish red; black and white stripes on the head. M. and S.R.

735 *Chickadee. Black-capped Chickadee.* Length $5\frac{1}{4}$ inches.

This famous little bird is easily recognized by the jet black cap and throat, contrasting sharply with the white cheeks and breast. The back is gray; belly and sides soiled white. Always busy searching for food on trees, bushes, and weeds. It calls its name, *chick-a-dee-dee-dee* in a high pitched and nasal voice, accent-



WHITE-BREASTED NUT-
HATCH



CHICKADEE

ing and prolonging the *dee*. In northern latitudes it is most frequently seen in late autumn and early spring. S.R. and P.R.

535 *a* Long-tailed Chickadee. S.R. Not common.

Kinglet Family. — With the exception of the Hummingbirds, the Kinglets are our tiniest birds, being only about four inches in length. They are olive green with whitish under parts; usually seen flitting nervously about the terminal twigs of trees and shrubbery. We generally observe them only on their migrations in spring and fall, as they breed north of the Canadian border. We have two species, both of them being good singers.

748 *Golden-crowned Kinglet.* Length 4 inches.

The male has a bright patch of gold and orange on the top of the head. Call-note is a high *tee, tee*; it sings only in its northern nesting regions. M.

749 *Ruby-crowned Kinglet*. Length $4\frac{1}{4}$ inches.

Similar to the Golden-crowned except that the patch on the head is red instead of orange, and is not easily seen at all. Two whitish wing-bars. Call, a clear *cack*. Song, "a surprisingly loud, rich, musical, varied, flute-like whistle,"



RUBY-CROWNED KINGLET



AMERICAN ROBIN

may be heard on its spring and fall migrations as well as in its nesting range. M. and S.R.



BLUEBIRD

Thrush Family.— This family is given first rank among birds, being noted for the gentle bearing of its members and the sweet and refined quality of their voices. They are of medium size, practically all of them being from seven to eight inches in length except the Robin, which is ten. The prevailing color of the upper parts is brown, though in some species this is replaced with olive or slate and in the Bluebirds, with blue. Their bill is not stout, as they live upon insects and wild fruits.

761 *American Robin*. Length 10 inches.

This is our best known and most popular bird. Brownish above, breast rusty red, the female being paler; white on the throat and lower belly; head and tail nearly black. Its

song and call-notes are quite varied but are loud, clear, and cheerful. It often seems to sing, *cheer up, cheer up, cheer up!* Its substantial nest is built of mud and grass, in trees or any odd place about buildings. On the prairies it is placed on the ground. The Robin arrives very early in the spring, and remains till late in the fall. Common S.R.

766 *Bluebird*. Length $6\frac{3}{4}$ inches.

Blue above, throat and breast rusty brown, belly white. Female is more of a grayish blue above, and paler below. Nest in bird boxes and hollow trees, and all sorts of cavities about buildings. The Bluebird is loved for his gentle disposition and soft notes that always seem to come from far away. S.R.

755	Wood Thrush. S.R.	758 a	Olive-backed Thrush. M. and S.R.
756	Veery, or Wilson Thrush. Rather Common S.R.	759 b	Hermit Thrush. M. and S.R.
756 a	Willow Thrush. S.R.	767	Western Bluebird. Occasional S.R.
757	Gray-cheeked Thrush. M. and S.R.		

CHAPTER XXX

DOMESTIC ANIMALS

DOMESTIC ANIMALS AND THEIR ORIGIN

Probably as long as man has possessed greater intelligence than other animals so long has he been in the habit of capturing and enslaving them and making them serve his own purposes. A great number of species have thus from time to time been brought into captivity, but only a few have been permanently domesticated. It is comparatively easy to take wild animals at a very young age and raise them, but much more is required if they are really to be domesticated. They must prove themselves worth while, must breed freely in captivity, generation after generation, must be able to thrive under the artificial conditions imposed by man, and their wild instincts must be capable of modification.

The most important of our domestic animals are familiar to all: horses, cattle, sheep, and swine; chickens, ducks, geese, and turkeys; dogs and cats. To these we might add certain kinds of less importance, as goats, pigeons, guinea hens, and peacocks; and we might also make several important additions from other countries, as the zebu and the camel of the Old World and the llama of South America. In all, about twenty species of mammals and a dozen of birds have been domesticated — which is not more than one in a thousand species of all mammals and birds known.

With a few minor exceptions, all of these were domesticated in the Old World, being derived from animals formerly

living in Europe, Asia, or Northern Africa in the wild state, and in some cases still to be found in that condition. Generally speaking, they were brought into captivity in prehistoric times, some thousands of years ago. Our domestic cattle were probably derived from at least three different species found wild in Europe in early times, as the bison, the elk, and the deer still occur in America at present. The horse was associated with man long before the beginning of historic times and its ancestry is largely a matter of speculation. But we recognize three very different families: the ponies of the Shetland Islands and other northern lands, the heavy horses found in the larger part of Europe in early historic times, and the lighter and swifter horses of Arabia and Northern Africa; and it is possible that each of these families descended from a different species of which we have no knowledge in the wild state. The ancestry of our hogs is clearer. It is generally assumed that they originated from the wild boar of Europe, North Africa, and Asia Minor. Of sheep there are more than twenty wild species in different parts of the world, one of them being the well-known Rocky Mountain sheep or bighorn of our own country. But it is not known for certain whether our domestic breeds were derived from one of these species or from still another that is no longer found in the wild state. The origin of our various kinds of poultry is discussed in another place in this book.

Of all the domestic animals, the New World has contributed only our turkey and the llama of South America. The bison, elk, deer, antelope, prairie chicken, wild ducks and geese are readily domesticated, but their use has not yet attained to any great degree of practical importance.

How Man Has Improved the Animals He Has Domesticated. — From the time when animals were first reared by

man, no doubt a gradual modification in their qualities has taken place by which they adapted themselves better and better to their new mode of life. Naturally their masters would save the better individuals and use them for breeding purposes; and, of course, when this practice is followed consistently for a period of time, it is sure to result in the gradual improvement of the race. It is necessary, however, that the selection shall be made on the same principle, uniformly and continuously. If a better horse is desired, it will avail very little to select one now for the sole reason that it is a fast runner, and in the next generation pay no attention to speed but breed from the one that is heaviest and strongest. Our ideal must be definite and fixed, and then we must breed toward that ideal, generation after generation.

In the history of stock breeding this was not done until comparatively recent times, and while farm animals have been undergoing gradual improvement from the time they were domesticated, it was not until within the last century or so that very great progress was made in the development of our various specialized breeds. The results of recent improvements are almost beyond belief. For example, in 1850 the sheep of this country produced an average of 2.4 pounds of wool per fleece, but in 1900 the average yield had increased to 6.9 pounds. The increase per cow in butterfat in the same period is considered just as striking. Steers are now matured for the meat market in their third year instead of the fifth year as in 1878, so that a much larger number may be supplied annually to the butcher from the same number kept on the farm. Again, it is estimated that the ordinary farm horse in America is 25 per cent more efficient than it was in 1851, when the breeding of draft horses in this country began.

How Domesticated Animals Have Benefited Their Masters. — The part that domestic animals have played in the history of the human race is very important and interesting. It would not be too much to say that primitive man has risen to a state of civilization on the back of the horse, the ox, and the sheep. Domestic animals exert a strong and beneficial influence upon their keepers. They compel habits of care and responsibility, for such habits are essential to success in rearing them. Moreover, man's contact with dumb animals soon results in a feeling of attachment to them and develops and broadens his sympathies and exerts an elevating and civilizing influence upon him.

But domestic animals are also a material requisite to civilization. Working alone and unaided, man would support himself with difficulty. Domestic animals aid him with their superior physical strength; they furnish clothing for his body and leather for shoes; and they are a source of his most nourishing food. It has been asserted that the native races of North America could not advance like those of the Old World because they had no domestic animals except the dog. They pursued even the bison of our prairies on foot and with only their dog. When Europeans brought them horses, they at once became vastly more energetic and efficient in the chase as well as in war.

LIVE STOCK AND FARM MANAGEMENT

In a new country the development of animal husbandry is always retarded by the large outlay of capital it requires, especially if stock is to be kept in connection with grain raising. But gradually the farmer accumulates more and more animals, because the advantages are numerous and great. These advantages may be briefly summarized as follows:

(1) Animals help to maintain the productivity of the land by supplying fertilizers and by making a better system of crop rotation possible.

(2) They enable the farmer to make more constant use of his labor, teams, and tools.

(3) They reduce the cost of living by helping to furnish the home food supply.

(4) They can make use of land that would otherwise be unproductive.

(5) They can make use of farm crops that would otherwise be wholly or partly wasted.

(6) They manufacture into meat, butter, eggs, wool, etc., farm produce which is too bulky to ship long distances.

(7) The management of live stock, manipulation of dairy products, and rearing of poultry require greater skill, and this commands higher returns.

Some kind of live stock is kept on practically every farm in the country, and while formerly it was a relatively small part of our national wealth, it has now attained a rank of commanding importance. About a third of the farm produce of the entire country is now fed to live stock, and if that feed is deducted from the total produce, the value of the remainder will scarcely exceed the amount annually realized from animals and animal products.

CHAPTER XXXI

HORSES

KINDS OF HORSES

Horses may be classified as light horses and draft horses. Under the first class are included the breeds that are best adapted for driving purposes and other uses requiring quick action but not great power, while the second class comprises the breeds of large and heavy horses suited for drawing heavy loads, but having slower movement. All race horses belong to the first type, while the horses used for heavy team work in cities belong to the second type. On the ordinary farm there are both kinds of work for horses — the work where fair speed is important, and heavy work where power is the chief requirement. No one horse can excel in both of these respects; a horse cannot be heavy as well as light, and have short legs as well as long ones. Consequently we have no breed that is eminently satisfactory for all general farm work. The advent of the automobile has greatly diminished the need for good roadsters, and fairly heavy horses now come nearer to meeting all requirements than they did before.

Draft horses, as already implied, are heavy animals with a broad, massive body, and short, muscular legs and neck. The leading breeds are the Percheron (pronounced *Persh'ron*), Clydesdale, Shire, and Belgian. The Percherons are the most popular farm horses, being quite active for a draft horse, and also gentle, intelligent, and strong.

The light breeds have a less massive body, and longer and more slender legs and neck than the draft type; the chest is narrower, the front feet closer together, and the shoulders more sloping; the action is quicker and more lively. To this class belong a number of breeds, the most famous being the



DRAFT TYPE: PERCHERON HORSE

Thoroughbred and the American Trotter. These two breeds have furnished all our race horses. The Thoroughbreds are the fastest horses in the world, but it must be remembered that they run their races under the saddle, that is, they gallop. The American Trotter is the best known of all the light breeds

and has given us all our great trotters and pacers. It includes several important families, such as the Hambletonians, Clays, Mambrinos, and Morgans. The last of these is probably our most useful horse for general purposes.

Grades and Scrubs. — Most of the horses in ordinary use that are spoken of as Percherons, Clydesdales, Morgans, etc.,



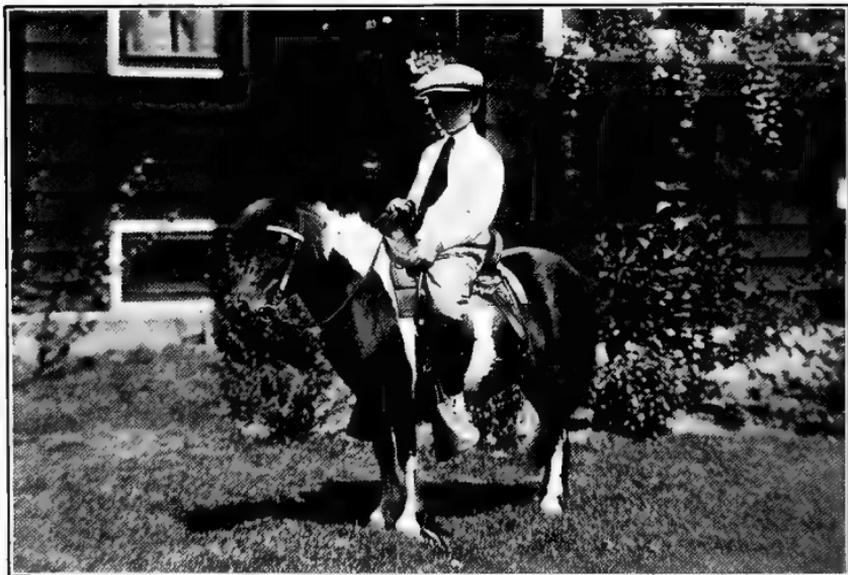
SPEED TYPE: STANDARD-BRED HORSE

are, of course, not pure-bred but merely grade animals. Large numbers of others that we see have no trace of blood from standard breeds and may be called *scrubs*.

The small horses raised in large bands on the Northwestern ranges are called *bronchos*. They have at least one valuable characteristic, namely their remarkable endurance. Their

spirit, however, is naturally wild and their disposition tricky, although they can be improved by kindly treatment. Indian ponies may be regarded as a small type of broncho.

Ponies. — Not counting the Indian pony just mentioned, there are five or six standard breeds of ponies, the best known



SHETLAND PONY

being the Shetland and the Welsh pony. Shetland ponies are the smallest of all. They have a remarkably gentle and amiable disposition, which makes them an ideal animal for children. For a strong, active boy, however, the Welsh pony is more desirable, as it is larger and more lively.

CARE AND TRAINING OF HORSES

Feeding. — The stomach of a horse is very small for an animal of its size. Consequently it cannot use so much bulky food as a cow. Many farm horses are fed too much hay,

though heavy horses may have more than driving horses. The best horsemen advocate giving a working horse only a fourth of his day's ration for breakfast, a fourth for dinner, and the other half at night. Dusty hay is very harmful and must not be fed to them. It is the principal cause of heaves.

Watering. — A horse should not be watered, nor fed grain, when very warm, but should wait a short time to cool off. If not warm, it should have water before feeding, and it is well to give it another drink after feeding. It must not be allowed to drink too large a quantity at once.

Muddy Legs. — When a horse comes to the stable with muddy legs, they should be rubbed down or washed to avoid stiffness or rheumatism. Of course, it is well to rub or curry the horse all over, but the legs are the most important.

Bridle Bits. — When bits are colder than freezing temperature, they should be warmed in some way before putting them into the horse's mouth. To such a cold bit the tongue and mouth may freeze fast, and this may tear the mucous membrane. If a person wants to take the risk, he can verify this by touching his own tongue to a piece of iron that is ten or twenty degrees below the freezing point of water. We suggest that he try a wet finger before using his tongue for the purpose.

Commands and Signals. — A horse has poor reasoning ability, but an excellent memory. This fact determines all methods of training. Do not expect the horse to exercise judgment or to reason out what you want him to do. The principle is, to make him do certain things in response to certain commands, and then ever after he will follow the same commands in the same way. On account of his remarkable memory, it is important not to let him do things that we do not want him to repeat. If we give him too heavy a load to

pull up a hill so that he fails, the very sight of a hill the next time he has a load may suggest to him that he ought to balk, and after he has balked a few times he will remember it many years. For the same reason a single runaway may be remembered all his life and spoil the horse.

Words of command and other signals should be very few in number and should always mean the same thing and be obeyed in the same way. For example, the horse usually starts when we get into the wagon, and if we allow him to do so without the spoken word, he will at once think that getting into the wagon is the signal to start, and he will try to obey that signal the next time. The word of command for stopping is *whoa*, but when a horse starts contrary to the driver's wish, he is often told to *back!* or *whoa-back!* Again, when that same horse goes too fast, his driver may tell him to *whoa*, when he should say *steady*. Such a horse is necessarily confused in regard to the real meaning of these commands, and, of course, cannot obey them.

Some drivers try to cure the results of such training methods by abusive language or harsh punishment. We have always noticed that good horsemen have well-trained horses, and that their motto is *kindness* and *patience*. We commend the reading of *Black Beauty* to all who may have occasion to manage horses. It is not only very interesting but it contains a large amount of horse sense.

QUESTIONS AND PROJECTS

1. *Breeds*. — What breeds of horses are found in your vicinity? Which of them are light horses and which belong to the draft type? What special merits do the owners claim for their breeds? Try to get so well acquainted with all the breeds found in your district that you can tell to which a horse belongs when you see it. Are there any pure-bred horses? If so, study them especially. Do you find that many of

the horses are scrubs and do not show a resemblance to any standard breed?

2. *Feeding.* — What kinds and what amounts of feeds are given the horse (a) when working? (b) at seasons when it is idle? Your answer should take into account the size of the horse. What difference is made between the morning and noon meals of a working horse and the evening meal? At what times are the horses watered? Is salt supplied to them regularly?

3. *Stall and bed.* — (a) What faults in the horse's stall will sometimes cause it to stand up all night? (b) Mention several reasons for giving the horse good bedding.

4. *Grooming.* — In what other way does the use of the curry comb benefit the horse aside from keeping its coat clean? Which benefits the horse more, to curry it at the end of the day's work or at the beginning?

5. *Blanketing horses.* — What is the best practice in regard to blanketing horses in winter (a) in the stable? (b) when allowed to stand outdoors for a time?

6. *The bridle-bit.* — Learn about several types of bits in use. What are the merits of each kind? Which type is the easiest on the horse's mouth? Bits are often too long. Find out from a good horseman the proper length for a good fit. What harm does it do if it is too long or not properly adjusted? Why not put a frosty bit into a horse's mouth?

7. *The check-rein.* — Observe the two methods of checking a horse's head, — by means of the side-rein, and by the over-check rein. What are the advantages of each? Explain the harm done by checking a horse's head too high.

8. *Defects.* — When there is opportunity learn to recognize the commoner defects of horses, such as ring bone, spavin, heaves. Bring a description to your school.

9. *Rising and lying down.* — How does a horse place its legs in lying down? How does it get up? How does a cow lie down and how does she get up?

10. *Parts of a horse.* — Where are these parts of the horse: Knee? Fetlock? Pastern? Cannon? Forearm? Hock? Thigh? Withers? Croup? Hip? Loin? Flank?

11. *The young colt.* — At what age is the foal taught to eat a little grain? What is the practice of feeding it after that? At what age is

it weaned? What care is given to the foal after the separation from the dam?

12. *Training the colt.* — The intelligence, care, and patience used in training the colt largely determine whether the horse is well behaved and obedient or stupid or tricky. Learn all you can about the process by personal observation and by conversation with the best horsemen you know. Notice such steps as these: How to handle or hold a foal, when and how to train it to the halter, to drive with lines, to the uses of the bit, to the harness, to be hitched to a vehicle, either single or double.

13. *Oral or written composition.* — This chapter offers a large variety of excellent subjects for compositions. A carefully prepared report or discussion of any of the preceding projects would be interesting, especially the following: *Breeds of Horses*, Project No. 1; *Feeding*, No. 2; *Blanketing Horses*, No. 5; *The Bridle-bit*, No. 6; *The Check-rein*, No. 7; *Defects of Horses*, No. 8; *Feeding the Colt*, No. 11; *Training the Colt*, No. 12.

CHAPTER XXXII

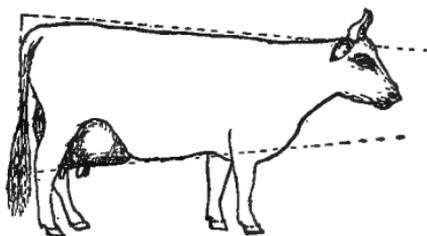
CATTLE

The growing of cattle is one of the most important branches of farming, although there are sections of the country that do not give so much attention to it as the best interests of agriculture demand.

There are many different breeds of cattle, each possessing its own special characteristics. They may be divided into two great classes, — the dairy breeds and the beef breeds. Each of these types is especially adapted to the purpose indicated by the name, and the two types are so widely different that it is impossible for a typical animal of one class to meet the requirements of the other class.

DAIRY TYPE AND BREEDS

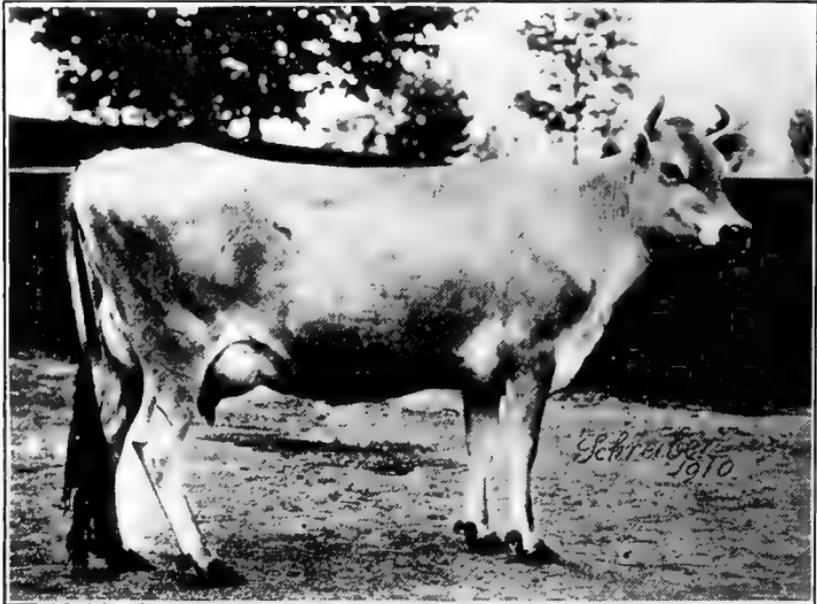
The aim in developing these breeds is the production of a large quantity of good milk. In order to produce much milk the cow must have a large stomach — room to digest much food; and this food must not be turned into meat and fat — she must be lean; the milk is secreted and stored in the udder, and this must be large. By way of further description, we may say that the dairy cow has a small head and an intelligent-looking face, with clear eyes and a large



DAIRY TYPE

mouth. Her head, neck, and legs are refined in form; but the general appearance of her body is bony and angular. Viewed from above or from the side, her body presents the shape of a wedge.

The principal dairy breeds are the Jersey, Holstein-Friesian, Guernsey, and Ayrshire.

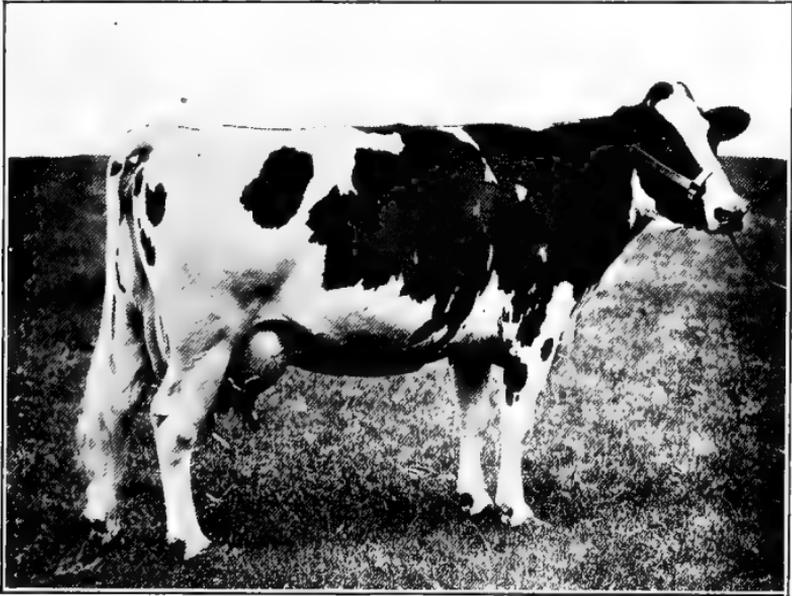


JERSEY COW

Jersey cattle are of small size and quite variable in color, gray and silver-fawn being the more common. They are a very popular dairy breed and are found on many farms except in the vicinity of large cities, where they are greatly outnumbered by Holsteins. They are famous for the richness of their milk and the large quantity of butter produced, and are especially prized for private family purposes where the finest grade of milk is desired. They are not considered so rugged

in constitution as some of the larger breeds and do not thrive on a poor pasture.

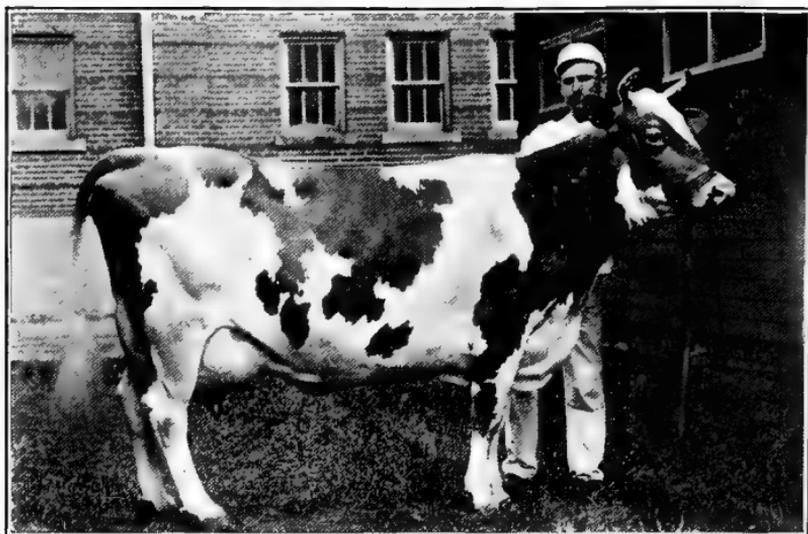
Holstein-Friesian cattle are black and white, the proportion of the two colors varying considerably in different animals. They are the largest of our dairy breeds. The cows produce



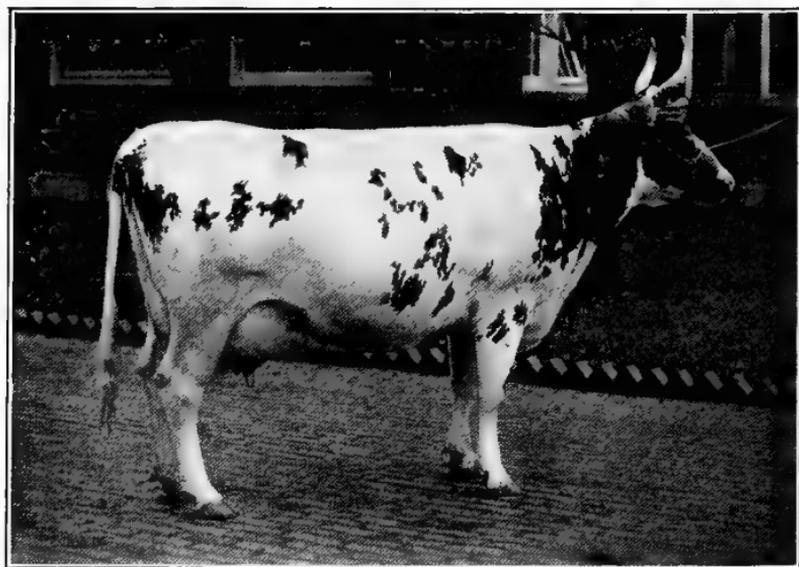
HOLSTEIN-FRIESIAN COW

a larger quantity of milk than any others, and for that reason they are the most popular breed among people who supply milk for large cities. Their milk, however, has a low percentage of butter fat, and, therefore, they are not so highly prized for butter making. Being larger than other dairy breeds, they are more valuable for beef purposes, which is a very important consideration. Another point in their favor is that they are hardier than most other dairy breeds.

Guernseys are similar to Jerseys in their milking qualities



GUERNSEY COW



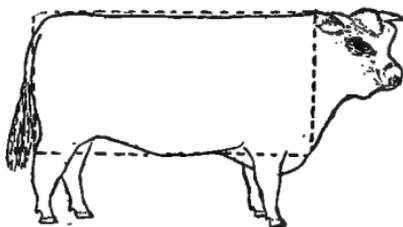
AYRSHIRE COW

and also in their appearance, except that they are never gray as the Jerseys often are, and they usually have white markings on the face, flanks, and legs. They may be most easily distinguished from the Jerseys by their flesh-colored noses, the Jerseys having black ones.

Ayrshires are more hardy and active, and thrive better on poor pastures than other dairy breeds. They are attractive looking animals. Their color scheme consists of patches of red or brown and white, their horns are turned upward and outward, and their form is not so bony and angular as that of other dairy cattle.

BEEF TYPE AND BREEDS

In developing this type of cattle, breeders have had in view an animal that shall furnish the largest possible quantity of high grade meat. It must, therefore, not use up food in the production of milk, but rather in laying on flesh and fat. The form of the body is blocky, resembling a brick set on edge. Viewed from the side or from the top, the



BEEF TYPE

outer lines are parallel instead of forming a wedge, as in the dairy type. The body is well rounded, not angular; the neck and legs are short and stout, the udder is small. The principal breeds of this type are the Shorthorn, Hereford (pronounced *Herford*), Aberdeen Angus, Galloway, and Red-Polled.

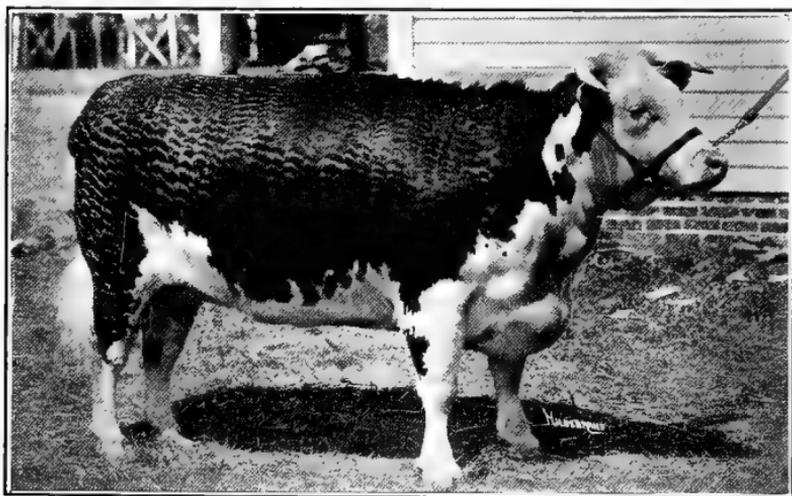
The Shorthorns outnumber any other breed of cattle in the country, and there are many distinct strains or families, some of which have been developed into fairly good milkers for the



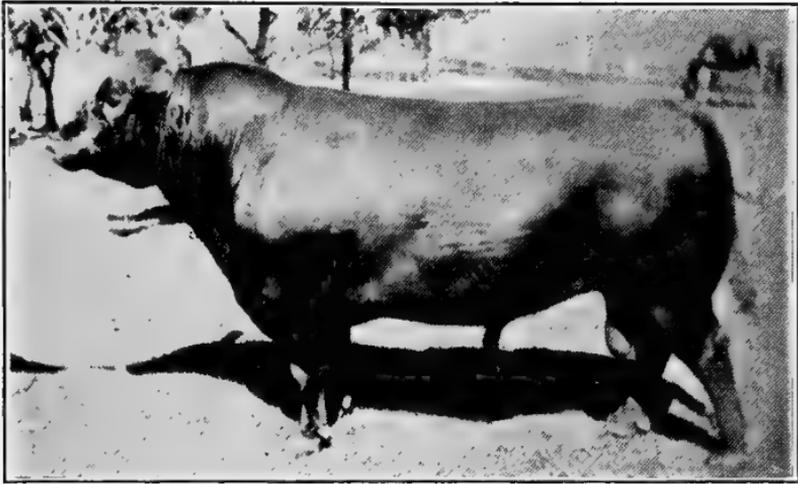
SHORTHORN BULL

production of butter and cheese. Shorthorns have a mild and quiet disposition and do well on all kinds of feed. Their color is red, white, and roan.

Hereford cattle are red, with a white head and other white markings. They readily adapt themselves to various condi-



HEREFORD BULL



ABERDEEN ANGUS BULL

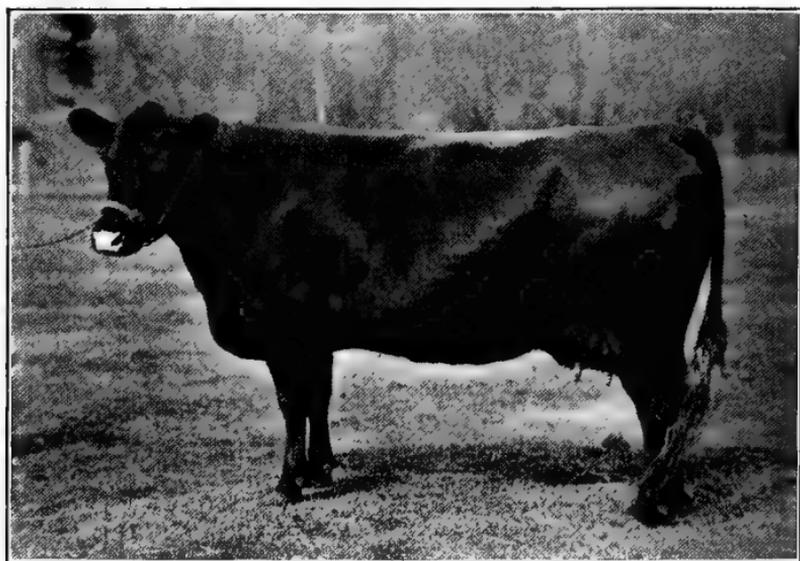
tions of climate and pasture, and have been the most popular breed on the western ranges. They produce very little milk and are strictly a beef breed.



GALLOWAY BULL

Aberdeen Angus cattle are black and hornless. They are best adapted to farms where they may have shelter in winter and where pasture is fairly good.

The Galloways are black and hornless like the Aberdeen Angus, but their hair is long and beautifully waved, while that of the other breed is short and smooth. Their hides are in demand for the manufacture of lap robes and overcoats.



RED-POLL COW

Red-Polled cattle, as the name signifies, are red in color and hornless. They are about the same size as the Galloways, but somewhat lighter in weight than the other three breeds of beef cattle mentioned. They are not so blocky and massive as ideal beef animals; their form inclines somewhat toward the dairy type, and they are very good milkers.

Dual Purpose Breeds. — Several of the beef breeds, as we have learned, are quite satisfactory milk producers and they

are, therefore, often called dual purpose or general purpose breeds. The Red Polls are the most popular breed of this class, and the milk strains of Shorthorns and some minor breeds not described in this book are also classed here.



SHORTHORN COW (MILK STRAIN)

SCRUB CATTLE AND GRADE CATTLE

The descriptions we have given apply to pure-bred stock, which is not the kind that forms the ordinary herds on our farms and ranches. Such cattle are either *scrub* or *grade* animals. By scrubs we mean the common cattle that have no relation to any recognized breed, but are a mixture of many strains and races. Although some of these scrubs are very satisfactory, they do not breed true, and the offspring of a valuable cow may be a very poor animal. Such a herd may be greatly improved by placing at its head a pure-bred sire of the desired kind. The offspring would then be what is

called *grade cattle*, and in a few generations the grades will closely resemble the sire and be nearly as useful as pure-bred cattle. Grade cattle are what we usually find when we hear of Jerseys, Holsteins, Shorthorns, Herefords, etc., in ordinary farm herds. Pure-bred cattle are too expensive for general use and are chiefly employed for breeding purposes.

QUESTIONS AND PROJECTS

1. *Breeds.* — What breeds of cattle are there in your vicinity? Which are the most common? Why are they preferred? Are any of them pure-bred? See as many herds as possible and note the breed and all its characteristics. Try to get interesting information from the owner.

2. *Milk and butter.* — Is there a creamery in your vicinity? If so, how much milk is received daily? How many cows supply this milk? Then what is the average milk production per cow? Find out what records are made by some of the better cows. Visit the creamery and observe the process of butter making.

3. *The pasture.* — Learn about the pasture of some herd. (a) How many acres in it? How many animals does it support? Is that a satisfactory number? (b) Are the grasses wild or have they been seeded? What kinds are there? Are there any other plants than grasses, that is, any legumes? What kinds? What are their merits?

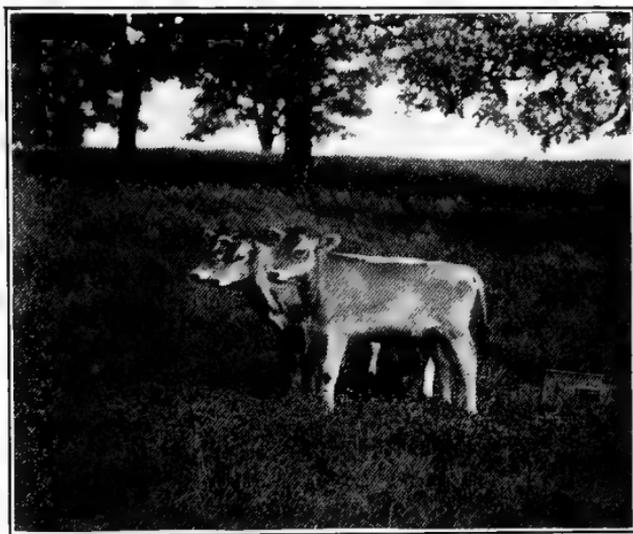
4. *The stable.* — Is it warm enough? An abundance of light? Well ventilated? What kind of floor? Is that satisfactory? What is considered the best kind of floor? In case of dairy cows, see whether the barn is thoroughly clean.

5. *Feeding milch cows.* — (a) Is the summer pasture supplemented with some grain or other concentrated feed? Is any use made of the soiling method, *i.e.* cutting green forage and supplying it to the cows? (b) For winter feeding what is the best kind of hay used in your vicinity for dairy cows? (c) Learn about a silo. How is it filled? What are the merits of silage for milch cows? (d) What grain or mill feed is used?

6. *Water. Salt.* — (a) What are the best methods of watering stock in your vicinity? Milch cows need more water than other stock. Do they get it several times a day? (b) How frequently is salt supplied to the cattle?

7. *Weaning and feeding the calf.* — (a) The young calf should get the first milk (the colostrum) of the mother, and it is best to let it suck at least a few times. What is the practice in your vicinity? (b) When the calf is fed by hand it must not go hungry too long. How many times a day is it fed? What quantity of fresh milk? (c) At what age is the change made to skim-milk? When is the calf taught to eat a little grain?

8. *Oral or written composition.* — When a study or investigation has been completed it is a good practice to prepare a full and interesting report of it. Any of the preceding projects are worthy of such a report.



THEY ARE JERSEYS

CHAPTER XXXIII

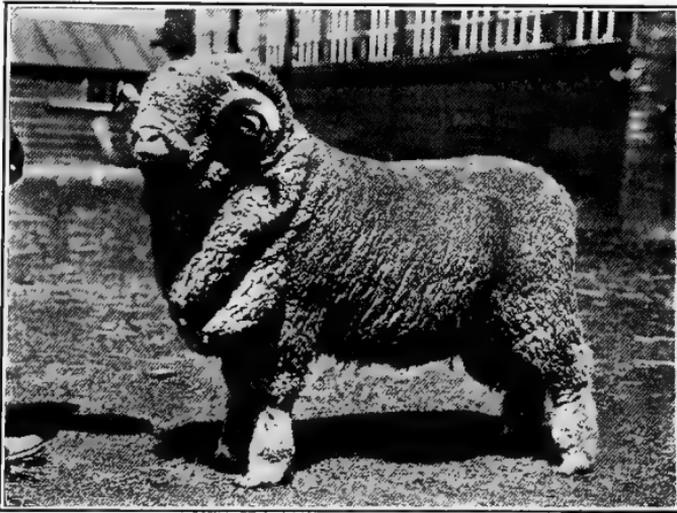
SHEEP

Sheep will thrive on pastures that will scarcely support other animals, and they require less grain than any other live stock. They are easily cared for; they increase rapidly and mature at an early age. These considerations make them very profitable farm animals. They are usually classified according to the kind of wool they produce, that is, according to the length and quality of the fiber. This gives us the fine-wool, the medium-wool, and the long-wool breeds. The last two types are often spoken of as the mutton breeds.

THE FINE-WOOL SHEEP

These are the Merinos, our best wool producers. On these sheep the skin lies in folds or wrinkles, thus increasing the surface for the wool to grow on. The fleece is heavy and the fiber short and fine. The wool is in demand for the manufacture of the finest and most expensive woolen fabrics. But the animals are small and their bodies spare, so that they are poor mutton producers. Merinos are hardy, are good grazers, and are able to adapt themselves to a variety of climates, so that they may be found all over the civilized world where sheep are raised. They originally came from Spain, but most of the improvements have been developed in other countries, giving us many different types, the principal ones being the American Merino, the Rambouillet or French Merino, and the Delaine Merino. Merino rams usually have horns.

The Rambouillet (pronounced *Rong boo yě'*) is the leading fine-wool breed of sheep raised in this country. It is the largest of the Merinos and the best mutton producer, though in this respect it is not equal to any of the medium or long-wool breeds. The skin is comparatively free from the wrinkles



RAMBOUILLET RAM

found on the other Merinos, thus making it easier to shear these sheep. Rambouillets are very hardy and are, therefore, popular on the western ranges.

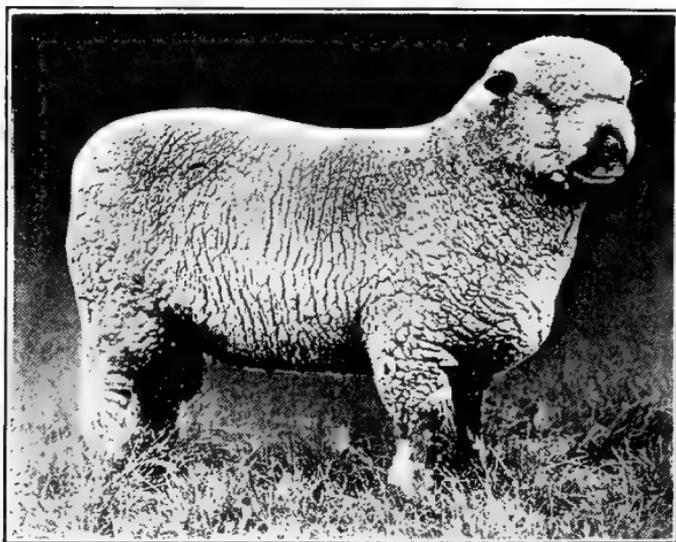
MEDIUM-WOOL BREEDS

The wool of all these breeds has a coarser fiber than in the Merinos, though the fiber is not generally longer, except in case of the Cheviot and the Oxford. Again, in all these breeds, except the Southdowns, the animals are heavier than the Merinos. All of them, including the little Southdowns, have a compact, blocky form and are ranked as good mutton

sheep. Horns are not generally found among them except on the Dorsets.

The principal breeds of this class are the Shropshire, South-down, Cheviot, Dorset, Hampshire, and Oxford. We can give space to only a brief description of the first two, these being the most popular in this country.

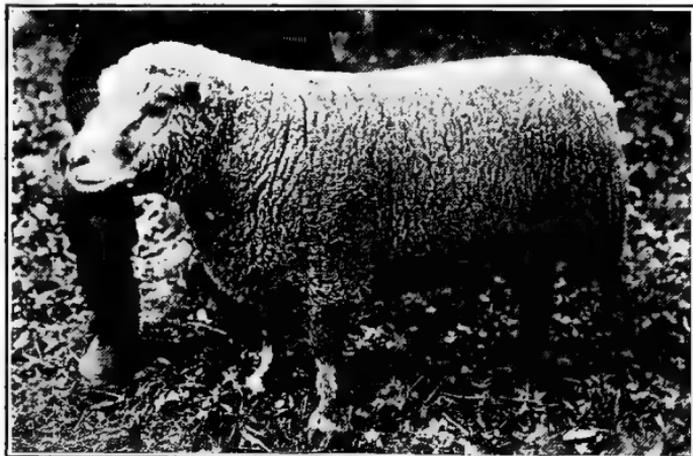
The Shropshires are the most numerous breed of sheep in America, excepting the Merinos. They are not so hardy as



SHROPSHIRE RAM

Merinos, and are not so well suited to the ranges, but they thrive well wherever they are given good pasture. They rank high both in respect to wool and mutton production, and might be termed a good general purpose breed. Moreover, they excel in the rapidity with which their numbers increase — an important item in the profits from a flock of sheep. These considerations account for their popularity.

The Southdowns are the smallest of the mutton breeds, but they have an excellent form, are heavy for their size, and their flesh is of the finest quality. As wool producers they rank very low. They are adapted to hilly pastures where the grass is short and fine.

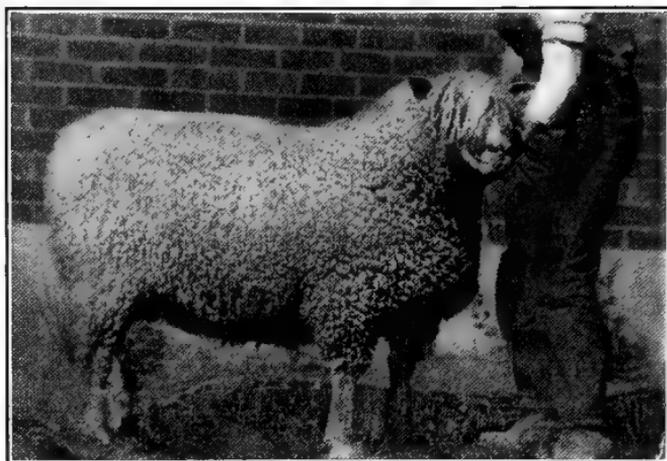


SOUTHDOWN RAM

THE LONG-WOOL BREEDS

These animals are generally still larger than the preceding classes and their wool has a longer and coarser fiber. They are chiefly valued for their mutton and are extensively raised in England for that purpose; but in this country they are not at all popular. The three leading breeds are the Cotswold, the Lincoln, and Leicester.

The Cotswold is the only one of these breeds that has been raised in large numbers in America and even that has in recent years been partially displaced by the Shropshires. These sheep may be distinguished by the peculiar looking head, which has long curls or locks of wool hanging over the face well down to the nose.



COTSWOLD RAM

The following table gives specific information that may be found convenient for reference. It has been made by combining and condensing similar tables given in Harper's *Animal Husbandry for Schools*.

BREEDS OF SHEEP. REFERENCE TABLE

NAME OF BREED	FACE	LENGTH OF WOOL FIBERS, INCHES	WEIGHT OF FLEECE, POUNDS	WEIGHT OF SHEEP, POUNDS	AVERAGE DIAMETER OF FIBER, FRACTION OF INCH
American Merino	White	2-2 $\frac{3}{4}$	12-25	100-150	$\frac{1}{1194}$
Delaine Merino .	White	3-5	10-20	100-150	the same
Rambouillet . .	White	3-4	10-15	150-185	the same
Southdown . . .	Brown or gray	2-3	4-8	125-175	$\frac{1}{865}$
Shropshire . . .	Dark brown	3-4	8-12	155-225	no measurements available
Cheviot	White	5-8	6-10	150-225	
Dorset	White	3-4	6-9	150-225	
Hampshire . . .	Dark brown	3-4	5-8	180-250	$\frac{1}{769}$
Oxford	Brown	4-6	6-10	200-325	$\frac{1}{561}$
Leicester	White	6-10	6-10	180-240	$\frac{1}{654}$
Lincoln	White	10-18	10-14	275-350	$\frac{1}{683}$
Cotswold	White	8-14	8-12	200-265	$\frac{1}{605}$

The lighter weights of the fleece and of the sheep are for ewes, and the heavier weights are for rams. These weights and the thickness of the fiber in the last column, are, of course, quite variable, and the figures merely show what is a fair average. As sheep are sheared once a year, the length of the fiber and the weight of the fleece are for a twelve months' growth.

CARE AND FEEDING OF SHEEP

We said at the beginning of our consideration of sheep that they are easily cared for. By that we mean that the work required is not heavy, nor is the total amount of it for the year large. A good part of the year they need very little care. On the other hand, they must never be left entirely without watchful oversight, and a knowledge of their nature and habits is quite essential. They are timid and defenseless creatures, so that dogs or wolves easily create havoc in the flock. They are liable to the attacks of parasites, which in most sections are greatly dreaded, though our cool northern states are in less danger from this source. Their constitution is not at all sturdy. They are subject to colds, catarrh, inflammation, and other sheep diseases if their wool becomes saturated with rain or snow, or from damp quarters. They easily injure themselves on a fresh pasture in summer or by eating succulent forage that is crisp with the night frosts of autumn. The most critical season, however, is the lambing time. The young lambs are often quite helpless, and if they do not receive prompt care, they perish.

Summer Pasture and Care. — Sheep are particularly fond of grazing short forage, as the younger plants are the most tender and juicy. One will often see patches that are eaten down almost to the bare ground, while other parts are not touched because the plants have become old and tough. In

such a case it is a good plan to run a mower over the pasture so as to start a second growth. This will also serve the good purpose of destroying the weeds, some of which are injurious to the wool. If one can have two pastures, it is advantageous to change the sheep from one to the other occasionally. This gives the closely cropped parts a chance to get a good start and helps to clear the pasture from the germs of disease. If sheep are pastured on clover or alfalfa or very succulent grasses, there is danger of bloating, especially if the plants are young, or if wet with rain or dew. In case of such pasture, the sheep must be accustomed to it gradually by turning them into it for only about an hour in the afternoon and lengthening the period the next day. When the forage is wet, they should be kept off.

Sheep wear a warm coat and should be able to escape from the rays of the sun during the hottest part of the day. Unless there are enough good trees in the pasture, the best way is to give the sheep access to a barn or shed. If the pasture is too distant for this plan, then a cheap roof should be especially constructed for the purpose.

In the Winter. — Proper shelter and clean bedding must now be provided to keep the fleece dry and thus prevent colds and the resulting complications. The feeding problem is much the same as in the case of other stock. Clover and alfalfa are especially good for sheep, but any mixed hays will answer. Succulent food, such as corn silage or root crops, is relished and helps to keep the digestion in good tone. A little concentrated feed, such as wheat bran or oats, is desirable, especially for ewes that are to lamb in the spring. It must also be borne in mind that sheep are no exception to the rule that all animals need regular exercise. Stormy weather and deep snows often make it difficult to arrange for this outdoor

exercise in the case of sheep, so that a little ingenuity and good judgment are necessary. Another matter that needs attention during the long winter is the feet of the animals. In summer the wear at the bottom of the hoof keeps pace with its growth, but when the feet are idle for months at a time, the toes may become so long that they must be trimmed to avoid bad results.

QUESTIONS AND PROJECTS

Find out all you can about the sheep kept in your vicinity (1) by personal observation, (2) by talking with the owners and others. Here are some specific questions.

1. *Breeds.* — What breeds are kept? Describe their general appearance, size, color of nose, ears, and feet; whether any of them have horns, etc.

2. *The wool.* — (a) Its quality; on what part of the body is the finest of the fleece produced? Where does the coarsest grow? (b) The weight of the fleece; are the entire head and legs covered, or partially bare?

3. *Mutton.* — What is the weight of the animals, and their merits as mutton producers? Is the flock primarily a mutton breed or a wool breed?

4. *The increase.* — (a) How many ewes are there in the flock, and how many lambs did they raise last year? (b) What special care do young lambs require? (c) How are the lambs disposed of the following autumn or winter?

5. *Summer feeding and care.* — (a) How many sheep in the flock? how large is the pasture? how many sheep is that per acre? (b) Do they feed on the same pasture all the time or are they occasionally changed from one pasture to another? What is the advantage of such a change? (c) What other feed do the sheep receive during the summer?

6. *Winter feeding and care.* — (a) What feed do the sheep receive in winter? How many times a day and by what method is it given to them? (b) What kind of shelter do they have? How often is fresh bedding put down for them? (c) Are they given daily exercise? How

is that managed when the snow is deep on the ground? (d) What care do the feet occasionally need in winter?

7. *Shearing the sheep*. — (a) At what date are sheep sheared? What determines the date? Is it done by hand or with a machine? What are the difficulties in the process? (b) Find out when some flock in your vicinity will be sheared, then go and observe the operation, and soon after describe it to your school.

8. *Dipping the sheep*. — (a) Does the owner dip the sheep? How frequently? Describe the operation. (b) Sheep are dipped to free them from ticks and scab-germs; describe each of these pests and the harm it does to the animal.

9. *Profits*. — (a) A flock containing 200 Shropshires yielded a clip of 1800 pounds which was sold at 20¢ a pound. Allowing enough lambs to take the place of old ones that were lost there still remained an increase of 150 lambs valued at \$15.00 each. The value of pasture, hay, and other necessities was \$300. What amount was realized for labor, interest on the investment, and profit?

(b) Secure data from owners of flocks and make up similar problems. Such examples, based on actual experience, are far more instructive than those given in books.

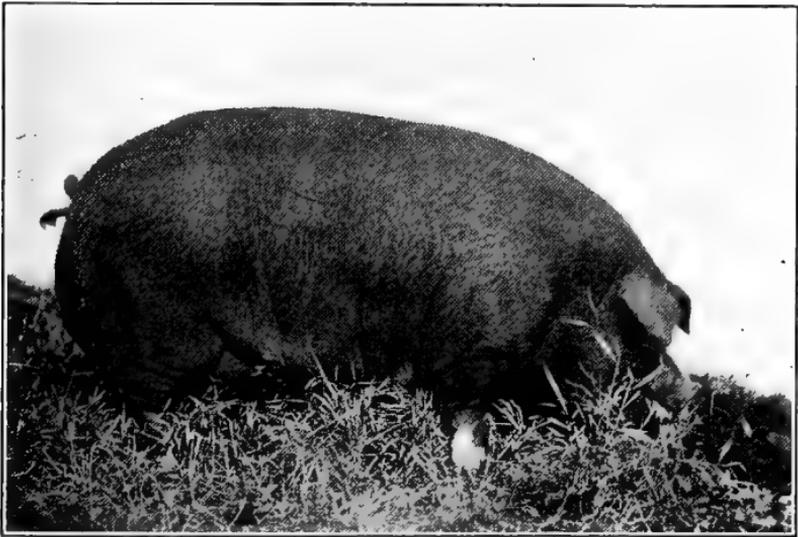
10. *Oral or Written Composition*. — Full and interesting reports should be carefully prepared and then presented to the class on at least a portion of the preceding topics. The most suitable for composition themes are: *Breeds of Sheep*, Project No. 1; *The Wool*, No. 2; *Summer Feeding and Care*, No. 5; *Winter Feeding and Care*, No. 6; *Sheep Shearing*, No. 7; *Dipping the Sheep*, No. 8.

CHAPTER XXXIV

SWINE

In the country at large, hogs rank second in the total number of farm animals raised, being exceeded only by cattle. In value they rank third, being exceeded by horses and cattle.

Breeds. — Our most important breeds of hogs are the Poland-China, Berkshire, Duroc-Jersey, Chester-White, and



POLAND-CHINA

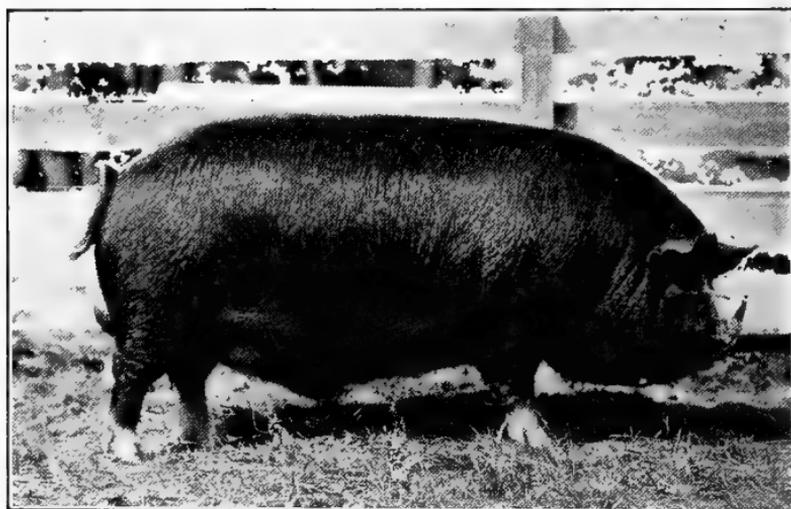
Large Yorkshire. All of these have very broad and fat bodies and belong to the lard type — except the Yorkshire, which has a narrower body, does not fatten readily, and belongs to the bacon type. The Chester-White is our largest

hog. The Poland-China is the most numerous in the corn belt, where so many hogs are raised. The Large Yorkshire is bred extensively in the Northwest where less corn is fed. We present other interesting information in tabular form.

BREEDS OF SWINE AND SOME OF THEIR CHARACTERISTICS

BREED	COLOR	TYPE	EARS	LEGS
Poland-China	Black	Lard	Drooping	Very short
Berkshire	Black	Lard	Erect, pointed	Medium length
Duroc-Jersey	Red	Lard	Drooping	Very short
Chester-White	White	Lard	Drooping	Medium length
Large Yorkshire	White	Bacon	Erect, large	Long

Pens and Pastures. — It used to be the common practice to keep hogs shut up the year round in pens which become



BERKSHIRE

very filthy and unhealthy. It is now recognized that a good pasture is not only necessary for the health of the animals,

but is also an important factor in the production of pork. Alfalfa is probably the best plant for such a pasture, and alfalfa hay is also fed to the hogs in winter.

QUESTIONS AND PROJECTS

1. *Breeds.* — What various breeds of swine are kept in your vicinity? From personal observation describe the appearance of each breed. How many swine in some of the largest herds? What breeds are those? Why do the owners prefer those breeds? Are any of the hogs pure-bred?

2. *Feed and pork.* — (a) It is said that hogs turn feed into meat faster than any other farm animal. At what age are they usually



DUROC-JERSEY

marketed? Approximately what is the weight then? (b) Arrange to feed some pigs through the season and keep an accurate account of what they eat. When you market them, notice the quantity of meat that has been produced from the food. Ask experienced farmers whether such result would be equaled by cattle or sheep.

3. *Feeding.* — (a) What grain is most commonly fed to swine in your vicinity? Is it fed whole or ground? Dry or soaked? What are the reasons for the prevalent practice as against other methods? (b) Is a pasture provided? How large? What are the pasture plants? Is

green forage cut and fed to them? (c) What other feed do the swine receive at any time of the year? (d) What difference is made in feeding the breeding hogs and those that are being fattened?

4. *Dipping*. — Do the hogs ever become infested with lice? Are they dipped periodically? How often? Describe the process.

5. *Shelter*. — Describe the pens or stables used for hogs in your vicinity. Are they lighted and ventilated and sanitary, or are they breeding places for disease germs? Are they convenient? Is there a hog lot connected with the pen? Is that filthy or is it kept fairly clean?



CHESTER-WHITE

6. *Diseases of swine*. — Find out what are the common swine diseases. Tell something of their nature. How can hog cholera be prevented?

7. *The pigs*. — (a) Do all breeds produce about the same number of pigs to the litter? What are the prevailing numbers among those in your section? What is the highest number reported? (b) At what age do young pigs begin to eat other food than their mother's milk? What is the best device for feeding them so that the old hogs cannot have access to the trough? What different kinds of food are given them now? At what age are the pigs finally weaned?

8. *Marketing*. — To whom do the farmers sell their hogs? What prices prevailed during the last year? What are the chief markets to which hogs are shipped from your section?

9. *Profits.* — (a) Secure these items from some farmer with successful experience in hog raising :

Number and value of the breeding hogs at beginning of the season.

Cost of additional hogs purchased, if any.

Number of pigs raised this season.

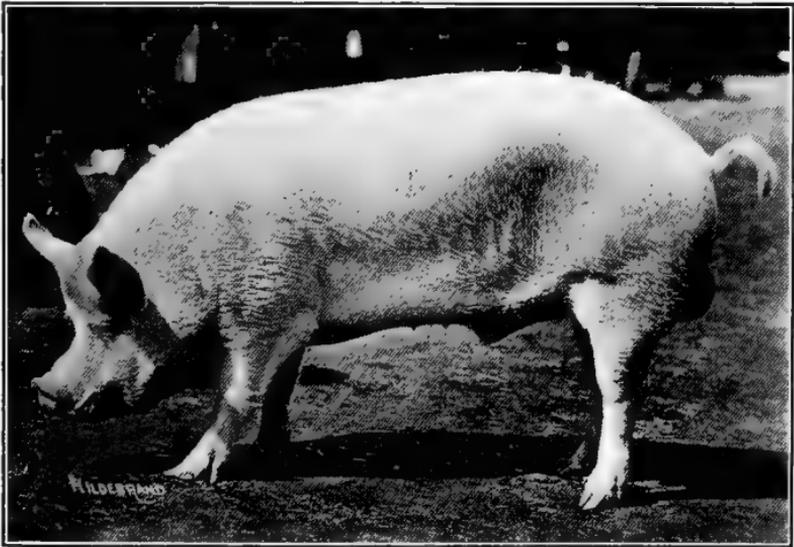
Value of feed used.

Cost of other supplies for the hogs.

Number of hogs sold at end of season.

Their aggregate weight, and the price received.

Number and value of hogs still on hand.



YORKSHIRE

(b) Determine the *gain*. This covers labor, interest on investment, and profit. What items should be included under "investment"?

10. *Oral or Written Composition.* — Any of the first seven of the above projects will make a good subject for an interesting composition.

CHAPTER XXXV

CATS AND DOGS

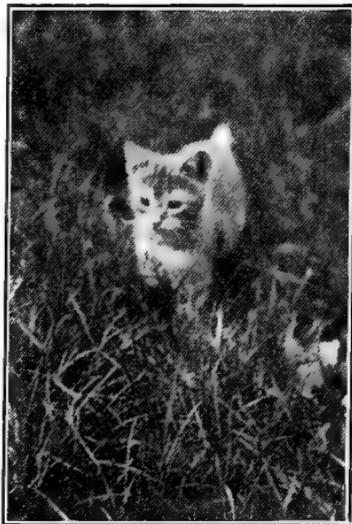
Any consideration of domestic animals would be quite incomplete if it did not include the cat and the dog, for no other animals are more generally associated with our home life. Though their economic value is not so evident as that of horses, cattle, sheep, and pigs, their relation to the family is much more intimate. Most people seem to have a natural craving for the companionship of some dumb animal, and so the dog and the cat have been adopted as pets. At the same time they do important police duty upon their master's premises, the cat giving special attention to such pests as rats and mice, and the dog keeping a lookout for larger intruders.

CATS

Origin. — Cats were domesticated before the dawn of history, and we have no knowledge of the wild species from which they descended. The earliest records of domestic cats are found in Egyptian history, and show that among the ancient Egyptians they were worshipped as sacred animals. Among the ancient Hebrews, Greeks, and Romans, cats were scarcely known, and they were rare in Europe even in the earlier centuries of medieval times. It seems probable, therefore, that our cats are descendants of the race kept by the ancient Egyptians, and that this in turn was derived from some wild species formerly living in Northern Africa or Southern Asia. Our cats are related to the lion, tiger, and panther of the Old World and to the jaguar, puma, Canada lynx, and wild-cat

of America, and this group of animals is accordingly known as the cat family. But none of these wild animals is as small as our domestic cat, and none resembles it closely enough to be considered its ancestor.

Races or Types. — We have two great types of cats, the short-haired and the long-haired. Our common cats are short-haired, and the Angora and the Persian are long-haired. The Angora, Persian, and other long-haired varieties have been so interbred for years that they can be no longer recognized as distinct breeds. But the difference between the short-haired and the long-haired races is so radical as to indicate that they may be descended from different wild ancestors. The famous Manx cat of the Isle of Man, an animal without a tail, may have still another origin.



A YOUNG PERSIAN CAT

Feeding and Care. — Cats are flesh-eating animals, and meat should be their chief diet. To this should be added some green vegetables, but starchy foods, as potatoes, rice, and oatmeal, should not be given them, and it is also said that they cannot digest milk and should not have much of that. They should have a clean and dry place in which to stay as they are naturally very cleanly animals, and they are subject to distemper, pneumonia, and other diseases that are brought on by dampness.

The Cat and Her Kittens. — Puss is an affectionate and intelligent mother. She keeps her kittens scrupulously clean

by washing them with her tongue from the end of the nose to the tip of the tail. When their bed does not suit her, she carries them to another by the nape of the neck without ever hurting them. She frolics with them and lets them bite and tease her as much as she deems proper, but if they take too many liberties she gives them a lesson in manners by holding their head in one paw and cuffing their ears with the other. She brings them mice that are half dazed so that by actual practice they may learn the art of catching them.

A Born Hunter. — Being a flesh-eating animal, the cat is by nature a hunter, and is endowed for that mode of life with wonderful instincts and powers. Her body is exceedingly lithe and strong. She does not chase her prey, as the dog does, but lies in ambush for it and springs upon it when it comes near. She has five sharp claws on the front feet and four on the hind feet, and when attacking her victim she uses them with good effect. When not needed for business, she draws them back into little pockets so that she may walk noiselessly on the padded toes.

The Eyes. — Much of her hunting is done at night, and Nature has fitted her eyes for that purpose in a remarkable way. In broad daylight the pupil is only a narrow slit, but at night it is expanded to almost the size of the whole eye and thus admits as much of the dim light as possible. At the back of the eye is a reflecting surface which catches all the light that enters and throws it upon the object in front after the manner of a searchlight. It is this flashlight effect that gives a cat's eyes the peculiar green glare when seen in the dark.

Use of Cats. — Cats have been of great service to agriculture by checking the excessive multiplication of mice, rats, and other rodents that are a menace to the stores of grain and groceries that the farmer may have on hand. It is

believed that the appreciation of this service led the ancient Egyptians, who were an agricultural people, to give them such careful protection and even to reverence them. But we now have at our command such simple devices for trapping rats and mice that by their diligent use we may easily keep them under control without the help of cats.

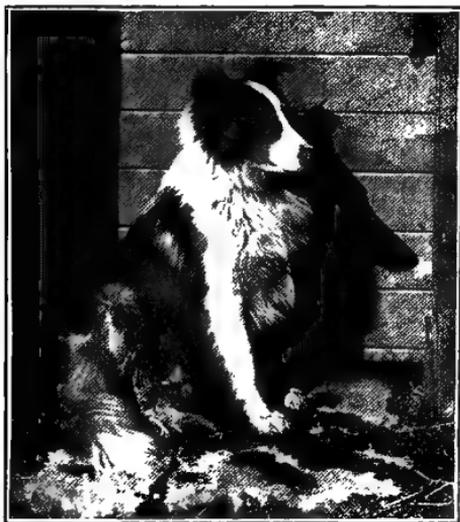
Harm Done. — We now feel that the cat's popularity is not altogether deserved. In allowing her to associate intimately with the members of the family we must bear in mind that her body is often infested with disease germs, so that she may easily be the means of spreading infection. But it is as the great enemy of our birds that she comes into conflict with the interests of the farmer and gardener. A cat can be trained when young to let birds alone, but we rarely see one that seems to have had the advantage of such an education. Especially fledglings that have just left the nest fall an easy prey to her. It is estimated that a single cat kills, on an average, fifty birds in a season. Many states protect the birds by law and impose a penalty for every one that people kill. But it seems absurd to fine a man for shooting one bird while his cat is allowed to roam at large and kill fifty every summer. If he were obliged to pay fines for her also, she would be an expensive luxury. In some European cities where birds are valued and protected more consistently, people having cats are required to confine them upon their own premises, and those allowed to run at large are regarded as public nuisances. In America it seems that we are merely protecting the birds for the sake of feeding them to cats.

DOGS

The dog is more widely distributed among the peoples of the earth than any other animal. Often he is kept solely for

a companion or pet, having very little, if any, economic value, but many dogs are more or less useful for guarding the premises, for helping to watch or to drive live stock, for hunting, drawing loads, and other purposes.

Qualities. — The dog is the most intelligent, shows the greatest ability and willingness to learn, and has the most human qualities of any of our domestic animals. His love



SCOTCH COLLIE

and devotion to his master make him an ideal companion and playfellow for children. His hearing and sight are keen, but his most striking faculty is his marvelous sense of smell. Think of being able to scent the track made by a man or an animal several hours previously and to follow it for miles!

Origin. — It is universally agreed that our dogs originated from wildwolves.

Young wolf pups are very cunning little animals and easily domesticated, and it would be perfectly natural for primitive people to capture them and raise them, not only for pets but for food supply to draw upon when game is scarce. We know that our American Indians and Eskimos make use of their dogs for food, and they are very fond of the flesh. Moreover, the dogs kept by such people always resemble their wild neighbors very closely.

Breeds. — Probably various races of dogs were derived from the various species of wolves that were domesticated

by different peoples in prehistoric times. Then, by interbreeding and selection there was obtained the great diversity in size and form that we see among the 200 breeds of dogs we now have. These have usually been developed for special purposes. For example, the pointer and the setter are favorite bird dogs; the water spaniel, Chesapeake bay, and



BROWN WATER SPANIELS

Newfoundland dogs excel as water dogs; the terriers have a propensity for digging the ground in pursuit of their prey, and can be trained to make war upon rats; the collie is the celebrated sheep dog of Scotland; bulldogs are very muscular and strong and are remarkable for their courage and ferocity; while the poodle and the pug are chiefly used for pets.

Feeding. — It is a common practice to feed dogs too much and too frequently, making them fat and lazy. For a grown dog having but little exercise, one meal a day is generally better than two or three. Moreover, such a dog should have very little, if any, meat as it is not good for him and it spoils his taste for other food. A good diet consists of coarse bread and bread crusts, vegetables, oatmeal, and bones without much meat on them. Potatoes should not be included as they are difficult for the dog to digest. Most of the ordinary scraps from the table are very satisfactory. Dog biscuit is good and is sometimes used on account of its convenience. A gnawing bone keeps his teeth in good condition and gives him much comfort and pleasure.

Fleas. — Of all troubles to which a dog is subject probably none gives him more intense annoyance than fleas. They keep him scratching and biting himself with very little relief, and are the great burden of his life. They infest carpets, bedding, sand, and other places and the dog may get them from those sources or from other dogs. To kill them, lather the dog with good soap, as castile or ivory, leave it on for two or three minutes, then rinse in clean water or let the dog take a swim.

QUESTIONS AND PROJECTS

1. *Oral or Written Composition.* — Though boys and girls are generally familiar with cats and dogs from their childhood, it requires the best efforts even of grown-ups to give a clear description or account of some particular phase of the subject, such as is outlined for each of the following projects. The effort should be to make the composition thoroughly interesting to the people who are to hear it or to read it.

2. *Cat language.* — The cat has many interesting ways of giving expression to her feelings. (a) How does she ask for something to eat? (b) How does she cry when she is hurt? (c) How does she call other cats? (d) What feeling does she express by purring? By spitting?

(e) How does she express her pleasure or affection? Anger? (f) In what mood is she when she carries her tail straight up in the air? When her tail "bristles up"? (g) In what other ways does she express her feelings?

3. *Cleanliness.* — Describe how puss washes her own face and coat, and how she washes her kittens.

4. *Cats and birds.* — Watch your cat closely when young birds in the vicinity are leaving their nests. Do you ever see her catch any? How many during the season? Do you know a cat that never pays any attention to birds? How was she trained? Remember that you may be wrong in saying that she never catches any just because you have not caught her in the act.

5. *The dog's intelligence and traits.* — Discuss the following, giving illustrations: (a) The dog and his master; love for and devotion to his master; his anxiety to learn, and to please him; his courage and strength in protecting him.

(b) The dog as a boy's companion: draws cart and sled; plays games, as fetching balls and sticks even from water; performs tricks, as sitting up, speaking, begging, etc.

(c) The watch dog: protecting the home premises; his master's property elsewhere; watching over the children of the family.

(d) The dog as a hunter: his great fondness for hunting; his keen scent and ability to detect game, and his usefulness on this account; speed and endurance.

(e) The shepherd dog: his work with sheep and other live stock.

6. *The dog and his food.* — (a) Notice his teeth, — the small front teeth, the large tushes or canines; the large molars behind the canines. To what purpose is each kind adapted?

(b) Compare with teeth of sheep, cow, or horse.

(c) How do the dog's teeth indicate that he is naturally a flesh-eating animal? Nevertheless, when our dog has very little exercise, as is usually the case with the ordinary house dog, he should be fed scarcely any meat.

7. *Breeds of dogs.* — Give a description of the different kinds of dogs you know, as the setter, pointer, spaniel, bulldog, hound, terrier, St. Bernard, poodle, pug, collie, shepherd dog.

8. *Feet and claws.* — (a) Compare the feet of the dog with those of the cat. Which has heavier toe-pads? Is there a reason why the dog's

foot needs heavier pads than the cat's? How many toes on the dog's hind feet? On his front feet? On the cat's feet? What kind of track does the dog make in the snow? The cat? (b) Compare the dog's claws with the cat's. Which are heavier? Can the dog's be drawn back out of sight like the cat's? Do the cat's claws touch the ground when she walks? Why is it necessary that the cat should walk more silently than the dog?

9. *The eyes.* — Compare the eyes of the cat with those of the dog, as to size and form of the pupil in the daytime and at night. Can the dog see in the dark as well as the cat can? In finding his prey, does the dog rely upon his eyes as much as the cat does? What is the color of the cat's eyes? the dog's?

10. *Catching their prey.* — How the dog follows his prey by the scent; can the cat do the same thing? Does she catch mice by running after them as the dog would? Tell how she lies in ambush. How she uses her claws when she pounces upon her prey. If you ever see her attack a big rat be sure to watch the fight. Describe it. What weapons does she use? How does the dog pounce upon his prey and kill it? What weapons does he use?

11. *The hair.* — Compare the fur of the cat with the dog's coat, telling how they differ. Which is softer? Warmer?

12. *Kittens and puppies.* — Tell how kittens look when but a day or two old, especially noting their closed eyes and helpless condition. Describe puppies of the same age and compare with kittens. How old are kittens when the eyes open? Puppies? How does the mother cat carry her kittens? Does the mother dog have a similar habit?

CHAPTER XXXVI

THE DOG FAMILY: WOLVES AND FOXES

This class of animals comprises the wolves and foxes, all of which bear a close resemblance to our dogs in structure and other fundamental characteristics. The members of this family and the weasels, skunks, and badgers whose description follows in the next chapter are our chief representatives of the great order of flesh-eating animals. Our domestic dogs, which are derived from wolves and after whom the family is named, have been described in the previous chapter.

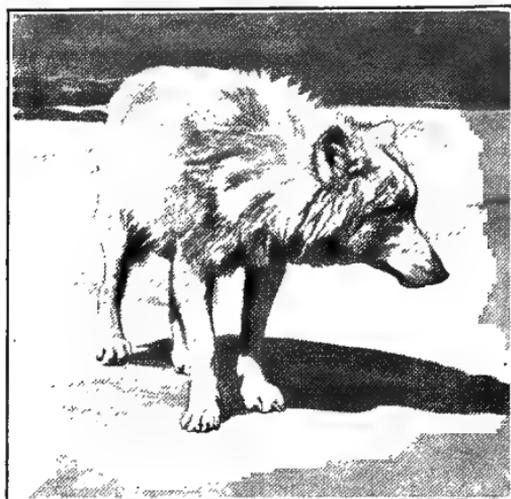
WOLVES

Wolves are among our fiercest and meanest flesh-eating animals. Hornaday says, "They are the only animals on earth which make a regular practice of killing and devouring their wounded companions, and eating their own dead. I once knew a male wolf to kill and devour his female cage mate, with whom he had lived a year." We may be glad that we have only two types in North America, the gray wolf and the coyote.

Gray Wolf, Timber Wolf, Buffalo Wolf. — This is the common wolf that is distributed over a large portion of North America as well as Europe and northern Asia, somewhat different varieties being found in the different sections, and known by different names. It is a strong and fierce beast, having an average length of four feet and standing 26 inches high at the shoulder. Its color is very variable. Generally

the hairs are black and white, and most commonly they are mixed in the right proportion to make a grizzly gray; but as one color or the other predominates we get darker or lighter shades, even a clear black or clear white. In Texas a reddish brown color occurs.

Although in some sections it is known as a timber wolf, it may also be found in prairie regions. It lives upon rabbits,



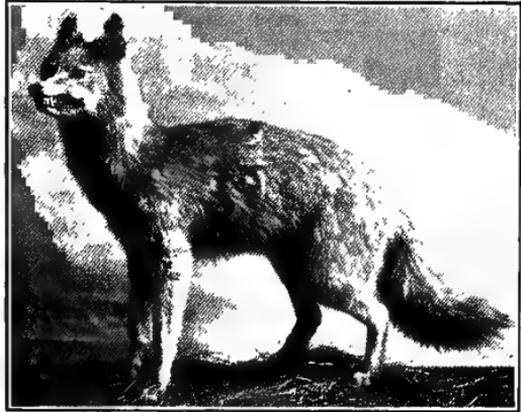
GRAY WOLF

birds, and other wild animals, and when these are scarce, it grows bolder and attacks the smaller animals of the farm, such as calves, sheep, hogs, and poultry, and in this way does much damage. Ordinarily, these wolves hunt separately or in small families, but under some circumstances, especially in winter, they gather in

packs and attack larger animals. They are frequently reported to have pursued people, but actual loss of human life from this cause has not occurred in many instances. Most states offer a bounty of from \$2 to \$10 for the destruction of a wolf, and thus its numbers have been greatly reduced. In the northern states it is now found in the forests of northern Minnesota and Michigan. It occurs also on the Great Plains and in the Rocky Mountain region from the Arctic Ocean to Mexico, but in the settled parts even there it is met with but rarely. It can be identified by its dog-like appearance,

the coyote being the only other animal that looks like it. From that it can be distinguished by its larger size, by the way it carries its tail, — raised to a horizontal line or a little higher, — and, if its call is heard, by the prolonged deep bass howl.

Coyote, Prairie Wolf, Brush Wolf. — Coyotes look very much like the Gray Wolf but are smaller, being three feet or a little more in length and about twenty inches high at the shoulders. Their color is generally gray or yellowish. They inhabit the prairies and plains from Saskatchewan to Mexico, living in burrows and subsisting on rabbits, ground squirrels, birds, and any other animal food they can find. They are a troublesome pest to the owners of calves, lambs,



COYOTE

or even sheep, and a determined war of extermination is being waged against them. There is often a bounty upon their life the same as in the case of the large wolf. They are quite prolific, rearing from five to seven puppies a year. They can be distinguished from the Gray Wolf by their smaller size, by the way they carry their tail, — low down, — and by their melancholy howl which consists of a short, quick bark followed by others in quick succession in a rising pitch until they merge in a long-drawn wail. This high-pitched yelping is most frequent in the evening and at daybreak, but may be heard at intervals all through the night.

There are two forms of coyotes. One is larger and darker than the other and is sometimes called the Brush Wolf. It ranges as far west as eastern Dakota, while beyond that the smaller and paler Prairie Wolf is common.

FOXES

The foxes differ from wolves in having more bushy tails, a more slender form, and an elliptical instead of a round pupil



RED FOX

of the eye. There are half a dozen kinds of foxes in North America, but in the northern states practically all that we have is the Red Fox; our only other species, the Kit Fox, being very rare.

The Red Fox is the common fox of Europe

and North America. It is distributed over a large portion of our continent from the Atlantic coast to Montana and Alaska, and though the shade of its coat varies somewhat, the typical color is a yellowish red. It is considerably smaller than the wolves, being only 13 inches high and 24 inches long, plus the bushy tail, which measures 13 inches. Its usual food consists of mice, ground squirrels, and gophers, and it is also very fond of poultry. It probably does more good by destroying pests than it does harm in the chicken yard. The Cross Fox and the Black or Silver-gray Fox are regarded as color-phases of the Red Fox.

The Kit Fox or Swift inhabits the Great Plains from Mexico

to Saskatchewan, but it is not so wary as the Red Fox in avoiding poison and other means of extermination, and has, therefore, become very scarce. It is much smaller than the Red Fox, and its color is described as "a beautiful silver-gray, with a tinge of yellow."

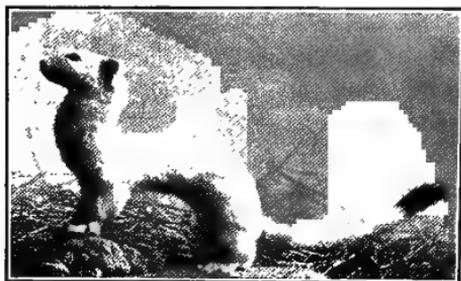
CHAPTER XXXVII

THE MARTEN FAMILY

WEASELS, SKUNKS, AND BADGERS

This family of flesh-eating animals includes most of our smaller fur-bearers, such as the marten, otter, mink, fisher, weasel, skunk, badger, and wolverene. On account of the value of their skins they have been trapped in large numbers, and most of them have become scarce in all settled regions. Nearly all of them are also in disrepute among farmers because of the poultry they sometimes kill, but in condemning them no account has been taken of the service they render

in clearing the country of pests that are far worse. Only the weasel, skunk, and badger are now at all common in the northern states. We give a brief description of these.



LONG-TAILED WEASEL IN WINTER COAT

The Weasel is the smallest member of the family and has the long, slender body that is typical of the marten, mink, otter, and fisher. Its legs are very short and set far apart, so that it walks with a peculiar gait. There are a dozen or fifteen species. Ours are brown above in summer and yellow or white below; but in winter, like all weasels in northern latitudes, they assume a white color all over, excepting the tip of the tail,

which is black. The fur of weasels, when in its winter condition, is greatly prized for its fineness and pure white color and is known as ermine. To obtain it great numbers are trapped in northern Europe, Asia, and British America. A single skin, however, on account of its small size, has comparatively little value. The animals are far more valuable alive, as they check the increase of ground squirrels and mice, which they kill in large numbers. In the interest of agriculture they should be protected. True, they have a bad reputation for attacking poultry, but the harm done in this way is very rare.

The Common Skunk. — There are said to be nine different species of these animals, but in the northern states we have only one of them, which is quite sufficient. The animal is black, with broad white stripes down the back, usually one on either side of the middle. The arrangement of the white marks on the black background is quite variable, but the horrible odor by which we know the skunk without seeing it is always the same. The offensive fluid is not urine, as many people suppose, but is produced and stored in two special glands situated near the root of the tail. It is the



COMMON SKUNK

animal's means of defense, and it seems to place much confidence in it, for it always walks about with great deliberation and will not show fear if it happens to meet you. It ranges from northern Canada to Mexico and seems to maintain its numbers even in thickly settled communities.

The usual food of skunks is ground squirrels, grasshoppers, beetles, and other insects. They are quite beneficial, and

should therefore be protected except when they become a nuisance around buildings. The animal walks about in search of food at all times of the day; but it is also a great prowler at night, and if it gains entrance into a henhouse, it will sometimes take little chicks right from under the mother hen.



RACCOON

Represents still another family of flesh-eating animals.

Skunks make their dens at the end of a deep burrow in the ground, and there they spend the winter months in a dormant or inactive condition. They do not lay in a supply of provisions for

this season, but live on the fat they have stored up within their body.

The fur of the skunk is quite valuable, and many thousands of skins are marketed every year. The white parts are dyed black, and the manufactured article is often sold as marten and under other names.

The Badger is found from Minnesota to the Pacific coast

and from Mexico to North Dakota and northward. It is about as long as the skunk, but the general appearance and form of the two animals could not be more unlike. The badger's body is peculiarly broad and flat, and the short legs raise it but a few inches from the ground. The color is mostly a hoary gray.

The badger lives in burrows and feeds principally on ground squirrels, which it digs out of their holes in large numbers. Mice are added for dessert when



BADGER

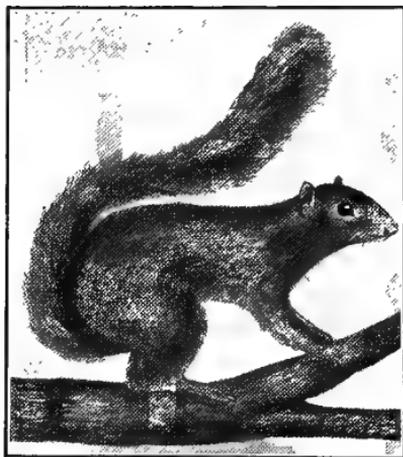
convenient. It is one of the most useful and harmless of animals and should be encouraged to remain on any farm where it happens to make its home. It is very shy and stays in its den quite closely in the daytime, so that it is almost as difficult to observe as the pocket gophers. But it is not a coward, and when at bay it fights savagely and shows great strength, endurance, and vitality.

CHAPTER XXXVIII

THE SQUIRREL FAMILY: TREE SQUIRRELS, CHIPMUNKS, AND GROUND SQUIRRELS

There are more than a hundred species of these animals in North America, comprising three distinct branches; namely, (1) the tree squirrels, living in tree tops, (2) the rock squirrels, living among rocks and the roots of trees, and (3) the ground squirrels, burrowing in the earth. The

Fox Squirrel and Gray Squirrel are examples of the first group, the Chipmunk of the second, and the Striped "Gopher" of the third group. This does not take into consideration the flying squirrels, whose relationship is more distant.



FOX SQUIRREL

THE TREE SQUIRRELS

Tree squirrels are very active and nimble climbers. They lay up stores of food for the winter and do not hibernate as ground squirrels do. Three species are common in the wooded sections of Minnesota and eastward, but in the Dakotas, except in the eastern part, they are rarely found.

The Fox Squirrel is one of the commonest of this group in the northwestern states. Though quite variable, its more

usual color is a rusty brown washed with black on the upper parts, and bright brown on the under side. The head and body measure about twelve inches in length and the bushy tail, eleven inches.

The **Gray Squirrel** of the eastern part of the country ranges westward into Minnesota. Its usual color is iron gray above and white beneath, and we may see all intermediate stages between this and black. It is much smaller than the Fox Squirrel. It is a beautiful and very graceful little



GRAY SQUIRREL

animal and easily becomes quite tame, making an attractive pet and park animal.

The **Red Squirrel**, or Chickaree, is our smallest tree squirrel, and is found in all the wooded parts of Minnesota and thence



RED SQUIRREL

eastward. It also occurs in many of the wooded areas in the eastern part of the Dakotas. Its colors vary with the seasons, but normally they are brown or red above and white beneath. Its merry *chir-r-r-r-r* is a note of pleasant surprise that we like to hear as we

approach its vicinity, but we cannot help thinking of its reputation as a little marauder, for it is said to drive all the gray squirrels out of its neighborhood, and to commit depredations upon the nests of birds, eating the eggs as well as the young.

THE ROCK SQUIRRELS OR CHIPMUNKS

There are said to be eighteen species of chipmunks in different parts of the United States, but the Dakotas and Montana were almost overlooked in the distribution of these pert little creatures, there being only a few wooded areas in which small numbers are found. They live on the ground and keep within easy running distance of rock piles, fence corners, or their burrows under the roots of trees. They like to nest in hollow trees that afford an entrance at the foot of the trunk. One species found in our region, the Eastern Chipmunk, is reddish brown in color with a black stripe down the entire length of the back and with a conspicuous yellow-brown stripe between two black ones at the side. It is about the size of the thirteen-lined Ground Squirrel ("striped gopher"), but it has a much longer tail. It burrows in the ground below the frost line, and in autumn it stores away great quantities of seeds and nuts, which it carries in its cheek pouches. It does not become dormant in the winter like the ground squirrels, but is like the tree squirrels in this respect, and on days that are favorable it will come forth and enjoy the sunshine and fresh air.

Chipmunks are delightful little fellows and when they learn that they are safe from harm they become very tame and confiding.

THE GROUND SQUIRRELS OR SPERMOPHILES

These are the "gophers" that are the farmer's pests in the prairie regions west of the Mississippi River. Naturalists do not approve of our popular name for these animals because they say that should be applied only to the Pocket Gophers. *Spermophile* is the name they use. That word means "seed-

lover ” and is a fitting name as it has reference to the very characteristic for which farmers try to exterminate them.

Ground squirrels burrow in the ground and do not ordinarily climb trees. They have cheek pouches in which they carry a supply of grain to their burrows in autumn for winter use. In cold latitudes they stay in their burrows through the winter, and become dormant at least a part of the season. As they are by nature seed-lovers, they of course appreciate especially those seeds that man has perfected by many centuries of careful selection. They therefore do considerable damage to grain fields. But they also eat seeds of every other description, green and dried grass, as well as all sorts of insects, mice, and other flesh that may come within their reach. Their numbers increase rapidly, as they rear from seven to ten young to each litter. The most satisfactory method of destroying them is to feed them grain that has been treated with strychnine.



THIRTEEN-LINED GROUND
SQUIRREL

There are over seventy varieties of Spermophiles in the United States and Canada, ranging over the western part of the continent and as far eastward as Indiana. In our northern states we have three species, and we are thankful that the number is not larger.

The Thirteen-lined Ground Squirrel. — This species, popularly called the Striped Gopher, inhabits all the prairie regions from Indiana to the Rocky Mountains and from Texas to Saskatchewan. Its general appearance is too familiar to require description here. Its burrow descends two

or three feet below the surface and then runs ten to fifteen feet farther in a horizontal direction. This animal furnishes a good example of what is called *hibernation*. During three or four winter months or even longer it lies curled up in its



FRANKLIN'S GROUND SQUIRREL

burrow in a motionless and apparently lifeless condition. Hornaday says, "By the investigations of Dr. P. R. Hoy, it has been discovered that in the case of the Thirteen-lined Spermophile, the action of the heart is reduced from 200 to only four feeble beats per minute, the temperature is reduced from 105 degrees to 58 degrees, and there is no visible breathing. The circulation of the blood was so feeble that when a limb was amputated, only a few drops of blood slowly oozed from the wound, while the nerves showed no sensitiveness. In fact, the animal was in a condition of suspended animation, as if under the influence of chloroform." In the northern portions of its range, this Spermophile hibernates from about November 20 to April 1.



RICHARDSON'S GROUND SQUIRREL

Franklin's Ground Squirrel, Gray Ground Squirrel, Gray Gopher. — The bushy-tailed gray ground squirrel is found from Wisconsin to the Missouri River and from the state of Missouri to Saskatchewan. Most of the body is a yellowish gray, with fine wavy cross-lines of a darker color; the head is a clearer gray and the under surface is whitish gray. These animals are not generally found on the open prairie, but like

to live near copses, and will sometimes climb a low tree when pursued. Their numbers have greatly diminished with the advance of civilization.

Richardson's Ground Squirrel, Flickertail. — This is the short-tailed yellow ground squirrel after which North Dakota is called the Flickertail state. It is the most abundant "gopher" within its boundaries, and ranges between the



WOODCHUCK

A gnawing animal related to the squirrels.

western border of the Red River valley to the Missouri River, and northwestward into northern Montana and Saskatchewan. It is similar to the preceding species in size and habits and is fully as destructive to grain fields.

PROJECTS AND QUESTIONS

Make out-door studies of tree squirrels, chipmunks, and ground squirrels and then give to your school a full account of what you find out. Study all kinds that are found in your neighborhood.

1. *The species and its characteristics.* — Notice the size, color, where it lives, general habits, what species it is.

2. *Feeding habits.* — What does it eat? Find out whether it will eat grain, grass, insects. Does it carry food away? To what place? Store it for winter? Where?

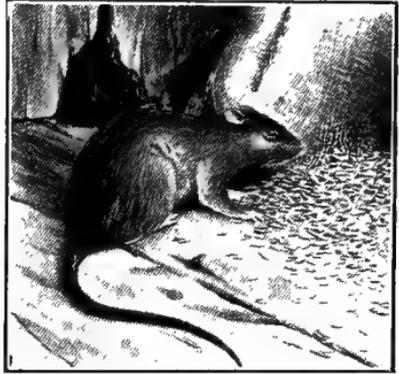
3. *Winter*. — How does it pass the winter?

4. *Ground squirrel's burrow*. — Though it requires considerable industry and patience, it is instructive to dig to the end of a ground squirrel's burrow late in autumn to ascertain its length and depth. Is the animal down deep enough to be safe from frost? What store of food has it laid in?

CHAPTER XXXIX

THE MOUSE AND RAT FAMILY

Mice are among the smallest quadrupeds known, there being no others to rival them in this respect, excepting the shrews. Rats are closely related to mice, being similar in structure and habits, and merely larger in size. We call those species rats that have a body and head five inches or more in length. All of the native American rats, except the muskrat, are much smaller than the common domestic rat. There are several hundred species of mice and rats in North America, all of them being native to the country except the house mouse and the domestic rat,—the two that are the best known and by far the most harmful of the whole family. We can present here only brief notes about those kinds that are commonest in the northern states.

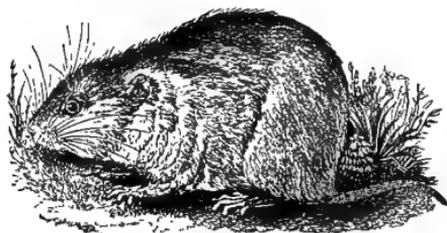


HOUSE MOUSE

The House Mouse is the species that is commonly found in houses, barns, and stables. It also ranges along fences and over fields and takes possession of grain shocks and stacks as soon as the harvest is over. It came to America from the Old World with the early colonists and follows civilized man in all his migrations, hiding away in packing boxes and freight cars and infesting the walls of wooden ships, and going whither-

soever they go. Everywhere these mice multiply with great rapidity. It is claimed that a single pair under favorable conditions will develop a family of 100 in twelve months. As compared with other species the house mouse has a slender body, large ears and eyes, pointed snout, and long tail. The amount of property destroyed annually by these mice is very large, but their habits are too well known to require description here.

Field Mice or Meadow Mice live in open fields and meadows. They are thicker-set little animals than the house



FIELD OR MEADOW MOUSE

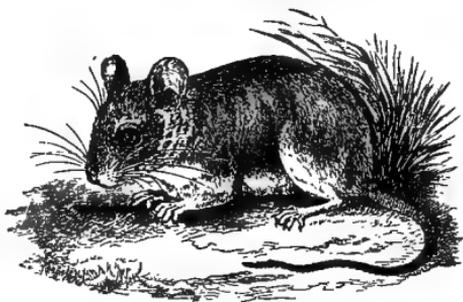
mouse, with shorter ears and shorter tail, and they are slower in their movements. Their head and body are about $4\frac{1}{2}$ inches in length and the tail $1\frac{1}{2}$ inches; their color is reddish brown above, and whitish gray beneath.

There are fifty or sixty kinds of these field mice, and some of them may be found in every part of the country. They feed on roots and grasses and grain, and in winter, when these things are difficult to find, they often eat the bark of young fruit trees and kill them. It is when grain and corn are in the shock that they live off the fat of the land, and on removing the shock we often find a nest full of them beneath it.

Field mice form a leading item in the diet of many hawks and owls, and they are also hunted by weasels, foxes, skunks, and other flesh-eating mammals. In some regions where the animals that prey upon them have been destroyed, these mice have become so numerous as to form a serious pest.

White-footed Mice or Deer Mice. — There are about seventy kinds of white-footed mice, — enough to supply

every state in the Union and all of Canada besides. They are our most attractive and interesting mice. It is easy to distinguish them from other types by their white feet, and the clean white color of the entire under part of the body and head. The back is usually a delicate gray or brown. They have a long tail, large ears, and large bright eyes, and are very dainty and cunning little creatures. They most commonly live in the brush along streams, and sometimes in buildings as house mice do. They nest in all sorts of crevices, in hollow trees which they climb, and also in burrows. Their food consists of seeds,



WHITE-FOOTED OR DEER MOUSE

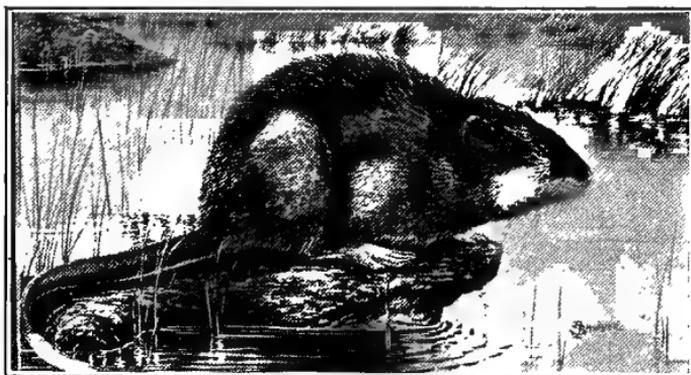


BROWN OR DOMESTIC RAT

nuts, and acorns, and they often collect and store up large quantities for future use.

Rats. — There are over fifty kinds of rats in North America, but the only species found in the northern states are the domestic rat and the muskrat. The common, domestic, or

brown rat is said to be a native of India and to have extended its range in comparatively recent times, arriving in Europe about 1750, and in America about the time of the Revolution. It does not seem to thrive in an arid climate and is as yet very scarce west of central Dakota. In most sections of the world it multiplies with great rapidity, producing from six to twelve young ones to each litter and three or four litters a year. It is the most injurious pest in the whole mouse and rat family and probably the worst in all animal



MUSKRAT

life, destroying millions of dollars worth of property in the United States every year. It is also a menace to our health. In case of some contagious diseases its body becomes infested with the germs and then it serves as a means of spreading them to all parts of the community.

Needless to say, rats should be kept off our premises, and people living in a town or city should cooperate and endeavor to exterminate them. They may be destroyed by poison, the best substance for the purpose being barium carbonate mixed with oatmeal. Their numbers may also be greatly

reduced by the diligent use of traps. A good cat or dog will often clear the place of them in a short time.

The Muskrat is the largest American member of the mouse and rat family and is distributed over a large part of the continent as far south as Mexico. They live in ponds and streams and are good swimmers and divers. They show much industry and intelligence in building their houses. These are constructed in shallow water out of coarse grass, weeds, and mud, and rise several feet above the surface. The living apartment within is located above the level of the water, but is entered from beneath, so that ice cannot close the entrance in winter. Muskrats inhabiting streams with high banks do not build these houses but merely burrow into the banks. Muskrats are among our commonest fur-bearing animals, and trappers catch large numbers of them every year. In some sections of the country muskrat farming has proved a profitable industry, and we have many suitable lakes and sloughs that might be devoted to the purpose.

CHAPTER XL

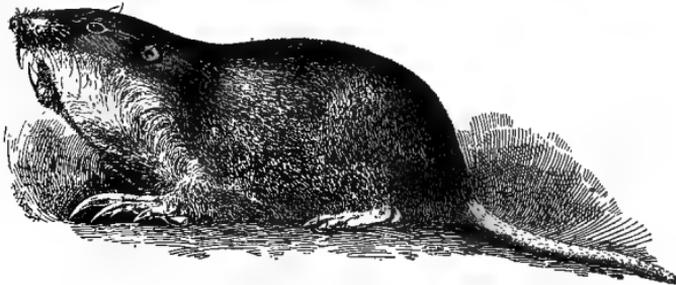
POCKET GOPHERS

Pocket gophers are among the most destructive rodents or gnawing animals that we have. They look somewhat like rats. They are about the same length, but are much thicker and more squatty, and they have uglier faces, more prominent teeth, and longer claws. With these claws they tunnel through the ground like expert miners, living the life of a hermit and venturing forth from their burrows very rarely and very cautiously, usually at night. They throw up little piles of earth all over the fields and prairies which they inhabit, and many persons who are quite familiar with these have never seen one of the culprits, either dead or alive, often laying the blame for this mischief upon the ground squirrels.

These mounds of loose earth interfere seriously with the harvesting of crops; and the animals also devour quantities of farm produce and often kill young trees, shrubs, and other plants by eating the roots. Some years ago it was estimated that the red pocket gopher caused an annual loss of \$800,000 on a single crop, alfalfa, in the state of Kansas. These creatures should be exterminated on every farm, and the best way to do that is by means of poisoned grain, corn being especially recommended. When there are only a few of the animals they may also be trapped. The weasel is their natural enemy and will follow through their burrows in search for them.

The "pockets" for which these animals are distinguished extend along the sides of the head to the shoulders and open at the mouth, outside of the mouth cavity. They might be described as fur-lined cheek pouches used for carrying food to the storeroom in the burrow. There are over thirty species of these gophers, and they are distributed over our whole country except the section east of Indiana and north of Alabama. We are concerned with only two of these.

The Red Pocket Gopher, or Mississippi Valley Pocket Gopher, is the most important species of all, because of the



POCKET GOPHER

great extent of the territory it inhabits. It is the big, brownish red gopher found in Wisconsin, Illinois, Missouri, Iowa, Minnesota, and the eastern part of the Dakotas, Nebraska, and Kansas. Only the one species inhabits this territory, as pocket gophers are too ill-tempered to live on neighborly terms with others. Even members of the same species hate one another, and it is said that when two captives are put in the same cage they usually fight until one is killed.

The North Dakota Pocket Gopher or Gray Pocket Gopher ranges all over the state whose name it bears excepting the parts of the Red River Valley occupied by the preceding species. It is a smaller animal than the other, but probably not less destructive if allowed to do business on our farms.

CHAPTER XLI

THE HARE AND RABBIT FAMILY

Some authorities would restrict the term *rabbit* to our domestic breeds kept chiefly as children's pets, and to the small European species from which they are derived, and apply the name *hare* to all other members of the family. But in this country this distinction is not generally observed, and we commonly call any animal of this class a *rabbit*.

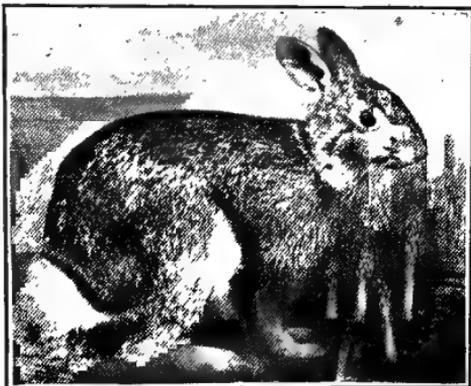
In the summer season rabbits live on the green and tender parts of plants, as leaves, buds, berries, grass, garden vegetables, green twigs, and bark. In winter they may not be able to find any of these items but the berries of the wild rose and the bark of bushes and young trees; and therefore it often happens that they include the bark of young fruit trees in their bill of fare. When very numerous, they devour large quantities of field and garden crops in summer and play havoc in the orchard when hard pressed for food in winter.

All these animals multiply rapidly, and under favorable conditions may become serious pests in a very short time. This is illustrated in Australia, California, and other regions, where great "drives" are often organized by the people and vast numbers of the animals slain. In the northern states there seems to be no danger of such a great increase. No doubt if we are wise enough to protect and spare our hawks and owls they will continue to hold these animals in check and keep them from becoming a pest.

There are more than twenty species of hares and rabbits

in North America. We give a brief description of the three that are common in the northern states.

Cottontail, Gray Rabbit, Common Rabbit. — This rabbit is found throughout the eastern part of the United States, westward to the central part of the Dakotas and southward as far as Central America. Throughout this region it is said to be about the best known of all wild quadrupeds. It lives in parts where brush ravines or rocks are close at hand to afford a refuge when pursued by dogs, foxes, etc.; for though it is a good sprinter it cannot trust its life to its short legs in case of a long chase.

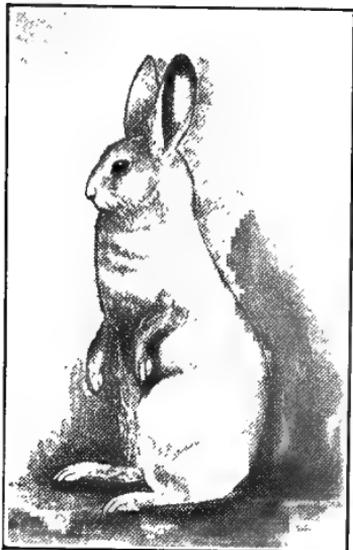


GRAY RABBIT OR COTTONTAIL

These rabbits do no serious damage to crops; and as they furnish good sport for the hunter and valuable food for the table, their presence in a country is desirable except in the vicinity of orchards, where they should not be allowed.

White-tailed Jack Rabbit, Prairie Hare. — This species inhabits the prairies and plains of the northwestern states from Kansas to Saskatchewan and from Minnesota to Oregon. It is one of the largest animals of this family, has long ears, and very long and strong hind legs that make it a wonderful runner. Its color changes with the seasons, being gray in summer and white in winter, and this helps it to escape observation by its enemies. Its tail is entirely white, a feature that distinguishes it from the jack rabbits with black-and-white tails that live farther south.

Like the cottontails these animals occasionally cause some



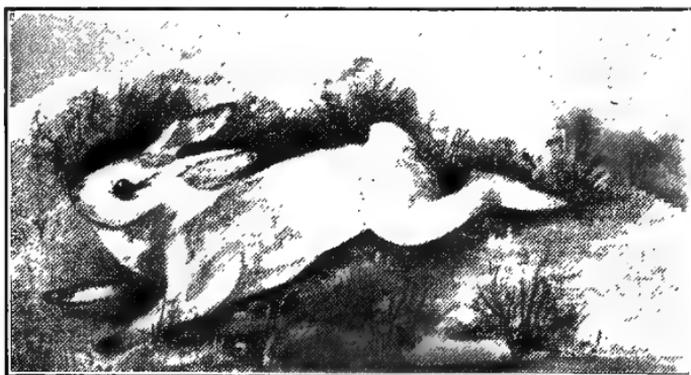
WHITE-TAILED JACK RABBIT
In winter coat.

damage to fruit trees, but on the whole they do very little harm and they are a good game and food animal.

If we followed the authorities referred to in the first paragraph of this chapter, we should regard the jack rabbits as typical hares.

Northern Varying Hare, Snowshoe Rabbit, White Rabbit. — The color of this hare, as of the jack rabbit, varies with the season, being white in winter and pale cinnamon-brown in summer. It is found in North Dakota and Minnesota and thence eastward to New

England and northward into Canada. Though it is nearly twice as large as the cottontail, its legs are comparatively short, their length being about midway between those of the cottontail and those of the jack rabbit. This makes it a



SNOWSHOE RABBIT
In winter coat.

swift runner for short distances only, and we therefore find it living in wooded areas where it can easily escape if pursued. There it can do very little or no damage. It is a good game animal and of considerable value for food, and might wisely be given some protection in suitable wooded regions to prevent complete extermination.

CHAPTER XLII

MOLES AND SHREWS, BATS, REPTILES, AND AMPHIBIANS

MOLES AND SHREWS

Moles and shrews are mouse-like creatures in general appearance and size, but they have no relation to mice, and their feeding habits are very different. They comprise a distinct group of animals called insect-eaters and live almost exclusively upon the diet indicated by that name. They



COMMON MOLE

therefore render a great service in clearing the land of cutworms, grubs, and other insect pests, but their merits are not so generally recognized as they should be. They are often blamed for the damage done by the insects they destroy, and their resemblance to the mice also leads to wrong inferences.

The Moles are squatty, awkward-looking animals with fine, soft, and velvety gray fur; with a long, pointed nose, extending half an inch beyond the mouth and reminding one of an elephant's trunk; without a neck; with exceedingly short front legs, but very large, broad hands that are always held with the outer edge up and palm outward; with a short tail; and apparently without ears and eyes. The ears are so short that they are entirely concealed beneath the fur;

and the rudimentary eyes are usually covered by the skin, and merely enable the mole to distinguish light from darkness.

Moles spend practically their entire existence beneath the surface of the ground, so that we rarely get sight of them. They burrow through the earth with marvelous rapidity, advancing at the rate of 100 feet a day in ordinary sod and several times as fast in loose plowed ground. The path is only a few inches below the surface, and its course may usually be traced by a ridge of loosened earth. Sometimes they also throw up small mounds of earth called mole hills. There are about a dozen species of moles, varying somewhat in size, but they are usually larger than mice and shrews. In Minnesota they are not found so often as in many other parts of the country, and west of Minnesota they are still more rare, there being none at all reported as yet for North Dakota.



SHORT-TAILED SHREW

The Shrews look like small mice, but they have longer and more pointed muzzles, with the nose projecting beyond the mouth, — though not so far as in the case of the moles. They have very small bright eyes that are situated rather far down toward the tip of the nose. Their colors range from dull gray to brown. They spend most of their time in their underground burrows and rarely come forth except at night. We occasionally throw them out with the spade or the plow, but we seldom see them moving about. There are 35 species in the United States and Canada, four of them being listed in North Dakota. Probably the commonest kind in the northern states is the Short-tailed Shrew. This is the largest of all the shrews, its head and body measuring four inches,

while its tail is only one inch long. The fur is as a velvety brownish black with some lighter and brushy areas, where the tail runs under cover of fallersect food.

This is a very large group of them, however, belong to a dozen found in our northern other mammals by the possession



FLYING

use with great ease and skill in connecting the elongated arm at the tail, with a tough skin or body of our common bats and ears.

Value. — It would be good beneficial animals as their food and other insect nuisances which they catch on the wing. They hide themselves during the day, and in the evening they come forth and feed upon night-flying insects that the birds do not get in the daytime. The tropical vampires are bats that have an evil reputation as blood suckers, but all the species in this country are perfectly harmless.

How They Pass the Winter. — In temperate regions bats pass the winter in hollow trees, caverns and deserted buildings. In some such places they congregate from great distances to sleep in a safe retreat

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2. Readers must return all books drawn on this ticket to the delivery desk before leaving the room. Every reader will be held responsible for books drawn in his name so long as his tickets remain unclaimed. Return tickets should be preserved if the books are needed again, to save time and labor.
3. Books must not be removed from the room without permission, nor should they be marked with pen or pencil. Many of the publications in this library are out of print and cannot be replaced.
4. Admission to the shelves within the barriers is restricted, and the indexes should be used as fully as possible in drawing books and looking up references.
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during the cold season. As bats confine their activities to the night, it is difficult to observe them, and consequently there are many interesting questions that remain unsolved. For example, it has been proved that some of our bats migrate as birds do, going south for the winter and returning in the spring. There are no warm caverns in Minnesota and the Dakotas where they are known to pass the winter. What becomes of them then? Do they all go south, or do some of them find places where they can hibernate without freezing?

Study of Bats. — Bats are very cunning little creatures and can easily be kept in a cage for observation. They will soon learn to take flies or bits of raw meat when presented on a hatpin or toothpick or the end of a pencil. The commonest species in our northern states is probably the Little Brown Bat. Its body is less than two inches long, and is dark olive above and lighter below.

REPTILES

This large class of animals includes alligators, crocodiles, lizards, turtles, and snakes. All reptiles are cold blooded, have a backbone, and breathe air by means of lungs; and their body is usually covered with scales or bony plates. As the temperature of the blood is low and the action of the heart very slow, some of them are able to remain under water many minutes without coming to the surface to breathe. The great majority of reptiles reproduce by laying eggs, but in some cases the young are brought forth alive. Reptiles are largest and most abundant in the tropics. In the northern states we have only a few species of turtles and snakes, and most of those are of small size.

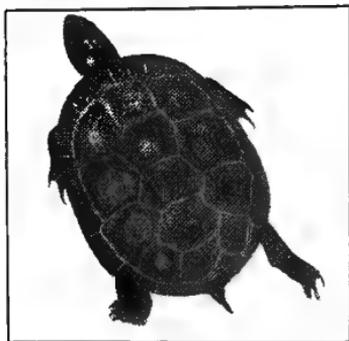
Turtles. — Turtles are reptiles that have most of their skeleton on the outside of the body, forming a bony box or shell in which the soft



LITTLE BROWN BAT

parts of the animal are encased. The upper half of the shell is formed out of the ribs, widened and grown together. Between the upper and lower halves of the shell there is an opening at each end, for front legs and head and for hind legs and tail. These organs may be withdrawn into the shell, and then the entire animal is safe from any ordinary danger.

There are many kinds of turtles, some of them inhabiting the land, others are found in ponds and rivers, and others in the sea. We are most likely to meet the smooth-shelled turtles or terrapins, which live half the time in the water of ponds and rivers and the rest of the time on



WESTERN PAINTED TURTLE

near-by land. Many species of this group are highly valued for food and have helped to make "turtle soup" famous. Of the smooth-shelled turtles the commonest is the Painted Turtle or Painted Terrapin. Its shell is scarcely six inches long, and is greenish black above, with yellow edges around all the plates except those along the side of the shell, which are marked with red. The under shell is yellow. This turtle has a habit of sunning itself on logs or stones over the water, ready to slide in at the moment

it thinks you are coming too near. By this habit we may distinguish this species from the mud turtles.

Turtles are reproduced from soft-shelled eggs which are slightly buried in earth or sand and left to hatch in the sun. In case of the smooth-shelled turtles just described the eggs are laid a short distance from the water which the animals inhabit.

Serpents. — Of the innumerable varieties of serpents only a few are found in the cold climate of the northern states, and not many of our readers will be apt to meet any other than the common Garter Snake. In a few limited areas the Rattlesnake also occurs. These two we therefore describe.

All serpents are flesh-eating animals, and live upon frogs and toads, other snakes, and small birds and mammals. Water snakes also catch fish for their meals. Some snakes bear their young alive as mammals do; other species lay soft-shelled eggs that are hatched in the sun.

The Garter Snake is a harmless little creature, and there is absolutely no reason for the persecution it suffers, except the evil reputation of its relatives. The young of this species are born alive, and as many as 45 are brought forth in one brood. It is no wonder that it is the most numerous and most widely distributed of all snakes. This is one of our smallest species; a Garter Snake 36 inches long is a very large specimen, the more usual length being 24 to 30 inches; and of course many that we meet are much smaller, being but partially grown.

Rattlesnakes are the most widely distributed class of poisonous serpents in America and are found in restricted regions in almost all sections of the United States. In the Dakotas they are met with in the Bad Lands and in the broken country along the Missouri River. There are fifteen different species, of which fourteen live in different parts of North America and one in South America. That found in the Dakotas and Montana is called the Prairie Rattlesnake. All the species are very



GARTER SNAKE

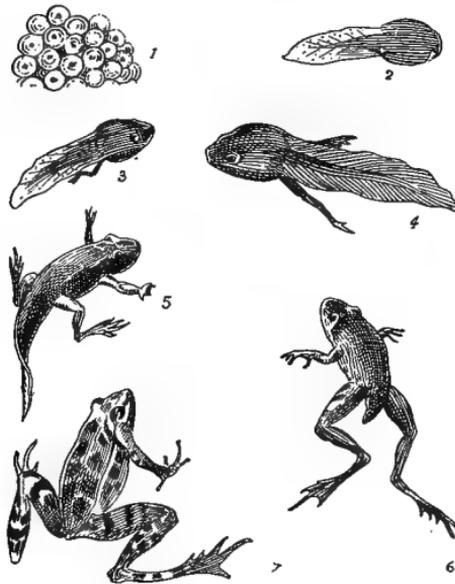
similar. Their most important characteristic is that they are very poisonous, and their bite often proves fatal. But fortunately they do not pursue their victim or lie in ambush for him to take him by surprise. They strike only in self-defense when expecting to be harmed, and then they always give fair warning by a vigorous shaking of their rattles. This warning saves the majority of people and animals that might otherwise be bitten.

The rattles consist of horny buttons or beads joined together and forming the end of the tail. The young of the Rattlesnake are born alive as in case of the Garter Snake, the usual number being from nine to fourteen.

AMPHIBIANS

The class of animals known as amphibians comprises the frogs, toads, salamanders, and other less familiar creatures that live in water during the first stage of their existence and then change to land-going animals.

The young are provided with gills with which they absorb sufficient air for the support of life from the water in which they live. In time they gradually lose these gills and develop lungs for breathing atmospheric air. This marks the transition from the larva to the adult. The latter, though generally quite at home in water as well as on land, must come to the surface of the water to breathe, and will drown if forced



THE DEVELOPMENT OF A FROG

1, eggs; 2, tadpole; 3, tadpole developing hind legs; 4, same tadpole but larger; 5, front legs appearing; 6, tail being absorbed; 7, frog in adult form.

to remain submerged. The transformation from water-living to land-living animals is very interesting and may be compared to that which insects undergo in changing from the larva to the pupa and then to the adult. We describe here our three commonest families of amphibians.

Frogs. — The life history of frogs shows a wonderful mode of animal development and is a favorite and instructive subject for observation and study. The eggs are laid in masses in water, usually attached to weeds, where they hatch out as tadpoles or polliwogs, consisting mainly of a large head and a long tail. The gradual transformation of these tadpoles into frogs can easily be observed by putting some frog's eggs into a glass jar in the school-room. Frogs also form an interesting example of hibernation. At the approach of winter they dive into the mud at the bottom of some body of shallow water and remain there in deep sleep till spring awakens them.

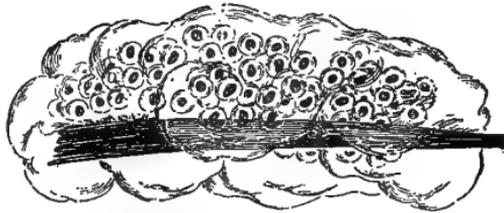
There are in all several hundred species of frogs, the most famous being the common Leopard Frog and the Bullfrog. The latter species we do not see in the Northwest, and we shall concern ourselves only with the former. Its body color is green or greenish brown, and this

is marked with several irregular rows of dark spots that are usually bordered with lighter color, the general color as well as the pattern varying considerably. The under parts are mostly white. This species is the first that we hear in the spring if we are near a good "frog pond." In such a place large numbers of these frogs gather, and their peaceful croaking gives the early spring evening an air of contentment.

Toads. — The toads, of which there are eighty or ninety species, are distinguished from frogs by their dull-colored, warty skin, short, puffy bodies, and short hind legs, and by their sluggish disposition and poor capacity for jumping. The common toad, which everybody knows,



TOAD SPAWN

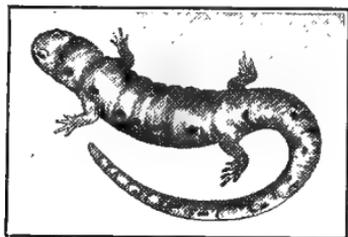


FROG SPAWN

deposits its eggs in water in long strings. The young are hatched without attention from the parents and develop into tadpoles like those of frogs. These in due time lose their gills and tails and after a summer shower we often meet in our path large numbers of the young toads, no longer than a house fly. At the approach of winter, toads burrow in the ground or hide in any sort of deep crevice or hole they can find, and there they hibernate through the cold season. Of course, in northern latitudes, they must freeze solid during this time, and yet when spring comes it calls them to life again. Warm-blooded animals would be killed by such an experience.

Toads live on insects, and like to stay in our gardens to search for such as may be found upon the plants. They are therefore distinctly beneficial.

Salamanders. — These are amphibians that have retained their tails instead of losing them as frogs and toads do when they change from water to land going animals. In form they resemble lizards, and some people mistake them for that class of animals. But they are not related to lizards. The body is not covered with scales like the lizard's, but they have a perfectly smooth skin like the frog's. They have four feet, but they have no claws as lizards have.



SPOTTED SALAMANDER

There are many species of salamanders. All are slow in movement, exceedingly helpless, and perfectly harmless. The most common is the Spotted Salamander, which is dark brown or black above and has a row of yellow spots along each side of the back. It meas-

ures about 6 inches in length, plus $2\frac{1}{2}$ inches for the tail. It lives in almost any kind of situation, but preferably where it is somewhat shady and damp, and is often found in cellars and old wells as well as in gardens and waste places.

PROJECTS AND QUESTIONS

The Bat

If a bat should be captured by any member of the school it should be kept in a suitable box or cage in the schoolroom for the purpose of getting thoroughly acquainted with it.

1. *Its food.* — When first caught the bat may open its mouth in a very threatening manner; drop in a bit of food — a fly or mosquito or small scrap of raw meat will do. It will soon become tame and contented in captivity, and then further tests may be made with a variety of insects. It will thus be seen that a family of bats, feeding on night-flying insects, must be quite beneficial to a garden or farm.

2. *Its mouth.* — Notice how wide the mouth opens, making it easy to catch insects on the wing. Birds with similar feeding habits also have a mouth with a very wide gape.

3. *Structure of the wings.* — Notice the bones of the legs and the arms with the four very long fingers; the attachment of the web to these bones

and the body and tail; the thumb is short and terminates in a hooked claw.

4. *How bats rest and sleep.* — Notice the toes on the hind feet; how the bat hangs itself up by these, head downward, and then rests.

5. *The bat on the ground.* — Notice how helpless it is on the ground, how awkwardly and slowly it crawls. Can it take flight from the ground or must it crawl up on some object and then spread its wings as it drops?

Development of Frogs and Toads

6. *The eggs.* — In the spring, soon after the frogs begin their croaking, visit their haunts in marshes or ponds and look for their eggs. They are as big as small peas and are embedded in transparent jelly in masses of varying size from a cluster of two or three eggs to a lump as large as a man's fist. Take some spawn to the schoolroom and put it in a dish of water, — only a small number of eggs in one vessel. An old fruit jar will answer the purpose, but a shallow dish is better for the tadpoles after they are hatched.

7. *Hatching* requires but a few days in warm weather. In cool weather it will take eight or ten days. Watch for the earliest signs of life in the eggs. Can you observe any movements before they are hatched? As soon as the tadpoles are hatched see how they swim. Watch for the appearance of external gills about the mouth. If you have a microscope put a tadpole under it and observe the flow of the blood through these gills. It is a wonderful sight.

8. *The tadpoles* must be fed or they will not grow. Put some green water plants in their vessel; they will also eat cooked corn meal. It is difficult to keep the same specimens alive through their entire development. Procure some large fresh tadpoles from the pond and watch for their transformation into frogs by the gradual absorption of the tail and the development of legs.

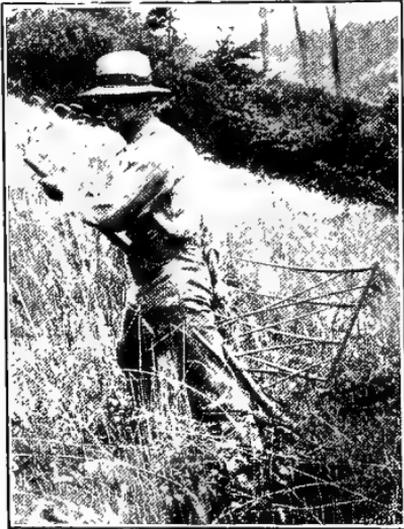
9. *Toad's eggs.* — Toads are more easily raised than frogs. Their eggs are found in the same shallow water as frog's eggs, but they are laid in long strings or ropes which are usually tangled up with the sticks or weeds at the bottom of the water. If the eggs have been freshly laid the string will look like a glass tube containing a row of black beads.

Salamander eggs are similar to those of frogs and toads and found in the same kinds of places.

CHAPTER XLIII

FARM WORK AND THE AGE OF MACHINERY

Farming in Former Days. — Until about the middle of the last century, practically all farm work was done in the same way as it had been done for 2000 years. With the exception of plowing, harrowing, and the drawing of loads, man's muscles



GRAIN CRADLE

furnished the power to operate such tools and implements as were in use. Corn was planted and cultivated with the hoe, and the corn cutter was merely a large knife for hand use. Grass was mown with a scythe, and the hay was raked and pitched by hand. Wheat, oats, and barley were sown by hand, cut with the sickle or cradle, and threshed with a flail. By those methods a farmer could produce very little more food and clothing material than he needed for his own family. In

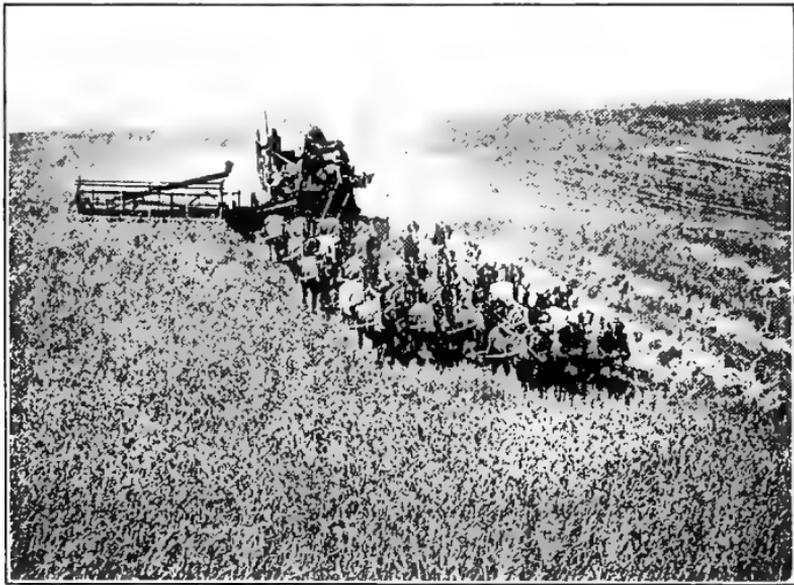
the early decades of the nineteenth century, four fifths of the families in the United States were engaged in agriculture, and beyond their own requirements they raised barely enough food and clothing material for the other fifth of the population, the few exports being hardly worth mentioning.

Effect of Machinery. — At the present time only about one third of our families are on the farm, and they not only produce enough surplus for the other two thirds but export enormous quantities to foreign countries. This great increase in the producing capacity of the farmer was brought about by the use of new and improved implements and machines, and by the employment of horses and mules for motive power. Nowhere else in the history of industry can be found so striking an illustration of the beneficial effect of inventions upon the welfare of mankind. The successful use of the complicated machinery of this age is proof of a high grade of mental capacity. In countries where we find a lower type of intelligence upon the land, the more complicated farm machinery cannot be operated, and sometimes through stupid prejudice the agricultural toiler refuses to adopt even the simpler improvements. In America the introduction of machinery has resulted in the cheapening of farm produce, has made farm labor much lighter, and has raised the vocation of the farmer to the rank of a profession.

Reaping Machines as an Illustration. — Perhaps the best illustration of the result of the introduction of farm machinery is found in the history of harvesting machines. As grain gradually falls to the ground and is lost if it is not cut soon after ripening, the harvesting of the crop cannot be put off till it suits the farmer's convenience, but must be accomplished in a comparatively short period. The size of the farmer's grain fields is therefore strictly limited to the amount he can harvest in good season with the help at his command.

Since time immemorial the usual method of reaping small grains was by means of the hand sickle, which enabled a man to cut an acre in three or four days, or from three to five acres in an average season. The sickle was in common use

in this country until the time of the American Revolution, but by the end of that century the grain cradle had taken its place. The cradle was developed by American ingenuity from the scythe by the addition of fingers for catching and holding the grain after it was cut by the blade. The scythe itself had previously been developed from the sickle by lengthening and bending the handle, and by lengthening



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A MODERN REAPING MACHINE

the blade and reducing its curvature. The American cradle is the most efficient of all hand implements for the reaping of grain. A good cradler could cut about two acres a day, but it required another man to rake and bind the grain into sheaves.

The reaper was first placed on the market for the harvest of 1845, and during the next ten or fifteen years the wheat

growing industry developed by leaps and bounds. Prior to 1850 corn was used extensively for bread because enough wheat was not raised for the purpose, but after that date we not only produced wheat enough for our own needs but had a rapidly increasing surplus for export.

The reaper was the product of many years of study and experiment by a host of inventors, the most notable of whom was Cyrus H. McCormick of Virginia. The earliest types used in this country were known as the dropper and the hand-rake. The first of these dropped the cut grain at intervals behind the machine, where it had to be raked, bound, and removed before the next round could be made. The hand-rake reaper had a board platform on which the grain was thrown by the reel, and when there was enough for a bundle an attendant raked it off. With the perfected self-rake reaper, a driver and a two-horse team could cut six to eight acres a day and drop it on the ground in small piles, and it took four good "hands" to bind these into sheaves. Many farmers increased this daily cut by using a larger machine and more horses.

The next improvement of importance was devised by the Marsh brothers of Illinois, and was known as the Marsh harvester. This machine, by means of a canvas elevator, carried the grain to a platform, in front of which stood two men who bound it as fast as it was delivered to them. This arrangement enabled two men, riding on the machine, to bind as much grain as four could bind on the ground after the reaper.

But the inventors were not satisfied even yet, and soon the automatic binder was made and attached to the harvester, taking the place of the two men. At first wire was used for binding the bundles, but after a few years John F. Appleby

of Wisconsin completed the development of the twine binder, and in 1880 placed it on the market. This did away with hand labor entirely as far as the cutting and binding operations are concerned. The binder, more than any other machine, made the production of wheat possible on its present enormous scale. A man with this machine in the harvest field can do the work of seventy or eighty men in the days of the hand sickle.

Other Machinery. — It is a long way from the hand sickle to the self-binder, and it is difficult to believe that we covered that distance so recently and in so short a space of time. During the early part of the same period the mower took the place of the scythe, the threshing machine took the place of the flail, the gang plow displaced the walking plow, the grain drill took the place of hand seeding, and the horse-drawn cultivator practically displaced the hoe. Even more recently most of the back-breaking work with the pitchfork has been eliminated by the hay loader and hay stacker; the equally hard but necessary drudgery with the staple farm fertilizer has been abolished by the power fork and manure spreader; and the tedious work of corn husking has been taken over by the husker and shredder, which at the same time converts the coarse stalks into palatable feed for farm animals.

Most of this machinery is usually operated by the muscular power of horses, but for some purposes it is more convenient or economical to use windmills, gas or steam engines, or electrical motors. The increasing employment of these farm motors is another evidence of the elimination of man power for the performance of hard physical labor, and it also relieves horses of some of their heaviest work.

Women's Work. — Women were our first farmers. Among

primitive people they do most of the planting, cultivating, and reaping of the crops. In this country they helped more or less with the farm work as long as the hand methods prevailed. The introduction of machinery made it possible for the men alone to produce the raw materials for food and clothing and to let the women devote their time to the work in the house. But there also machinery has come to their assistance. In the middle of the last century the inventions of Howe, Wilson, and Singer put into American homes the sewing machine, which relieved women from the tedious handwork with needle and thread. Such former household duties as spinning, weaving, soap-making, and candle-making are now turned over to the factory. The cream separator and the modern creamery system have abolished most of her labor in the dairy; electric light eliminates the work on kerosene lamps; the electric motor and washing machine and the electric flatiron reduce laundry work to a mere fraction of the former labor; piping the water supply into the kitchen and bath room, and installing sewer connections to carry off the waste, save many hundred steps a day; and the basement heating plant eliminates the work occasioned by stoves in the several parts of the house. Best of all, the telephone, rural mail delivery and parcel post, and the automobile keep her in easy and constant communication with trading centers and the society and assistance of friends, and relieve her isolation and loneliness.

As yet many of these advantages are enjoyed by only a small part of our farming population; but all, or most of them, may be secured in the country as well as in the city, and our farmers will certainly see to it in the near future that the equipment of their homes shall be as modern and convenient as that for the barn and the field.

The Future of Farming. — Most normal men and women love the open country, and for such persons farm life has many attractions. The disadvantages can be removed. With machinery to replace much of the hand labor in the house as well as in the field, with the farm home more comfortable and its setting more attractive, with better prices for farm products, better coöperation, better roads, better schools, better churches, and better opportunities for culture, social enjoyment, and recreation — with these things there will come a new rural life. That life will be more completely satisfying to an intelligent and enterprising people, and a larger proportion of the more energetic, capable, and ambitious sons and daughters of the farmer will remain as permanent residents in the open country. We should take every opportunity to do our part in hastening the day when all of these improvements shall be made and these conditions fulfilled, for then the golden age of American agriculture will be at hand.

CHAPTER XLIV

FARM MANAGEMENT

The successful farmer is an industrious and intelligent workman who knows how to raise large crops and fine stock and to keep his place in a trim and orderly condition. But that alone is not sufficient. He must have considerable business ability. In making a start he must have the necessary knowledge and judgment to decide wisely where to locate and the type of farming to undertake; whether to buy or rent; how far he may safely go in debt, and what particular farm to choose. Then he must determine the shape and size of the fields that will make them most economical to work, the most practical way to maintain the fertility of the soil, what machinery and other equipment to buy, what labor to hire, when and where to sell his produce, and many other problems in farm management that arise from time to time. We have space for only very brief notes on a few topics belonging to this important field of study.

KINDS OF FARMING

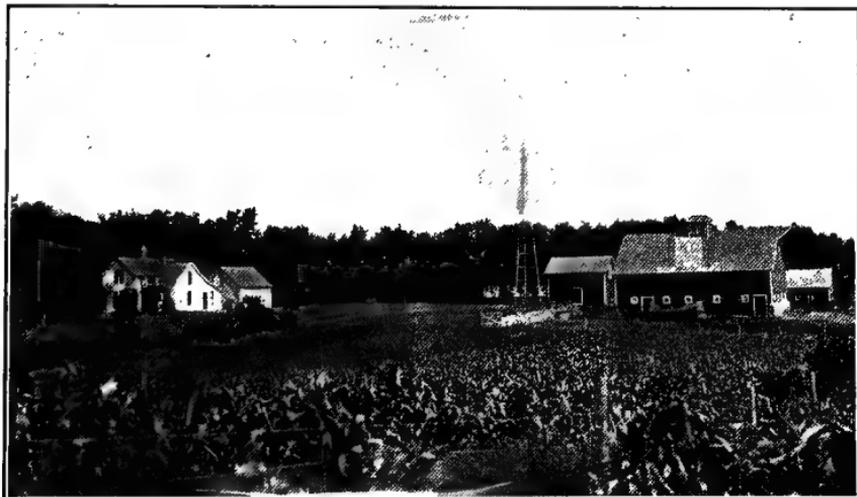
Specialized and Diversified Farming. — In a new farming district it is customary to devote the land to the production of a single kind of crop, and in the Northwest that has been wheat. This is raised from year to year until the soil is finally impoverished to such an extent that the farmer is compelled by sheer necessity to turn to some other line of operation. Usually cattle and other stock are then added. This brings with it the raising of legumes for pasture and hay, and

perhaps also the planting of corn. With a greater diversity of crops he may adopt a system of rotation, devoting each field by turns to small grains and flax, corn and potatoes, hay and pasture, and other products. With diversification and a good scheme of rotation, the productiveness of the soil is kept at a high standard and agriculture may then be considered to be on a permanent basis.

Extensive and Intensive Farming. — When land is very cheap it is the common practice to farm as large an area as can possibly be seeded and harvested and to reduce the amount of labor per acre to the minimum. The receipts per acre are small, but the total income is made satisfactory by the extensiveness of the operations. Generally there is no diversification, the work is done poorly, and the yield becomes lighter from year to year. In old countries where land is scarce and high priced, a very different system usually prevails. The farms are very small, and they are fertilized and worked with the greatest care. Crops are raised which require a great deal of labor and their value per acre is relatively large. This is called intensive farming. Farmers often make more money from a small place under intensive methods of cultivation than others make by working many times as much land. Of course the Northwest is best adapted to fairly extensive farming operations, but the time has come when we should cease striving for the largest possible acreage; more care should be taken to increase the yield by diversification, fertilization, and better cultivation. The history of agriculture shows that as a farming country grows older there is a gradual change from the extreme type of extensive, single-crop farming to diversification and somewhat more intensive methods. The wise farmer adapts himself gradually to these changing conditions.

FARM BUILDINGS

The Farmhouse should be built low rather than high, and the lines should be simple and strong. Petty ornamental features often seen on city houses look out of place on the farmhouse and merely serve to spoil its dignity. Far more effective than any artificial decoration is an attractive, natural setting for the house — a pleasant yard with fine trees and



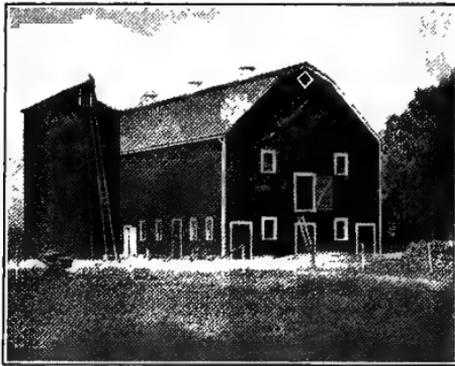
FARMSTEAD WITH GOOD WINDBREAK

shrubbery and flower beds. As soon as the farmer's financial condition enables him to get beyond the primitive conditions of life, he should install improvements that will reduce the burdens of domestic labor to the minimum and increase home comforts to the maximum. There are farmhouses in every state that are provided with a bath and toilet room, have water piped to this room and to the kitchen, and are equipped with modern heating and lighting systems and with the necessary conveniences to make the laundry work as easy

as possible. There are thousands of other homes that can amply afford these comforts and conveniences and would have them if the house were brought up to date as completely as the equipment of farm machinery.

Other Farm Buildings. — In recent years we have learned to pay more and more attention to the lighting and ventilat-

ing of the stable in which live stock is kept, believing that these two factors, as well as warmth, are as essential to the health of horses and cattle as they are to human beings. If diversified farming is carried on, a good silo should be included in the layout. Other important buildings, as granary and machine sheds, our



MODERN BARN WITH SILO

readers are quite familiar with and require no comment here. All buildings from which the water supply might be polluted should be kept at a good distance from the well.

FARM MACHINERY

The invention and employment of labor-saving machinery for the farm during the last fifty years forms a most interesting and important chapter in the history of human progress. With modern implements, horse power, and farm motors, one man can now accomplish as much labor as many men could accomplish fifty years ago and do it with less of the tedious drudgery and backache of former days. This machinery, however, which is doing so much for the modern farmer, is also quite often the means of his financial ruin, for it costs

a great deal of money. It may be very easy to buy it on time, but very hard to make the payments when they become due. A good farmer keeps himself well informed on the subject, knows exactly what machinery will pay for itself by the saving of hand labor, and as a good business man, he confines his purchases to such as will yield returns on the investment. A good farmer is also a good machinist; he knows how to keep his machinery in perfect repair and to make it last. He takes care of it in seasons when not in use and does not allow it to decay or to be eaten up by rust. It is said that farm machinery is often damaged more by exposure to the weather during the long seasons of idleness than by the wear resulting from the short periods of use.

FARM ACCOUNTS

The farmer, like any other successful business man, must keep accounts. They should show (1) his business relations with other persons, (2) what branches of his operations have been profitable, and (3) the value of his possessions.

Personal Accounts. — The most important of all accounts are those that show clearly one's business relations with other persons. It often results in misunderstanding and unpleasantness even between friends if the facts concerning labor and purchases and payments are intrusted to a fickle memory instead of a written record in which the exact indebtedness of either party is clearly shown beyond question.

Departmental Accounts may be kept with the leading departments or branches of the farming operations. Their purpose is to show which have been profitable and which have been conducted at a loss. Such accounts may, for example, be kept for wheat, cows, horses, sheep, and in fact any or all of the principal factors in the farm business on which

we might wish to keep information. The chief task is the keeping of an accurate record of the labor expended upon the item in question. Other charges, as well as the receipts, are more easily entered. Then, at the close of the year, the expenditures and receipts are compared and the gain or the loss on that branch of the business determined.

Inventory. — This is a statement showing one's possessions and their value at a particular time. It is a good plan to make it out at the end of each year. The farmer lists all property and all items due him; these constitute his resources. Likewise he also lists all amounts which he owes to others — his liabilities. Subtracting these from his resources he gets what is called his present worth. By comparing this with the present worth of the year before, he can determine the gain or the loss for the year. It should be noted, however, that this may take no account of the interest on his investment and of his wages, nor on the other hand of the living and other personal expenses of himself and family that have come out of the business.

EXERCISES AND PROJECTS

Changes in values. — (a) Is the value of farm land in your vicinity increasing or decreasing? (b) How about the value of live stock? (c) The value of farm products? (d) How do farm wages compare with those formerly paid?

Plowing. — A farmer wants to get along with one gang plow (two plows each 14 inches), keeping it going quite steadily from harvest until the ground freezes up; how many acres can he hope to plow with it during that time? (Take the judgment of experienced farmers.)

Cutting grain. — What area will a six-foot binder cut during a harvest period of fourteen days working twelve hours a day? (Obtain estimates from farmers.)

A farm map. — Make a map of your farm showing (a) the location of the farm buildings, (b) all fields, meadows, pastures, groves, etc. with

the number of acres in each indicated, (c) what crop each field is now devoted to or was devoted to last year.

Map of farmstead. — (a) Make a map of your farmstead showing the exact location of the house, barn, and all other buildings; the yards, garden, trees, and shrubs; also the well. Let the map show the directions correctly and the approximate distance of the house from the barn, the well, etc.

(b) Make another map showing all these things, but locate or arrange them in a way that you think might be more convenient, more sanitary, or more attractive in appearance. Explain why this arrangement would be better.

Modern conveniences. — If you know of a farmhouse that has any or all modern conveniences, bring a description to class and tell of their advantages. If you do not know of such a farmhouse, perhaps you can describe these conveniences as you have seen them in some city house.

Farm inventory. — Make an inventory for some farm with which you are well acquainted, including in it the land and buildings, live stock, machinery and all other property except household articles. What percentage of the total capital is in real estate? In machinery? In horses or any other important item?

Crop rotation. — What practice prevails in your district in regard to the rotation of crops? What improvements could be made? Ask the opinion of the best farmers. Make out a scheme for a four-year or five-year rotation that seems the most practicable for your vicinity. Would this scheme require more diversification than you now find?

CHAPTER XLV

BOYS' AND GIRLS' CLUBS

In recent years Boys' and Girls' Industrial Clubs have been organized all over the country for the purpose of securing



CLUB LEADER EXPLAINING THE POINTS
IN A GOOD EAR OF CORN

self-improvement among the members in the pleasantest and most effective way. These clubs originated in the state of Iowa in 1906 and are now fostered by the United States Department of Agriculture in coöperation with the state agricultural colleges. The extension departments of the agricultural colleges employ state club leaders who coöperate with the county superintendent of schools, the county agricultural agents, and others serving as leaders for the county, and these assist the local clubs of the different communities in form-

ing an organization and in making their work as successful as possible.

Object. — These clubs devote themselves to the study of farm and home problems. The members work on some project or exercise and at the meetings they describe and compare their experiences and as a result they learn to observe more closely, and become more expert in recognizing merits and faults in things pertaining to their special interests. The aim or object is well stated in the following extract from a model constitution of such a club.

The purposes of this club are :

1. To broaden our education by taking an active part in our club projects, programs, and other activities.
2. To promote wholesome recreation and enjoyment among the young people of our community.
3. To give, through the actual conduct of our own club, a better knowledge of the requirements of good government and an understanding of the responsibilities of being a good citizen.
4. To increase local pride and community spirit by demonstration, exhibits, programs, and fairs.
5. To secure information helpful to our daily life by means of literature and speakers.
6. To develop men and women who can lead others to appreciate country life and its spirit.
7. To show that agriculture and home making are as inspiring and profitable as other professions.

Lines of Work. — Experience shows that better results are accomplished by doing one or two things rather than undertaking to do a great many. The projects that form the major lines of work vary in different states and from year to year. Here are a few that are favorites in our section of the country.

Acre Yield Corn Project. — Each contestant raises and

cares for not less than one acre of corn. Purpose: to extend the corn-growing area and to increase the yield in places where it is now being grown; also to develop varieties that shall ripen earlier.

Potato Project. — Each contestant plants, cultivates, and harvests one eighth of an acre of potatoes, increasing the area to one fourth acre the second year, one half acre the third year, and one acre the fourth year. Purpose: to in-



BOYS' AND GIRLS' CORN CONTEST

crease profits in potato raising by proper seed selection and cultivation, and effective treatment of potato diseases and injurious insects.

Pork Production Project. — Each contestant enters one sow and her litter of pigs, and feeds and cares for them through the season. Purpose: To demonstrate (1) that spring pigs can be raised to a marketable size before extreme cold weather; (2) that the feeds of the state are well adapted to pork production; (3) that very satisfactory returns can be secured from the money invested; and (4) that it pays to exercise care in the selection of breeders.

Garden Canning Project. — Each contestant plants and

cares for a small garden plot and cans at least twenty quarts of any three vegetables. Purpose: (1) to acquire skill in growing vegetables and in preserving the surplus crop by canning; (2) to demonstrate the value of a garden as a source of an economical and wholesome food supply.

Garment Making Project. — Each contestant works these exercises: apron, cap, sleeves, darning, kimono, night-



CHAMPION CANNING TEAM

gown, patching, drawers, fasteners. Purpose: to teach plain sewing and the use of patterns, and cultivate habits of neatness and accuracy in sewing.

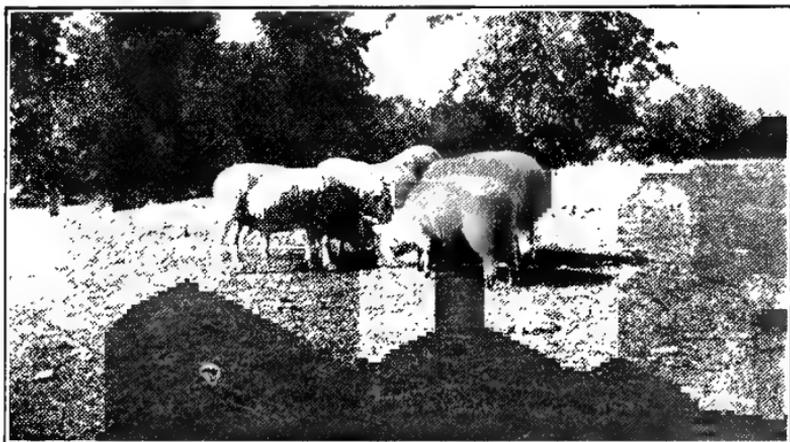
Other Projects. — There are, of course, a great many less extensive undertakings to which these clubs devote themselves. Here are a few examples of that kind:

1. *Poultry.* — Start with two settings of fifteen eggs, and

then care for the brood. The project may in subsequent years be enlarged till it includes the care and management of the whole farm flock.

2. *Pigs*. — Select two pigs, and feed and care for them from May 20 to October 17.

3. *Sheep*. — Select two ewes and care for them and their lambs through the season.



PRIZE WINNERS IN A SHEEP RAISING CONTEST

The two ewes were purchased in the spring for \$32 and in the fall the three lambs were easily worth that amount. The wool, which was sold for \$10, covered the expenses, and the lambs represent profit.

4. *Baking*. — Twelve bakings, including five or more kinds of bread.

Certain phases of most of these subjects are presented in the various chapters in this book. Further details about the projects are supplied by the county and state leaders.

Interest; Meetings. — The club is not only instructive but is usually very interesting and enjoyable. For the major projects upon which the members are engaged prizes are usually offered which stimulate the best effort. At the

meetings reports of work are given, samples of products shown, essays read, and the work of members discussed. Exhibits of products are planned for school and county fairs at which premiums are awarded for superior work in the various lines. Perhaps the county leader or other visitor present contributes some helpful suggestions. A very popular feature is what is known as demonstrations, in which certain



EXHIBIT OF VEGETABLES

members or visitors give an exhibition of some important process, as the canning of vegetables and meats, the dressing of poultry for market, selection of seeds, treatment of seeds for disease, candling of eggs, etc. The meetings afford opportunity to satisfy our instinctive desire to mingle with others of like interests, exchange views with them, and enjoy their company.

Relation to Class Work. — This club work is easily correlated with the regular class work in agriculture and domestic science and art, and also in language, writing, spelling, and arithmetic. In many places school credit is given for good club work and the completion of a project is sometimes even required for eighth grade graduation.

Results. — Government agents in charge of this movement say, "Experience shows that the activity of the club members reënforces the work of the school and dignifies the work of the home, the farm, and the garden. Through the club there is cultivated community spirit, coöperation, team work, social life, and an appreciation of neighbors so essential to the success of any community."

How to Begin. — If there is no Boys' and Girls' Club in your neighborhood write to your County Superintendent or County Agricultural Agent for information, and failing to receive it write to your state Agricultural College. Whenever five or more boys and girls between the ages of 10 and 19 years wish to take up some lines of club work the county and state leaders will assist them in organizing; but any one not able to join a local club may fill out an enrollment blank and receive assistance whether he belongs to a local club or not. The Extension Division of your Agricultural College will furnish you complete and helpful directions for the state projects.

APPENDIX A

BOOKS, PAMPHLETS, AND PERIODICALS FOR REFERENCE

It is desirable that literature be accessible which gives additional information and assistance upon any subject the student wishes to pursue. Such reading matter should be in the school library. The literature here named has been selected for the teachers and pupils studying the present book ; technical works for advanced students and specialists are not included.

FOR ALL PARTS OF THE SUBJECT

1. *Nature Study*

Nature Study, Holtz. Scribners.

Nature Study and Life, Hodge. Ginn & Company.

Practical Nature Study, Coulter and Patterson. Appletons.

Handbook of Nature Study, Lange. Macmillan.

Biological Nature Study, Downing. University of Chicago Press.

1. Field and Laboratory Guide.

2. A Source Book.

2. *Elements of Agriculture*

Elements of Agriculture, Shepherd and McDowell. Webb Publishing Co.

First Principles of Agriculture, Goff and Mayne. American Book Co.

First Book of Farming, Goodrich. Doubleday, Page & Co.

An Introduction to Agriculture, Upham. Appletons.

Fundamentals of Agriculture, Halligan. D. C. Heath & Co.

Elements of Agriculture, Warren. Macmillan.

Agriculture for Common Schools, Fisher and Cotton. Scribners.

Agriculture for Beginners, Burkett, Stevens and Hill. Ginn & Company.

3. *Periodicals*

Nature Study Review, published at Geneva, N. Y.

Garden Magazine, Doubleday, Page & Company.

Agricultural Papers and Magazines like the *Country Gentleman*, and *Breeders' Gazette*.

Annual catalogs of nurserymen and seedsmen.

4. *Publications of the U. S. Department of Agriculture*

The United States Department of Agriculture publishes a large number of bulletins, covering a wide range of topics in agriculture and nature study, and every student of this subject should avail himself of the help they afford. Most of those of general interest are known as Farmers' Bulletins, while others are called Department Bulletins, Biological Survey Bulletins, Year Book Separates, etc. A number of them are named in the classified lists below. We might also mention the Year Book of the Department of Agriculture which appears annually, and gives much valuable information upon the year's activities of the department. Many of the bulletins may be secured free of charge, and the rest are sold at a nominal price. Address: Division of Publications, U. S. Department of Agriculture, Washington, D. C.

5. *Publications of the State Agricultural Colleges*

The experiment stations and extension divisions of the state agricultural colleges publish bulletins from time to time upon subjects of special interest in their section of the country, and often also of national importance. For obvious reasons those bulletins cannot be named in this book. Teachers and students should write to their own college and get particulars about publications that are available and of interest to them. For the convenience of our readers we name here the post office of the agricultural colleges of the northwestern states.

Illinois, Urbana
 Indiana, La Fayette
 Iowa, Ames
 Michigan, East Lansing
 Minnesota, University Farm, St. Paul
 Montana, Bozeman
 Nebraska, Lincoln
 North Dakota, Agricultural College
 South Dakota, Brookings
 Wisconsin, Madison

FOR PART I. PLANTS

Garden and Orchard

Elements of Botany. — A few good modern textbooks should be on hand as they cover many of the topics presented in these chapters.

- School and Home Gardening, Davis. Lippincott.
 Garden Making, Bailey. Macmillan.
 The Practical Garden Book, Bailey. Macmillan.
 The Beginners' Garden Book, French. Macmillan.
 School and Home Gardens, Meier. Ginn & Company.
 Vegetable Gardening, Green. Webb Publishing Co.
 House Plants and How to Grow Them, Barnes. Doubleday, Page & Co.
 Popular Fruit Growing, Green. Webb Publishing Co.
 Principles of Fruit Growing, Bailey. Macmillan.
 The Beginners' Guide to Fruit Growing, Waugh. Orange Judd & Co.
 Among School Gardens, Green. School Garden Assn. of America.

Farmers' Bulletins :

- 61 Asparagus Culture
 113 The Apple and How to Grow It
 154 The Home Fruit Garden
 185 Beautifying the Home Grounds
 195 Annual Flowering Plants
 198 Strawberries
 213 Raspberries
 218 The School Garden
 220 Tomatoes
 254 Cucumbers
 255 The Home Vegetable Garden
 282 Celery
 289 Beans
 354 Onion Culture
 408 School Exercises in Plant Production
 428 Testing Seeds
 617 School Lessons on Corn
 642 Tomato Growing
 664 Strawberry Growing
 750 Roses for the Home
 818 Small Vegetable Garden

Field Crops

Farmers' Bulletins:

- 35 Potato Culture
 537 How to Grow an Acre of Corn
 544 Potato Tuber Diseases
 678 Growing Hard Spring Wheat
 680 Varieties of Hard Spring Wheat

Soils

Books on general agriculture usually give all the information on this subject that our readers are apt to need.

Farmers' Bulletins:

- 257 Soil Fertility
 406 Soil Cultivation

Weeds

Farmers' Bulletin:

- 660 Weeds, How to Control Them

Plant Diseases. Insects.

Farmers' Bulletins:

- 856 Control of Diseases and Insect Enemies of the Home Vegetable Garden
 939 Cereal Smuts and the Disinfection of Seed Grain

FOR PART II. INSECTS

Most of the books on nature study and also those on general agriculture devote a chapter to the consideration of insects. More extended treatment may be found in such special works as the following:

- Insect Life, Comstock. Appletons.
 Economic Entomology, Smith. Lippincott.
 Entomology for Beginners, Packard. H. Holt & Co.
 Insects and Insecticides, Weed. Orange Judd & Co.
 Field Book of Insects, Lutz. Putnam.
 Brief Guide to the Common Butterflies, Scudder. H. Holt & Co.
 Farm Friends and Farm Foes, Weed. D. C. Heath & Co.

Farmers' Bulletins:

- 155 How Insects Affect the Health of Rural Districts
 640 Hessian Fly
 657 Chinch Bug
 679 House Flies

- 856 Control of Diseases and Insect Enemies of the Home Vegetable Garden
 908 Information for Fruit Growers about Insecticides, Spraying Apparatus
 and Important Insect Pests
 940 Common White Grubs

Bulletin of the Entomology Bureau (secured from same source as the
 Farmers' Bulletins):

No. 4 (New Series) Principal Household Insects of the United States

FOR PART III

Poultry

Books on general agriculture, — all of them contain chapters on
 poultry.

Farm Poultry, Watson. Macmillan.

Poultry Husbandry, Davis.

Good poultry journals.

Farmers' Bulletins:

- 51 Standard Varieties of Chickens
 64 Ducks and Geese: Standard Varieties and Management
 200 Turkeys: Standard Varieties and Management
 287 Poultry Management
 574 Poultry House Construction
 585 Natural and Artificial Incubation of Hens' Eggs
 836 Standard Varieties of Chickens: I. The American class
 898 Standard Varieties of Chickens: II. The Mediterranean class
 889 Back Yard Poultry Keeping

Department of Agriculture Bulletin:

- 464 Lessons on Poultry for Rural Schools

Wild Birds

Birds of the United States, Apgar. American Book Co.

Handbook of Birds of Eastern North America, Chapman. Appletons.

Handbook of Birds of Western U. S., Bailey. Houghton Mifflin Co.

Bird Guide (with colored pictures), Reed. Charles K. Reed, Worcester, Mass.

Part I. Water Birds and Birds of Prey.

Part II. Land Birds, except Birds of Prey.

Birds of Eastern North America, Reed. Doubleday, Page & Co.

Birds of the West, Holmes. Hammond & Stephens Co., Lincoln, Nebraska.

Bird Life, Chapman. Appletons.

Birds of Village and Field, Merriam. Houghton Mifflin Co.

Farmers' Bulletins :

- 497 Some Common Game, Aquatic and Rapacious Birds
- 506 Food of Some Well Known Birds of Forest, Farm and Garden
- 513 Fifty Common Birds of Farm and Orchard (with colored pictures)
- 609 Bird Houses and How to Build Them
- 630 Some Common Birds Useful to the Farmer

Bird Lore, a monthly magazine published by the National Association of Audubon Societies, 1974 Broadway, New York.

Educational Leaflets, published by the same association. Write for a list of these leaflets and other excellent helps for bird study in the schools.

Colored pictures of Birds, published by A. W. Mumford, 536 South Clark Street, Chicago, and also sold by many other dealers. Price 2¢ each.

FOR PART IV

Farm Animals

Books on general agriculture devote considerable space to this subject and usually give all the information that will be required by our readers. The following contain a more extended treatment :

Animal Husbandry for Schools, Harper. Macmillan.

Types and Breeds of Farm Animals, Plumb. Ginn & Co.

Farmers' Bulletins :

- 612 Breeds of Beef Cattle
- 619 Breeds of Draft Horses
- 893 Breeds of Dairy Cattle
- 952 Breeds of Light Horses

U. S. Department of Agriculture Bulletin :

- 94 Domestic Breeds of Sheep in America

Wild Animals

The American Natural History, Hornady. Scribners.

American Animals, Stone and Cram. Doubleday, Page & Co.

Natural History, Miles. Dodd, Mead & Co.

Book of Natural History, Young Folks Library. Hall & Locke.

Farmers' Bulletins :

- 670 Field Mice as Farm and Orchard Pests
- 896 House Rats and Mice

FOR PART V

Farm Buildings

Farmers' Bulletins :

- 126 Practical Suggestions for Farm Buildings
- 270 Modern Conveniences for the Farm Home

Boys' and Girls' Clubs

Farmers' Bulletins :

- 203 Canned Fruits and Jellies
- 256 The Preparation of Vegetables for the Table
- 359 Canning Vegetables in the Home
- 562 Organization of Boys' and Girls' Poultry Clubs
- 566 Boys' Pig Clubs
- Circulars issued by the Bureau of Plant Industry (obtained from the same source as Farmers' Bulletins)
- 104 Special Contests in Corn Club Work
- 803 Organization and Instruction in Club Work
- 883 Tomato Growing as Club Work
- 884 Potato Growing as Club Work

APPENDIX B

BIRDS OF THE NORTH

The following lists will be found suggestive to bird students in the northern states. Observers should make similar lists for their own particular locality, and it will be of interest to compare them with these.

WINTER BIRDS

Not many birds care to brave such winters as those of northern Maine and Vermont, Minnesota, and North Dakota, and most of the species that are called winter birds in Connecticut, Illinois, or Nebraska, for example, hie themselves a little farther south during the coldest weather in our northern latitudes, so that but few are found there between the middle of November and the middle of March. Those residing in a state during this period may be considered its winter birds. They live during this season mainly upon the seeds of weeds and the eggs and larvæ of insects, and thus do an immense amount of good, — probably much more good than an equal number during the summer season. They may be classified as permanent residents and winter visitants.

1. *Permanent Residents*

(a) Birds that are represented in a state throughout the year are its permanent residents. In the north these include the

English Sparrow	Great Horned Owl
Prairie Hen	Western Horned Owl
Prairie Sharp-tailed Grouse	Screech Owl
Ruffed Grouse	Northern Downy Woodpecker
Canada Ruffed Grouse	American Crossbill
Sage Grouse (in western part of Dakota)	White-winged Crossbill
Bald Eagle	Canada Jay
Golden Eagle	Magpie (in western part of Dakota)

(b) Half-hardy Permanent Residents. — These nest in a region in summer and at least a few of them are found there throughout the winter. But they dislike our severest weather and during the middle of the winter they become scarce, for then most of them go a little farther south. As soon as milder weather sets in, that is, in the North, between the middle of March and the first of April, they become more numerous again. To this class belong the

Long-eared Owl	Prairie Horned Lark
Short-eared Owl	Blue Jay
Saw-whet Owl	White-breasted Nuthatch
Hairy Woodpecker	Chickadee

2. *Winter Visitants*

(a) Our true winter visitants appear to enjoy our winter climate and may be seen during the coldest weather. They rear their young in the far north, come to us for the winter and return north in the spring. Here belong the

Goshawk	Snow Bunting
Snowy Owl	Redpoll
Great Gray Owl	Hoary Redpoll
Richardson Owl	Greater Redpoll
Arctic Horned Owl	Winter Wren
Arctic Three toed Woodpecker	

(b) Half-hardy Winter Visitants. — A few of these birds may usually be found within the borders of our northernmost states in any month of the winter, but, like the half-hardy permanent residents, they shun our severest weather, and most of them disappear during that time to return the middle of March. Then, after staying a few weeks, they move on to higher latitudes to build their nests. To this class belong the

Junco	Evening Grosbeak
Tree Sparrow	Pine Grosbeak
Lapland Longspur	Bohemian Waxwing
Smith Longspur	

A BIRD CALENDAR

The "summer residents" of a region are the birds that rear their young there and then go south for the winter and return in the spring.

Birds known as "migrants" in a region nest farther north and winter farther south, so that they are found there only in spring and fall, when they linger for a transient visit as they pass through on their migrations. It is an interesting study for the bird-lover to note the earliest date when these summer residents and migrants arrive in the spring. The calendar below is the result of such observations at Grand Forks, North Dakota, extending over a series of years. It is incomplete and is given merely as an illustration. The date of the first observation of the bird is in many cases ten or fifteen days earlier than the arrival of the species in full force.

The half-hardy permanent residents and half-hardy winter visitants begin to appear in larger numbers about the middle of March, as explained on the previous pages. These are

Lone-eared Owl	Junco
Short-eared Owl	Tree Sparrow
Saw-whet Owl	Lapland Longspur
Hairy Woodpecker	Smith Longspur
Prairie Horned Lark	Evening Grosbeak
Blue Jay	Pine Grosbeak
White-breasted Nuthatch	Bohemian Waxwing
Chickadee	

Summer residents and migrants arrive

March 12	Crow	March 26	Brewer Blackbird
15	Meadowlark	28	Bronzed Grackle
17	Canada Goose	29	Fox Sparrow
19	Robin	31	Mallard Duck
19	Brown Creeper	31	Red-tailed Hawk
19	Pintail Duck	April 1	Sparrow Hawk
19	Song Sparrow	1	Sharp-shinned Hawk
20	Killdeer	1	Northern Shrike
24	White-throated Sparrow	2	Broad-winged Hawk
24	White-crowned Sparrow	4	Belted Kingfisher
24	Red-winged Blackbird	4	Yellow-bellied Sapsucker
24	Marsh Hawk	4	Green-winged Teal
24	Blue Goose	4	Blue-winged Teal
24	Snow Goose	5	Phoebe
24	Caspian Tern	7	Golden-crowned Kinglet
24	Bluebird	7	Ruby-crowned Kinglet
24	Flicker	8	Swainson Hawk
25	Rough-legged Hawk	10	Yellow-headed Blackbird

April	10	Red-headed Woodpecker	May	8	Magnolia Warbler
	13	Cowbird		8	Least Flycatcher
	13	Mourning Dove		9	Clay-colored Sparrow
	13	Vesper Sparrow		9	Yellow-headed Blackbird
	14	Red-headed Duck		10	Grasshopper Sparrow
	14	Canvas-back Duck		10	Yellow-billed Cuckoo
	15	Migrant Shrike		10	Rose-breasted Grosbeak
	15	Palm Warbler		10	Arkansas Kingbird
	15	Greater Yellowlegs		10	Tennessee Warbler
	15	Wilson Snipe		10	Black-poll Warbler
	15	Herring Gull		10	Black-throated Green Warbler
	18	Myrtle Warbler		10	Northern Yellow-throat
	18	American Bittern		10	Short-billed Marsh Wren
	18	Chipping Sparrow		10	Long-billed Marsh Wren
	18	Olive-backed Thrush		10	Catbird
	20	Hermit Thrush		10	Yellow Warbler
	22	Rusty Blackbird		11	Blackburnian Warbler
	23	Franklin Gull		11	Ovenbird
	23	Purple Martin		11	Red-eyed Vireo
	24	Kingfisher		12	Indigo Bunting
	27	Chimney Swift		12	Solitary Sandpiper
	28	Brown Thrasher		12	Wood Pewee
	28	White-breasted Nuthatch		13	Water Thrush
	28	Great Blue Heron		13	Baltimore Oriole
	28	Red-breasted Nuthatch		14	Bobolink
May	1	Goldfinch		14	Barn Swallow
	1	Cedar Waxwing		15	Lark Bunting
	1	Upland Plover		15	Nighthawk
	1	Spotted Sandpiper		15	Prothonotary Warbler
	1	Bank Swallow		16	Wilson Warbler
	1	Semi-palmated Sandpiper		16	Redstart
	1	Least Sandpiper		17	Tree Swallow
	4	Cliff Swallow		19	Rough-legged Hawk
	4	Barn Swallow		19	Goldfinch
	4	Sora Rail		20	Gray-cheeked Thrush
	4	House Wren		20	Dickcissel
	4	Lark Sparrow		21	Wilson Thrush
	5	Black-billed Cuckoo		21	Cape May Warbler
	6	Black and White Warbler		22	Ruby-throated Hummingbird
	7	Harris Sparrow		22	Crested Flycatcher
	7	Kingbird			
	7	Semi-palmated Plover			

May 22	Chestnut-sided Warbler	May 23	Warbling Vireo
22	Towhee	26	Orchard Oriole
23	Virginia Rail	26	Bay-breasted Warbler
23	Nighthawk		

BIRDS NESTING IN ANY GIVEN REGION

As a rule the birds found in a region in midsummer nest there. They include the permanent residents and the summer residents. An observer in the northern states should find most of the following among the birds nesting in his vicinity. The names are preceded by their check list number.

6	Pied-billed Grebe	366	Long-eared Owl
77	Black Tern	367	Short-eared Owl
131	Hooded Merganser	373	Screech Owl
132	Mallard	387	Yellow-billed Cuckoo
139	Green-winged Teal	383	Black-billed Cuckoo
140	Shoveller	390	Belted Kingfisher
143	Pintail	393	Hairy Woodpecker
147	Canvas-back	394 c	Northern Downy Woodpecker
190	American Bittern	402	Yellow-bellied Sapsucker
212	Virginia Rail	406	Red-headed Woodpecker
214	Sora	412 a	Northern Flicker
221	American Coot	417	Whip-poor-will
256	Solitary Sandpiper	420	Night hawk
261	Upland Plover	423	Chimney Swift
262	Spotted Sandpiper	428	Ruby-throated Hummingbird
273	Killdeer	444	Kingbird
305	Prairie Chicken	447	Arkansas Kingbird
308 b	Prairie Sharp-tailed Grouse	452	Crested Flycatcher
316	Mourning Dove	456	Phoebe
325	Turkey Vulture	461	Wood Pewee
331	Marsh Hawk	467	Least Flycatcher
332	Sharp-shinned Hawk	474 b	Prairie Horned Lark
333	Cooper Hawk	477	Blue Jay
337	Red-tailed Hawk	488	American Crow
339	Red-shouldered Hawk	494	Bobolink
342	Swainson Hawk	495	Cowbird
343	Broad-winged Hawk	497	Yellow-headed Blackbird
360	American Sparrow Hawk	498	Red-winged Blackbird

501	Meadowlark	614	Tree Swallow
506	Orchard Oriole	616	Bank Swallow
507	Baltimore Oriole	619	Cedar Waxwing
510	Brewer Blackbird	622	Loggerhead Shrike
511 <i>b</i>	Bronzed Grackle	624	Red-eyed Vireo
	English Sparrow	627	Warbling Vireo
529	American Goldfinch	626	Philadelphia Vireo
540	Vesper Sparrow	628	Yellow-throated Vireo
542 <i>a</i>	Savanna Sparrow	636	Black and White Warbler
546	Grasshopper Sparrow	652	Yellow Warbler
552	Lark Sparrow	674	Oven-bird
560	Chipping Sparrow	681 <i>d</i>	Northern Yellow-throat
561	Clay-colored Sparrow	687	Redstart
581	Song Sparrow	704	Catbird
584	Swamp Sparrow	705	Brown Thrasher
587	Towhee	721	House Wren
595	Rose-breasted Grosbeak	724	Short-billed Marsh Wren
598	Indigo Bunting	725	Long-billed Marsh Wren
604	Dickcissel	727	White-breasted Nuthatch
605	Lark Bunting	735	Chickadee
608	Scarlet Tanager	755	Hermit Thrush
611	Purple Martin	756	Veery
612	Cliff Swallow	761	Robin
613	Barn Swallow	766	Bluebird

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