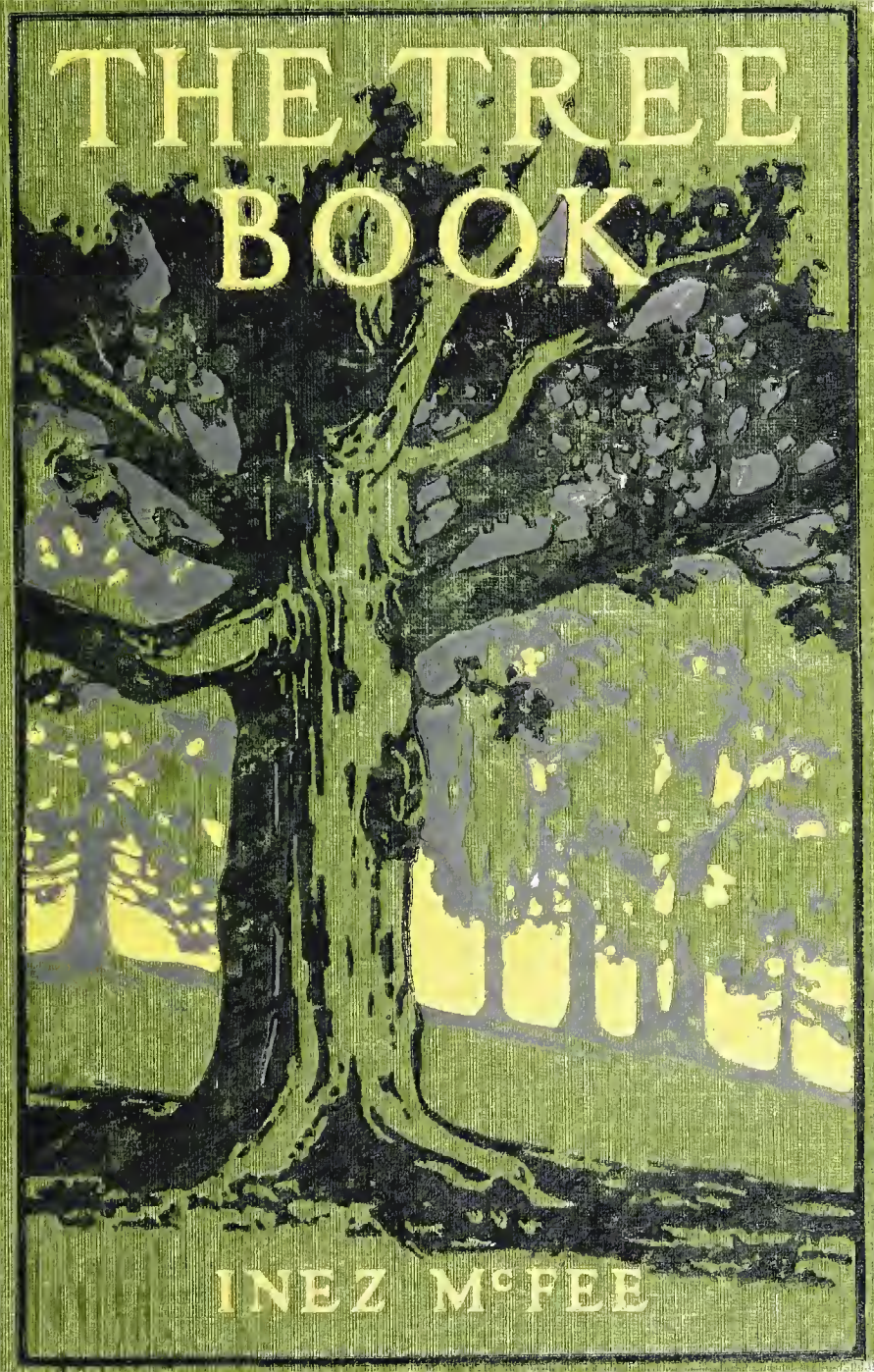
# THE TREE BOOK



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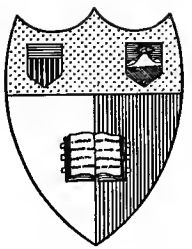

# THE TREE BOOK

THE WHITE BIRCH IS A DELICATE GIPSY OF THE WOODS

# THE TREE BOOK

BY

**INEZ N. McFEE**

*Author of "Boys and Girls in Many Lands," "American Heroes from History," etc.*

*WITH FIFTEEN ILLUSTRATIONS FROM PHOTOGRAPHS*

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*"A man who plants a tree and cares for it, has added at least his mite to God's creation."*

—Lucy Larcom

# FOREWORD

In this little volume the author has brought together an interesting fund of information concerning the life history of the common species of American trees, and such foreign species that have been acclimated here, as one may ordinarily meet in garden and forest, together with the folk-lore and poetic fancies associated with them.

In *The Life and Work of the Trees,* the suggestions for interpreting the sign language of the trees lead the young student into the open to gather all manner of interesting facts concerning the hopes and disappointments of the trees about him, the trouble with their neighbors, the secrets of age, how they prune themselves, and how they take care of cuts, bruises and broken limbs. How the trees grow, and the record of the year's work from the stirring of the sap and the coming of the first fruit and leaf buds, to blossom-time, and on to seed-time and sowing, the falling leaves, and the sleep of the trees, is most fascinatingly told. The reader travels from the nethermost root to the

tip-top leaf laboratory, taking in all the wonders along the way, and it is a marvelous journey! He can but feel at its close how truly wonderful are the trees, and how little most people appreciate their real worth and beauty. Why trees die, and what we may do to help protect and save them, is explained in the section, "Some Enemies of the Trees." The student is led to see that trees are like men. They have their prime and their decadence. They are subject to a host of natural enemies and to diseases and infirmities which gradually bring about their downfall, in spite of the fact that each year their working forces are made new, and that they have within themselves the symbol of immortality.

In the second part of the work, "The Kinds of Trees," all the important tree families are considered. The principal individuals are introduced in such a way as to make them lasting friends, and there is a fund of legend and folklore which is most interesting.

The third and last part, "The Forester and His Work," differs slightly in treatment from what has gone before. It is hoped that the intimate study of the trees will lead young readers to entertain a personal feeling for them. Perchance there may be some who will wish to be-

come champions of their forest friends and to take up some day the study of forestry in real earnest. If so, this chapter will answer many preliminary questions. It gives an idea of the breadth and scope of the great subject of forestry and shows in brief the life and work of the forester. A hint is also given concerning the interesting details of tree botany, and of the scientific possibilities in laboratory work.

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Acknowledgment is made to The United States Department of Agriculture, Forest Service, Washington, D. C., for use of photographs of trees reproduced in this volume.

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# THE TREE BOOK

# I

# THE LIFE AND WORK OF THE TREES

# THE TREE BOOK

## I

### WHAT THE TREES ARE

THE trees are among the very best gifts of God, but they are so common that we do not half appreciate their worth. We accept their shade and beauty as a matter of course. Occasionally some poet reminds us that:

Each breeze a message brings,—
"Be brave," from Oaks and Cedars,
"Look up," the Pine tree sings,
"Oh, earth is fair," the Elm calls,
"And Heaven is just above!"
"Do good," the Maples whisper,
All chorus, "God is love."

The oak tree is pointed out as an example of rugged strength; the pine typifies constancy; the beech, with its low, wide-spreading branches, is a picture of hospitality; the birch, in its wrappings of silver gray, "shows that beauty needs

not to make gorgeous display''; the ash teaches resistance in every strong fiber: and so on. Beyond this we are not apt to go. The real uses of the trees in providing shelter, food, and raiment, and their value in the economic plan of Nature are as nothing.

For instance, how many know that if the forests were cut down our country would soon become a desert? The roots of the trees, extending deep into the earth, are constantly bringing up water and discharging it into the air as moisture. It is said that the largest steam boiler in use, kept constantly boiling, could not evaporate more water than one large elm would in the same time.

We have been in the habit of thinking that the clouds get most of their moisture for rainfall from the vast ocean. But they do not. By far the better part of it is drawn up from the soil through the trees and plants. Here is a little experiment which you may try in proof of this: Take two glasses of equal size and fill them with water. Place them in the direct sunlight in the open air. Into one put a few cuttings of growing plants with their leaves; let the other stand idle. In a few hours the water will disappear from the glass containing the plants, while that in the other glass will scarcely be diminished.

If you were to keep the glasses going, no doubt the one containing the cuttings would throw off *gallons* of water, before a single *gill* would evaporate from the other glass. So you see that the proportion of moisture exhaled from any given surface of ground is vastly greater when covered with trees and plants, than when covered with standing water. Thus we come to one of the first great uses of trees: *they are the most important agents of Nature for conveying the moisture of the earth into the air.*

If a few cuttings will evaporate a half-pint of water in twelve hours, how much more would be exhaled by a tree! And what would a grove of trees accomplish! Over a forest, as over a lake, there rests always, in calm weather, a stratum of invisible moisture. This moisture is a good conductor of electricity, and may be the direct means of bringing down a shower. Electricity is always of more or less importance in the clouds. A cloud is made up of millions of little vaporous particles suspended in the air and held apart by a law of electricity which allows them to come nearly together but will not allow them to touch. The effect of the electric current is lessened by cold and increased by heat. So that, in summer, when earth and air are both heated, and drought has prevailed for some

time, electricity plays a very important part indeed in the clouds. It holds the little vapor particles apart, and the clouds float hither and yon till the electricity gets a chance to escape. This is where the trees sometimes help.

A forest of trees, with their multitude of tiny branches, is like so many lightning-rods, presenting their millions of points both for the discharge and absorption of electricity. When the cloud reaches the damp stratum of air above the trees, its electricity is attracted by the numerous vegetable points below; the electricity eagerly seizes the conductor offered; the particles of vapor rush together, and the whole comes down in a copious shower. Thus, *trees may be the direct agents in producing rain.*

As there is a layer of moisture above the woods, so there is a layer of dry, heated atmosphere above the plains. Sometimes a rain cloud, floating toward the dry section, is drawn out of its course—attracted by the stratum of damp air, above the woods along a river valley, and this section gets the rain which the plains really need far more. Again a dense electric cloud will pass over our heads, without shedding a drop of rain, until it reaches the ocean, when the cool, moist air above the waves, acting as a conductor, causes the cloud to part with its elec-

tric fluid, and to fall in heavy rain at the same moment.

Trees and groves are considered a protection to buildings near them. But it is not safe for men and animals to take refuge under a tree in the open plain. Lightning is supposed to be conducted by the water passing down on the surface of the branches and trunk, rather than by the tree itself. If the tree acted as a conductor, the lightning would pass through the trunk into the ground, and the tree, like a true lightning rod, would be a protection to objects near, so long as they do not touch it. Some trees are thought to be more exempt from lightning than others. Hugh Maxwell, an American writer, says: "Lightning often strikes the elm, the chestnut, the oak, the pine, and less frequently the ash: but it always evades the beech, the birch, and the maple." Pines are said to be safe when growing among oaks. Tiberius, the cruel and lawless Emperor of early Rome, used to don a crown of laurel leaves when a thunder storm threatened, under the belief that lightning never touched the leaves of this tree.

*Not only are the trees a safeguard against drought, but they are a considerable protection against floods and overflow.* In Holland, Belgium, France, and Germany willows are planted

as a protection to river banks. In our country they plant themselves. Their long, rigid roots are invaluable in binding together the loose shifting soil of sand dunes and bars. Their foliage decays and helps to form a soil in which other trees and plants can live and thrive.

*Trees everywhere are great makers of soil.* You will understand this better if you dig up a little soil in the forest or grove. Under the loose dry leaves you will find leaves in all stages of decay: lower, you will find a dark soil, called leaf mold; below this is a loam made by filterings from the leaf mold; and lastly the soil of that particular locality. Trees, planted upon a hill-side, fertilize and irrigate the lands below and protect them from winds.

*Trees are of untold value in purifying and renovating the atmosphere.* Trees take in the deadly carbonic acid gas, which is produced in immense quantities by the decay of animal and vegetable matter, by the breath of animals, and by all fires in which wood, gas, coal, or petroleum is burned; and by some process, recorded only in the closed book of Mother Nature's secrets, decomposes it and gives forth pure atmospheric air. Of course, the plants, too, aid in this process of purification: but as all the plants united are not equal in bulk to the trees, it is

safe to say that if the forests should be destroyed the world would be sadly crippled in its supply of life-giving oxygen, nay more, the atmosphere would be without a source for regeneration. Men and animals, every form of life, would perish from the face of the earth.

*Trees are also of immense importance in affording shelter to birds and beasts of the forest, and in the many productions which they furnish. to mankind.* These productions or "Gifts" are too numerous to be mentioned here. Suppose you pause a moment and see how many of them you can name off-hand. It is possible to write a list as long as your arm, and then the half will not have been recorded! But at any rate you will have additional proof of the inestimable value of the trees.

The industry of forestry is second to agriculture in the number of people and amount of capital employed and in value of product.

## II

### READING SIGNS

Trees speak a sign language, which is easily understood if one has the patience to study it, and from it we may gather all manner of interesting facts concerning their hopes and disappointments, the trouble with their neighbors, the secret of age, how they prune themselves, how they take care of cuts and bruises and broken limbs, and their struggle with the long catalog of tree diseases, most of which are as catching as the measles or the whooping-cough.

The best way to study this sign language is among the trees themselves. So let us hurry away to the woods! Here we find the trees jostling each other, like rude boys in a crowd, the big fellows conquering the weaker ones and pushing them aside. All are eagerly reaching upward and outward for the sunlight which makes life possible.

Close at hand our sharpened eyes detect a smooth spot on the rough bark of an oak. What does it mean? That spot marks a place

where once a limb projected. For some reason, probably from lack of light and leaf, due to crowding neighbors, the limb died, decayed, and broke off near the trunk of the tree. Nature patched the rent. The bark is smoother than the other, only because it is younger. Each year the bark of the tree grows thicker and heavier.

A little farther on is a tree with a large knot hole. As we look at it wondering, an incautious woodpecker backs out and flies off with a startled *ker-r-ruck*. Did he make the hole? No. At least he did not begin it, though he may possibly have drilled it a little deeper. It, too, marks the place of a former limb. This limb was slower in dying than the other, and it broke off so far from the tree that Nature could not possibly cover the stub. So, as the years have passed, the limb has gone on decaying deeper and deeper into the trunk of the tree.

Over here is a branch, dead but not fallen. Let us find what steps Nature has taken to prune this. Ah! See here is a sort of collar around the base of the dead branch. Next spring, when the tree wakens to active growth, a new layer of young wood will be spread all over the living trunk and branches. About the ill-fated branch no new wood can form, because

the cambium layer, which promotes the new growth, is dead. New wood, however, will be added to the collar which encircles it. This will go on year after year, unless some outside force intervenes; the collar will grow tighter and tighter and the pressure of the young wood will become so strong that the old dead wood will be pinched and ready to snap at the first chance. A gust of wind, a heavy fall of snow, or even its own weight may break it off finally. Each new year's layer of wood will build around the ring encircling the dead stump, until finally its disk will be covered by a patch of smooth bark, such as we noted on the first tree. In the course of a few years this, too, will vanish, and the record of the dead branch will be buried forever, unless perchance the tree is felled and the action of saw or axe brings the stump disk to light.

Here is a great, lengthwise scar on the trunk of a towering old monarch of the forest. What does it mean? Surely it is not an example of Nature's pruning? No, indeed. It is the work of Jack Frost. See, it is on the southwest side of the tree. Probably after a succession of warm days, the tree was deceived into thinking spring at hand: the rootlets began to drink thirstily, and the water they absorbed moved

upward through trunk and branches. Then, suddenly, winter came howling back and the "sap" froze, making a great ugly split or wound in the tree. Probably that was years ago, when the tree was young and vigorous. Nature set to work at once to grow new wood over the wound. In time the scar will probably entirely disappear. Should such an accident happen to-day, the tree would, no doubt, be too old to repair the damages, and the wound would become a point of attack and way of entrance for a horde of insect enemies, which would soon bring death in their wake.

Let us look about a little and find the stump of a tree cut recently. Note that it appears to be made up of numerous rings, one within another. Begin in the center and count outward. Forty-seven rings! A ring for each year. A study of the rings close to the pith or center shows them to be very close together. Probably the little seedling was shaded by older neighbors growing near it, possibly, too, they greedily robbed it of water and soil nourishment. At the seventeenth ring the circles begin slowly to widen. Something evidently increased the tree's vigor, possibly some of its nearest neighbors were cut down: it gives every proof of having started to grow lustily. The

rings go on showing increase in width to the very last—a mute record that the tree fell in the very prime of life. On stumps with a greater record of rings, we find the circles getting nearer together on the outward side, showing that trees, like people, lose their vigor as they grow old. Trees usually cease to grow rapidly in height after their fiftieth year.

It is not always necessary to cut down a tree in order to tell its age. Each twig and branch bears a record of years, written in the scars of bud scales and leaves. A branch finishes its year by forming buds. In the spring it starts to grow by casting off the scales that protected the buds from the cold. The scales leave a little group of scars to mark their place. So the length between each two groups of scale scars represents a year of growth. Beginning with any little tree you can easily count its age from tip to base. The oldest branches are a year younger than the main stem. Every branch, large or small, must be a year younger than the stem that bears it. The youngest wood bears buds in winter: in summer all the leaves are borne directly upon shoots that grew from the winter buds.

With these clews in mind, test your knowledge. Here is a certain stem you think is five

years old. Cut it off and see if you can count five rings around its pith. If so, your judgment is correct. It would be well to try this experiment a few times; then you are ready for older trees. A twig that gets the most light and air shows the lustiest growth, and hence is easier to read. And remember *bud scales always mean winter* or a year of growth.

Frequently we find branches that tell a story of poverty and woe most plainly. Here is a tiny twig that grew in the shadow. It is small and weak. It did not have enough to eat or drink. Probably it could not even breathe freely. It was crowded and jostled all season. It made a very short growth and scarcely increased at all in diameter. A most unhappy little twig in the midst of others that fairly shouted freedom and independence! Verily want and plenty, misery and happiness, exist side by side, even in the realms of the tree tops!

Their trail is a pathway of tragedy and cunning, for always there is battle and murder in the heart of the buds. And the survival is to the fittest here, as in any other walk of life. Each leaf bud set on the twigs is a branch in miniature. Naturally it opens with high hopes to become a leafy shoot. Should all the buds

achieve their ambition, what would be the result? Let us figure a moment. Here is a twig with three shoots rising from a common point. Each bears side buds, scattered along, less than an inch apart; and a cluster of stronger ones at the tip. Last summer a leaf marked the place of each side bud. And they were not too close. But suppose each bud increases this year to a spray of ten leaves? It would mean about three hundred leaves on a two year old branch scarcely twelve inches long! Naturally, the plans of a large percentage of these miniature sprays or twigs must be "nipped in the bud." Some are too weak ever to enter the contest. The others contend in a silent, continuous strife for room, for food, and for sunshine. We may learn whole volumes in ethics by just keeping an eye on them, for truly they have a patience and courage almost sublime, and an eye quick to perceive their opportunity. Those farthest out have the best chance. They quickly attain full size, and shade and starve out the unfortunate strugglers beneath them, so that vigor and a favorable situation are the magic keys. Usually death to the side shoots and the persistence of one or two of the terminal ones is the rule. Always Nature shapes to serve the best interests of the whole tree. And she has

a sort of life insurance plan that is most ideal. Among the buds sacrificed, a few are kept dormant, that is asleep for a year or two, waiting for any emergency that may arise. If an accident cuts off the shoot above them, they spring into action and carry on the business of that particular branch, which is to keep itself ever growing toward light and space, lest some envious neighbor outdistance it and "throw it in the shade."

Because of their craving for light, trees have a tendency to grow straight toward the zenith, no matter on what slope they may find themselves. Look about you for the crippled trees —those bent by storms or partially uprooted by accident. They tell some wonderful stories of perseverance and fortitude, in their efforts to attain the upright. A little study of the trees in any region plainly shows the strength and direction of the prevailing winds. Knowledge of this enables the forester to make a compass of the tree tops. The soft, tapering top-most shoots of the pines and hemlocks, bowing before the breeze, are guides more trustworthy than brass-buttoned policemen.

All this is but a beginning in the interesting study of sign language. One skilled in the art says: "It has the fascination of detective

work. After your first successes, you find yourself questioning every tree you meet. . . . The old apple tree by the roadside challenges you to make out the story of its eventful life. You can learn to read the record of last year's crop. You can tell exactly how many fruits a particular branch has ever borne, and even whether they reached maturity or were picked green. The promise of next year's crop is revealed to you, though you cannot foretell whether the flowers will be frosted. The veteran recites to you its past successes and failures, declares the year it came into full bearing, the time of the big wind or the ice storm that broke so many large limbs, and you can even give a shrewd guess as to whether the tree has been a profitable investment or not. It is as if the owner kept an account with each individual tree and opened up to you his book of record for this one."

## III

### HOW TREES GROW

A TREE is made up of three important parts—the roots, the trunk or stem, and the leaves. Altogether it is a combination of earth elements, water, and buoyant, invisible gases—the latter comprising about one-half. If we burn a stick of wood in the open air, those parts akin to it pass off in the form of gas: the water goes up in invisible steam; that which is left, the ashes, is of the earth earthy. The ashes never comprise more than one-tenth the weight of the dry timber. All the rest is but a vapor and a breath! Think of it.

The alchemist that magically constructed a strong and mighty tree of these primary elements is the leaves. No fairy tale is so wondrous as the work they do. Besides serving as lungs for the tree, each leaf is a tiny laboratory in itself, devoted principally to the manufacture of starch. It obtains raw materials from the air and from the soil. The sun furnishes the power. The machinery is the soft green leaf-pulp.

The watery parts of the wood, which pass off as vapor when it burns, come into the tree by way of the tiny root hairs which reach out in every direction to find plant food. Much of the gases which go up in flame and smoke have entered by the same lowly door, as elements of the soil water. All must be worked over in the leaf laboratories before it can be used to build new tissue. There are regular avenues leading from the roots to the leaves and back again. Raw material travels in one: elaborated, life-giving sap in the other. The upward route is by way of the youngest fibers of the sap wood. The return trip is made through the inner bark or *cambium,* by way of slender, thin-walled tubes, of most delicate tracery.

Given the proper elements, leaves can make "not only wood, but cork, the tender petals of flowers, the flesh of fruits, and a large number of gums, oils, essences, and perfumes, which have become indispensable in art, manufactures, and medicine." How wondrous must be the machinery compressed between the thin leaf walls! Let us see what we can find out about it, with the aid of a compound microscope.

*First:* We note that the leafy skeleton—the veins and arteries—divides and subdivides into the tiniest capillaries, a perfect network of

woody threads. The leaf veins connect with larger tubes in the leaf stalk and these in turn are joined to tubes in the branch.

*Second:* Filling in the spaces between the network, is a green pulp, which somewhat resembles honey comb in arrangement. It is made up of rows of cells. Each cell is a little bag of delicate transparent skin, filled with colorless jelly. This jelly is called protoplasm —"the thing first made"—and looks very much like the white of an egg. We are told that it contains six ingredients: oxygen, hydrogen, carbon, nitrogen, phosphorus, and sulphur. The proportion varies according to the supplies taken in.

*Third:* We note that, though the protoplasm, or cell jelly, is itself clear, it is so full of floating specks of vivid green, that these give their color to the whole leaf. These specks are called chlorophyll bodies. Chlorophyll forms only in the direct light of the sun. Baby leaves, just peeping from the bud scales, appear in various colors. They have, as yet, little or no chlorophyll. As one authority puts it: "The sun has not yet given them their working outfit."

*Fourth:* Over network and cells stretches a protective transparent leaf skin, or epidermis. The thickness of this skin varies to suit climatic

conditions, the object being to prevent the sun from drying up the leaf juices. The India-rubber tree, of the East Indies, has a leaf skin composed of three layers of cells. Always the leaf skin must be thin enough for the water which constantly streams up from below to evaporate readily, otherwise the starch factory would soon be submerged!

*Fifth:* To aid in this work of evaporation, the lower leaf-skin is full of little pores, for the easy passage of air and vapor. Some leaves have such pores on the upper surface too, and they are found on green stems and young branches less than a year old, and also on green fruit. These little pores or mouths are called *stomata.* It is through the leaf stomata that the great quantity of vapor, which we have already spoken of, rises from the trees. The little mouths swell up whistle-shape in wet weather and collapse in times of drought. So smooth and polished is the leaf-skin that, in a rain storm, most leaves shed water like tiny umbrellas.

On a bright summer day, the leaves of a good sized tree will make over a pound of starch. To do this several hundred pounds of soil water must be taken in, sorted, and passed off in vapor. Starch is the vital food for all plant

life. It is made up of carbon, hydrogen, and oxygen. The carbon is drawn from the carbonic-acid gas absorbed by the leaves; the hydrogen comes from the soil water soaked up by the roots; some of the oxygen comes in by way of the roots, the balance is breathed in by the green stems and the foliage.

Miss Going, in her book *With the Trees,* tells us that: "The newly made starch in leaves appears in tiny grains inside the chlorophyll bodies or close beside them. It does not remain there and grow into larger starch grains, but with the withdrawal of sunlight it seems to melt away. It has been changed into fluid glucose, and this travels slowly along, passing through cell wall after cell wall, till it reaches some growing part of the tree, where it is used at once, or some resting place where it is turned into starch again, and stored away to meet the needs of the future. In spring all the starch which the leaves can make is changed to glucose, and used immediately, for growth. But in latter summer the tree puts it by. It may be saved in wood or pith to feed next spring's blossoms and shoots, or it may be packed into seeds and support the tree's children during their infancy."

The wood of a tree is not active. Neither is

the bark. But between wood and bark, from root tip to twig end is the *cambium,* through which, you remember, the sap avenues descend. This is the important factor in the life of the tree proper—the carpenter, if you please. It builds new root and bark, lengthens branches and roots, and adds to the girth of the tree, using the material supplied by the leaves.

The cambium is made up of millions of cells. Always the cells have a disposition to increase in size and divide in two parts. This division goes on so long as the food supply lasts. Thus one cell may increase to two, four, eight, sixteen, thirty-two, sixty-four, etc.

A new layer of woody tissue and one of bark is formed by the cambium each year, adding to the tree's thickness just that much. The cambium never adds to its own width, but remains always a thin layer of dividing cells, ambitious only to add to the bark on one side and the wood on the other. A tree grows taller only as the terminal branch shoots upward. Cell division is the most rapid in the green shoots, which are practically made up of pith and cambium. Being so full of chlorophyll, they can make their own food, and hence are independent of the leaves. Besides, the cambium cells here have a wonderful power which is lacking in the cam-

bium cells of the trunk and yearling branches. They can lengthen as well as thicken. So the vigorous shoot goes forward by leaps and bounds until warned by Nature to prepare for winter's cold.

The heart wood, or pith, of a large tree has lost all capacity for growth. Its avenues for water are closed, and it is of little use to the tree beyond the support given by its strength and staunchness. Thus trees sometimes live and flourish for years after their trunks are mere hollow shells. But what happens if the cambium is destroyed? The return current, the food supply, cannot descend from the leaves and the roots starve. The leaves die and fall, for they are dependent on the roots, and so the tree perishes. "Girdling," or peeling a circle of bark and cambium clear around the tree, usually means sure death to the oaks, maples, and other broad-leaved trees. If by chance any such survives, its trunk thickens above the wound, because the food supply gathers here in an over-abundance, while waiting for the chasm to be bridged. Some trees "bleed" to death if a place of any size is bruised. On the other hand, the evergreen, because of the gummy, resinous quality of its sap, can withstand severe marring and girdling.

This is an item of vast importance to the turpentine "farmers."

A tree's growing season begins with the warm, mellow days of early spring, and usually ends by midsummer. The leaves, battered by wind, eaten by insects, and clogged with the weight of mineral matter they have sorted out, are beginning to feel old. The summer droughts have cut short the water supply. And there is a great deal to do before winter. The buds are to be made ready; the shoots must be hardened; the new wood ripened; the twigs and roots stored with food. So thickening of trunk and lengthening of limb give way to more urgent business, and it is seldom that Jack Frost finds the tree unprepared.

## IV

### FRUIT AND LEAF BUDS

When the leaves fall in the autumn, next year's buds—the winter buds, as we term them—are already in place. You may see them at the base of the leafstalk on any of the trees, if you care to look. But some of them, like those of the maple, are very small and hard to find. If you chance to gather a handful of sumach leafstalks, or those of the honey locust, you will probably say, "There is nothing doing!" But, if you pull off a sumach leaf, and wipe off the drop of milky fluid which immediately fills the wound, you will find a tiny hump, very small and pale, to be sure, but still next year's leaf bud, made up of tiny clusters of leaves. You can pick out each one with a magnifying glass and a needle. And the honey locust? You will notice that each leafstalk has a swollen base, shaped something like a horse's hoof. If you break into it you will find a tiny chamber, all lined with walls of white fur, and cuddling there are three or four baby leaf buds.

The shining willow is, perhaps, the easiest tree to examine for leaf buds, and you would better try it first. The bud, enclosed in a single wrapping, is found at the base of the leaf-stalk. This wrapping is an ideal sample of Nature's way of doing up a parcel. It is made of two tiny leaves, joined by their margins, and fitted to their new use. If you are careful you may strip the wrapper off in one piece with a needle. Then the little bud will lay bare before you. But you will not be able to see how perfect it really is unless you have a magnifier. Here are five or six of next year's leaves, perfect in every way, even to the branching veins and the delicate toothing at its edges. A tiny space separates each leaf and the one next within the cluster. This space quickly lengthens under the loving glance of the spring sunshine, so that a bud left to achieve its destiny, becomes a spray. The inmost leaves of the bud inclose the flower cluster; for, on the willow, blossoms and foliage appear together.

Buds containing both blossoms and foliage are called mixed buds. Leaf buds are usually slender in form; flower buds are plump and hairy; mixed buds are larger than those containing flowers or leaves alone. Sorting the kinds of buds, and finding out all we can about

them is a most delightful pastime. Such undreamed of possibilities in wrapping, packing, and varnishing! Such unsuspected beauties of form and color! They call to us from all sides when once our eyes are opened, and we wonder how we could ever have passed them by unheeding.

All the tree's hopes for the future lie in her winter buds, and she guards them most carefully. Each little package is wrapped in layers of scales, securely gummed together, and the whole given a coat of varnish, that it may be safe from the elements. As a further precaution some buds are carefully lined with fur, others with cotton, or with tiny plant hairs. All are very snug and warm in their ingenious cradles.

Sometimes in place of scales there is a nice little brown cap tightly fitted over the bud. Sycamore buds have such caps, neatly covered on the outside with fine hairs. Some of the little caps are quite pointed. They contain leaf buds. The others have both leaves and flowers, and are plump and rounded. The willows, too, wear caps, or leathery hoods, all made in one piece and lined with a silvery fur. The buds of the wild cherry are slender and pointed, and each sits upon a little shelf. Butternut buds

also occupy a shelf, and over them is "a beetling hairy ridge, like a pair of eyebrows." They are perhaps the oddest of all buds. Their pungent odor and general clamminess would reveal their identity in the dark. Black walnut buds are clothed in rich gray velvet. Those of the beech taper to delicate points, and are wrapped in scales thin as tissue paper, and covered with soft silken hairs. The big terminals of the horse chestnut are easy to examine for "inner secrets." These generally contain flowers and leaves. The bud scales are in pairs, shingling over each other, and coated with a gummy substance which makes them thoroughly weatherproof. On carefully removing the scales, we find the miniature leaves, folded in pairs, palms together, over a spike of flowers. The winter buds of the catalpa are altogether discouraging. Indeed at first glance you may think the tree dead. But examine a branch carefully. The oval leaf scars stand out very plainly. They are set at intervals in whorls of threes or in pairs about the stem. Above each scar is a tiny dot. It is a bud, and a mixed bud at that! Inside are the miniature leaves and flower clusters which will be a crown of glory in latter June or early July. The catalpa does not waken to active business until the middle of

May, but once in the arena it is surprising how rapidly it outdoes all the efforts of its neighbors. The large heart-shaped leaves are full grown before the cream-colored, purple and gold flecked flowers appear.

On almost every kind of twig we note a few very small buds, often no larger than a pin head. These are called latent buds. They do not open with the other buds. The tree holds them in store for a very wonderful purpose. Let us see if we can find out what it is. Suppose we break off a twig just above one of these buds on one branch, and on another let us clip off all the large buds near. What happens? The tiny buds begin very shortly to swell. Soon they burst and put forth new growth, as though seeking to repair the damage done. That is their business. They are emergency buds. They lie asleep until some accident calls them into service, when they swing into the breach with a vigor and energy truly surprising. Often these little buds lie imbedded in the bark. A severe wind, or other destroying agent, breaks off a big branch, and presto! the little bud leaps to grow a new one.

There is another class of buds called "adventitious" buds. These arise to meet the urgent call of necessity. We see them most

often springing from trees that have been dehorned, from willow fence posts, and from the stumps of felled oaks and maples. The latter show brilliant bits of color in the early summer and fall. Always adventitious buds make a remarkable growth, because of the extensive root system which finds it but child's play to bring up material for these few shoots, after having once supplied the needs of many branches.

Yet another kind of bud is the "summer" bud. In August we find it on the same branch with the winter bud. Its business is to promote the growth of the young shoot, so it does not need to be made into a parcel, and devotes all its time just to stretching out. With some trees the growing season is very short, with others, like the staghorn sumach, the locusts, and the catalpa, it lasts until frost kills the ambitious buds. It is the summer buds which tip the yellowish-green and rosy shoots of young saplings and the branches arising from stumps. They persevere until blighted by the cold. Beside the topmost spring buds of the late growing branches is always a little black scar—"the memorial of last year's spray tip." On occasion winter buds may change to summer buds. If in latter summer a branch top is broken off,

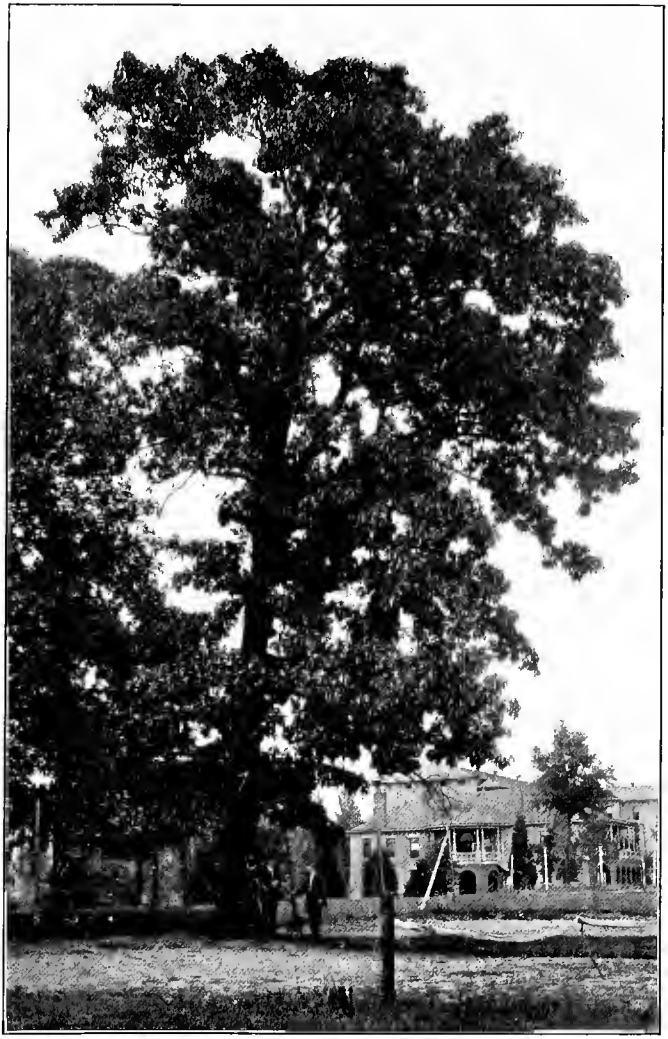
the nearest winter bud will rouse from its slumbers, throw off its wrappings, and become a summer bud forthwith, lending itself to an entire change of program for the good of the cause. For buds, like leaves, work "each for all, and all for each." Always the hopes and ambitions of the individual give way to the common interest for which they labor—the making of a strong and mighty monarch, which shall be a tree of trees amongst its fellows.

A study of buds reveals some interesting things in leaf arrangement. Here is an apple twig. Note how the buds are arranged. They are set, one at a joint, on alternate sides of the twig. A line joining them is a spiral that goes twice around the twig before the sixth bud is reached directly above, or below, the one chosen as a starting point. This is called the five-ranked order. It is the plan adopted by all the common fruit trees, and it is quite popular among the forest trees. This "Rule of Five" is also repeated in the flowers and fruits, for floral parts, the botanists tell us, are simply "modified leaves," brought into the same plane by the shortened stem.

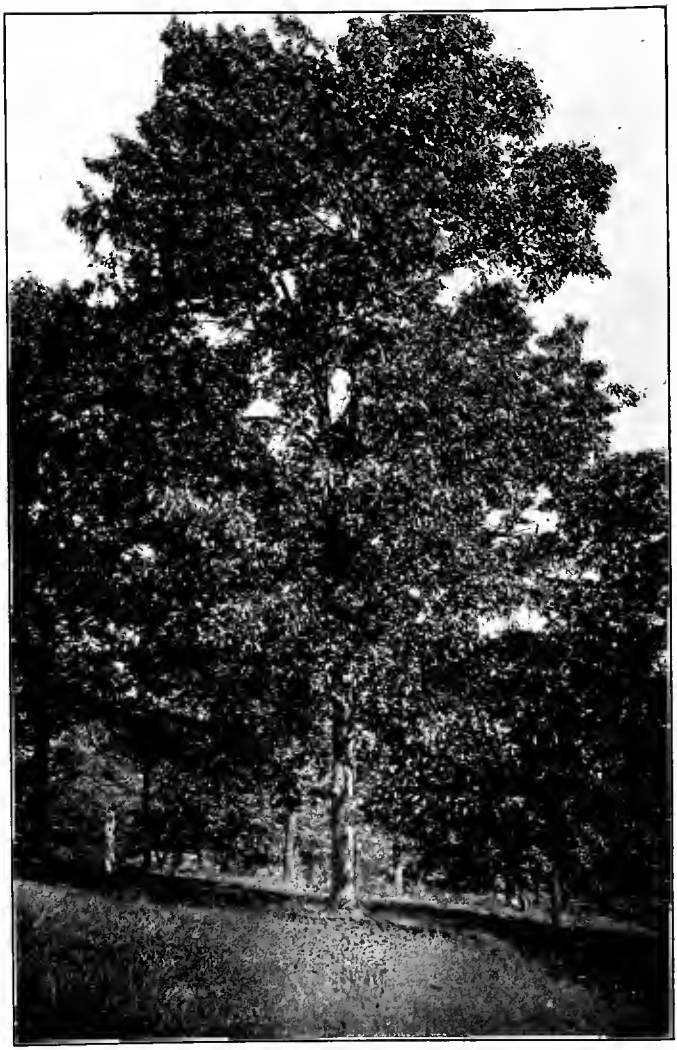
There are many ranking plans—from twos to thirteen and up, the object being always to secure the best possible exposure to the sun and

air. The maples, the horse chestnut, the ashes, and many others follow what is called the opposite or four-ranked plan. It consists in having each pair of leaves cover the space between the pair below. Thus a pair of leaves starting from opposite sides of the same joint and pointing north and south are set above a pair pointing east and west. The beech, sycamore, elm, basswood, chestnut, linden, and many other trees have the two-ranked plan. The leaves are arranged in two flat rows, one on each side of the twig.

At first glance the top of a tree seems a mass of disorder. But give it a moment's study and you will note that it definitely follows the arrangement of its leaf buds, although it is often difficult to discover the law on the older parts of the stem, as many branches have been destroyed. This explains why, even from a distance, the experienced eye can distinguish the kind of a tree by its form alone. Some trees curve their branches either upward or downward, like the lombardy poplar and the willow; others grow them horizontally, like the apple tree; some prefer the hollow cup-fashion type; others build up in mushroom shape; some fashion themselves into pyramids tall and straight; and again others, like the birch, allow them-



THE BLACK OAK IS A LARGE, LOOSELY HEADED SPECIES



THE RED OAK HAS A ROUNDED, DOME-LIKE TOP

selves to float at the pleasure of the wind. Note the misty lace-work of the curving elm twigs, like the spray of a fountain; the big arms of the oak, each one a tree in itself; the sturdy, spreading branches of the chestnuts and hickories; the maples' graceful outline and delicate tracery in branch and twig; the beautiful form of the silvery beeches. What wondrous beauty and varying color is everywhere presented in bud and stem as they weave their

> . . . "plush-like mantles,
> Brownish, grayish, reddish, green,
> Changing, changing, daily, hourly,
> Till they smile in emerald sheen!"

## V

### BLOSSOM-TIME

It begins in a little hint of color on the hillside slopes—a color that no one can name. It is brought about by the swelling of innumerable buds, crimson, purple, olive, yellow, and silver, but very seldom green.

"And the next thing, in the woods,
The catkins in their hoods
Of fur and silk will stand,
A sturdy little band.

And the tassels soft and fine
Of the hazel will untwine,
And the elder branches show
Their buds against the snow."

For most trees shake out their blossoms while their foliage is still folded away in the bud. They are dependent on the capricious will of the wind to set their seed by spreading the pollen. Outspread leaves would hinder the flight of the precious dust, so it takes place while they are still folded away in their cradles, or at best

only half-awake and too small and crumpled to impede the work of the wind.

What blossoms are first out? You know—the pussy willows. We find them on the willow shrubs by the water-side. Note the tough, brown varnished bud scales, arranged alternately on the twigs. Some are small and pointed, others large and round. The small buds contain leaves. Let us pass them by and see what comes from the larger ones. Ah! here are some beginning to burst. Inside is a soft mass of shining, silvery gray fur. As they come out of their brown covering they look like little pussies clinging to the twig. What are they? Fairies' muffs? No, indeed, they are bunches of blossoms. In a few days they will lengthen into tassels or catkins. If we look carefully we shall see that there are two kinds of these tassels. The blossoms from one tree are made up of two stamens and a leaf each. Those from another have a single pistil and a leaf. The staminate blossoms are covered with bright yellow pollen. The pistillate blossoms are green.

But how does the pollen from the staminate catkins get away over here on the pistillate ones? For it is the duty of the pistils, you know, to form the seed, then to nourish and shel-

ter it until it is ready to be sent out in the world. Suppose the wind refuses to blow in the right direction? Go nearer and read the answer. The color and fragrance of the blossoms have attracted the bees. They look as though some one had sprinkled them with gold dust. And, indeed, the blossoms have. In return for nectar, the bees agree to act as messengers, and very faithful little fellows they are. The staminate tassels fall when their pollen is gone. Their business is finished.

By the time willow pussies begin to shed their pollen, their nearest neighbors, the alders and hazels, put forth their long catkins, "tremulous like teardrops in the wind." The alders are a few days in advance. According to Thoreau, "We see them a russet maze in earliest spring, and all out-doors is fawn-colored in dry weather, and grows tawny when wet by showers."

Each flower in the pendulous alder tassel is made up of four petals and four stamens. These are the pollen-bearing flowers. The seed-bearing blossoms are found at the tips of the smallest twigs. Here each flower is a group of three pistils sheltered by a scale. A number of these pistil groups and scales grow close together, forming a dainty little cone.

The hazel catkins are long, soft swaying

chains of stamens and scales. We may readily detect the staminate buds, in winter time, shining brightly on the bushes. The pistillate ones are demurely hidden under their scaly buds. They burst forth in tiny crimson star clusters —"the most richly colored flowers of earliest spring."

The slender drooping catkins of both alders and hazels swing with the slightest breath, sending forth showers of light, dry pollen for the wind to waft onward. And a most reckless, wasteful messenger he is, "dropping quantities to the ground, and blowing other quantities to the four points of the compass!" But there is enough and to spare. For every bunch of eight or ten hazel florets, Nature has lavishly prepared at least one catkin with from three to eight hundred stamens, each shedding innumerable pollen grains. And she has been no less provident with the alders.

Closely following the tassels of hazel and alder, come the humble, greenish flower clusters of their neighbor, the soft maple. A little later the red maple of lawns and village streets puts forth its bloom. Both these trees bear staminate and pistillate flowers, the kinds being easily distinguishable, even when the lowest branches are away above our heads. The

staminate, or pollen-bearing, flowers are orange colored and fragrant. The pistillate ones are scentless, and of a rich, ruby red. Roving flies and bees carry the pollen from one to the other in their quest for nectar.

On a warm sunny day in the latter part of March, or the first of April, those of you who are familiar with the elm, have perhaps noticed that its buds seem to swell, and you think it is going to put out its leaves. Everybody says we are going to have an early spring. Then suddenly the cold winds and frosty nights come on again, and the leaves do not fulfil their promise. Now the fact is, the buds which you noticed were not leaf buds at all. They were the flower buds. Had you been more observing and studied the twigs at close range, you would have found a multitude of beautiful little flower clusters, purplish or yellowish-green in their general effect, and slightly fragrant. Each little cup-shaped flower contains from four to nine stamens, and in their midst a funny green pistil forking into two feathery prongs. In almost every cluster there are some flowers which have no pistils. These, of course, have no use for their pollen and it flies away with the wind. Each fruit is in the middle of a circular green wing, and as they huddle together on the boughs

they are easily mistaken for young leaves. But if you look, you will find the young leaves folded carefully away finishing their winter sleep, in buds much smaller than those from which the blossoms came.

Side by side with the elm blooms the poplar, its soft, gray catkins, "like the tail-tips of little kittens," bursting from the brown varnished, resinous buds, that all through the winter have been "as water-tight as well-calked canoes." There are staminate and pistillate trees. Both kinds of flowers are borne in long, swaying chains of cup-like florets, each shielded by a tiny silvery-fringed scale, that seems to have nothing but beauty as its excuse for being. With Nature, however, "handsome is as handsome does." Through the winter the little tortoise shell scales, with their furry fringes closely overlapped, have been keeping the little flower babies warm in their tiny cradles.

The flowers of the nut-bearing trees do not open until the leaves are about one-third grown. The staminate flowers are chains of scales, dropping below the leaves, each scale being covered with many little pollen-shedding heads on its lower surface. The wind scatters the precious dust to the pistillate blossoms. Thus those which grow nearest the branch tips are

surest of fertilization. This is the reason why ripe nuts appear in such hard-to-reach places. Nor is it easy to discover the blossoms, they are so nearly the color of the young leaves surrounding them. When the outer bud scales of the shell-bark hickory part and curl backward the form of the bud is thought to resemble greatly the fleur-de-lis. Half-expanded buds have been compared to opening magnolia blossoms. When the bud scales fall and the inner scales "suddenly enlarge till they become four or five inches long, they are then of the texture of heavy, velvety-piled glove kid, beautifully fringed and of a gorgeous red or salmon color." The staminate heads of the beech blossoms dangle on slender, pendulous cords. The pistil-bearing flowers are found at the tips of the boughs. The staminate catkins of the oaks hang in clustered, swinging fringes at the base of last year's shoots. The pistillate flowers are few in number and borne in the axils of the new leaves.

Nature runs her business by common sense methods. If all the insect-depending trees bloomed at once, some would certainly be neglected. So we find them waiting for one another. This is especially discernible in a sugar maple grove. Here we find trees in all stages

of bud and leaf development. On a tree close at hand the blossoms are just peeping forth, on another the seeds are set, still another has hosts of "keys" fluttering here and there, a fourth is in the full glory of leaf foliage, with blossom-time and seed-sowing all but forgotten. We say that the sap has risen earlier in some of these trees than in others. True. But did not Nature so design it?

The same rule holds good all through blossom-time. From the pussy willows in March, one tree follows closely upon another, till the

> "Tulip tree, high up
> Opens in airs of June her multitude
> Of golden chalices to humming-birds
> And silken-winged insects of the sun."

Such a wealth of beautiful blossoms! Imagine a gigantic tree all decked out with garden tulips, of a clear lovely green, flecked and dashed with orange! It is a sight never to be forgotten. The seeds are hidden under the scales of curious little cones, which dry in the winds and frosts, forming a lily-like cup, the very ghost of its flowery glory.

A little later, "in the fervor of July," the linden spreads her feast of greenish-yellow, pendulous blossoms. How the bees love them!

No matter how far the tree may be in the depth of the forest, they never fail to scent its white-clover fragrance and go humming after its nectar. Honey made from the linden is nearly equal to that made from wild clover. Besides the nectar in its flowers, the linden provides another feast for the bees. This is a sweet juice, called honey-dew, which exudes from the lower surface of the leaf. Just how and why this is formed is one of Nature's mysteries. Sometimes it gathers where little pricks have been made in the leaf-skin by insects, again it is found where none of these little pests have been at work. Sometimes the honey-dew runs so freely that it drips from branch to branch. Usually, however, it dries on the leaf surfaces and coats them with a sticky film, making an ideal place for molds and mildew to get a foothold later.[1]

While the lindens hum with bees, the flies are busy feasting on the ill-smelling chestnut bloom. They fairly revel in the long, creamy spines of the staminate blossoms, dusting themselves over and over with pollen. Then they slip away with their precious load to the short cat-

[1] Many other trees besides the linden yield honey-dew. The oaks are specially prone to it. In tropical countries, orange, lemon, and coffee trees have a tendency toward it, which often works serious injury.

kins borne on the stems of the branches. These are the pistillate flower clusters which ripen into chestnut burrs, each containing from one to three fat, brown nuts.

Now, too, the catalpa spreads its gorgeous bouquet, until the broad, heart-shaped leaves are fairly hidden by the showy panicles of white and cream. The inner surface of each blossom is flecked with purple and gold. The tubular, two-lipped flower is so poised that its upper lip shields the pollen from rain, while the lower one offers a convenient shelf-like standing place for the insects, upon whose good offices the tree depends. The catalpa, like the linden, secretes nectar in its leaves. This oozes out of groups of tiny glands, situated at the angles where the large side veins part from the mid-rib, and serves as an additional bait to the insects which might be tempted to pass the catalpa bloom in favor of the many flowers blossoming in field and garden at this season.

We are told that "The bee which comes to the catalpa can learn from its code signal, not only whereabouts the nectar may be sought, but whether it is worth while to seek it at all." Suppose we look into this:

Inside each thimble-shaped bloom are two stamens, with a pistil standing up straight and

tall between them. The stamens are so arranged that they are sure to rub against the back of any visiting insect. And, on the first day of the flower's life, when the pollen from the stamens is eager to be gone, the pistil stands with its two funny little arms pressed together and raised upright, carefully covering itself so that it may not be fertilized by the stamens in the same blossom. By the second day, usually, the many insects which love the catalpa have carried off the pollen from these particular stamens, and they stand empty, dry and brown. Then the pistil lowers its arms and bends forward, bringing its sticky tip into the mouth of the blossom cup. Here it is in fine position to rub against the coat of the bee, coming in all dusty with the pollen from another blossom. Nor does the visitor have to prospect for his reward! A little groove in the center of the lower lip is carefully outlined with streaks of yellow to catch his eye, and a tiny passage nicely adapted to fit his proboscis leads straight to the nectar.

If by chance a bee stumbles in where there is no need of his services, he knows it instantly, for the yellow marking the "refreshment stand" is tinged to tawny yellow, and says plainly: "Nectar gone; flower fertilized."

Thus he does not need to waste his time. And he is, no doubt, glad of the sign. For working days are few at best, and his object is to gather as much honey and incidentally to fertilize as many flowers as he can. Those who have taken the trouble to observe these wise little creatures, say that they keep to one kind of flower at a time, visiting hundreds of blossoms in succession, and carefully passing over any that might be mixed with them. Thus is another of Nature's wise economies fulfilled!

The calendar of tree blossoms begins and ends along the low thickets of the water-side. You remember it was here we found the first blossoms—the pussy willows. And here, along in October, "when the leaves fall shivering from the trees, and Nature seems at last to have lost heart and given up the game," we find the last ones—the "elfin blossoms" of the witch hazel. How cheery they are! Such a bright, clear yellow—a yellow whose brightness not even the soddening rains, which seem striving to drive out all color from the landscape, can dim! Jack Frost turns the dainty petals into crepe, and curls them up into ringlets that dance merrily in the winds.

A witch indeed is the witch hazel. For she chooses to bloom at the very time she is sow-

ing her seed! All summer, closely hidden on the bases of the leafy side spurs, are clustered groups of little green buds as round as marbles. These slowly turned to grayish-green buttons, and at last, on a bright autumn morning Jack Frost and the sun work the magic key which unlocks them. Snap! one of the little button heads flies off and out springs the tiny seeds, like squirrel-shot from a gun. Indeed, that is just what Mr. Bushy Tail, busily gathering nuts near at hand, takes it to be. He makes a frightened jump and is off through the brush for dear life. How the witch hazel laughs and shakes her gay yellow cap-strings! But she does not pause in her target practice. No, indeed! She seemingly tries to spring each seed a little farther than the last. And it is surprising how skilful she becomes. Often seeds fall fully eighteen feet from the tree. It is thought that the lining of the little seed cells contracts as they snap open and in this way adds to the force that throws the seed out.

If you chance past the witch hazel in winter, you note the widely yawning pods, from which the last shot has been fired. But, unless you take particular pains, you will not see the new store of ammunition hidden in the tiny balls behind the four shriveled ribbons which sway from every twig.

# VI

## BABY LEAVES

When the early spring days begin to grow warm and bright, it is well to keep an eye on the swelling leaf buds. How they stretch and glisten—a myriad of twinkling colors in the sun! Soon the scales, whose work is done, drop off and drift away. Then

"The maple crimsons to a coral reef:
Then saffern swarms swing off from all the willers,
So plump they look like yaller caterpillars.
Then gray hoss-chestnuts little hands unfold,
Softer'n a baby's be at three days old."

How interesting it all is! The little "hoss-chestnut" babies wear woolen mittens. The leaves of the poplar, the mountain ash, and the pear tree are as downy as newly hatched ducklings. Many others are carefully protected with little furry coats and bits of wool. These drop off as the days go by, and soon the baby leaves stand naked in the breeze.

How lovely they are! The little maple leaves are tinged with crimson or purple; the oaks

show all shades of tawny, pink, and red; the willows are golden-green; seldom do we find a baby leaf that is really green. This color is developed later by the action of the sunshine. Green is considered in the vegetable world, as "the color of sober and honest work."

At first the baby leaves, like Topsy, "just grow." They feed greedily from the glucose which the mounting sap brings them so freely. They stretch and bask in the sunshine enjoying their babyhood, which is brief at best. For they have their work to perform, as we have seen, and it is not long until Mother Nature whispers that they must be busy.

While the leaves are still very young, it is interesting to study out their folds and creases, and pry into Nature's methods of packing. Here is an oak leaf. Note how it was folded lengthwise down the middle, so that its edges came together like the covers of a book. The apricot and the plum were rolled like a scroll. The maple and the currant leaf were plaited together like a fan. Often the manner of their folding seems to determine the shape of a leaf. Here is a tulip-tree leaf baby. It looks as if its tip had been cut off with two clips of the shears. Its creases show that, when it slept in the bud, it was folded lengthwise down the middle, and

then bent over on its stalk, till its green blade was upside down. The bud scales which covered it were oval and fashioned like a little shallow dish. They were two in number and placed together face to face, forming a dainty little almond-shaped box, which alas! left no room for the tips of the leaves. They had to be sacrificed in order that the lodging might be warm and water tight.

Scientists, however, advance a much weightier reason for the toothing and pointing of the various leaves. It has been observed that the leaves of American trees are not nearly so deeply notched as those of their kin in the old-world. Sir Herbert Spencer, the philosopher, explains that this is due to the moister climate and less brilliant sunshine of Europe. When light and heat. Perhaps, on a hot summer day, points and tongues to grasp it. They turn this way and that, adapting themselves readily to light and heat. Perhaps, on a hot summer day, you may have noticed the leaves poised edgewise to the sky? This is to protect them from the fierce rays of the sun, and so keep the little chlorophyll babies and the leaf juices from becoming parched and withered.

In our southwestern deserts, there is an odd plant, called the pilot weed, or compass flower,

which cleverly avoids the hot rays of the sun by pointing its leaves north and south, and training them edgewise to the sky. Longfellow tells us about this in *Evangeline:*

" 'Patience,' the priest would say, 'have faith and thy prayer will be answered.
Look at this delicate plant, that lifts its head from the meadow;
See how its leaves all point to the north, as true as the magnet.
It is the compass-flower, that the finger of God hath suspended
Here on its fragile stalk, to direct the traveler's journey
Over the sea-like, pathless, limitless waste of the desert,
Such in the soul of man is faith.' "

Many trees protect their leaves with a fine coating of downy hairs. In some cases this coat acts as a sun-screen; in others it serves as a blanket. The desert willow and the sage brush of the dry plains are clothed all over with short, thick hairs. In the far north, a little coating of soft, furry hairs protects the leaves and twig tips of the hoary willows.

Nearly all of the leaves we examine have pale under surfaces; indeed some of them, like the poplar, are silvery-gray, shading almost to

white. Most of these under surfaces are coated with fur, or with wool, or silk, or even tiny particles of wax. Why? Do you recall what we said about the leaf stomata? These little mouths which enable the leaf to breathe off the moisture it does not need are nearly all located on the under side of the leaf. The extra coating is to prevent them from giving off their moisture too rapidly.

Did you ever watch the leaves go to sleep? Baby leaves cuddle down shortly after sundown. All their little stomata close drowsily and they shift themselves so that as little of their leaf surface as possible is presented to the sky. For their skins are very thin and tender, and even with all the little mouths closed, moisture radiates from them. If too much escapes, they may get very chilly. Indeed, scientists have found that often leaves radiate and chill so rapidly that their substance is from six to ten degrees colder than the air. You know what this would mean on a cool night in early spring. The little leaves might get pretty severely nipped! So they huddle close together and wish, no doubt, that they had not been so hasty in shedding their blankets.

Nor are the baby leaves the only drowsy, chilly ones! As twilight deepens, all the

smooth-surfaced, thin-leafed trees prepare for bed. The common locust is among the first to say good night. She shifts her leaves so that the end leaflet of each long cluster trails earthward, while the side leaves dangle loosely in rows, back to back. The honey locust raises her leaves and folds them so that each little leaflet partially covers the little mouths of the one growing just above it. Other leaves, like the willows, are raised upright; still others fold themselves along the middle, or turn edgewise. Always the effort is to turn the broad surface of the leaf as far as possible from the sky.

Take hold of a sleeping leaf. How stiff it is! We cannot make it keep any position but the one it has chosen to take. Suppose we try pinning some of the leaves in a horizontal position. What happens? In the morning these leaves are coated with dew, while the neighboring leaves, which were allowed to sleep, are nearly dry. This proves that the imprisoned leaves were much colder. So, you see, the sleep of the leaves is a very important thing—often a life or death matter to the baby leaves.

How fast the little leaves grow! Long before our interest in them begins to wane, they cease to be babies. But full-fledged leaves are none the less interesting. An ideal leaf is made

up of three parts—the blade, or surface, the foot stalk, and a pair of stipules. The latter are absent from many leaves, and disappear early from others. They consist of two odd little flat bodies, or in some instances blade-like organs, which cling to the lower end of the leaf-stalk or stand on either side of its base. Some stipules look like little leaves, and share the life and cares of the leaves above them. More often, however, they bear no resemblance whatever to their leaves, and live for an important purpose of their own. Perhaps you may have noticed the tough, horny little lobes which jealously stand guard over some of the baby leaves? The stipules of the thorny locust and the barberry change to prickery body-guards, and so repel browsing animals from their foliage. The little bristle-shaped objects at the base of the apple leaf are stipules. The stipules of the smilax and similar vines change to little clinging tendrils which help them to climb. Often the stipules are altered into scales and serve to shelter the leaf buds. The oak, the beech, the elm, and the big, sticky poplar leaf bud are stipules, carefully welded together, and made water tight with a coat of Nature's varnish.

Leaves are divided into two general classes—

simple and compound. Simple leaves are those wherein the blade is unbroken, like the maple and the oak. Compound leaves are those made up of separate leaflets, like the locust and the horse chestnut. All of our northern trees, except the evergreens, have what are called "netted veins," that is, veins which branch and branch again into delicate web patterns. There are two types of net-veined leaves: those whose veins branch from a strong mid-rib, like the chestnut, beech, and elm; and those having several large veins starting from the top of the foot-stalk and diverging like the rays of a star. The maple and the grape leaf are types of the latter class.

A collection of leaves is most interesting. There are dozens of things to discover concerning their skeleton make-up, and as to their shapes, we find a most bewildering array. Suppose you try grouping leaf specimens under the following heads: oblong (two or three times longer than broad), oval, egg-shaped, heart-shaped, arrow-shaped, kidney-shaped, lobed, shield-shaped, spatulate (like a paint knife), wedge-shaped, circular, lance-shaped, auricular (with ear-shaped lobes at the base), grass-like, compound, and double-compound. Directions for pressing, labeling, and mounting these speci-

mens can be found in any good text on botany. It will be a pleasure to put them away carefully so that you can have them for future reference.

# VII

## SEED-TIME AND SOWING

SEEDS are the most important things belonging to a tree. It works for many weeks forming them and storing them safely away. Indeed the making and sowing of seeds is its chief business, in order that its kind may never die from the face of the earth.

Such wonderful treasure boxes as are constructed for storing the seed! They are of many kinds, sizes, shapes, and colors. And some of them are very odd. Some open by springs, some have hinges, and some must be broken open to reach the treasures. Many of the most beautiful treasure boxes are good for food. Take, for example, the apple, the peach, the pear, the plum, and the cherry.

Let us examine an apple. First it is enclosed in a thin, smooth, tough covering. The toughness protects the apple from bruises; the smoothness keeps dirt from clinging to it. The juicy pulp is built around a core made up of hard cells. Within the cells are the little brown

seeds. What a safe and altogether cozy place for the little apple seed babies!

Did you ever consider why the trees hide their seeds in fruit? And why these fruits are colored so beautifully to contrast with the foliage? They are advertising schemes, pure and simple. And most alluring ones, too! Neither man nor beast can pass them by, and all must do their share in helping to scatter the seed. When we eat a peach, we throw away the stone. Perchance, it falls in a likely spot and a seedling peach is the result!

Seeds and the methods Nature employs to get them sowed are most interesting. But, first of all, we want to see how the seed itself is formed. No tree makes shorter work of the seed business than the maple. Let us see about her methods. We have already noted that the tree has two kinds of blossoms, and we have admired the little cups set with crimson petals. See, in this cup, or calyx, are a number of little threads tipped with yellow knobs. These knobs are the anthers and out of them shakes the golden pollen dust. Over here is a cup that is different. Instead of anthers, there is a little red, forked tongue, called a stigma. The inner faces of this stigma are sticky. At the base of the stigma is a closed chamber in which lies a tiny soft

body called an ovule. Its ambition is to become a seed. Let us mark it and view it from day to day.

All the air is full of pollen grains, not only from the maple, but from the poplar, elder, and birch, the elm and willow. The bees that buzz from flower to flower are laden with it. Pollen from all these trees may lodge on the little sticky red stigma, but a grain of maple pollen is the only kind that makes any impression. This dust is quickly absorbed by the juices of the stigma, and a little tube starts to grow downward into the loose tissues. This little tube has a sperm-cell from the pollen at its end. Presently the tube grows long enough to reach the ovule. The little sperm-cell enters through a tiny doorway and mingles with the little egg-cell lying inert in the ovule. Thus the fertilization of the ovule is accomplished. It will ripen into a seed.

By and by the little crimson petals which served to attract the bees fall to the ground. So, too, do the little pollen knobs. Their work is done. The little stigmas wither, and we watch very carefully the one we have marked. Presently in the place of the little forked tongue, two pert little horns arise. They are to be the wings of the maple seed. Slowly the stem

lengthens and shortly two crimson-winged key fruits, or samaras, swing gracefully where once the little pistillate flower bloomed. By and by it is ripe and ready, and we pluck the little key before the wind has a chance to bear it away. We will plant it, and several others, later and watch them grow. (See chapter "Seedlings and Shoots.")

Let us look at a cherry blossom: Both pistil and stamens are found in one flower. In the depths of the cup is a straight column of dainty green. This is the pistil. The stamens are poised near the rim. A bee or fly settles upon the blossom in quest of nectar and a shower of pollen is scattered from the stamens. It is probable, too, that the insect is already well-dusted, and a speck of pollen settles upon the sticky part of the pistil. If this bit of pollen is from another blossom, so much the better. It will form a much stronger seed than that which has ripened in the same flower, and thus the little seedling which may result will have a much stronger constitution. The tiny speck of pollen is at once absorbed by the eager little stigma, and a tube is begun, as in the case of the maple. When the little tube reaches and enters the ovule, a tiny drop of jelly from the pollen passes down the tube and unites with a similar drop al-

ready in the little chamber. From this union the cherry stone is formed. The juicy fruit pulp or seed-case which surrounds it is "bait" for bird and man. For the sake of the fruit they scatter the stone, and so the race of cherry trees is perpetuated.

An ideal seed-case has three parts, the outer skin, the pulp, and an inner skin to which the seeds are fastened. All these may be plainly seen in the fleshy pod of the lima bean. Here is a seed box from the thorn locust, a forest member of the bean family. It is a big brown curled pod, about eight inches long by one inch wide, with a seam all around it. There is a row of little lumps along the pod showing the outline of the seeds inside. The lining is soft and smooth and of a light brown color. There are twenty seeds in the pod, each fastened in at the seam like a little hinge. And how hard they are! It does not seem possible that they could ever spring up into locust trees.

Do you know these seeds with one wing? They belong to the ash tree. The seed from the elm tree is very like these, only the wing is more nearly oval in shape. Snap open one of the long catalpa pods and see the many seeds which it contains ride away on their filmy airships. The seeds of the linden, too, are fur-

nished with dainty air-ships. The fruit of this tree is a little hard, olive-green nut, covered with soft hairs. As it lies on the ground these hairs suck up water like a sponge, and the moisture hastens the germination of the seed.

Baby peaches, plums, and cherries are little green seed-cases, in color and texture not unlike the tiny pods on the locust trees. But what a change as summer advances! Take the peach: the outer part of the seed-case becomes velvety and damask-hued, the middle part swells to rich, juicy lusciousness, and the inner part becomes as hard as ivory. No less wonderful is the change in the plum and the cherry. In all these fruits the seed is the kernel at their very heart. Its bitterness is an added precaution against its being eaten.

How many have seen the treasure boxes of the chestnut or the chinquapin tree? So round and prickly and so hard to open! Inside in a soft velvety lining are the smooth shiny brown seeds, or nuts, with white at the tip. Soon you will be gathering the treasures in the boxes of the hazelnut, walnut, and hickory nut. They are enclosed in green shelly coverings. What is it makes the shells open and the nuts come dropping out?

What precaution Nature has taken with the

seeds of the nut trees! "All our common nuts are green when on the tree," says Wallace, "so as not easily to be distinguished from the leaves; but when ripe they turn brown, so that, when they fall to the ground, they are equally undistinguishable among the dead leaves and twigs, or on the brown earth. Then they are almost always protected by hard coverings. The walnut has a bitter rind, the chestnuts and beechnuts are inclosed in prickly coverings. The hazelnuts are hidden in leafy cases, which seem a part of the foliage and are not readily seen."

The large round shelly coverings enable the nuts to roll quite a distance from the mother tree. They serve, too, as sailboats. The cocoanut is fond of ocean voyages. Our native nuts, however, cannot stand much sailing. They soon become water clogged. Nor are they even enterprising land travelers. If left on the ground, they are more likely to decay than to sprout. Most of the forest nut trees owe their being to the squirrel's habit of burying nuts. How well this active little chap knows whether a nut is worth saving! The decayed ones he tosses scornfully aside; the doubtful ones he taps on a branch and surmises their promise by the sound.

Some of our most troublesome weeds have burr seed boxes. We never find such boxes on the trees. Why? One of our little friends suggests that the trees are too honorable for such methods! No doubt they are. But the real reason is probably because they depend chiefly on the wind as the sower. They must fashion seeds which he can scatter with ease. So winged seeds are borne by the birch, maple, pine, ash, elm, elder, and a host of others. The willows and poplars fling swarms of plumed seeds to the breeze. The sycamore seed has a little furled sail. The sweet gum tree sways little balls of woody, pointed pods, which snap open in the wind. The little flat, triangular seeds of the magnolia hang by threads from their opened pods.

The majority of trees ripen their seeds from September to November. Most of these seeds lie buried in the grass and leaves until the following spring, or possibly until a season later, before they begin to sprout. Nearly all trees have their off years in producing fruit. Forest trees, like orchard trees, are apt to "slacken their efforts every other summer." Trees in the open always bear more freely than those in clumps and groves. Why? What becomes of the vast quantities of seed which ripen every

year? Do you fancy that all those not used for food will sprout and grow? Collections of treasure boxes are especially interesting. How many do you suppose you can find?

# VIII

## SEEDLINGS AND SHOOTS

"Who does his duty, is a question
Too complex to be solved by me;
But he, I venture the suggestion,
Does part of his who plants a tree."

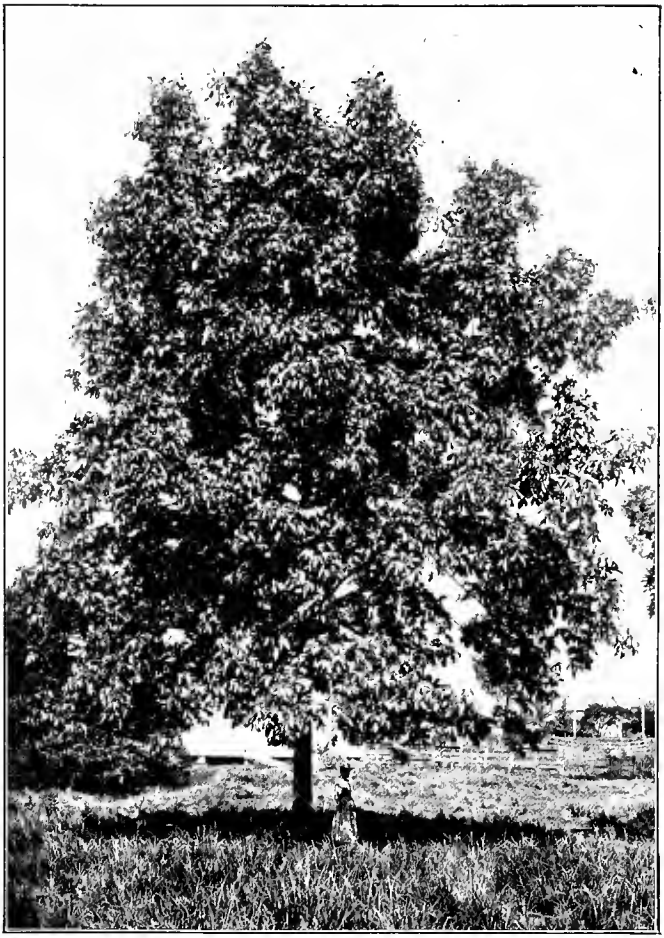
—*Selected.*

Did you ever stroll slowly through a forest set with broad-leaved trees and evergreens, and wonder how the trees happened thus to mingle together? Here stands a group of queenly maples; yonder is a tattered, white-gleaming sycamore and a great willow; there an elm neighbors with a graceful birch; just beyond a towering cottonwood and a shag-bark hickory jostle a poor little juniper bush. How did they all come to be growing just here? If they could suddenly be given voice, what wonderful tales we should hear of miraculous adventures and narrow escapes in seed-time and sowing, of youthful quarrels and envious neighbors, happy chances and lucky falls, and the final "survival of the fittest"! Indeed, a large part of these tales are written on trunk and bough and branch.

We may read them at our leisure. We may also learn many things by watching the trees from May to November, as they ripen their seeds and send them forth to find their fortunes. How loth some trees seem to part with their treasures! It takes the blustery gales of March to shake the last dangling fruits from the boughs of the catalpa, ash, and honey locust.

The maples, poplars, and willows, and many other trees which grow naturally by the riverside, prefer to launch their seeds in the spring, when there is likely to be plenty of warmth and moisture. If the little adventurers fall in a favorable spot, they settle down and sprout in short order, coming on thereafter in such rapid strides, that by fall they have grown several inches of wood and are in fine condition to weather the winter. A red maple by the garden fence often rouses the gardener's wrath by her prodigality in scattering "weeds." They spring up everywhere.

Few trees, however, are so happily placed. For one seed that sprouts, there are multitudes destroyed. They fall upon barren ground and perish for lack of moisture and plant food; or, perchance, they get too much moisture and so mold and decay; they are eaten by the birds and the little furry creatures of the woodland; man



THE SHELL-BARK HICKORY HAS ROUGH, SHAGGY BARK

THE WHITE ASH IS FOUND IN FERTILE, WELL-WATERED PLACES

and the domestic animals, too, get their share. The seed from most of the late maturing trees will not grow till after it has been frozen. This is true of most of the nuts and stone fruits. Often seed lies in the ground a season before germinating. Horse chestnuts, acorns, and beechnuts sleep under coverlets of mold and withered leaves, where they have quite likely been stored by the busy squirrels, which fortunately forgot their whereabouts. Perhaps you may have seen the rosy tip of a little oak making its way above ground? Possibly, too, you may have had the good fortune to dig up sprouting acorns and peach stones?

Trees exercise great care in providing for their little plant babies. All mature seeds contain not only a tiny plant, but a store of nourishment to feed it, while its first root develops and its tiny leaves unfold. Let us examine a walnut: How tightly the "goody" is packed to fill every niche and cranny of its shell! When the nut was forming, it had four little rooms or chambers, in one of which lived a little embryo plant all alone. In its seed leaves were packed the starches and oils for the little tree it hoped to become. Soon these little leaves became so stretched and distended that they filled all four rooms and were forced to lobe and fold back to

accommodate themselves in their close quarters. Little walnut and hickory plantlets cannot lift their fat, heavy seed-leaves above ground. Their shoots rise straight into the sunshine, till they are well above the surrounding plants and herbs, and their first three or four pairs of leaves are mere scales. They do not need to put their earliest strength into making leaves as most seedlings do, for they have a good supply of food in their buried "pantries."

Seed-leaves are called cotyledons. They are in truth little storage plants, and their sole business is to nourish the seedling until it is ready to support itself. The walnut and hickory cotyledons are typical of most of the nut seed-leaves. They are so heavily stored with nourishment that they are quite unfit to act as leaves, and so never make their appearance above ground. Most seedlings, however, push up their seed-leaves, and these do service until the real leaves have developed and are ready for action. When they are no longer needed, the cotyledons shrivel and drop off. The majority of tree seedlings are di-cotyledonous, that is they have two cotyledons or seed-leaves. The pine family are exceptions. Their little seedlings boast many seed-leaves, and so are poly-cotyledonous.

Do you remember the maple keys we were going to plant? Let us examine one of them closely. Two long seed-leaves are folded palms together and coiled in the little seed pocket of the key. When carefully straightened out, these leaves prove to be thick and strap-shaped, as unlike as possible from real maple leaves. They are joined by a tiny stem, and between them is a little red bud, which contains the first pair of true leaves for the little seedling.

Let us put some of the keys in a box of damp sand, or some place where we can get at them easily to note their progress. They begin at once to absorb moisture from the soil, and in a few days, the seed coats crack along the edge; the little stems begin to lengthen, and presently the strap-shaped leaves swell and stretch and burst from their prison. How thick and tough are these odd little pennants! But the tiny leaves they shelter are delicate and fine enough for any connoisseur. How fast they grow! In a few days they are fully developed, and with the tiny roots which have grown apace, promise soon to be able to glean their living "from honest mold, and vagabond air." Soon there is a second pair of leaves, and then a third; the little strap-shaped cotyledons are shriveled and withered, and the next time we look for them noth-

ing remains but a tiny scar on the stem where they were attached.

For a few days, the stems of the little maple seedlings are a delicate green, with a skin of leaf-like texture. They are so fragile we are almost afraid to touch them, and a few meet with disaster in a heavy wind. Gradually, however, the baby trunks stiffen and assume a woody texture, and we decide to set out the most promising ones, here and there on the lawn, in places where we think their shade will be appreciated in the years to come. We are very careful to take up plenty of soil with them, so as not to disturb the little rootlets, and the seedlings never seem to know that they have been moved. They put out another pair of leaves, the stems grow stouter, and we think happily of the time when the birds will be nesting amid their silvery temples.

But alas, for "the best laid plans of mice and men!" Brother Fred, whose business it is to mow the lawn, turns in old Brindle to do the stunt while he goes fishing, and when we get home from school, all that remains of our precious seedlings is two poor forlorn little plantlets, both bitten back to their first two large leaves! It is most vexing, and we try to forget

our disappointment by avoiding the little seedlings.

What, then, is our surprise sometime later, when we chance to pass their way, to find that the seedlings in no wise regarded the event as a discouragement! Both little plantlets have forced the two tiny buds in the axils of their leaves into little forked shoots, and are growing lustily. Already each small "limb" has two leaves! Such courage and fortitude! We are ashamed of our own dejection.

As the days pass, it becomes very evident that there is a race on in our ambitious little seedlings. Each small fork is trying to outdo its partner. How eagerly they reach out for the sunshine! How they stretch and grow! When the time comes to prepare for winter, each little tree has one fork that is a trifle longer than its rival. Will they always grow this way? If so, the trees will both be forked close to the ground. Again, we are disappointed! We already pictured two arrowy-straight maples, full of queenly beauty and grace, delightful for their coolness of shadow and their symmetry of outline!

Spring comes. Once more the race is on, but in one little seedling the contest is unequal.

One fork outstrips the other by leaps and bounds, and finally the weaker fork gives way in a fierce wind storm. A forester, who looks at the little tree, says that no doubt the stem will straighten shortly and grow on into a single trunk, giving no sign whatever of its early misfortune. If all goes well, it bids fair, then, to become the tree of our dearest hopes; for no other trees are near enough to rob it of light, food, and foothold. We have only to guard it from accident, and leave the rest to Time.

But we have seen enough in our study of these little trees to know what the struggle for existence really means. Once more our thoughts turn to the forest. What hotly contested battles must have taken place here while the trees we have noted were gaining their places! And where are the parent trees which gave them being? Fallen, no doubt, beneath the hand of the wood-cutter, the lightning stroke, or the less merciful agencies of insect enemies and disease. Nor is the struggle for existence over here, by any means! It goes on deathlessly, tirelessly, a continuous battle among the twigs for light and air. Each tree, also, encroaches daily upon its neighbors' food preserves: beneath the soil the little rootlets are struggling every whit as fiercely as the

twigs above them. Surely it was a cruel Fate which placed that poor little juniper between the towering cottonwood and the lordly hickory! What a continual record of blasted hopes and cruel disappointments its life must be!

Let us look about on the forest carpet for seedlings. Here, half-hidden in a clump of rank weeds, are a few baby maples and elms. Unless something intervenes they stand every chance of being choked to death. Over yonder is a thrifty young two-year-old sycamore; here is a slender birch sapling of four seasons; and close at hand is a scrubby post oak, grown no doubt from an acorn planted by a squirrel or a jaybird, as there is no parent stock in sight. Here, too, is a thrifty honey locust shoot and a sassafras sapling. What has become of all the hosts of seed which the trees in this little clump must have sown in times past? What will be the fate of these striplings which have gained a fair foothold?

We noted the tender skin of the little maple seedling, and the gradual thickening of the stem into woody fiber, but no mention was made of the well-fitting suit of cork, which it donned early in the summer, as a protection against heat, so that the soil-water might be

kept from drying out on its upward journey. This little cork suit is a fine, transparent brownish skin, which overlays trunk and branch to the very twig tips. It is made up of cells, ranged row on row, and joined together as accurately as tile flooring. Besides serving to keep out the heat, the cork layer also acts as a barrier against cold. Each season the tree will add a new cork layer. This is accomplished by a layer of young cells just beneath the cork suit.

Most trees wear their cork garment beneath their shriveling, weather-stained outer bark, like a union suit. The beeches, birches, sugar maples, and sycamores carry on their cork-making industry lightly and close to the surface. These trees have a very thin bark. Other trees, like the oak, the honey locust, and the cork-elm, go into the business on a large scale, making deep plates of cork far beneath the surface. Such trees have a curiously ridged and much-patched bark. For the bark is nothing more nor less than old cork layers, which have lost their elasticity and been rent and torn and burst asunder as the tree has grown. Some trees, like the pines and larches, make upright, curving cork-plates. These slough off in little irregular shapes, which

dovetail together like the pieces of a puzzle. The lovely white bark of the canoe birch is a cork sheet thin and strong as parchment.

In summer, Nature wisely adjusts the tree's cork garment so that it is not quite air and water tight. This is managed by little vents, or lenticles, in the bark, through which the tree tissues can breathe out superfluous vapors and gases. The lenticles are little cork cells, round instead of brick-shaped as the ordinary cells are, and jumbled together with many a chink and cranny. Not only do the crevices admit the passage of vapor and gases, but air gets through them into the wood. They are often lens-shaped; hence the name lenticles. It is not easy to find the lenticles on some trees, but they are always there, no matter how thick the bark. We may see them plainly on the trunks of the birch and alder. They stand out as small humps, much lighter in color than the surrounding bark. On the older birch trees the lenticles stretch out horizontally, and may be seen close to the ground as black strips running part way around the trunk. When the tree prepares for winter, little cork seals are built across the vents; for it would be folly to wear a porous union suit in winter. No moisture is coming in; therefore none must be al-

lowed to escape. In spring, the lenticles are opened again by the pressure of new cork cells forming beneath them.

The seeds of many trees do not "come true to type," that is the trees which they produce are not like the parent stock. The oaks, unlike most of their neighbors, are often cross-fertilized by the wind, that is, the pollen from one kind of oak is blown on to the pistil of another and germinates there. The seedling which this union produces is a hybrid, with characteristics of its parents, but unlike either one. We may find many of these hybrid oaks even in a short walk through the forest. An English nurseryman, experimenting with the hawthorn, produced twenty-nine distinct varieties from [redacted] Another investigator found that not one [redacted] in 20,000 of the weeping-ash came true to type. There are many trees of a weeping habit. People used to think that such trees were produced by planting a seedling with its roots in the air and its head in the ground! Others a little better informed in tree science, thought that they were produced by grafting in buds set upside down. As a matter of fact, these trees are fashioned by grafting scions of the species desired upon an upright tree of a closely related variety. Scions are pieces of

twig four to six inches long, bearing two or three buds. They must be fastened, or grafted, so that the cambium of the tree and the scion are tight together. When this is done correctly, the scion and the living stock knit, or grow, together, and thus the whole type of the tree is changed.

Grafting and budding are interesting subjects. Perhaps you already know something about them. All our seedling fruit trees and most of the ornamental trees, too, must be worked over by the nurseryman. If we plant an Elberta peach stone, we get a seedling of nobody knows what variety. If we wish to grow an Elberta peach tree, we must bud the little seedling with buds taken from an Elberta tree. The nurseryman grows his seedling trees in long rows, cultivating them as carefully as he would any other crop.

Let us see the steps employed in making an apple tree. The seeds usually come from the cider mill, or apple evaporator, and are of all kinds and varieties. They are sown in drills of well-prepared soil, and carefully cultivated all through the growing season. In the fall, they are little unbranched whips of various heights. These are dug and "heeled in," that is, they are placed slant-wise in shallow

trenches, with their roots covered with soil. Here they remain, until the leaves "sweat off." Then they are taken up, sorted as to size, and the roots and tops are cut back. Next they are stored away for the winter, with their roots in damp sawdust. In many sections, these little trees are raised and prepared for large nurserymen, who prefer to buy such stock rather than to bother with raising it.

In the spring, the seedlings are set out about one foot apart in rows, and carefully cultivated as before. Soon they begin to put out side branches, the roots thicken and multiply, and by August the little trees are about three-eighths of an inch at the base of the stem. Now they are ready to bud. The leaves and buds are removed for a few inches above the base of the stock all down along the rows. Then the bud sticks are made ready. Suppose it is desired to make one row of the little seedlings into Yellow Transparents, another into Rome Beauties, another into Stamen Winesaps, and still another into Black Twigs. Bud sticks must be cut from trees of these varieties. These bud sticks are leafy twigs bearing ten or a dozen well-grown buds. The terminal buds are too soft to use. These are clipped off; so, too, are

the leaves, care being taken to leave about an inch of stem. These stem stubs come in handy later. Next the bud sticks are cut into pieces about an inch long, each with a bud in the middle. Usually the cuts do not go quite through the stem, so that each bud is left hanging to its original stick by a few bits of fiber.

Everything is now ready for the budder. He is an expert workman and every move counts. With two motions of his sharp knife, he makes a T-shaped slit through the bark of the first little tree, just an inch or two above the ground. Next he clips a bud from the bud stick, and holding it firmly by the leaf stub slips it down under the bark in the little T-shaped slot provided until the cambium of the bud and the stock press close together. The bud is now set and the budder's work on the little tree is finished. Its whole nature has been changed—it is "born again." The budder passes on to the next tree and a boy with a bunch of strings, or wood fiber, takes his place. Very carefully the lad binds and ties the bud set, so that the bud and stock will stay together until they "knit." The binding serves, also, to keep death-dealing insects and disease germs from settling in the wound. A good budder can keep two or three boys busy. He often sets three thousand buds a day. In

about ten days, the buds have grown fast and the boys go back over their work, clipping the bands and leaving the loosened strings to unwind and blow away. If the bandages were left on, their tight pressure would interfere with the growth of the little tree.

The next step is to remove the tops of the little trees just a few inches above the bud set. Then, when the bud has made a growth of an inch or two, the main stub is cut off. The nurseryman is now ready to begin to count the age of his apple trees. Two or three seasons of growth are still needed to prepare the trees for customers. The first year, the bud sends up a single, leafy shoot. The next year the little tree begins to send out branches. All shoots which start out below where the bud was set are rubbed off, as they would bear seedling fruit. Many other branches, too, are discouraged, so that the tree may be kept well-shaped. A good three year old apple tree has its main branches well-outlined and a trim, spreading top.

In making over old apple trees, grafting is the method employed. By this process, it is possible to entirely change the variety of a tree in three years' time. Suppose a man has an orchard of Ben Davis apple trees and he wishes they were Yellow Transparents. All he needs

to work the transformation is a bundle of Yellow Transparent scions, a pruning saw, a grafting knife, and a mallet or heavy hammer. First, a lusty limb about two inches in diameter is sawed off squarely, then the grafting knife is set upon the stub end and given a smart blow with the hammer. A little rift or split is thus made in the stub, and the knife easily pries open the crack sufficiently to place a scion at each end of the crack. The lower bud on each scion must come just at the top of the stub, and care must be taken to have the cambium of stock and scion in close contact. That is, the scion must be set so that it is in position to "knit" with the inner green belt of the bark. When the knife is withdrawn, "the pinch" of the stub holds the scions fast. The wound and the tips of the scions must be carefully covered with grafting wax to keep out insects and tree diseases, and then the process is complete—the transformation has begun on this one limb. About one-third of a tree may be treated the first season; the remaining foliage will be sufficient to stock the tree that year. Always the work should be done when the sap is rising in early spring, as then the work of "knitting" will be soonest accomplished. Next season the shoots which have grown from the scions will furnish a supply of

leafy branches, and another third of the tree may be worked over. The third spring the balance of the old top may be cut away. Now the old Ben Davis tree has none but Yellow Transparent leaves. Next season it may produce a full crop of Yellow Transparent apples. This transformation is steadily winning favor in the Ozark apple section—the home of the writer. By grafting Yellow Transparents to Ben Davis stock, the orchardist gets a deeper, lustier root system, a stronger, sturdier trunk, and much wider spreading branches than he can secure by growing true Yellow Transparent trees.

Often old apple trees can profitably be made over into new varieties. An old tree can be forced into new life and vigor much quicker than a young nursery tree can be brought to the bearing stage. Fortunes have been made by rejuvenating old neglected and abandoned orchards. Apple trees usually live to great age, and a tree not badly broken or diseased is well worth making over. Perhaps you know of one such to experiment with! Try it, there is no end of fascination and satisfaction in the work.

Dwarf trees often furnish amusement to the nurseryman and to the dabbler in tree science. To make a dwarf tree we have only to set a bud or scion from a rapidly growing species upon a

slow-growing stock. The stock starves the top into keeping pace with it. The Japanese have a passion for dwarf trees. They have potted forest trees centuries old that are no larger than an ordinary geranium. Such trees are merely grotesque and interesting. There are, however, several things to be said in favor of dwarf fruit trees—as, for example, the dwarf pear. These trees are made by grafting pear scions upon quince stock. They take up less room than ordinary pear trees, the fruit is more easily picked and is usually of a finer quality.

Most of the cut-leaved, colored, variegated, and unusual forms of ornamental trees are made in the nursery by budding and grafting, or are grown from cuttings. Very few "come true to type" from seed. Seedlings from ornamental trees as a rule, revert to their original wild types, just as fruit trees do. Often, however, some among them will have some individual charm or oddity which can be preserved by taking cuttings. For this reason, nurserymen frequently plant seeds from ornamental trees—for there's no telling! They may get hold of something that will take gardeners by storm. The first purple-leaved beech known to landscape gardeners grew in a forest near Zurich, springing up from a spot "where five brothers

murdered each other." Other trees of this variety have appeared from time to time in various old-world localities. "Sports," the gardeners call them. The leaves of the copper hazel, the copper beech, the purple barberry, and the richly tinted Japanese maple are said to owe their fancy hues to a dye which overpowers the green of the chlorophyll bodies. Seedlings from the purple barberry are all "to the purple born," but not more than one-third of the copper beeches come true. Usually the copper beech is produced by grafting scions on stocks of the wildwood beech, which bears green leaves.

Nearly all trees can be grown from slips or cuttings. The power to throw out roots and leafy shoots is especially active in the cambium of the willows and poplars. Just without the window is a beautiful graceful willow that, some twenty years ago, cavorted across the lawn, a gay and irresponsible "stick horse." Mother stuck it into the ground and presto! within two weeks it began to put forth miniature branches. To-day it towers high above the maples it once stood "tied to." Willow stakes driven into the ground soon grow into hedgerows. Green willow fence posts become roadside trees in a season or two. A willow hedge "pollarded"—that is, deprived of its top and branches—comes on

again with incredible swiftness, on account of the number of adventitious buds which are immediately thrown out below the wounds. In the same way, the soft maple is often rejuvenated. A thicket of lusty shoots spring up to take the place of the lost head, and by careful thinning are soon fashioned into a graceful, shapely outline.

Many trees grow readily from root cuttings. The hickory and the oak are examples. Indeed, the fashion of producing adventitious buds from the roots and sending up shoots seems to be a sort of "life-insurance scheme" among the trees. We see such suckers springing up about stumps all over the woodland. It is a common thing to find a little grove of saplings growing from the roots of a fallen giant chestnut or chinquapin. Some trees whose twigs droop along the ground may root at a joint, after the manner of a raspberry tip. The viburnum family—better known as the cranberry tree, the black haw, and the sheep berry—will root in this fashion.

# IX

## FALLING LEAVES

HAVE you ever listened to the wind, the forest harp whispering through the trees in early fall? It has a mournful sound, which as the days pass, gradually grows louder and louder, until it swells into a deep, grand funeral hymn. For it means that the leaves are dying, and that soon they will "put on their dresses of red and gold," and flutter down to keep the roots of grasses and trees warm through the winter.

What makes the leaves die? Once we thought it was Jack Frost, but now we have learned better. We know that they drop off because the tree has no further use for them. All summer she has breathed through them, and used their cells to store up food and drink. She has, also, used them as a mill for the manufacture of starch. They have helped her in all her undertakings throughout the season. Now her work is done. She is getting ready to go to sleep for the winter. She will stand as nearly dormant as possible, her sap will cease to flow,

and all her energies will lie quietly in twig and trunk. So the leaves must go. Slowly the mother tree absorbs their nourishment, and prepares to part with them. She is just going to sleep, and, mayhap, she is tired and quite willing to go. The leaves, too, are not averse to donning their party dresses and sallying forth for a little frolic with the wind. Their work, too, is done. They are old and worn, weighted down with the minerals they have sorted from the soil-water.

To get some idea of this weight of mineral matter, burn a pile of dead leaves. You will be surprised at the large heap of ashes. Chemists say that the chief constituent of leaf ashes is silica, a substance identical with sand. This the leaf absorbed along with the potash, phosphorus, and other useful substances contained in the soil-water. Silica is of very little use to the tree, hence the leaves are forced to store it in their cells. Mixed with the silica is considerable lime, as a far larger quantity of it is taken in than the tree can possibly use.

As we look casually about us in the early days of September, there is but little to tell of the "kindling into glory" which is soon to take place. To be sure, the leaves seem dusty and have a sort of listless air, as though tried by the

summer heat. But, if we examine them at close range, we see that they are beginning to lose their deep green luster. There may be splotches here and there of russet, or red, or yellow, or the whole leaf may be tinged a sort of yellowish-green. This is caused by the sap of the tree slowly absorbing the living matter and food cells of the leaf. The nourishment so stored will help to keep the tree alive during the winter, and serve to feed the tiny buds next spring until they get old enough to look after themselves.

The chlorophyll grains, the machinery of "the mill," of course, contain no food value. As the living substance is withdrawn and the action of the leaf broken up, the waxy granules slowly change to a yellow liquid, which shows through the thin leaf skin as plainly as when its elements were still green. This is the yellow in the brilliant autumn foliage. The red is the color which the cell sap assumes. The browns are dead leaves. Other colors are caused by the decomposition of the mineral substances. Because the brilliant colors of the leaves come when warm days and frosty nights are common, we have erred in thinking them due to the action of the frost. It is true frost hastens the breaking up of the chlorophyll, but

trees often show bright splotches of color long before the first frost, and in very warm autumns most of the changes in foliage occur before there has been any frost.

In the tropics trees retain most of their leaves the year round, excepting where there is a severe dry season. This would be impossible for broad-leaved trees in our latitude. Soil-water could not be absorbed with the ground at or near freezing temperature, and without this moisture the leaf would die. Again the leaves would serve to catch the snow, the branches would become heavily laden and break. Trees that shed their leaves in the autumn are called deciduous trees. The needle-like leaves of our cone-bearing evergreen trees, such as pines, spruces, and the like, are so constructed as to withstand successfully winter blasts. Hence they remain on the tree. But they are not really evergreen. One by one they fade and fall, making a brown carpet beneath the tree, till, in the course of a few years, all the foliage has been shed. We do not notice the discoloration of aging leaves amid the general greenness of their surroundings, unless we look specially for them, and the space left by their fall is soon filled by fresh needles. Pines turn to a brownish olive in winter, and spruces, seen

against a snowy hillside, look black rather than green. Cold and frost has changed the chlorophyll grains to a somber and dingy tint. They will take on greenness with the return of the sun.

"The junipers do not look very green in winter either," says a lover of the trees, "but their subdued color is caused by the position of the leaves, which have turned their backs towards the beholder. In summer these leaves bristle outwards 'like quills upon the fretful porcupine.' In winter their tips are raised and their upper surfaces are close against the stem. Thus cuddled together, they may mutually help to keep one another warm. Their winter position is like that taken on summer nights by the tender foliage of the honey locust and the sensitive plant."

When we break a leaf from the branch, we usually tear and injure the bud to which it is joined. But when Nature removes the leaf no harm is done. Why? Because she first builds a layer of tissue across the end of the petiole, or footstalk, of the leaf. This loosens the leaf and the first slight breeze carries it to the ground. A waterproof scar marks its place on the twig. This is a wise provision of Mother Nature. Sap cannot drip from the wound, and

there is no chance for molds to attack the bark or wood and cause it to decay.

In compound leaves the leaflets frequently separate from the petiole just as the leaves do from the twig. The horse-chestnut is an example. There is a small layer of corkplate, or cutting-off tissue, at the base of each separate leaflet, and a larger one at the base of the stalk which holds the fan-shaped group of five or seven. "The leaf-fans collapse like houses built of cards, and a litter of leaflets and stalks strews the ground beneath the trees." Such large, funny-looking leaf scars as they leave behind! They are like tiny horseshoes, with the holes for the nails. Look at them closely, and you will find that the holes are really not holes at all. They are the ends of the woody threads, which joined twig and leaf-stalk, overlaid by a dark, glistening gum. A fitting specimen of Nature's wise surgery! By counting the holes in the tiny horseshoes, one can always tell how many leaflets the leaf had last year. Can you find the bud-scale scars? The small ones at the side are the leaf buds. The large ones on the end are either mixed buds or they contain the new growth.

It is most interesting to make and press collections of falling leaves, grouping them ac-

cording to different shades of color. Such beauty of painting and texture! Such endless variety of leaf forms! They are a constant source of wonder and delight.

"If die we must," the leaflets
Seem one by one to say;
"We will wear the colors of gladness,
Until we pass away.
No eye shall see us falter;
And before we lay it down,
We'll wear, in sight of all the earth,
The year's most kingly crown."

—*Sangster.*

# X

## THE SLEEP OF THE TREES

"And when the autumn winds have stripped thee bare,
And round thee lies the smooth, untrodden snow,
When naught is thine that made thee once so fair,
I love to watch thy shadowy form below,
And through thy leafless arms to look above
On stars that brighter beam when most we need their love."

—*Jones Very.*

NOWHERE is forehandedness better exemplified than among the trees. They begin to get ready for winter in midsummer. By this time the twigs are as long as they expect to grow that season; the ring of new wood is formed around the trunk; and the business of thickening the bark of the tender shoots and sealing the buds up warm and tight is begun. Then, too, the trees prepare to part with their leaves. They know that their usefulness is nearly gone, for the summer's heat has greatly diminished the water supply. Each day less soil-water is

taken in, and so the food supply, "the grist" for the mill, is daily growing scarcer. The sleep of the trees is, then, a necessity, caused by the cutting off of the food supply. So, like the bear and the woodchuck, they don their warmest coats and settle down contentedly to wait for spring.

As the cold increases, most of the water within the cells of the living layer of the tree filters through the cell walls and forms into little ice crystals in the surrounding spaces. There is room here for the expansion caused by freezing and the delicate cell walls are thus saved from injury. Often the cold becomes severe enough to stiffen the gummy substances still left in the cells. But the tree is safe. It is now in a death-like trance, and may even freeze solid without injury. The pines, hemlocks, and water-side maples are often frozen throughout, their roots, thrust sidewise into the surface soil, "as frost-bound below as their creaking boughs above." But the deeply-rooted trees, like the ashes and oaks, have their long tap roots driven below the frost-line into the region of perpetual spring.

We call the woods bare in winter, but it is then that the trees best display their majestic grandeur, their strength and sturdiness. Some

stand out in defiance of wind and tempest; others, with long drooping branches, bend meekly to the gale, like the slender shoots by the wayside.

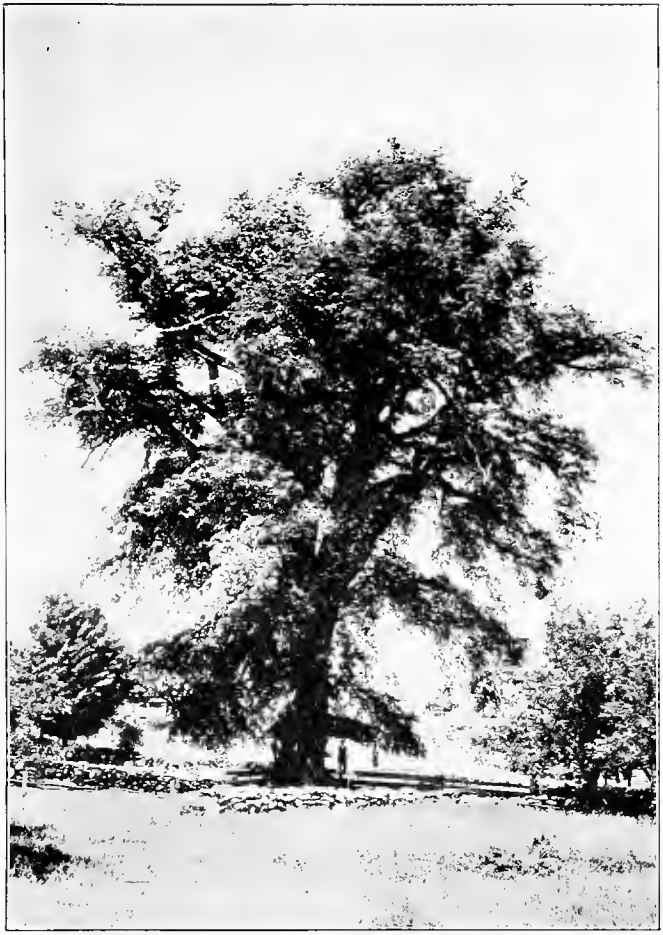
"An elm tree is always beautiful," says Mrs. Charles, "but to me it becomes more so when its branches are free from obscuring foliage. . . . Look up through the top of a typical elm on a morning when everything is covered with a frozen mist. You will see the tree in all of its exquisite beauty. The misty lace-work of the small twigs is accentuated against the sky, and the white blanket on the ground completes the beautiful picture."

How conspicuously the majestic hickories stand out in the winter woods! They are stately in summer, but when thrown in black relief against a white world, their beauty is truly imposing. The walnuts and chestnuts reveal to the full their sturdy, spreading habits. The oak waves its mighty, gnarled arms, beautiful in its ruggedness and strength of purpose. The maple stands a model of grace and symmetry. The white birch answers to the poet's call as "the Lady of the Woods"; while the ash is the "Venus of the forest." The young fir trees are such admirable types of primness, standing staunch and straight, here and there, that many

of their kin have been dubbed "spruce," in recognition of their formality.

Here and yonder, under the sheltering boughs, where the snow lies fold on fold in soft, fleecy blankets, go the tracks of countless little wood creatures in search of food and adventure. "Here," says one delightful writer, "are the delicate marks made by birds' light feet. Here, perhaps, is the track of a fox, much like that of a dog, but with sweeps of the brush among the footmarks. Scattered fan-shaped prints show which way Brer Rabbit wandered in his search for food. The little shrew and field mice, creeping over the surface, leave their marks like double stitching on a white coverlet. Here, too, one may see the little pairs of footprints which show which way the squirrel ran." Here, also, are the trails of the mink and the weasel, much like those of the squirrel, save that the mark of the animal's long slender body stretches between every other pair. And here, a little apart from the others, is the odd little track of the coon, like the print of a baby's hand, in the snow under the trees.

Under the blanket of snow and the deep masses of leaves, lie the eggs and cocoons of little insects which will rouse in the spring to feed upon the trees. Down there, too, are the



THE AMERICAN ELM AS IT GROWS IN MASSACHUSETTS

WEEPING WILLOWS ALONG THE POTOMAC RIVER

wood-ants and the mole deep in their long sleep, and the chipmunk napping in his burrow. Some flies and grubs are buried well below the surface soil. Farther still are the tip ends of the tree roots, slowly absorbing water, that they may be ready for business when the Frost King withdraws to his realms in the North.

As spring draws near, the tree, like the bride of the Canticles, sleeps while her "heart waketh," listening through her dreams for "the voice of her beloved and his knock upon the door." Soon the frost-line begins to rise, the little rootlets are released from their prison and begin to stretch and grow eagerly. Long before the trunk and boughs rouse to activity, they are busily at work, storing every tiny cell with soil-water. The warm days of early spring find them ready and soon "the sap begins to stir." Slowly, steadily, through avenues long unused, it mounts upward and onward through the many cells, stored with starches and other plant foods, to the very ends of the twigs—a marvelous journey! And one which no one fully understands. Often it is all of 400 feet from the nethermost root to the topmost spray, much of the way the sap must climb straight upward, and always it is a slow process, for the journey is through tiny hair-like

tubes. Nor are these tubes continuous, like water-pipes in a house; they are a series or chain of wood cells, "like little oblong boxes piled end on end." A thin membrane separates each tiny cell from its neighbor, adding just that much more to the complexity of the situation. How does the sap ever get through?

The sap in the cells is much denser than the soil-water in the root hairs. So, by a natural law which governs fluids, the soil-water seeps through the thin cell wall and mingles with the sap. This extra fluid distends the tiny chamber, and it swells and expands until its walls will give no more. Now the soil-water has diluted the sap-fluid in the cell until it is much thinner than that in the cell above; so following the same rule of attraction, the sap is drawn up into the denser cell, and so on and on, until it has mounted to the very topmost twig.

Some think that the sap is carried through trunk, branch, and twig by the action of the cell walls, much the same as food is conveyed through the cells in animal bodies. Then again some scientist upsets all theories by proclaiming that poisonous solutions, strong enough to kill all cell life, are regularly carried in large quantities to the tops of the tallest trees. So, speculate as we may, the mounting sap is in a

way another of Nature's wondrous mysteries.

At every "station" starchy particles mingle with the mounting soil-water and change to glucose, so that the sap soon assumes a sweetish character. It is also stored with minute gummy particles—a product of undissolved starch. There are, too, certain mineral substances taken in by the root hairs. But it is the combination of water, grape sugar, and mucilage that the little buds need most. How they thrive upon it!

A few days of bright, warm sunshine, and the buds swell and glow with color, each individual tree taking on pale shades of the wondrous tints which marked her autumn dress. Thus, in early spring, we may often tell trees at a distance by the color of their buds alone. The maples show red against the sky; the willows and poplars are yellowish green; the oaks glow with purplish-red and russet shades; the birches reveal a chocolate color diverging from their clean white shafts. Everywhere is the joy of awakened life and the glory of the resurrection.

"And though, on plain and hill,
'Tis winter, winter still,
There's something seems to say
That winter's had its day."

# XI

## SOME ENEMIES OF THE TREES

How small is the span of human life—three-score years and ten—when compared with the patriarchs among the trees! A poplar tree, you know, is hardly grown up till it reaches one hundred and fifty years; a cypress may live five hundred years or more; some of the large redwoods, "the big trees" of California, began life long before Christ was born!

A tree never dies of old age. Each year its vital organs are renewed. The tiny cambium cells are continually dividing and sub-dividing, forming new tissues. The roots are reinforced by the multiplication of the hair-like feeders, which reach out farther and wider for food for the tree's upbuilding. The annual renewal of foliage puts into action new machinery and new forces. Each year the tree increases in height and in girth. Why, then, should it not live forever?

The answer is simple enough. The trees are preyed upon by a host of natural enemies, and

they are subject to accident and to disease. They accumulate infirmities with the years, and sooner or later death overtakes them.

Is there anything we can do to help save the trees? Certainly. We can help them fight their enemies, and to do this successfully we must find out what these enemies are.

*Insect Enemies.* Since Pharaoh ruled in Egypt, centuries ago, history has been keeping record of insect plagues. More harm and ruin and death has been worked by insects than by all other creatures of the animal world. They are by far the most dangerous enemies that the forest has. Small as they are, and insignificant as they may seem in many instances, they fulfil the old slogan, "In union there is strength." All insects multiply very rapidly and so are able to work in immense numbers. The female bark beetle of early spring is often represented by half a million of her offspring before the end of the second summer. The leaf-eating moth is quite likely to be the ancestor of some four hundred thousand greedy followers in three years' time.

The feeding habit of insects divides them into three divisions—chewing, sucking, and boring insects. The first have mouths arranged for chewing food; the second suck up plant juices

by means of mouth-tubes; the third burrows deep channels beneath the bark into the very heart of the tree, where it feeds upon life elements. Chewing insects are easily destroyed by poisoning their food. Paris green and arsenate of lead are the two best remedies for this purpose. They are dissolved in water and sprayed upon the foliage, flowers, and fruit. Sucking insects, of course, cannot be reached by this method. They are best destroyed by spraying with lime-sulphur solutions. The sulphur suffocates the insects by stopping their breathing pores; the lime is a destructive agent of their delicate bodily tissues. Boring insects are not readily reached by sprays. Indeed, for this destructive little miner there is nothing quite so effective as a flexible wire thrust into his burrow, that surprises him at work and destroys him without a hearing. A bunch of sawdust or a discharge of wax or gum are pretty sure indications of a borer. Locust borers commonly render that tree unfit for lumber. Fruit trees are often so honey-combed at their bases by borers that they break off close to the ground. Peach growers make a practice of drawing the earth away from the base of the trees every spring and wiring out the borers.

The many bark beetles which are so destructive to shade and forest trees are borers. Let us see how they work. In the spring, the young beetles pair and fly off in search of a home, preferably an old injured tree of large dimensions. Here the female beetle at once sets to work to bore a passage or gallery, partly in the bark and partly in the firm wood beneath. She lines both sides of this snug nursery with eggs, usually from fifty to one hundred in number. When the eggs hatch, the tiny grubs begin to bore toward the outer world, running a host of little parallel galleries which form all sorts of odd-shaped patterns and work no end of havoc in the tree's sap passages—for each little gallery hinders the upward trend of the crude material, and also delays the return of the manufactured product. After a few weeks, the grubs roll themselves in the wood dust they have bored, and are transformed into beetles in three weeks' time. Then they finish tunneling their way out, mate and fly off, and thus repeat the cycle, so that a second, and sometimes a third generation is produced the same season. If it happens that the beetle mother takes up her abode on a branch, the chances are that it will be girdled by the little galleries and so killed. If the mother chooses a place on the trunk, and

her offspring are numerous enough to tunnel a square foot of space, the tree will be killed. As a rule, however, bark beetles prefer dead or dying trees, but it is certain that if they are hatched in sufficient numbers they will attack live trees. The forester's method of destroying the bark beetle is to cut "trap trees." The beetles attack these, and the "traps" are burned before the young have time to appear.

Here and there, in the winter time, we may see what looks like a small band of shellac painted on an apple twig. The microscope shows that this band is really a circle of little eggs, placed closely together, and covered with water-proof varnish. It is the work of the apple tree moth. Every banded twig destroyed saves the tree from unsightly caterpillar tents, or webs, the following season. For, with the first warm days in spring, the varnish loosens and tiny caterpillars emerge to feed upon the opening leaves. How hungry they are! If undisturbed, they will often entirely strip the branch of foliage. Then they begin to spin a silken web or tent for their comfort and shelter at night and on stormy days. As they increase in size, they range widely over the tree, and often spin themselves down to the ground and journey off to forage on other trees. In mid-

summer the full-grown caterpillar abandons the tree and spins a loose white cocoon on a fence or building, or perchance in a curled leaf. The moth that emerges returns to the orchard and lays her eggs on the apple twigs, as we have seen.

The various members of the tussock-moth family, chief of which is the gipsy moth, are tent-builders which work upon shade and forest trees. The canker-worm is a smooth-bodied "measuring worm," striped with yellow and brown, which respects neither fruit nor forest trees. We often see these worms hanging suspended from the leaves by a silken thread. The codling moth and the curculio are insect pests which work entirely upon fruit. The curculio belongs to the class of snout beetles, and numbers the cotton boll-weevil and other highly injurious characters among its kin. It punctures the fruit with its snout for the purpose of feeding, and to make holes in which to deposit eggs. A crescent-shaped slit is made around each hole where an egg is deposited, so that the egg will not be crushed by the growth of the fruit. This ingenious scheme works all right in the case of the plum and other stone fruits, but an egg seldom hatches in a growing apple. However, in the host of "stung" apples which

fall to the ground, in from three to five days, a small army develops.

Always the trees are more or less beset by the ravages of scale insects and plant lice. These pests lie close upon the bark of twigs and branches and on the skin of leaf and fruit to suck the juices. Among them, the San José scale is the one most dreaded by orchard men. This insect is very minute, being only one thirty-second of an inch in length at maturity. Yet, if unchecked, it will soon destroy an orchard, a single female having been estimated to produce a progeny of over one and a half billions in a single season! The aphids, or plant lice, are small sucking insects, most difficult to combat. They often attack the roots as well as the parts above ground, and their multiplication is very rapid. They live in clusters, and secrete over themselves small patches of a cotton-like covering.

The grape-vine bark louse is an aphid. It lives under an odd brown, hemispherical scale, with one end shut in by a cotton-like "awning." This awning forms an ideal nursery for the young aphids.

If we keep our eyes open for them, we may discover many odd and ingenious nurseries established in the trees by their cheeky little ene-

mies. For example, who has not observed the thick clusters of slender twigs called "thunder besoms," or "old witch's broom"? Strange tales used to be told concerning them. But now the witch that makes them has been caught red handed. She is a tiny fly, whom Mother Nature has cunningly taught to pierce a twig and lay her eggs in the pith. In this snug nursery hosts of little grubs hatch in the warm spring sunshine. While they live and feast inside the branch, it puts forth a cluster of little deformed shoots or "brooms"—the sign manual of a fly nursery.

The familiar "oak-apples" are leaves which have fallen victims to the gall-fly. She puts an egg into each middle vein, and by a queer process of Nature's own, turns it into a brittle shell, which gradually fills and swells with a greenish-white spongy substance. In the center of this is a hard, pea-like kernel, containing a tiny white grub. Oak apples turn brown and fall with the leaves, and in the spring the little grub is transformed into a gall-fly and eats its way out. Occasionally the gall-fly pierces a hole in a branch or twig and deposits her egg. Then woe to the victim! The wood becomes diseased and changes color and presently a queer lump or knob is formed. In the very heart of this

odd little room the worm reposes securely until the wind brings down the diseased branch and so liberates it. Oak galls contain tannin—a substance much used in making ink. Those in our woods have not sufficient strength, however, to make them valuable. The galls which ink manufacturers use are the product of the dyer's oak, an Asiatic species.

Perhaps you may have noticed the little red-cheeked "apples" borne by some of the heart-leaved willows? These are the snug quarters of the saw-fly larvæ. Imagine living in a house whose walls yield abundance of meat and drink! But there are drawbacks even in such an ideal existence. The birds mistake the small apples for cherries, and many a plump grub furnishes compensation for the disappointed ones. Then, too, there is a little snout beetle which prospects in late spring for a safe place to deposit her eggs. She finds the small, fleshy lumps on the willow leaf just to her liking. In a twinkling she probes it with her beak, thrusts in an egg, and goes her way little knowing or caring that the odd little house already has an occupant. And, indeed, so far as she is concerned it really does not matter! Her offspring is a hearty, voracious little chap, entirely capable of taking care of himself. He promptly eats the little

saw-fly grub and assumes all proprietary rights and control. Again, instead of a beetle, it may be a poor relation, the beggar saw-fly, which intrudes. The grub hatched from her egg is a greedy little wrangler that takes the best of everything and finally starves his host to death. But, once more, it does not matter! The mother saw-fly, a few days before her death, made some three hundred slits in as many hapless willow leaves, with the odd little saws which worked back and forth from a socket on the under side of her abdomen; if a pair of saw-flies grows up from the eggs so hidden, the race of saw-flies will never die out. The "willow apple" falls with the leaves, and its inhabitant changes into a pupa. In the spring, when the willow buds are loosening their leathery poke bonnets, the young saw-fly emerges and stretches its four rainbow-colored wings in a mad revel of flight, that is as brief as it is gay; for ere the leaves are full-blown its life-cycle is ended. "Not how long, but how merrily," seems to be their family motto.

Pine cones are often found growing on pussy willow bushes. At least that is what we take the little green scaly knobs for at first glance. In reality they are pine cone galls—the nursery of a midge-like fly called a gall-gnat, which vis-

its the willow when the leaf buds are beginning to unfold. She chooses the topmost bud on a branch, pierces it with her beak, and thrusts in a tiny egg. The warm sunshine soon coaxes out a hungry little orange-colored grub, which begins at once to feed upon the heart of the bud. Surprised, and no doubt pained, the poor little bud, instead of stretching out into a leafy spray, swells into a knob, with broad, over-lapping scales—sorry reminders, indeed, of the leaves they were destined to be. Safely within the little tiled house the grub lives a life of gluttony till the willow leaves begin to drop. Then it is tired and sleepy and settles itself quietly to pass into the chrysalis stage and wait for spring. With the first warm, bright days, a tiny airy-winged creature creeps forth from the loosened end of the dry cone, and flits away with its fellows to enjoy its brief span of life. Shortly before their death the females lay their eggs, and their life cycle is repeated in their offspring.

Often the pine cone galls serve as tenement houses for the larvæ of spiders, katydids, and others of the insect world. The little chambers between the scales are their apartments, and such delicious sap as the walls contain! Nor do the claims of the tenants in any way conflict

with those of the owner in the center of the building. There is room for all in these model nature flats, without the necessity of a janitor, or perhance a policeman, to adjust the little difficulties of daily life.

*Fungus Enemies.* Fungi are low forms of vegetation which have no leaf green and are obliged to obtain their food by stealth. They attack the forest in many ways. Some infest the roots; some grow up from the ground through the heart wood of the trees, changing the sound wood of the trunks to a useless rotten mass; and the spores, or seeds, of others float in the air and often lodge in cracks and wounds where they breed disease and decay.

Perhaps you may have noted the little odd-shaped brown knobs which dot the red cedar here and there. You may have passed them carelessly by, calling them cones. If so, just keep your eyes open in the wet spring weather, and presto! you will see the little knobs galvanize into action, for they are really cedar rust fungi. Innumerable fringes of orange-brown, jelly-like spores, sometimes an inch or more in length, are quickly thrown out. These spores give rise to a crop of smaller secondary spores, which, upon drying, are carried like dust particles on the wind. When they lodge upon the

fruit or foliage of the apple, the quince, or the pear, they are as seeds upon fertile soil. They soon throw out a little fungus thread which delves into the tissues beneath it for nourishment. By and by cluster cups are formed which in turn produce spores that are carried back to the cedar trees. This usually takes place in July, August, and September. The fungus begins to grow in the tissues of the cedar branches, and there passes the winter. It starts to grow in the spring, and by fall the "cedar apples" have reached full growth. But the cycle of the spore's life is not complete until the following spring, when at about the time the apple trees are in bloom, the cedar apple begins to swell with the spring rains and produce its jelly-like "bloom" of spores. Infection of the apple fruit and foliage may take place over a period of three to six weeks, depending upon weather conditions. If there are frequent rains, with days of bright sunshine between, the cedar apples may swell and dry several times, liberating quantities of cedar spores after each drying. Often cedar spores are carried on the wind for several miles. They cause unsightly yellow spots and deformities on the fruit, sometimes changing it into grotesque shapes almost beyond recognition as apples. The greatest dam-

age, however, is done to the foliage, by the formation of the little yellowish cluster cups or blisters, which destroy the functions of the leaf. Cedar rust must have two hosts to complete its life cycle. As the fruit trees cannot become infected with this disease from any other source than from cedar balls, the destruction of all the red cedar trees in the fruit areas is the easiest way to become free from the pest.

Apple-scab is another fungus disease that thrives in cool, moist weather. It is most troublesome to fruit growers. Indeed it was to combat this disease that spraying was first inaugurated. It is caused by a fungus which feeds on tissues of the fruit and foliage. Its presence on the fruit is shown by a series of circular, dark-gray spots, which in bad cases often dwarfs the affected side, pitting and cracking it out of all shape. Apple-scab attacks both sides of the foliage, producing smoke-brown patches, causing the leaf to curl and often to drop off. Apple-scab lives through the winter on fallen leaves, and starts growth in the early spring, producing spores which are discharged into the air and carried to the young leaves and blossom buds, where they germinate and start infections.

Bitter rot, another dreaded fruit fungus, ap-

pears under hot, moist conditions. The fungus spends the winter in the mummied apples of the previous crop, and is one of the best reasons why all refuse should be cleaned from under the trees, and why culls should not be left to wither on the twigs. The spores of bitter rot fungi germinate readily in the dew and rain, during the heat of July, August, and September, sending out minute threads which work through the skin of the apple and feed upon its flesh. These threads branch out and grow rapidly, producing the circular, brown sunken spots which you have often noted on the apple. Fruiting pustules bearing innumerable pink, massy spores start up from the center of the fungus circle. At first these masses are wet and sticky and easily transferred from fruit to fruit by the feet of insects. Drops of rain also help in the distribution of fungus by striking the diseased spots and splashing the spores to other fruits. Thus millions of spores may spread from one fungus circle; and so ruin the entire crop of an orchard.

*How the Government Helps.* It has been estimated that more than 90% of the vast annual loss to the farmers and fruit growers of America has been caused by insects and diseases introduced from abroad during the past twenty

years. For example, the terrible battle with the gipsy moth which has cost the State of Massachusetts alone millions of dollars, began when a certain professor, who had imported some of these creatures for silk-culture experiments, carelessly allowed a half dozen or so of the pest to blow from his desk out of the open window. Such haphazard experiments are not allowed to-day. The Bureau of Entomology, under the Department of Agriculture, has been so organized that Uncle Sam is virtually the leader of the world in the warfare against injurious insects. We have strict quarantine laws covering insect importation, and there are several field laboratories scattered over the country, where expert workers give their time to the study of insect control.

The Office of Foreign Seed and Plant Introduction looks after the matter of disease importations. The government has agents in all foreign countries continually on the lookout for trees and plants which may be naturalized here to advantage. Ornamental trees and new species of fruit and nuts are especially in demand. But don't imagine "the finds" are allowed to enter as they please. No, sir. Uncle Sam has four "Ellis Islands" for the plant immigrants. These are located at Miami and Brooksville,

Florida, Chico, California, and Bellingham, Washington. If a suspicious character arrives at any of these stations, it is promptly ordered to the quarantine station. This is the Yarrow Gardens, near Rockville, Maryland. Sometimes the plant itself may have nothing to condemn it, but if it comes from certain danger zones, off it goes to the quarantine. Here it is held, often for weeks and months, until all possible danger of the development of disease is past. In some instances, plants must have passport certificates to leave their own land, and they cannot enter here without a special permit.

Nursery stock of all kinds, fruits, seeds, and foreign lint cotton are subject at all times to the most rigid inspection. The cotton is fumigated in a vacuum, so that there can be no possible chance of the pink boll-worm entering with the cotton seeds. The "finds" which go to the various stations, or gardens, are cared for and studied for the purpose of learning their value. If they seem at all promising, they are extensively propagated and sent out to the state experiment stations and to plant breeders throughout the country. Often every resort of the craft is necessary to save some plant immigrant which arrives out of season, or in a criti-

cal condition. Sometimes an immigrant has lost its card of introduction, and the plant propagator is forced to depend entirely upon his own ingenuity to discover its needs and value. Imagine the complications that must arise! But the plant or tree must be saved at all hazards. It may be the beginning of a valuable species.

*A Bird Foe.* As the leaves drift away in the autumn, laying bare the trunk and branches, we frequently observe dozens, and in some instances hundreds, of little pits bored in the bark of the sugar maple, the birch, the linden, and other sweet-sapped trees. They are the honey pots of the sapsucker, or yellow-bellied woodpecker. He kills many fruit and shade trees every year for he loves the sap so well as to be almost intemperate in his thirst. Moreover, he knows that insects are fond of it, too, and many an unwary creature is caught sipping at his sticky little "cups."

*Fire.* "Of all the foes which attack the woodlands of North America," says Pinchot, "no other is so terrible as fire." Forest fires rise from many different causes, chief of which is *carelessness.* Often a smoldering camp-fire is left to be scattered by the wind; again some one thoughtlessly drops a half-burned match or

cigar, or loses a pipe; or, perchance, a fire set to clear a field of rubbish breaks from control. Occasionally lightning fires a forest. Many fires are set for malice or revenge. Not infrequently huckleberry pickers have been known to burn off a forest in order to increase next season's crop of berries! The same method is also followed by the sheep-men who want better pasture for their herds.

*Man and Animals.* Man has done much to stamp himself as one of the worst foes of the forest, by his reckless, wasteful lumbering. Animals work destruction by browsing upon the seedlings and young saplings. Birds and squirrels often prevent young growth by devouring quantities of nuts and other seeds; while porcupines and mice frequently kill young trees by gnawing their bark.

# II

# THE KINDS OF TREES

## THE MIGHTY OAK

"Sing for the oak tree, the monarch of the wood.
Sing for the oak tree, that groweth green and good!
That groweth broad and branching within the forest shade;
That groweth now, and still shall grow when we are lowly laid!"

—*Mary Howitt.*

THE oak tree is the king of the forest. It is the very embodiment of strength, dignity, and grandeur. "Out of life-long struggles has come the ruggedness of its branches. In its whole aspect are breadth and tolerance—the dignity of a patriarch, the majesty of a king."

The broad base and curving trunk of the oak suggested the model for the Eddystone Lighthouse, which has battled with tempest and wave for nearly one hundred and fifty years and today stands as firm as a rock. The oak sends a strong tap root deep into the ground, while its wide-spreading, horizontal roots remain close to the surface. It is among the last trees to leaf

in the spring, but the oak has hundreds of years to live and can afford to wait longer for his "green coronal" than his short lived neighbors.

Remarkably long, indeed, is the life-span of the oak. There are oaks in England that are known to be over a thousand years old. Tradition says that some have reached twice that age. The Round Table of King Arthur was made from a cross section of an old oak eighteen feet in diameter. The very structure of the oaks, with their breadth of top and wide range of roots, frames them for long life. The strength and toughness of their fibers fit them to cope with storms. The bark of the oak is in great demand for tanning and dyeing. Its wood is unsurpassed for durability and strength. Its broad medullary rays make it one of the most valuable ornamental woods. Much of the beautiful carving in the great European cathedrals is on oak wood. Always oak has been the ship-wright's favorite lumber, because it is so durable under water. Before the art of bending wood artificially was understood, the crooked trunks and boughs of the oak were particularly valuable to those needing curved timbers.

Since earliest time people have worshiped the oak. The Greeks believed it was the first tree

that grew upon the earth. They dedicated it to Jupiter, the king of the gods. In the north it was sacred to Thor, and in the east to Perun, the thunderer, the chief god of heathen Russia. Always the oak has been the thunderer's own tree, and hence our grandfathers were wont to warn their children, "Beware of the oak, it draws the stroke." In ancient Greece, one of the most venerated oracles was the prophet oak of Dodona. Its priestess was supposed to be able to read the will of Jupiter, the great wielder of thunderbolts, by the rustling of its leaves.

The old Romans crowned their heroes with a chaplet of oak leaves. The Druids offered sacrifices under the shade of the oak, and in Germany the fairies made their homes in its roots. The holes sometimes found at the base of the trunks were called "fairy pathways," and the spirits of the trees were supposed to pass in and out as they pleased. The worshipers of Thor would never allow an oak tree to be cut down, for fear their god of thunder would let his hammer descend upon them! (It is really a pity that there were not some disciples of Thor among our early woodmen; for we might then have had some of the ancient oaks preserved, which fell so mercilessly.) The Stuarts chose

oak leaves for their emblem, because their beloved Prince Charlie (King Charles II) saved his life, when fleeing from Cromwell, by hiding in an oak. The Charter Oak, of Hartford, is the most famous American oak tree.

There are in all more than three hundred distinct species of the oak. They belong to the great natural family of cup-bearers. The chestnut and the beech are near relatives. Fifty species of oak are found in North America, more than twenty of them being located east of the Mississippi River. Suppose we take a trip into the woods and see how many of these species we can locate. We shall have no difficulty in spotting the trees as oaks, even at a distance, for they may be known by their irregular, crooked growth. Oak trees also have a foliage peculiar to themselves. The leaves are of a firm texture, with a glossy upper surface, and most of them are deeply scalloped, as though each little point reached out eagerly for sunlight. An oak tree, beyond the age of twenty years, may also be known by its fruits, the acorns, which scatter the ground in every direction and furnish the creatures of the forest with tempting food. Oak woods also emit a peculiar fragrance almost as strong in its way as the "piney" scent of the evergreens. The oak

bears two kinds of flowers on the same tree. The staminate flowers grow in catkins. The pistillate flowers are like tiny pink balls. The pistil becomes the nut of the acorn. It is sometimes difficult to tell the type of an oak. But there are only two natural divisions. These are the annuals, which mature their acorns in a single season; and the biennials, which require two seasons. They are known as the White Oak and Black Oak groups.

Ah, here is a great white oak right beside us. It is the most common, as well as the most noble of its group. Note its pale gray, scaly, shallow-fissured bark. The twigs are dark, ending in tufts of leaves, and each twig gives rise to several new shoots each year. In springtime the leaves cover the tree with a beautiful veil of rose and silver. As the summer advances they turn to a bright green, with a paler lining, and grow to a rather large oval shape, being divided by hollows into from seven to nine fingers or lobes. The slender, pointed sweet-flavored acorns, in their scaly, shallow cups, ripen and fall late in the summer.

Over here is a stocky, rough-looking, undersized tree, called the post oak. Its gnarled and twiggy limbs seem to say that life has been one long struggle. It belongs to the white oak fam-

ily. Close beside it is another member of the family. It is a sturdy tree, with "antlered arms." Its bark is warty and ridged, and the leaf is almost cut in two by a pair of deep wide hollows that come near the midrib on opposite sides. This tree is the bur oak. It bears the largest acorns of the white oak family. They are half-hidden in deep mossy fringed cups. Such fine doll cups and bowls and what not as these acorns make! Watch out for them when they are ripe and see what your busy fingers can fashion.

In the boggy regions of the East and South, there is a quaint cousin of the bur oak, which has the odd fashion of shedding the bark of its young branches. This tree often grows to a great size and is remarkably long-lived. It is called the swamp white oak. The chestnut oak, with its long tapering acorns sheltered in a downy lined cup, and its bark rich in the tannic acid so valuable in the preparing of leather, is another member of the white oak family, commonly found in the Eastern states. The beautiful evergreen live-oak of the southland also belongs to the white oak group. It is a stately tree, covered with dancing leaves, which depart from the usual oak-family custom in being oval instead of scalloped.

For one member of the white oak group we find a dozen of the black oak family, and the reason is not hard to find. These trees bear bitter acorns and animals do not care for them, consequently the trees bid fair to crowd out the sweet-kerneled white oaks, as more of the acorns are allowed to germinate. Also the wood of this species is not so valuable to man, the trees' greatest enemy. We recognize the trees of the black oak group by their black, rough, deeply furrowed outer bark, and their inner bark of orange tint, rich in dyestuff.

Here, close at hand, is a red oak, one of the most stately members of the black oak species. Note its rounded, dome-like top. Its wood is coarse and reddish brown; its bark also has a tinge of red in its brownish-gray surface. The leaves have from seven to nine triangular lobes, which point in the direction of the tip. The leaves are thin and smooth. They come out pink in the spring and all covered beneath with a white down. In the fall, they turn to a fine dark red, or to various shades of russet. The acorn sets in a quaint curved-rim saucer, instead of in a cup after the usual fashion of acorns.

Over here is a group of pin oaks. They shoot up in tall, unbroken shafts, branching out to-

ward the top into a pyramid, something after the fashion of the evergreen. Near by are sports from the red oak and the pin oaks, caused by the exchange of pollen. These trees differ from either parent, yet they have certain characteristics of each.

A little farther on we find a great open, loosely headed species, called the black oak. Its leaves are coarse and thick and a dark, shiny green, with a faint tinge of down in the lining. The twigs are stout and stocky, and if we had happened this way in early spring, we would have found them covered with pointed brown buds, protected by a rusty wool. In the autumn the leaves turn to russets and dull reds. The pointed acorn sets deep in a scaly cup.

Other well-known members of the black oak group are the scarlet oak, the scrub oak, the laurel oak, and the willow oak. You will know the scarlet oak at once, for it flaunts its name in bark, flowers, and foliage—scarlet is written plainly all over it. The scrub oak is the dwarf of the family. You will find it growing in colonies in poor rocky soil. The laurel or shingle oak is a handsome, wayward tree, which often grows to a large size. Its leaves resemble those of the mountain laurel, hence the name laurel oak. The willow oak gets its name from its

slender willowy twigs and leaves. You will be most apt to find it growing near the water. It is quite popular as a shade tree in the southland.

## II

### THE MAPLES

THE maples are such well-known, generally loved trees that there is hardly any one who is not familiar with at least some members of the large family. The headquarters seems to be in Asia, more than thirty species living in China and Japan. America has fourteen native maples, nine being found east of the Rockies. Besides these many Japanese and European kinds have been imported and now seem perfectly at home.

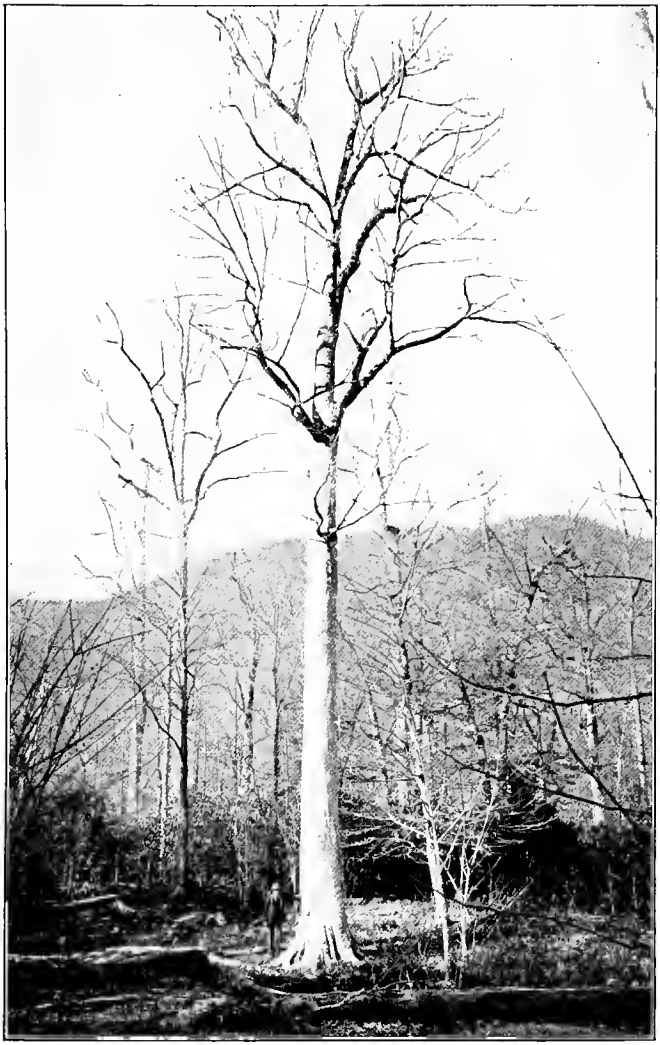
Though spread over a wide area and a general favorite with the poets, the maple does not seem to have commended itself to the gods or to have been interwoven into myths and legends. Perhaps its "key" has served to unlock any mystery which may have been inclined to settle around it. Certainly it has always served as a means of identification, and everywhere the maple may be known by its keys, or samaras. These keys consist of two "wings," thick on the lower margin where the tiny seed babies are

concealed, and very thin and papery on the upper. They do not fly very well because of their uneven balance, and we often find quite a large family of seedlings growing up around the parent tree.

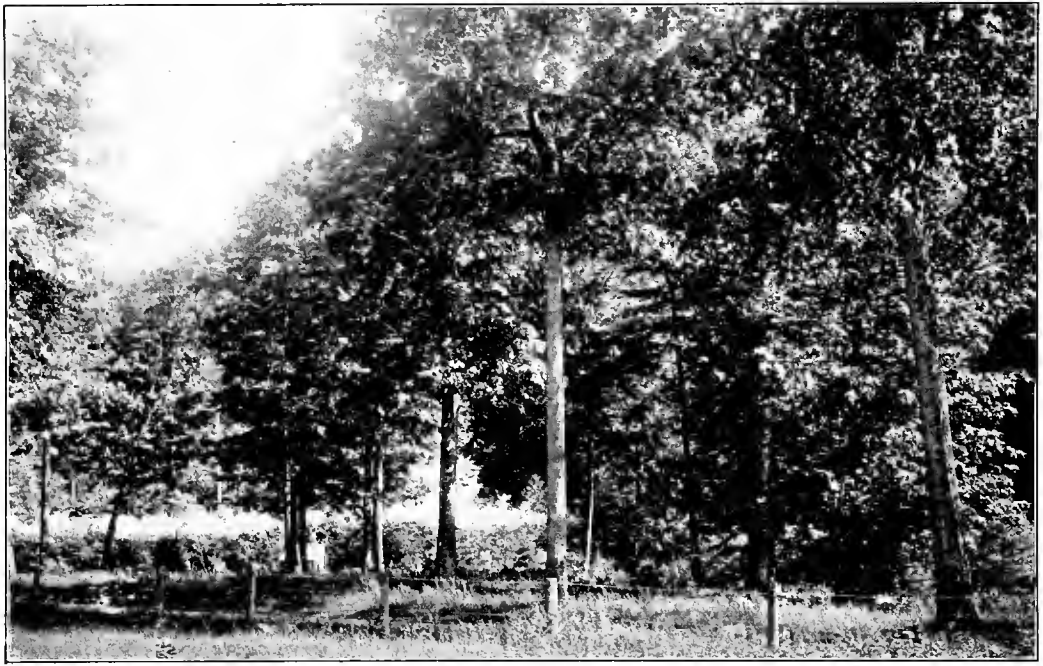
Side by side with the oaks in the woodlands, we find the red, or scarlet maple. It is often spoken of as the "Queen of the Forest," and surely no tree is more fitted to reign beside King Oak. Few trees, if any, can surpass it in general beauty of form and foliage. "It comes forth in the spring like morning in the east, arrayed in crimson and purple," says Wilson Flagg, "bearing itself not proudly, but gracefully in modest green; and, ere it bids adieu to the season, steps forth in robes of vermilion and scarlet, the pride of all eyes." The tree grows very rapidly, and is found from New Brunswick southward to Florida, and westward to the Dakotas and Texas. Surely no tree was ever more appropriately named! Indeed one could not call it anything but "red maple," for its name is printed on bud, twig, and leaf in varying forms throughout the season. "Its first blossom flushes red in the April sunlight, its keys ripen scarlet in early May, all summer long its leaves swing on crimson or scarlet stems, its young twigs flame in the same colors," and in

September the leaves burst forth in a scarlet glory, the very brightest in all the surrounding autumnal beauty. The Indians made dye from its bark. Ink has also been made from it.

Many of you know the sugar, or rock maple. It is perhaps the most useful of its family, and is a beautiful tree, sometimes growing one hundred and twenty feet high. It is a favorite shade tree, though rather slow in growth. In New England and the Middle states it makes up a considerable part of the native forests. In autumn it tints the landscape with beautiful shades of red, orange, and yellow. The wood is light reddish-brown, very strong and close-grained, and capable of taking a fine polish. It is much used for furniture and house finishing. Now and then it shows some of the beautiful bird's-eye and curled maple effects, which are so puzzling to account for. It is highly prized for its sugar-making qualities. Almost every one knows how the trees are tapped and the pails hung on the spouts in the early days of March, when the warm sun and the rough winds start the sap to stirring. Only about seventy drops run into the pail per minute, when the flow is at its best, but it keeps doing this for three weeks or more, until the tree has yielded up about twenty-five gallons of its life blood. This will



THE RED MAPLE IS CALLED "THE QUEEN OF THE FOREST"



THE SUGAR MAPLE IS A FAVORITE SHADE TREE

boil down to about five pounds of sugar. Nowadays this is done in a patent evaporator over a bricked-in oven. But in our grandmother's time the change was wrought in a big kettle swung gipsy-fashion over a bonfire, while the young people played games and told stories and sniffed the delicious-smelling sap.

It is said that maple sugar was first discovered by the squaw of Woksis, a mighty hunter. It seems that her chief had gone away on a big hunt and bade her have a good dinner of boiled venison on his return. She put the kettle over the fire and then went about some basket-making. She was so absorbed in her task, that she never thought of the meat again until she heard a great crash and sizzle. The fire had burned the cord which held the stone kettle and let it drop into the flames. Quickly she raked out the meat and kettle, and then, fearing her lord would return before the food was done, she did not want to wait to melt snow, so filled the kettle with maple sap from a trough near by and hung it over the coals. Then, straightway, she forgot all about it. By and by she saw Woksis coming and ran to see about the dinner. Behold! the sap had all boiled down and the meat was sizzling, spoiled as she thought, in a sticky mess. Hastily she snatched the kettle from

over the coals and hid herself in fear and trembling. An hour or more passed by and hearing nothing she ventured out. Woksis sat with the kettle between his knees, munching in silent enjoyment. He was as near delighted as an Indian could well be and made haste to tell his squaw's wonderful discovery to the other braves.

The Iroquois used to have a public festival every spring to celebrate the tapping of the maples. When the first crows appeared, everything was got in readiness. Temporary wigwams were put up in the sugar grove, and all the sugar-making utensils brought out. Then a big dance was held and all sorts of charms worked to bring on warm weather and start the sap to flowing.

If you have ever gone picnicking anywhere along the river in the Mississippi Valley, you must have met the silver maple. It is also known as the soft maple and the white maple, and is a favorite shade tree in its locality. Should your home chance to be in a village in this section, no doubt you have one of these lovely trees in your door yard. It grows about one hundred feet high and forms a wide-spreading head with drooping branches, somewhat resembling the elm. It is the first tree to bloom

in early spring and produces long stiff-winged keys. The leaves come out of the bud pale green and downy, and when full-grown are pale green with a silvery lining. In the fall they turn a pale dull yellow. The wood is slightly tinged with cream, and very strong and coarse-grained, but rather brittle. The lumber is used for cabinet work and house-finishing. A beautiful cut-leaved, weeping variety of this species is called Wier's maple.

The Norway maple comes from Europe, as its name indicates. It is very common along city and village streets, and no doubt you are on friendly terms with it. The tree greatly resembles the sugar maple, but it does not grow so tall and the leaves are thicker and darker in color. They hang on the tree fully two weeks longer, and turn a dull yellow, or, more often, fall with scarcely any change in color. One may always tell a Norway maple by breaking a leaf stem, a bitter milky sap will leak out and quickly thicken.

Other quite well-known maples are the sycamore maple, the great timber tree of Europe, popular in our country as an avenue tree; the striped maple, or moosewood, and the mountain maple. The two last named maples are "the Tom Thumbs of their family." They love the

mountain slopes and the company of the hazel bush and yew, and their only excuse for being is their beauty. The box elder, or ash-leaved maple, is so well known that it scarcely needs any introduction. It grows so rapidly that settlers of the prairie always plant it. It differs from all other maples in having compound leaves, and in bearing staminate and pistillate flowers on separate trees. Like the silver and Norway maples, it bears no touch of red in its autumnal coloring, but flaunts a pure pale yellow.

The Japanese take great pride in their potted maple trees. Such wonderful variations in form, color, and texture as the leaves show! When the maples are at their best, they have a Maple Fair. Every one turns out to see and exclaim over the beauties of the miniature trees, many of which are more than a hundred years old.

## III

### THE ELM FAMILY

Because of its arching branches and its drooping, lace-like twigs, the elm is a favorite shade tree. It bends gracefully to the breeze and is seldom broken by the wind. The oriole loves to hang her nest upon its long flexible branches. In New England the elm is a favorite tree, not only by the country wayside and farmhouse, but in the spacious city avenues and parks everywhere are rows and borders of magnificent elms. However, in cities where much soft coal is burned the tree does not thrive, for the soot clings to the rough leaves and in time smothers the tree.

The elms are an ancient race. According to Norse mythology, Odin, the god of heaven, made the first woman from a branch of the elm tree. The early Britons considered the elm a good weather prophet, and regulated the planting of certain seeds by the coming of its leaves. Thus the old rhymed proverb warned them:

"When the elm leaf is as big as a mouse's ear
Then to sow barley never fear."

And again:

"When elm leaves are as big as a penny,
You must plant kidney beans, if you mean to have any."

In our country the elm has a number of interesting historical associations. William Penn made his famous treaty with the Indians beneath the shade of a beautiful elm in Philadelphia. It blew down in 1810. The site is now marked by a marble column. The Burgoyne Elm, at Albany, N. Y., was planted the day Burgoyne was brought to Albany a prisoner. Washington took command of the American army at Cambridge, Massachusetts, under an elm. Alice Lounsberry, in writing of this tree, says: "Longer than any other being the Washington Elm remained to testify to the younger generations that it had been a witness of the scene. Although not at all a phenomenal tree in size, the estimate was at the time made that it developed every year a crop of seven millions of leaves, and that they exposed to the air a surface of foliage equal to about five acres."

The elm has several "earmarks" by which it may be known. Keeler says one may tell its dark outline against the sky even at night, for the elm is one of four shapes: vase, umbrella,

dome, or plume, the former being the most common. The elm branches are arching and slightly drooping, with fine, delicate spray and small shiny buds. The average height of the tree is seventy or eighty feet, but it often reaches one hundred feet or more.

The leaf of an elm is oval, about six inches long by three inches broad, and may be known by its unequal base, the part upon one side of the midrib being considerably larger than that on the other side. They are rough, dark green above, pale green and smooth beneath. They turn a golden brown or yellow in autumn. The bark of the tree is dark gray and rough. The reddish-brown wood is strong and very tough. You remember how the Deacon's famous "Wonderful One-Horse Shay" was made of the very best wood:

> "The hubs of logs from the 'Settler's ellum,'
> Last of its timber,—they couldn't sell 'em,
> Never an axe had seen their chips,
> And the wedge flew from between their lips,
> Their blunt ends frizzled like celery-tips."

Many people think that the elm never blossoms, but if they were to examine the topmost branches of the tree in early spring, when the sap begins to stir and the sun shines warm and

bright, they would note a number of brown shining buds. Soon they burst their scales and appear in clusters of from ten to twenty tiny reddish-brown blossoms. "In cities where the elm is a common tree the sidewalks are strewn with these discarded bud scales," says Keeler, "but the flowers are so small, so brown and so high that the world walks by, thinking, 'The elm never blossoms.' Six weeks later the same sidewalks are covered with little, flat, green samaras half an inch long, often as unnoticed as the blossoms which preceded them. The leaves come out of their buds a pale tender green and folded like little fans. They appear late because it is a law of the woodlands that the trees shall bring forth flowers before leaves."

There are thirteen types of the elm. The American, or common elm, has perhaps the widest range, and excels all others in height and beauty. It is also known as the white elm and water elm. The tree grows rapidly and was a great favorite with "the settlers." We find it in rich moist soil throughout the Northern Hemisphere.

The slippery elm is familiar to nearly all country boys and girls east of the Rockies. The inner bark of the tree is "slippery," fra-

grant, and nutritious. They love to chew it. Grandmother makes a fine sore throat remedy from the "slippery" bark. The tree is called red elm, from the color of its wood, and moose elm, because moose are fond of its young shoots. It grows best along hillsides and the banks of streams, and ranges from the St. Lawrence basin southward to Florida and westward to the Dakotas and Texas.

The hickory elm, or cork elm, is the most useful of the family. It grows from Quebec west to Minnesota and Nebraska and south as far as Tennessee. It may be known by its rough reddish-gray corky bark and its hairy buds, twigs, and fruit. The wood is strong, tough, easily cut, and takes a fine polish, hence it is in great demand. This elm is also known as cliff elm, swamp elm, and rock elm.

Other important elms are the English elm; the Scotch, or wych-elm; the wahoo, or winged elm of the Southern states; and the false elm. The latter, also known as the hackberry, sugar berry, and nettle tree, is a peculiar tree ranging from Quebec southward and westward to the Rockies. East of the Alleghenies it is a stunted tree and bears little resemblance to the elms; in the Mississippi Valley it reaches a height of from sixty to seventy feet, with a beautiful

round tipped head; but in the southwest it is at its best, growing often one hundred fifty feet high and five feet in diameter. The fruit of the hackberry is a very sweet, one-seeded dark purple berry. It dries and hangs on the tree all winter, furnishing many a delightful bird feast.

The wych-elm, or witch hazel as it is most commonly called, was long connected with the elves who hold the treasures of the earth in keeping. In the hands of the right person, a "wishing rod" or "finding stick" cut from this lucky little tree would point unerringly toward hidden veins of precious metal. It is said that the Cornish miners had such firm belief in the rod that seldom was a shaft sunk except by its direction. In our land, the "wishing rod" used often to be brought into service to determine the right spot for a well, it being well known that the stick had special power to point out underground springs. The writer recalls an old man skilled in the use of this "divining rod." It used to delight us children to watch him "find" water. His rod was a straight stick with a Y-shaped handle. He explained that it had grown upon the tree in such a position that the rising and the setting sun looked between the prongs of the Y. Uncle John always crossed his arms and grasped the

Y-shaped prongs with his knuckles down and his thumbs outward. The rod was pointed straight forward, and when water was "found" the stick twisted over of its own accord till the foot of the Y pointed toward the ground. It was a marvelous performance, and nothing could shake our faith in the old man's power. Usually, too, water was found where he indicated; if it was not, the water was *there* all right; the men had not dug down far enough! It is said that "divining rods" cut from the cherry tree are equally as effective as those taken from the wych-elm. We see no reason to doubt the statement.

# IV

## WILLOWS AND POPLARS

Botanists group the willows and poplars together under the title of "The Willow Family." The trees differ widely in size and habit of growth, yet they are very much alike. All have abundant watery juices; scaly, furrowed bark charged with salicylic acid; soft, pale-colored wood of small value for lumber; slender branches; and tough fibrous roots. The flowers are rich in pollen and honey. They are borne in furry catkins on male and female trees, and the seeds from the latter are wafted through the air in long hair-like plumes. The seeds are very weak and easily dried out. But their loss is a small matter. There are hosts of adventitious buds in root and branch, and the trees are readily started from cuttings. They grow rapidly and prefer a damp soil, many of the willows being especially fond of standing with their feet in water.

Most of you know the sand bar willow, the shining willow, and the dear little pussy willow

which delights our hearts in early March. You may be familiar, also, with the slender osier, or basket willow, whose yellow twigs spring up among the rushes along the river brink. In the far north is a cousin of this dainty willow, called the polar willow. It is a stunted pigmy, less than six inches high, with leaves no larger than your finger nail, and the tiniest of catkins, which it manages to shake out in the brief Arctic springtime. For though placed in unfavorable conditions, it never fails to remember that it is a willow and to follow faithfully the customs of the family.

Nature seems fond of fashioning small willows. There are over seventy species in our country which never grow to be anything more than ambitious shrubs. All our large willows are imported. One of the best known of these is the crack willow. It was introduced from Europe for its fine basket-making qualities. The crack willow is easily recognized by the brittleness of its twigs. On a windy March day the ground beneath the trees is strewn with them. The crack willow may also be known by the dark color of its shining leaves. It is easily pollarded into various picturesque shapes. Another familiar large willow is the white willow. It reveals its identity in summer by the

silvery undersurfaces of its glimmering leaves. In winter, it may be known by the golden-olive color of its twigs.

The leaves of all the willows are simple, and feather-veined. They vary in color from all shades of green to yellow and even red and blue tints. The bark also shows a wide range in color. The golden osier and the shining willow have beautiful foliage. So also does the weeping willow, a native of Asia, but now quite at home in our own land and much used in cemeteries. The leaves seem fairly to drip from the twigs, and it has long, slender, drooping branches—the very picture of sorrow. The silky willow has purplish twigs, and the baby leaves are densely covered with silky hairs.

Somehow the willow has become linked with sadness and despair. Tradition has it that the rods with which Christ was scourged were cut from the weeping willow, and because of this it sorrows always. Judas hanged himself upon a willow, 'tis said, and hence the devil clothes it with attraction for suicides. In Iceland, the first-out willow twigs, placed in a sickroom, will keep death from entering. A garland of willow was long considered the proper head-gear for one forsaken in love. Thus sings an old poet:

"She that long true love profest,
She hath robbed me of my rest,
For she a new love loves, not mee,
Which makes me wear the willow tree."

The poplars are spoken of as "nurse trees" and as "pioneers." They so often prepare the way for other trees. When a fire sweeps through the forest, the poplar is almost sure to be the first seedling to spring up in the charred waste. It grows rapidly and is soon large enough to form shade for the more slow-growing trees which require such protection. The early settlers always planted poplars. How often we find venerable cottonwoods at cross-roads! Here and there stretch broken lines of Lombardy poplars, marking the sight of a fence row. Frequently a forlorn white poplar stands alone in the middle of a pasture. Here was once a pioneer home, or perchance an Indian village. What tales some of these old trees might tell!

Though it is so closely related to the willow, the poplar can never be mistaken for it. The twigs are angled and stout, with none of the supple grace of the willow. The leaves are hard and thick and set on long petioles, or leaf stems. In winter the leaf buds are covered with

overlapping scales, and sometimes tightly sealed with a sticky substance. There are twenty-five species of the poplar. Twelve of these live in America, nine being found east of the Rockies. Since earliest time the poplar has been regarded as a weather prophet. Have you not often heard your grandfather say: "It is going to rain. See the poplar leaves turning silver side up."

The cottonwood is the largest of the poplar trees east of the Rocky Mountains, and is familiar to all, though it bears different names, being called the Carolina poplar and the necklace poplar. This tree, unlike most members of the family, will grow in dry soil. The swamp cottonwood, or downy poplar, a smaller type of this tree, grows in boggy soil.

The white poplar, "the poplar that with silver lines his leaf," is a well-known tree, but it is not a favorite for city lawns because the fuzzy silver lining catches and holds the soot. Also the tree has the bad habit of continually sprouting from the roots. In ancient Rome the tree was dedicated to Time, because the leaves were nearly always stirring and their blackish-green, with the white linings, resembled day and night. The Grecians made the tree the emblem of Hercules, because he destroyed Cacus in a

grove of them. Heroes who had gloriously conquered their enemies in battle were crowned with chaplets of the silvery leaves.

The Lombardy poplar is familiar to all who have traveled the country roads. A century ago it was very fashionable as a lawn and hedge tree, and to-day there is no tree that can make a narrow leafy wall sooner or better. Its branches grow close to the tree and slant upward, making it look very much like an umbrella turned inside out. Legend has it that once a pot of gold was stolen from the rainbow and hid in the forest among the sleeping trees. The wind messengers were sent to find it. All the trees denied having seen it, and one and all held up their branches as a proof. When lo! the pot tumbled out from the Lombardy poplar. The tree was terribly chagrined, and ever after remained with its branches standing upward to show its honesty.

The aspen, or quaking asp, is the most restless of its uneasy family. The leaf is always in motion. Botanists tell us that it is because of the slender, peculiar leafstalk, but legend tells us that when Joseph and Mary fled through the forest with the infant Jesus, all the trees bowed their heads in reverence excepting the aspen. This tree only raised its proud head a trifle

higher into the heavens, where it met the reproachful, sorrowful look of Christ and at once began to tremble, and it has never ceased.

The fragrant balsam trees also belong to the poplars. The fishermen of the Great Lakes use bits of bark from the Tacmahac, or balsam poplar, instead of cork to float their nets. The wood of this tree is soft and brown. It is a favorite in making paper pulp, which is in turn fashioned into everything from a baby's rattle to a car wheel. The balm of Gilead is often spoken of as the heart-leaved balsam poplar. It is the most majestic of the poplars, and is a great favorite for lanes and parks and along driveways. You may distinguish it from its relatives by the stickiness of its shoots at all times, caused by the slow oozing of a fragrant oil or "balsam." In winter the buds are gummy with this resinous substance. When the early spring sunshine melts the "balsam," one could find the tree in the dark, by its pungent odor. In April, the tree is a mass of snow-white "cotton tails." The fleecy sails come down in clouds with each passing breeze, and are often carried long distances from the trees.

Until just recently the willow family was regarded as of little value commercially. But since the rapid rise of the willow ware industry,

the discovery of making paper and various articles from wood pulp, the excellence of willow charcoal for gunpowder, the dyeing and tanning properties of the bark, and the use of balsam and salicin in medicine, the trees have become valuable indeed.

## V

### THE BEECH

"Mottled trunk and shining leaves,
Mossy limb and lichened bark,
Where light's flying shuttle weaves
Golden threads in warp of dark,
Still the pleasant beech tree stands,
Like a gentle, genial host
Welcoming with gracious hands
Bird or squirrel, man or ghost."

—*B. F. Parker.*

Since earliest time the beech tree has been lauded in song and story. The ancients believed that ill-luck would overtake the man who used its wood for fuel. The old Greeks considered the tree a symbol of prosperity. Certainly it would be difficult to find a more noble type, with its great round dome and its perfect leaves unmarred by insect blotch or blight. Perhaps you may have noticed the young beeches in winter. They are the aristocrats of the forest. There is an air of quiet elegance in their smooth, close-fitting gray suits, with their dark

polished branches and brown satiny lance-shaped buds.

How carefully Nature protects the tiny beech leaves! Each little bud is wrapped and counter-wrapped with dark-brown scales. If we examine one carefully we find that usually no less than sixteen scales surround the base of each one. Inside these are longer scales, protected by soft, silky hairs. All these are but the outside guards of the treasure. One must displace eight of them before the first tiny leaf is uncovered. It is delicately plaited together under the shelter of its own specially detailed guardian scale, and clothed with dense silky hairs. A minute section of stem separates it from its alternate neighbor—another leaf, carefully guarded and protected in the same fashion as itself. From five to nine leaves make up a bud, and the whole is a fair sample of Nature's packing. The little leaves are creased and folded palm-fashion, with the parallel veins crowded close on the lower side. A comb of silky hairs edges each fold above, and each rib below. These combs overlap one another, furnishing protection alike from heat and cold and giving the unfolding leaf-babies a silvery look. As soon as the little leaf walls get acclimated and begin to thicken, the hairs shrivel and drop

off. Their mission is finished. Beech scales begin to loosen when the wood violets are blooming. But they are loth to fall, and cling to the twig by their silky fringes, giving the tree a decoration of golden-brown till the spring winds finally send them scattering.

When the leaves are about one-third grown, the beech hangs out little head-like clusters of stamens from the bases of the new shoots. The pistillate flowers appear in a pair of scaly cups borne on short little stems in the axils of the leaves. The fruit is a burr of bristly prickles, and when ripe splits into four valves, showing a pair of three-sided, shiny brown nuts, each about half an inch in length. The nuts are sweet and of a delicious flavor. All the woodland creatures relish them, and "beech mast," as they are familiarly called, is said to make the finest pork in the world. Beech nuts have long been used in the old world as food for man. They are sold regularly in the French Canadian markets, and also in various localities in our own Middle and Western states. The English named them "buckmast," because deer eat them. It is said that buckwheat is so called because its three-cornered seeds are like miniature beechnuts.

In the early days beechnut oil was widely

used in lamps. It is still burned in France to some extent, and the thrifty French cook uses it in food preparations much as we use cotton-seed oil. Beechnut oil has a delicate flavor, and is a splendid substitute for olive oil. The cake which remains after the oil has been extracted makes excellent food for the stock, when ground into meal.

In our trips to the woodland, through the long summer, we find no tree more handsomely gowned than the beech. The leaves are thin and soft as silk. They are set alternately along the branches in level, flat sprays, and are exceptionally straight veined. As the season advances the leaves thicken somewhat, thus affording deeper shade, but they yet remain the thinnest leaves in the forest. In the autumn they are a glorious mass of golden and russet shades, and later, when most of the woods are bare, many of the beech leaves still cling to the tree in curling bunches of rich, light brown, that make pleasing bits of color in the winter landscape.

Botanists class all the American beeches in one species. But lumbermen find a difference between the trees which keep their leaves and those which shed them. The former are termed the "red" beeches. They have a considerable

quantity of dark-colored heart wood, and are much harder to work up than the "white" species, which has a softer wood of a much lighter shade. The leaves of the hard-hearted "red" trees, which will not be dispersed by the soddening rains of autumn, nor by winter's heaviest snows, nor by the most boisterous gales of March, have been compared to prejudices which no amount of reason and persuasion can remove. They cling with stubborn tenacity till the tree rouses to renewed activity, and the young leaves are ready to burst their buds. The American beech ranges over the eastern half of the continent, its western border being Wisconsin and Texas. It may be known even in winter by its smooth, silver-colored bark, its glossy rich dark-brown stems, and its slender spindle-shaped buds.

The European beech is a favorite park tree. You may distinguish it from the American species by its darker bark and rich glossy leaves, dark green above and lined with an abundance of fine hairs which lighten the under surface to a pale shade. This tree also has a more oval head than our native species. Its leaves often remain fresh and perfect until November. The beautiful copper beech, with its shimmering masses of glossy russet leaves,

is a variety of the European beech. So, too, is the handsome weeping purple beech.

Side by side with the hazel and alders along many of the river banks from New Brunswick to Minnesota and southward to Florida and Texas, grows the blue or water beech. But, "What's in a name?" you say, for the tree is not a beech at all! It belongs to the birch family. In some localities, it is more properly known as the American hornbeam or ironwood. It is an enchanting little shrub, fond of growing in a one-sided fashion, so that it may see its own reflection in the water. The flowers, or fruit clusters, hang at right angles from the boughs, their rich yellowish tint contrasting beautifully with the dark green leaves.

Let us examine a log of beechwood. It is close-grained, hard, and heavy. It is well adapted to the making of farm implements, coopers' wares, shoe lasts, and household utensils. Beechwood bowls never leak. No wood makes better pulleys, tool handles, chairs, and milking stools. It is often used for piles in submerged or very wet places, but it is not durable when placed in contact with the soil.

Do you know that the roots of the beech, in common with those of the oaks, the locusts, and many of the conifers, have no power to feed the

tree? Food is gathered from the soil by the little thread-like fibers of a colorless fungus whose fairy meshes are woven in webs about the root tips. This fungus has no chlorophyll grains, and never sees the sunlight; hence it would soon die if dependent upon its own exertions for food. So it has established "a treaty of reciprocity" with the tree. It gathers plant food from the soil and transmits it to the tree. The tree sends the food up in the form of crude sap to the leaf laboratories to be worked over into starch. A part of this product is returned to the roots and then the fungi claim their share. Thus the big plant and the little plant live on, mutually helpful, in a fair exchange which is no robbery. In transplanting beech trees, you must be careful not to destroy the root fungus, else the tree will be doomed to die of starvation.

A beechwoods is a forest enchanted. How delightful it is to tip-toe softly about on the fairy carpet of small ferns and moss which spreads so invitingly! Here and there in the dainty green gleams the reddish-purple and russet shades of the beech-drops. These are root-parasites whose gay coloring of stem and flower and the mere scales which take the place of leaves, proclaim plainly that they do not work for a living. They rob their host and victim of

the elaborated sap, which has been made over in the leaf mills and returned to feed the growth of the roots. Here, too, one may often see the familiar Indian pipe or ghost flower. It is the turkey buzzard of the vegetable world, getting its living from dead and decaying vegetable matter, and has a valuable purpose to fulfil. It is an own cousin to the queenly rhododendron and the lovely azalea. But no one but a botanist would ever suspect it! The whole plant —stalks, six-parted flowers, and the little scale "leaf apologies"—look as though fashioned of white wax. The fairies love the beechwoods and are said to hold revel in it on Midsummer night. We frequently find their footstools scattered about—the toadstools. These are really humus plants, like the Indian pipes, and get their living in the same manner.

# VI

## WALNUTS AND HICKORIES

Let us visit the walnuts and hickories in nutting time, when the woodlands are ablaze with their gorgeous autumn coloring. Keep your eyes open for bright yellow tree tops, standing in the ranks of the tallest. These are pretty sure to belong to the nut trees.

We shall have no difficulty in telling the walnuts and hickories apart, for though they are very close kin, they are widely different in many ways. Indeed, we may recognize the trees as far as eye can reach. Let us see. Yonder is a shining mass of yellow foliage. It belongs to a tree which seems to tower straight and tall among its neighbors, the branches being massed and flattened at the top. It is a hickory nut tree. Away to the right is another gleam of yellow. It is a deeper tint, and the outline of the branches is wide and spreading. We feel sure that its lower limbs must be within easy reaching distance. And we know that this tree is a walnut. Set out by itself the walnut becomes a very prince and rivals the noble oak

and the spreading chestnut. No doubt the walnut would oftener be chosen for a shade tree were it not for the fact that its leaves are late to come and among the first to fall. Then, too, it is apt to become a prey to the web worm in the late summer and lose most of its leaves. Of course, this latter evil can be overcome by spraying the trees, but many people think this is too much trouble. The flowers of the walnut and hickory are very much alike, but their fruit is widely different. The hickory nut is smooth-shelled, and when ripe drops out of the husk, which splits into four valves to discharge it. The walnut is wrapped in a green covering, which clings closely to the rough, deeply cut shell, until it is torn off or decays.

The name "walnut" means foreign nut, and was bestowed by the Saxons to distinguish the nut from the hazelnuts and beechnuts grown on English soil. The walnut to receive this name, and the only one known in early times, was the English or Persian walnut of the market. The Greeks called it the *Persicon* and the *Basilicon;* the Romans named it the acorn. The Greeks esteemed the walnut tree highly, and always held their outdoor festivals beneath its shade. There is a story that Diana, the daughter of the Grecian god, Dion, was turned into a walnut

tree. The Greeks and Romans believed the walnut a symbol of good luck, and walnuts were always scattered at their weddings. But, like many trees once reverenced, the walnut finally fell into evil repute. The foliage of a certain walnut tree in Rome became "peopled with demons," and Pope Paschal II had the tree cut down, and a church built where it stood. Soon the shade of the tree was thought unwholesome to men and plants. People were supported in their belief because of the fact that nothing seemed to thrive under a walnut tree. No doubt the reason of this is because of the astringent properties of the decaying leaves and nut shells. Our forefathers believed that walnuts should never be gathered by hand, lest the tree die. Also no one dared to plant a walnut near an oak; for the latter would surely wither.

Time was when the black walnut and its cousin the white walnut, or butternut, were plentiful in our woodlands. Now we may search in vain for them. For the relentless hand of the chopper has whisked them away to be made into furniture or for the interior finishing in houses. Agents from the lumber companies have scoured the forest here and there until scarcely a tree of any size is left. At the present time, in many woodlands, the young walnut trees that have

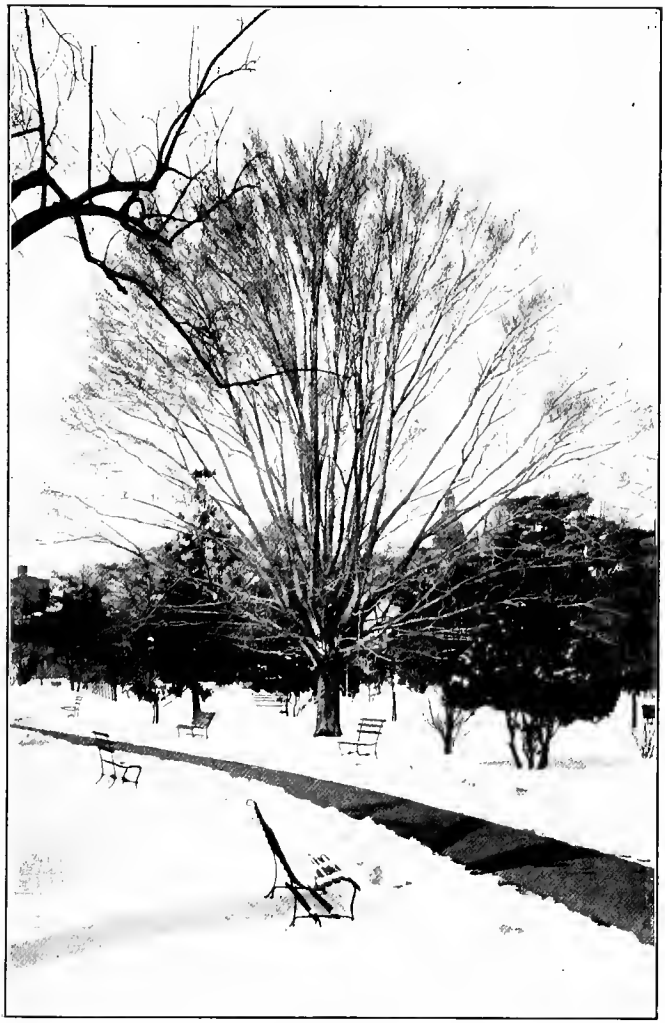
grown almost to marketable size, have already been sold "on the stump" to lumbermen. They will soon fall. Indeed, many of them are now being sacrificed. Their need is urgent in the making of rifle stocks. The walnut is a slow-growing tree, and it is said that it takes fully one hundred years for it to grow into the proportions necessary for a valuable timber tree.

The butternut is a smaller tree, with a rougher, more deeply ridged bark than the black walnut. It has a short, stout trunk, and the crown is broad and dome-like, with grayish-green branches. The sticky twigs and young leaves are covered with fine short hairs. The nuts are hidden in pointed, oblong, sticky green husks, two or three inches long. When ripe the husks turn brown and begin to decay away from the nut. The shell is cut into rough, deeply furrowed ridges. The kernel is sweet and delicious. Butternut wood is a rich, pale brown, particularly beautiful in the natural finish for house finishing and cabinet work. The tree grows rapidly, but like all the members of the walnut family, it is an easy prey to insect and fungus enemies on account of the chambered pith of its twigs. The butternut grows from New England southward to Georgia and westward to the Dakotas and Arkansas.

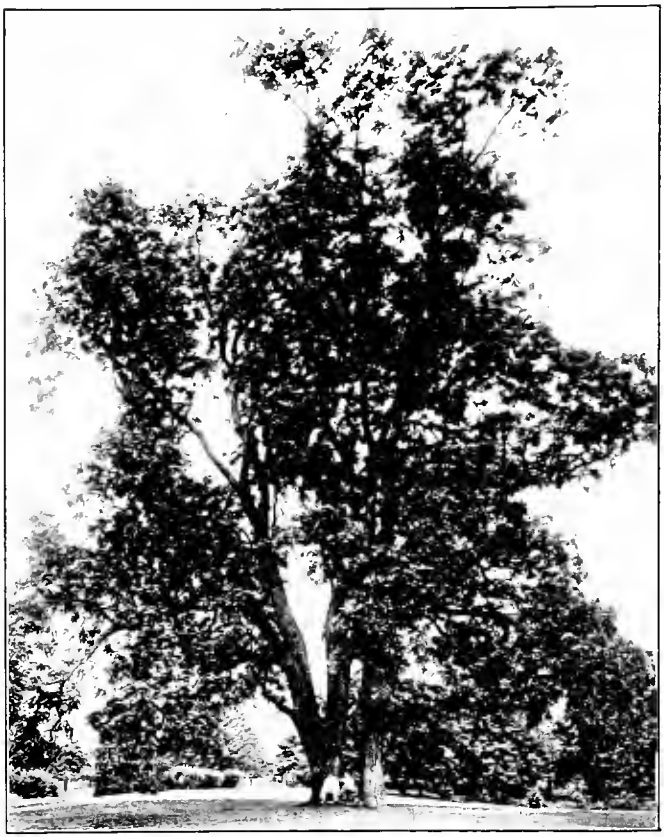
The American walnut and the butternut have never become articles of commerce. They contain much oil, and unfortunately do not keep very well. The English or Persian walnut is now grown profitably in California. It is a tender tree, and cannot stand our northern winters. The Japanese walnut, a tree of the butternut type, has lately been introduced into this country. It is hardier, and promises to become quite a favorite, as the nut is said to be superior to our native butternut.

Walnuts tend to vary and intercross, producing many hybrids. Horticulturists are continually experimenting with artificial crosses, in the hope of finding new and better-keeping varieties. While they are thus employed, "It behooves us all," says Rogers, "to keep planting the old kinds, especially in areas from which the trees have been taken. We may thus atone for the sins of our forefathers, who stripped the land of the first walnut crop and had not the foresight to provide for another."

The hickory is a natural born American. The name "hickory" is of Indian origin. The Indians prized the hickory nut highly, and always laid in a big supply for winter. There are nine different kinds of hickory trees, and for some reason, Nature saw fit to place all but



THE AMERICAN BEECH IS KNOWN BY ITS SMOOTH, SILVERY BARK



A BLACK WALNUT TREE BELIEVED TO BE A CENTURY OLD

one variety of these in eastern North America. The exception is the pecan hickory,[1] which grows in Mexico and the Southwest.

It is not an easy matter to tell the different hickories apart, for they closely resemble each other. But it is the shagbark and the big shell-bark that we are most interested in, because they are the ones which furnish us with nuts. Fortunately these hickories are readily recognized by their rough, shaggy bark, which is shed in thin plates. In winter the shell-bark is easily identified by its orange-red twigs. But we must visit this tree in the spring to see its real glory in the unfolding of its leaves. The outer bud scales drop off; the smooth velvety inner ones lengthen and fold backward, and lo! there stands a salmon-red bud, shaped like the fleur-de-lis. Occasionally we find pinkish or tawny buds, and never was there real velvet of a deeper, richer pile. In the midst of these lovely, velvety scale-petals, presto! the downy little leaves rise and lengthen out like fingers from an opening hand. How interesting it is to watch them from day to day and note their progress! Hickory blossoms are a modest

[1] Several pecan orchards have recently been set out in the Ozark fruit section. The young trees are thriving nicely, and it is thought they will prove very successful.

green, and so unobtrusive that you may never see them at all unless you look closely. Most of the smooth-bark hickories, such as the swamp hickory and the pignut, have very bitter nuts which are highly prized by pigs and the wild animals of the woodland.

The hickories are slow-growing trees. Their wood is hard and tough and strong as wrought iron. Even the youngest fibers are like threads of steel, as many a lad has discovered when he sought to break a hickory branch for a fish pole. Hickory is not an ornamental wood, but wherever strength and suppleness is needed it is just the thing to choose. It is a favorite for making parts of carriages, for agricultural implements, and for the handles of pitchforks and axes.

# VII

## LOCUSTS AND OTHER POD-BEARERS

The pod-bearing trees are the connecting links between the plant and the tree world. They belong to a variety of families, but their fruits prove their relationship to the peas and beans of the garden. Many of them also carry the resemblance further, bearing flowers of the sweet pea type.

The yellow locust is perhaps the most familiar pod-bearing tree. We often find it growing in little clumps in the woodland, and along the country roadside. We may see it at its best in the deep, rich soil of the Appalachian Mountains. There it grows to its greatest height, about eighty feet, and produces its most valuable timber. The Indians prized locust wood for bows, and carried the tree from the mountains to the low countries, both east and west. No American tree is more common in Europe. It is planted in parks and gardens, in hedges and coppices, along railroad embankments, and in sandy stretches to retain the soil. It is also

grown extensively for stakes and poles, and for the fodder provided by its young leaves and shoots. Foresters regard the yellow locust as a good nurse, because it is favorable to the growth of seedling trees beneath its branches. This is due partly to its thin light foliage, and partly to its leaves drooping sleepily in a rain, thus allowing plenty of moisture to reach the ground. The leaves of the yellow locust appear late in the spring. They are silvery green at first, because of their covering of down. This soon shrivels, leaving the leaf dark green and smooth. Each leaf-stalk is composed of from eleven to twenty-five oval leaflets, rounded at both ends and occasionally tipped with the end of the midrib. The white fragrant blossom clusters are very like those of the sweet pea. So bountifully are the trees covered, in May or early June, that at a little distance they look white rather than green. The bees love the honey-like odor of the locust blossoms, and hum busily among them, giving good service for the nectar they sip. By fertilizing the flowers they increase the number of seeds and so add to the world's supply of locust trees. The pods are thin and tapering and contain from four to six brown seeds. They hang on the trees all winter. This locust is of rapid growth, and sends

up suckers in such quantity that it soon takes possession of neglected lands. It has more than its share of insect enemies, because of its rough, deeply tunneled bark. Often the wood is rendered quite useless by the merciless locust borer, which even riddles the young shoots. Frequently stray seeds, sown by the wind or perchance by the birds, lodge in deep crannies of the locust and spring into being. Miss Going speaks of having seen a raspberry and an elder both growing from one locust tree and apparently doing well.

Do you know the honey locust, or three-cornered acacia? It is regarded by many as the handsomest of the pod-bearing trees. Its foliage is a feathery mass of once- and twice-compounded leaves, both kinds on the same tree. So fine and airy are they that the light sifts easily through, and thus the tree is often leafy to the very center. The honey locust has been much planted in hedges, but it is not the best tree for this purpose on account of its suckering habit—often producing shrubs far afield in just exactly the places where they are not wanted. Then, too, its murderous thorns, sharp as bayonets, seem continually to lie in wait for the unwary. The thorns are the tree's defenses against enemies that would climb its trunk, or

eat its attractive foliage. They are three-pronged, richly-colored affairs, sometimes several inches in length, and frequently bearing a stunted leaf or two which proves that they are branches which have been forced into adopting a military career. In winter they give the tree a certain fierceness, which is strengthened by the ominous rattling of the long brown pods. Presently, however, the pods twist into odd cork-screw shapes and finally let loose their hold and go careening away over the fields, to lodge at last in some favorable place where the pods decay and liberate the hard shiny seeds. The honey locust bears small inconspicuous greenish-white flowers, which grow in long narrow racemes, or clusters, after the fashion of the locust family. It is quite a favorite as an ornamental tree, notwithstanding that it is rather late in getting its foliage and early in putting it off. All summer long the leaves are tinged with yellow. In autumn they are a mass of yellow and russet shades, often tinting to purple. The honey locust gets its name from the honey-sweet pulp in which the seeds are packed. When fresh and green, this "honey" is sometimes relished by man and beast.

The moss locust, or rose acacia, is familiar to many as an ornamental lawn and garden

shrub. It is a beautiful thing in early June, when the large, showy, deep rose-colored blossoms hang in long, loose clusters. Its leaf-stalks and twigs are covered with fine bristles; so, too, are the narrow pods. Like other members of its family, the moss locust has leaf-stalks hollowed at the base, forming a sort of little house for the protection of next year's buds. You will delight in examining these.

The clammy locust is a rough-barked little tree, which we find growing naturally on the mountain slopes from Virginia southward to Georgia. It has a beautiful, showy, pink bloom, greatly resembling the sweet pea, and has been much planted in gardens for this reason, throughout the Middle and Eastern states and even in Canada. Its rough-stemmed twigs, buds, and blossom stalks are clammy to the touch.

The American or Kentucky yellow-wood is a beautiful tree with a silvery-gray bark, something like the beech. We find it growing wild in Kentucky, Tennessee, and North Carolina, and it has been much planted as an ornamental tree in various localities, not only for its beautiful bloom, but for its graceful foliage, which changes in the autumn to various tints of gold. Nothing lovelier than the tree in full bloom can

well be imagined. The flowers unfold in great fragrant pea-like racemes, often a foot in length, and of the purest white. Lounsberry tells us that: "When the sun shines upon them after a shower, they sparkle as with innumerable drops of crystallized dew, and tiny, round specks of reflected sunshine gleam over their white petals. . . . Sometimes they blend crimson, yellow, and green. The crimson tint is bordered with gray, and the green sinks into a deeper blue." The wood of this tree is light yellow and so brittle that the branches often break in a high wind. The pods are thin and flat, containing from four to six seeds.

The Kentucky coffee tree is an interesting pod-bearer. It is so coarse and burly that, notwithstanding its height of from forty to one hundred and ten feet, it is often called the stump tree. Its branches are stout and stiff, and in winter the clumsy twigs are fairly weighed down with their load of broad, flat, reddish pods. The seeds are hard and gray. The Kentucky pioneers used them as a substitute for coffee. Let us examine the twice-compound leaves. They are coarse and unusually large, often measuring three feet in length. There are from seven to thirteen taper-pointed leaflets on each division of the blade. They are rounded at the

base, dark green above, pale yellowish-green below, and slightly hairy along the ribs. Always the leaves of the coffee tree seem to delight in color effects. But we never find them experimenting, or trying on new fashions. We know just what to expect at each season. In spring, the little buds open in clusters of pinkish down; the first leaves have yellowish tints, as the summer advances they are a bronze-green; in the autumn, they turn to bright, clear yellow. The flowers are white tinged with green, and differ from those of their locust kin in shape, being small, round, and five-toothed. The name "Kentucky" coffee tree is misleading, for the tree ranges from New York southward and westward.

The catalpa and the red-bud, or Judas tree, are very near relatives of the locusts. They have heart-shaped leaves, and the most exquisite stalks of bloom. Almost every one knows the purple-and-gold flecked fragrant white blossoms of the catalpa. The flower is tubular and two-lipped, and so poised that the upper lip serves as an umbrella for the pollen, while the lower one makes an attractive resting place or shelf for the winged insects. The long slender pods are pistils "grown out of all knowledge." They hang on the tree well into the winter, each

fierce blast doing its share toward unlocking the treasure boxes and starting at least a few seeds upon their adventurous journeys. The name catalpa is an Indian' word meaning "winged head." The light, large-plumed seeds are carried far and wide by the winds, and are able to travel long distances by floating on the water. The tree grows rapidly, and is especially valuable for posts, telephone poles, and the like. The catalpa *speciosa*, the largest member in the catalpa family of two, often grows one hundred and twenty feet high and bears immense pods. Because of its large fleshy roots, the tree transplants more easily than almost any other kind, quite large trees being moved with safety.

The little Judas-tree is so called because 'tis sometimes said that the prince of traitors hanged himself on the old-world relative of this species. It is a handsome tree at all seasons of the year, but in the latter part of April and the first of May, when its rosy, butterfly petals fairly cover the tree, it is a sight to behold. So eager are the blossoms to decorate the tree that they sometimes appear even upon the trunk. The bark of the tree is purplish gray, with almost smooth twigs and younger branches. The shuttle-shaped pods gleam with a hint of yellow

among the summer leaves. The flat, puckery-tasting seeds are winged to the pods. The tree grows rapidly under cultivation, and is coming to be a favorite with landscape gardeners.

# VIII

## THE BIRCHES

THERE are in all some thirty-five members of the birch family. Of the nine American species, Nature has with seeming favoritism placed six of them east of the Rocky Mountains. They are as a rule quick-growing, short-lived trees with a wide variety of uses.

The birch served the Indian for countless purposes. He drank the sap, and boiled it into sirup. He made boxes, buckets, baskets, and canoes from its bark. Strips of bark, rolled closely, made him a good torch. Small oblong pieces, with strange figures drawn upon them, served him as playing cards. The lodges were covered with sheets of birch bark. The papoose was cradled in it, and one northwestern tribe, the Liloots, wrapped their dead in shrouds of it, and lined their graves with the same material. Scrolls of birch bark may still be found among some tribes whereon "medicine songs" are inscribed in picture writing. They also wrote their "picture letters" on birch bark.

These were called Wikhegan letters, and were either sent to the persons for whom their message was intended, or left where he could find them.

In the early days no country school could have existed without a bundle of birch switches! People in northerly regions depend upon the dwarf birch for fuel and for material to stuff their beds. The seeds of the birch are the chief food of the ptarmigan, the grouse of the Laplanders. The laborers of Scotland make various articles of tableware from the birch. They also make a sort of wine from the birch sap, which is sweet and pleasant to the taste. Birch sap is used in the preparation of Russia leather, and gives it its pleasant odor. The wood of all the larger birches is fine-grained and firm and is much used by coopers and turners. The black birch of our northern woods is rose-colored and very valuable for cabinet work.

The manufacture of birch oil is becoming quite an industry in the Northern hardwood forest region, especially in the mountainous parts of Vermont, New York, Pennsylvania, and West Virginia. It is distilled from the inner bark of the sweet birch, also known as black birch and cherry birch. Birch oil is a colorless liquid with a pleasant taste and smell, closely

allied to the oil of wintergreen. It is widely used as a flavoring in soft drinks, candies, extracts, liniments, tooth powders, and gums. It is also used occasionally as a medicine, particularly in the treatment of rheumatism and gout. At the present time, distillers are getting about $30 per gallon for birch oil. It retails at fifty cents an ounce. The best oil weighs about eighteen ounces to the pint or nine pounds to the gallon.

In ancient Wales, the Maypole was cut from the "bedwen," or birch, a tree which the Welsh always associate with gracefulness of motion. Games of various sorts were played around the "bedwen," and great vigilance was necessary to keep rival parties from stealing it. If this was somehow accomplished, great was the rejoicing and celebrating of the victors. This rivalry for the possession of the Maypole has been explained as typical of the ancient idea that the first of May was the division between winter and summer, "when a fight took place between the powers of the air, on the one hand striving to continue the reign of winter, on the other to establish that of summer."

All of the birches have thin, dainty foliage, which sways gracefully in the lightest breeze. "Whether their end be conversion into the ig-

noble shoe peg, or into furniture that shall pass for mahogany," says one of their many admirers, "the birches live their lives with cheerfulness. The beauty and individuality of each tree, young or old, is its own sufficient excuse for being."

Both staminate and pistillate catkins are borne on the same tree. The seed in most instances is a flat heart-shaped samara, winged on the edge like the elm seed.

Seldom is there more than one member of the birch family found in any one locality. So, if we mean to visit those trees in person, we shall have to sail away on the fairy rug of fancy. It is a delightful way to travel and we arrive directly before the object of our pilgrimage. Are you ready? All aboard!

We shall find the canoe, or paper, birch along the wooded slopes and beside the streams of the mountainous regions of Pennsylvania and northward. This birch was a part of the Indian's daily life.

"With his knife the tree he girdled:
Just beneath the lowest branches,
Just above the roots, he cut it,
Till the sap came oozing outward.
Down the trunk from top to bottom,
Sheer he cleft the bark asunder,

With a wooden wedge he raised it,
Stripped it from the trunk unbroken."

And presently went floating swiftly and silently down the river in his birch-bark canoe, "lightly as a leaf in autumn," guided by a paddle made from the wood of the tree.

The chalky white bark of the canoe birch is noticeable at considerable distance. It is smooth, tough, and disagreeable to the touch, and continually being shed in tattered patches which show layers of orange yellow under the white exterior. A small strip of birch bark furnishes a surprising number of thin sheets of "note paper." Thoughtless people often girdle the birch to get these sheets for souvenir paper, thus destroying in a few moments what has taken Nature twenty or thirty years to make,—for you know the girdling process usually means sure death to the tree.

The black birch may be seen in almost every woodland from Nova Scotia to Florida and westward to Minnesota and Kansas. It looks much like the cherry tree and is often called the cherry birch. The wood is dark colored and takes a high polish. It closely resembles mahogany and is much used in the making of furniture. Every country lad in its locality knows

the sweet, aromatic flavor of the leaves, twigs, and inner bark. This characteristic has given the tree the familiar name of sweet birch. It has also given rise to the birch oil industry previously mentioned. Children of long ago used to hear many a tale of the evil spirits which lurked in the branches of the sweet birch, feeding greedily upon its fragrant bark.

As we sail along, we may readily recognize the yellow birch by its fantastic yellowish-gray bark, which has a fashion of cracking and curling up into little ribbon decorations. The tree wears a lusterless gray undervest, and is often spoken of as the gray birch. It is closely allied to the cherry birch, but it has coarser leaves and catkins and the aromatic flavor is much less pronounced. We note that the yellow birch thrives best where there is plenty of moisture. In Canada and New England it is one of the largest trees grown; in its southward range it is often but a mere shrub. The large trees are valued for their excellent timber. The light reddish-brown wood planes to a satiny surface and takes a fine polish. It is much used in the making of furniture, boxes, and the like.

The river birch is the real southerner of the family. We find it growing to its largest size

in the damp, semi-tropical regions of Florida, Mississippi, Louisiana, and Texas. It is fond of standing up to its knees in water, and it is of great value along the marshy shores of lakes and streams, where its roots help to give strength and permanence to the shifting banks. The tree is often called the red birch because of its bark, which is a clear bright red in twigs and branches, shading to a deeper color in the sturdy, heavily furrowed trunk. If we chance upon this tree in winter we find it a picturesque "tatterdemalion" indeed, sporting no end of little red bark streamers and fringes. The branches droop gracefully, often almost touching the ground, as though they yearned to paddle in the water. In autumn, the foliage is of a bright clear yellow. Many a negro cabin and humble southern home is swept with brooms made from the twigs of this birch.

The white or poplar-leaved birch is a restless, short-lived gipsy, with delicate pointed leaves almost as tremulous as those of the aspen. It is fond of wandering over old abandoned fields, and for this reason the New Englanders have named it the oldfield birch. Because of its dingy-white, chalky bark, it has also been called the gray birch. We find that the younger branches of the tree are clothed in rich reddish-

brown and spotted with many wart-like dots. And look at those little rough triangular patches of dark color under each arm! These grow with the growth of the tree, and often serve to mark the spot where a branch was but now is not. Subsisting as it nearly always does on scanty living, this birch is the smallest and least widely distributed of its family. Its wood is too perishable to be of much value. Spools and barrel hoops are made of it, and it makes a quick wood for the kitchen fire. The weeping birch and other ornamental varieties which we meet on our pilgrimage are propagated from a European species of the white birch.

# IX

## THE ASHES

THE ashes belong to the olive family. There are about forty known species, but only twelve of these are American born. The ash strikes its roots deep into the earth, and is often called "the husbandman tree." It will not grow in barren soil. Hence the foundation for the oft-expressed wish of our forefathers: "May your foot fall by the roots of the ash," meaning may you live in a fertile, well-watered land.

The ash has lost in favor because of its short foliage season, being late to leaf and among the first trees to be denuded in the autumn. But there are other trees equally as late in budding. The butternut, walnut, sycamore, and thorny locust hang out their blossoms at about the same time; many of the oaks are later; so, too, are the catalpa, the linden, and the chestnut. In England, the saying is current that if the ash puts forth its leaves before the oak, the following summer will be wet; but if the oak is the first out, then a dry season may be expected.

Ash blossoms sleep between brown wool blankets in the cosiest of purplish-black buds. They open before the leaf-buds do and seem loth to vanish. None but a botanist, however, would call them blossoms. They are without petals, perfume, and nectar—the merest apologies for bloom. Usually the staminate and pistillate flowers are borne in branching plume-like bunches on separate trees, but sometimes the white ash, reverting, no doubt, to ancient family types, produces a pistil in a little group of stamens, or hangs out a misplaced anther on its slender little filament amidst a sisterhood of pistils. Pollen from the purplish anthers flies from tree to tree and in time nearly every green branching pistil ripens into a winged box or fruit. The wings of the ash fruit are not like the gauzy, katydid wings of the elms and maples; they are papery and opaque, but they scud rapidly before the wind and are often carried considerable distances.

The ash ranges farther north than the oak. It is the chief timber tree of northern Europe. The old vikings of Norway and Denmark were frequently termed "ash men," no doubt because their ships and the handles of their weapons were of ash. Then, too, the tree itself in life and character was not unlike those sturdy he-

roes of the Sagas. Everywhere throughout the north the wood and leaves of the ash are regarded as a protection against snakes. In Shakespeare's time, even among the learned, it was firmly believed that a snake would escape through fire rather than through a barricade of ash. An old Devonshire belief held that: "If a circle be traced with an ashen staff round a sleeping viper, the creature will be unable to pass beyond it." Babies suspended in their cradles from the branches of the ash were safe from harm while their mothers worked in the fields.

In Scandinavia the ash was long regarded as a sacred tree. It is recorded in their Eddas that the whole universe is supported by a mighty ash tree, called Ygdrasil, which sprang from the body of the giant Ymir. One root of this great tree penetrates into the realm of the gods, another reaches the dwelling of the giants, and a third extends into the abode of darkness. Each root is watered by a spring. The spring in the realm of the gods is tended by three Norns, or goddesses, who represent the past, present, and future. They are regarded as the dispensers of fate. The spring at Jotunheim, the home of the giant, is a well in which wit and wisdom are hidden. The third spring, in the

abode of cold and darkness, feeds a terrible adder, which gnaws forever at the roots. Four harts play in the tree's branches and feed upon the buds: they are the four winds. Under the tree lies Ymir: when he tries to shake off his burden the earth quakes. Aske, the first man, was made by the gods from an ash tree. They also made Embla, the first woman, from an alder.

The ash tree has certain fairy gifts concealed in her leaftips. The leaves are compound, and usually there is an odd number of leaflets on the stalk, one at the tip, and the rest ranged down its sides in pairs. Now and then, however, a stalk may be found with the odd terminal leaflet lacking. This is called the even ash, and to find one is every whit as lucky as to find a four-leafed clover. Thus the maid of old England disposed of it:

"The even ash in my left hand,
The first man I meet shall be my husband.
The even ash leaf in my glove,
The first I meet shall be my love.
The even ash leaf in my breast,
The first man I meet is whom I love best.
Even ash, even ash, I pluck thee,
This night my true love for to see."

Ash wood is tough, straight-grained and pliable. That of the white ash is of great value in cabinet work, and it is much used in the framework of farm machinery. Most of the ashes take a good polish and are well adapted for making furniture. Black ash lumber divides easily into its annual layers. It is used extensively for barrel hoops, for splint basket work, and the like.

The ashes do not form pure forests. We find them scattered here and there among other trees in the woodland, their favorite haunt being the banks of the mountain stream, where they lean gracefully over the water, adding much to the somber color of the rocks in the background. The white ash and the red ash are often found growing side by side, and are so nearly alike that only those with sharp eyes ever note their difference. The red ash may be distinguished, summer and winter, by the velvety texture of its leaves and twigs. The bark of this tree is reddish on the branches, and it produces a more slender, longer "key" than any of its kin.

The green ash is very closely allied with the red ash. It is, however, the smaller of the two trees. Its leaves are shorter and narrower and more sharply toothed. We see it mostly in parks and gardens, as it is the favorite ash for

an ornamental tree, because of its lustrous bright green foliage. It readily adapts itself to new surroundings, and delights in excessive sun-baths.

The blue ash is, perhaps, the least common of the ashes. Its flowers differ from those of its kin, bearing both stamens and pistils in its plume-like clusters. The tree gets its name from the fact that its bark contains a substance which gives a blue tinge to water.

The black ash loves the marshes. If you chance upon it in winter, you may recognize it from all its kin by its bluish-black buds. The leaflets, all but the terminal ones, are without stalks. The samara is an oblong seed body, with a notched wing attached all the way around it. This tree is found farther northward than any of its American kin. Nor does it seem to be afraid of spring frosts, the leaves coming out early in March with the bravest of the brave.

The mountain ash is a deservedly popular tree in parks and gardens. Long after all the leaves about have fallen, we find its berries hanging in scarlet clusters—the most cheerful things in Nature. The flowers of the mountain ash are small and white, growing in great flat-topped clusters, often as many as a hundred

blossoms in a bunch. Let us examine the leaves. They are compound alternate, with red grooved stalks and from nine to seventeen sharply toothed leaflets. The rowan tree, or European mountain ash, differs from the American species in its hairy young leaves and its woolly flower stems and calyx. This tree holds a particular attraction for the will-o'-the-wisp and the mountain fairies. It has also been linked with witchcraft, and there is said to be a power about it to dispel evil spirits.

# X

## CHESTNUTS AND CHINQUAPINS

"It seems as though every one should know the chestnut's tall, column-like shaft, its dense characteristic foliage, and its quaint fruit," says Lounsberry. But alas! the chestnut does not venture much beyond the 44th parallel without considerable encouragement, and even in the latitude of New York it is a tree of the valleys. "It is not to be found in Adirondack or Catskill woods," Miss Going tells us, "but any one traveling from Kaaterskill towards the Hudson River will see it as the valley is approached."

So let us go to the haunts of the chestnut, be they near or far. And let us go in blossom-time, which will be when cherries are ripe. Chestnut catkins have a heavy odor which is unpleasant to many people; but the flies, upon whose kindly interests the future of the chestnut realm depends, come in great numbers to revel at the feast. We find them delving in the long, creamy spines, fairly covering themselves with yellow powder, and then rushing off with their

precious load to taste the nectar in the shorter catkins borne at the tips of the branches. The latter contain the pistillate flowers, and here the fruit develops in a green prickly husk, which opens at Jack Frost's command into four sections, disclosing the brown-polished, white-tipped nuts, slightly flattened on one or perhaps both sides.

The chestnut belongs to the great race of cupbearers and is classed with the beech family. In the Old World it is listed with the forest trees. Italian and Swiss peasantry depend upon chestnuts for a large share of their food. Boiled chestnuts are a part of every noonday meal. Cake and bread are made from *polenta*—chestnut flour. European chestnuts are larger than ours, but not so sweet. The chestnut grows very rapidly, but it is comparatively worthless as a timber tree. The reddish-brown wood is soft and weak and warps badly when dried.

The horse-chestnut is familiar to most country-boys and girls because of its nuts, but it is not a native tree, having been introduced to this country from the mountains of northern Greece. Nor is it a member of the chestnut species. It is a "horse of another color" entirely, and belongs to the soapberry family, being an own

cousin to the beautiful buckeyes of the South. The sudden glistening and shining of the big horse-chestnut buds in their heavily varnished coats is as much a harbinger of spring as the first bluebird. The winds may blow cold afterward, snow may come down in real earnest, but the buds continue to glimmer and glisten. And then one day when we begin to think they are holding out false promises after all, presto! the skies clear, the sun shines out warm and bright and the buds bravely begin to loosen their brown scales and show their downy linings. How like they are to little soft fleecy balls of silvery wool! But only for a few hours, especially if there is bright sunshine and wind with the sunshine. The buds swell and expand very fast, and shortly raise themselves into quaint little green tents. Who knows what wonderful secrets are disclosed behind these fairy bowers? Surely they are fitting booths for the dryads, but we find no tales of fairy lore connected with them. Perhaps because they are of such short duration: for it is not more than a day or two at best until the tents unfold and spread out like a hand with the fingers extended. Soon they are full-grown leaves, strong and large and of a rich dark green, fashioned in the type known to botanists as *palmately compound.* The long,

oval leaflets number five, or more, often seven, and center on the leaf-stalk by their tapering bases, forming great leaf-fans which effectually hide the tree branches and make ideal canopies for birds' nests. But for some reason the birds do not fancy them and appear to shun the tree. Who knows why?

Everything about the horse-chestnut seems to be planned in a characteristic fashion entirely its own, and it has a seeming passion for beautiful effects. The flower buds, like the leaves, are a delight from the very beginning. They open into exquisite bunches of creamy white flowers, with little spots of pink, yellow and purple reflecting the sun's rays. The orange-colored anthers protrude from the flowers on long filaments in groups of seven. The blossoms have a unique fashion of pointing upward, and their fragrance is so strong and unmistakable that one could easily find the tree blindfolded. The bumblebee finds them exactly to his liking. He settles down over the protruding stamens, with his legs fitted comfortably into the spaces between the petals, and cares nothing at all for the heavy pollen which fairly powders his underparts, as he thrusts his proboscis into the nectar sac at the base of the flower. Nor does he tarry long at the feast.

Indeed, the greedy fellow seems anxious only to see how many sacs he can empty per minute, so that he accomplishes no end of good for the future horse-chestnut family in a very short time.

The prickly burrs of the horse-chestnut are held high up out of harm's way. They are satin lined, with a delicate partition in the middle, and contain two mahogany-colored nuts, white scarred on one end. How daintily the nuts are polished by Nature's practised hand! They fall with a loud thud when frost and wind unlock the burrs. But after all they are a huge disappointment, and they have the "horse laugh" on those who expect to enjoy their treasure. They are as bitter as gall, but they are not poisonous, as many suppose. In the old country, cattle, sheep, and pigs feed upon them, and the rooks are said to relish them heartily. According to ancient superstition, a horse-chestnut carried in one's pocket will keep away rheumatic attacks. An old authority proclaims that the horse-chestnut got its name from the fact that the people of the East "do with the fruit thereof cure their horses of the cough, shortness of breath, and such like diseases."

Horse-chestnut trees were in great demand as ornamental trees in the grounds surrounding old colonial mansions. They "possess the

streets, if not the gate," of many of our cities, and as we have seen, there is much about the tree to make it worthy of preservation. It is of no value as a timber tree. Its beauty and the delight the huge nuts are to the small boys, is its only excuse for being. The second excuse may seem a slim one indeed. But ask the lad who has bounced them on a string, and finally shot them upward to dangle in a snarl from a tree or a telegraph wire!

The chinquapin is the "chestnut" tree of the South. It is a short, round-headed tree, with wide-spreading branches in woodlands where it is not crowded. In the Ozarks we find it springing up in thickets on every wooded hillside. The bark is smooth, granite-gray on young trees, and shows interesting patches of light and dark as the sun strikes it. Old trees wear deeply ridged coats. The leaflets follow the compound five or seven ranking plan. They are oblong, feather-veined, and "conspicuously serrate,"—that is they have many short, sharp teeth which point forward. They are a rich green above but below a dense white fuzz lightens their shade many tones. The prickly brown burrs hang in clusters, and we have found from experience that, if we want the nuts they contain, we cannot wait for Jack Frost's uncertain

THE HORSE CHESTNUT POSSESSES THE STREETS IN MANY OF OUR TOWNS

THE BASSWOOD OR AMERICAN LINDEN IS A STATELY TREE

arrival to bring them down. There are too many boys round about, nimble as squirrels and skilled in the use of the long pole! How sweet and delicious the goodies are! They contain considerable oil and unfortunately do not keep very well. A handful of the nuts looks like so many tiny dull-brown polished tops, with dainty white tips. They are sold on the market in "chinquapin time," in many of the Southern and Western cities. Chinquapin wood burns with a delightfully cheery snap and sputter. But it is never safe to go away from home and leave it burning in the fireplace. The cinders are too fond of popping out into the room in search of adventure.

# XI

## THE BASSWOODS OR LINDENS

THERE is no more interesting tree than the basswood or American linden. In the chapter on "Blossom-time," we considered its profusion of bloom and the attraction its wondrous honey dew has for the bees. Let us now take a peep at the foliage. It seems to be made up of two distinct shades of green: the dark green of its heart-shaped leaves, and the glimmering light apple-green of its curious bracts. These bracts are merely modified leaves, or leaf-blades, long and slender, fashioned for the purpose of holding the flower clusters.

Later the place of the dainty little blossoms is taken by downy little balls of fruit. They are joined on a single stem which grows out of the middle of the bract, or leaf-blade. All the latter part of the summer they nod and sway, dancing gayly in the breeze. Then presently the bracts begin to lose their color and to assume a scale-like, wingy character. By and by they let go their hold upon the tree and act as a

parachute to steer the little olive-green balls or nuts into a place of safety. How the wind loves to toss them about! Gravitation and buoyancy strive for the mastery, and usually the little basswood balls, which contain from one to two fertile seeds, have quite an adventure.

Basswood seeds come true to type and are very easily grown. Moreover, they are well protected from drying and will keep for some time. The early colonists brought the seeds from their old home, and to-day one may see towering lindens shading the dormer windows and quaint roofs of colonial mansions throughout New England. Basswood cuttings grow almost as readily as willow twigs. The trees endure the severest pruning, and landscape gardeners have cut them into all sorts of shapes, grotesque and otherwise. In England, the linden is known as the lime tree, and stately avenues of it are to be seen everywhere. The tree grows to a great age. There is on record the description of a French lime tree more than fifty feet in circumference and said to be nearly 600 years of age. The famous linden of Neustadt, in Wurtemberg, is thought to be at least 1000 years old.

The Germans love the linden, and speak of it as "The tree of the Resurrection." It is the

custom in many a German village to have the Easter sermon preached beneath a linden. The avenue of Unter den Linden in Berlin is famous far and wide for its beauty and luxuriance. Siegfried, the wondrous hero of the Nibelungen, was buried under a linden. The old Romans honored the linden. The Greeks planted it for its blossoms and its honey dew. Linnæus, the Swedish "father of botany," received his name from the linden tree, when he rose from the peasantry to the dignity of a surname. The Russians thought the goddess of love inhabited the linden.

To-day, however, the Russians regard the tree with a practical mind. Linden saplings are cut down when the sap is rising. The inner bark, or "bast," is separated from the trunk and branches and stretched out to dry. From this the "bast" shoes of the Russian peasants are made. It also furnishes the "bass" mats which the gardener spreads over his cold frames to ward off the frost. Countless numbers of these mats are exported from Russia every year.

Our American Indians well knew the quality of the tough, stringy inner bark of the basswood. They made thread, cord, rope, and fishing nets from it. They also found it useful for various

weaving purposes. The Louisiana Indian belles made mantles of basswood-bark network, which they covered with swan's down.

Basswood is the joy of the woodcarver, because it is so uniform in texture that the rings are hardly noticeable. The timber is whitish and without knots. It is a favorite for carriage paneling, but extreme care is necessary in handling it, because of its disposition to crack.

# XII

## EVERGREENS

"If Mother Nature patches the leaves of the trees and vines,
I'm sure she does her darning with the needles of the pines:
They are so long and slender, and somewhere in full view,
She has her threads of cobweb and her thimble made of dew."

—*Selected.*

THE evergreen, or cone-bearing trees, are the oldest trees known to man. And no tree has been more widely used by him. Considering how ruthlessly he has destroyed it at all times, and that the seeds are slow to ripen, slow to be distributed, and slow to grow, the trees are doomed, and the time is sure to come when there will no longer be great forests of evergreens.

The family group contains a host of noble trees, noted everywhere for their strength, dignity, and lofty bearing. Among them are the pines, firs, cedars, spruces, larches, hemlocks,

cypresses, sequoias, arborvitæs, junipers, yews, and gingkos. Once the first four covered most of our country, but easier germinating, faster growing trees crowded them out, and "like the wild Britons when the Saxons invaded England," they fell back to the bogs and waste lands, the mountains and the shifting sand dunes, where broad-leaved trees cannot grow.

There are about twelve species of the pine east of the Rocky Mountains. It is one of the most widely known evergreens. Legend tells us that once the pine was a beautiful maiden. Pan, the forest piper, loved her and used to woo her with his loveliest music. One day Boreas, the wild north wind, overheard some of his sweet strains, and was very angry, for he, too, loved the maiden. He caught her up quickly, in a jealous frenzy, and flung her down the mountain. But the gods had pity for the maiden and changed her into a pine tree. So she has gone on for ages blessing man with the choicest gifts. And think of the countless thousands of birds and squirrels she has fed and sheltered!

Among all the pines, the white pine is the tallest, stateliest, and the best known. Its wood is light and soft-grained and takes a beautiful polish, making it such a favorite for furniture

building and house decoration that now it is growing rare indeed. We may know the tree by the number of "needles." There are five in each sheath. In the winter the white pine has a fashion of folding its needles restfully together for its long sleep. The cones of this pine are long and slender, with thin scales, and fall in the winter of their second year.

The Georgia, or long-leaved pine, is the most valuable of the "pitch" pines. It grows in large forests along our southeastern coast, and has found its way all over the land. Its branches are widely used for Christmas greens, and beautiful indeed they are with their closely tufted twigs of glossy needles, often sixteen inches in length. Its pitch supplies the greater part of our turpentine, resin, and tar; its wood is made into railroad ties, trestles, viaducts, and bridges; even its stumps are cut up and sold in bundles for kindling wood. The color of the wood is a deep, rich orange yellow, or light red, and it is more ornamental than that furnished by any other of the pines. Indeed, the very usefulness of the tree threatens to be its doom.

In barren, stony ground we find the junipers, yews, and cedars. The juniper has awl-shaped leaves, arranged in whorls of three. The fruit is a large, dark-blue berry, much used in flavor-

ing gin. The juniper seed is two years in germinating. Gardeners are fond of the juniper tree, because it can be pruned to any desired shape. The ancients thought it an emblem of faith, because its heart was always sound. It is supposed to ward off evil, and a spray of it tacked upon the house door is as magical in bringing good luck as the old-time horseshoe. The Indian made his best bows of juniper wood.

The cedar family is much confused. There are several varieties of the white cedar. The arborvitæ, or tree of life, and the northern cypress are perhaps the best known. The trees are very much alike, and many people call them "white cedar," and deem it classification enough. The most noticeable difference is their cones: those of the northern cypress being round and variously decorated with points and knobs, while those of the arborvitæ are oblong and made up of six or eight loose scales. The savin or red cedar is the "real cedar." Its wood has been used so extensively that it has become a scarce article and very expensive. Most of our supply now comes from the swamps of western Florida. The cedar was held sacred by the Indians. In some mysterious manner they linked it with immortality and the powers of the air, such as thunder, lightning, etc.

Some of the tribes always chose a cedar for the center of their ghost dance circle, others burned a smoldering fire of cedar around the couches of their sick at night, to frighten away ghosts and evil spirits. Orchard men regard the red cedar with baleful eyes. "Down with it!" is their slogan, because of the cedar rust disease which affects the fruit and leaves of the apple, the quince, and the pear.

The firs and spruces may readily be distinguished from the pines because of their short needles arranged singly, in rows along the branch instead of in tufts, their smaller cones which ripen every year, and the horizontal spread of their more numerous branches. But it is not so easy to tell them from each other. However, if the trees have matured cones the solution is easy: firs bear their cones erect on the boughs, and the spruces suspend theirs. There are four or five species of the spruce. Most of them grow in our northern row of states and in British America. The one most commonly seen in lawns and gardens is the Norway spruce. In its native land it is one of the tallest trees of the forest, and in the Alps it reaches the height of one hundred and fifty feet. It grows quite rapidly and is a beautiful tree, but Wilson Flagg says it cannot compare in grace

and natural beauty to either our white or black spruce. The Chinese consider the fir a symbol of longevity. In northern Europe it stands for peace and good cheer and is consecrated to the Christ Child, hence it takes a prominent part in the Christmas festivities. In Sweden two fir trees are placed before the door on Christmas Eve. Our favorite is the balsam fir, which, in its youthful days, is a beautiful tree, having bluish-green foliage, with a silvery under surface, closely arranged upon branches which curve gracefully upward at the tip. It is a cousin to the silver fir of Europe, so remarkable for its great height, grace, beauty, and valuable timber. The northern camper loves to make his bed of the elastic, fragrant balsam boughs, and its needles make the highly prized "balsam" pillows, which retain their fragrance for years. The bark of the tree is dotted with little "blisters," or reservoirs filled with resin. These are drained and furnish the market with "Canada balsam."

The larch, or tamarack, and the bald cypress are cone-bearing trees, but they are not evergreen. The leaves turn yellow and fall in the autumn. Both trees love the swamp lands, the former favoring the North, and the latter the South, and produce a resinous timber which is

very durable under water. You remember it was the roots of the tamarack which Hiawatha used to bind his canoe together. The cypress is a symbol of immortality, and is much used in strewing biers and graves.

Going back as they do to the vegetation of the very earliest times, all the evergreens are simple in construction. They bear their stamens and pistils in different flowers and depend upon the wind to scatter their pollen. Because of the liberality and wastefulness of their messenger, they are forced to supply great quantities of the yellow dust. We see it lying in sulphurous streaks upon the streams in the neighborhood of the evergreen forests, gusts of it are spilled and scattered all about on the objects along shore. Each tiny grain is as light as a fairy balloon, and with reason, for each is provided with a couple of minute sailing bladders. Pollen dust is borne in little sacs on the lower surfaces of curious shield-shaped scales, called "staminate leaves." These odd scales are needles altered to serve their purposes. They usually grow in close tufts. The pollen blossoms of the pines appear in May or June. Have you ever noticed them? They are scarlet, orange, or yellow, according to family preference, and massed in clusters at the base of the new green shoots.

The staminate blossoms of the red cedar and the juniper bathe the trees in a little glint of gold, though the individual flowers are so tiny and so hidden among the needles that it takes sharp eyes to find them.

The pistillate flowers on the conifers are much more simple than the staminal ones. Indeed they cannot even be called flowers. They are mere oval bags of jelly, fastened to a tiny scale, which is called a carpel. The young cone is built up by a community of carpels arranged spirally around a woody stem. The tiny berry of the red cedar and the juniper is a ring of carpels inclosing the jelly-like ovules. The ovule of the yew has no carpel. After the precious pollen dust has been united with it, the little ring-shaped disk about its base begins to swell and forms a little red cup or berry about the tiny seed. Most of the evergreens bear pollen and ovules on the same tree, often on the same branch.

The evergreen trees which bear berries depend upon the agency of the birds to get sown, and their ripe, juicy fruits are a great boon to their little feathered friends when all other food is hidden beneath the snow. Most of the cone-bearing trees loosen the scales of their ripened cones and give to the winds a tiny winged seed,

fashioned something after the style of the maple key. The hickory pine, of California, departs from this rule. Its cones are bathed so bountifully in resin that the little seeds are imprisoned as securely as though bound in ivory. And so they remain until some chance starts a forest fire, and the resin is melted. Then they escape from bondage and flee away on the wings of the wind to clothe some steep, rocky slope where other trees cannot grow. Always, too, some of them manage miraculously to escape the flames, and so the hickory pine is among the first to spring up in fire-blackened areas in the West.

# XIII

## THE MULBERRY

THE mulberry tree is familiar in many farmyards and in village gardens, from western New England southward and westward. Indeed, Lounsberry says, "A homely barnyard scene, where chickens and pigs rove about at will and a lordly turkey gobbler exercises a surveillance over all, is hardly complete without the shade of a red mulberry tree. No doubt it has been planted there by the farmer or his predecessor, who knew that its juicy fruit would fatten his hogs and nourish well his poultry. The flavor is a trifle insipid, but these animals are not over discriminating, and root and scratch under the tree when the berries are falling until the ground is often stained to the same deep, blood hue."[1]

The white mulberry is similar to the red species, save that it is smaller in stature and bears fruit that is white, or in some instances slightly tinted with pink. The leaves, too, differ from the red mulberry, being smooth and shiny on

[1] *A Guide to the Trees.*

both sides. It is to this tree that credit must be given for one of the world's greatest industries —silk manufacture. For it is upon the leaves of the white mulberry that silkworms have been fed, since time immemorial.

The paper mulberry is a Japanese relative that has escaped from cultivation, and may frequently be found about old homesteads. It gets its name from the fact that in China and in its native land paper is made from its extremely fibrous bark. The leaves of this species are much like those of the red mulberry. The fruit is club-shaped and far from edible.

The wood of the mulberry is light yellow and soft. It is a favorite for piles and posts, because of its durability when exposed to moisture. The early Indians of Louisiana wove robes and suits from the fibers of the tree's inner bark.

# XIV

## HOLLY AND MISTLETOE

Most of the American holly on the market comes from Delaware and Maryland. The holly is mostly found growing in shrub form: but in the bottom lands of the South it sometimes becomes a slender tree, some thirty or forty feet high. The southerners, however, do not see it at its best: for it needs a rich background of snow to be appreciated. English holly has darker, more waxen leaves, and the berries are a deeper scarlet than those borne by our species.

The association of holly with the season of merry-making and the festivities of Yule-tide dates back far beyond the birth of the Babe at Bethlehem. Heathen peoples all over the Northland used to celebrate the Yule-tide—the wheeling of the sun, in a great sun feast. For to them the winter was a time of great suffering and hardship, and they rejoiced when the sun turned toward them again. He always brought them peace, plenty, and happiness. And they met and rejoiced together and sent sprigs of holly to their absent friends as tokens of their

best wishes for a plentiful year. Also boughs and green wreaths were hung in their temples as a comfort and shelter for the poor woodland spirits, whom they imagined were having as sorry and cheerless a time as themselves.

When the news of the Savior's birth spread abroad, sprays of holly were hung up as symbols of gladness. Later the spikes and leaves of holly came to suggest Christ's crown of thorns, and the red of its berries his blood, so that in Germany and Sweden it is called the Christ-thorn. Legend says that the holly was the burning bush from which God spoke to Moses. In the old Bible countries the tree grows low and bushy. Our fathers called it the holy tree, and gave it honor on Christmas day.

The holly is supposed by some races to have sprung up in the footsteps of the baby Christ, and it is said that, though man has forgotten, the beasts know and respect it. No animal feeds upon the holly. Insects are supposed to let the tree strictly alone. Probably a large part of this avoidance is due to the fact that the holly leaves have such a bitter taste. Do you know how the holly leaves are kept green? It is one of Nature's best contrivances. The thin waxy skin which covers them forms an air-

tight case and protects them from heat, cold, and wet.

Beauty is not the only excuse which the holly has for being. The berries hang on the trees well into the winter and furnish supplies for hosts of birds. The wood is a favorite with cabinet makers. It is hard, fine-grained, and almost white. It is fashioned into work tables, fancy boxes, and all kinds of dainty articles.

The mistletoe, perhaps, has no real place in a book about trees, for it is a parasitical plant or vine. But it is inseparably linked with the holly, and so beautiful that we overlook its real character. The name mistletoe is derived from the Greek, and means "tree thief." But the mistletoe is not a ruthless robber. It steals only crude sap, by means of the naustoria, or suckers, which serve it instead of roots. It has its own working outfit or chlorophyll, though the leaf is rather dingy, and shows quite plainly that it is averse to carrying on the busy laboratory methods of most leaves. The mistletoe is common throughout the South and westward on the oak, the elm, the red maple, and occasionally on the apple and the walnut. It has a pearly white berry, which blends nicely with the red of the holly.

In the Northern woods there is a species of mistletoe found clinging to the twigs of the spruce. It has all the appearances of a thorough-going parasite, for its leaves are nothing but tiny brownish-green scales. Often the whole plant is no larger than a single spruce needle.

The mistletoe has been handed down in legend as a symbol of good luck and blessing. Balder, the Norse god of sunshine, loved it and claimed it for his own. The pagans claimed that it was thrown from the upper world, and the finder of the mistletoe was supposed to be greatly in favor with the gods. The old Druids worked all manner of pleasing charms with the mistletoe.

# III

# THE FORESTER AND HIS WORK

# I

## THE FORESTER AND HIS WORK

HAVE you ever thought what it would mean to live far away in the heart of the still, deep woods, with the birds and beasts for your neighbors, and the soft fragrance of the forest all about you? To know not only the trees and the story of their joys and successes, their troubles and failures, but the whole intimate history of the plants that grow upon the forest floor—the shrubs and little tender woodland herbs, the mosses and lichens, the root parasites, and the humus plants? To know, also, the soil and conditions best suited to the private needs of each individual tree neighbor, and their enemies and how to control them? All these are part of the life and work of the forester.

There are as many sides to the subject of forestry as there are to that of agriculture. Indeed, forestry has so many possibilities and avenues of interest that hardly any one has the same idea of just what it really is. For instance, suppose you ask the hunter and sportsman. His mind will immediately turn to big

game and trout fishing and the forest preserves where such things abound. Ask the poet. He sees a vision of shadows and soft murmurs and woodland nymphs, and sniffs at odors faint and sweet as those of Araby. Ask the statesman. He will say that forestry is one of the greatest national movements of the day. Ask the student who has chosen it for his life work. He will tell you that forestry is the careful management of the woodlands to serve certain purposes. Its object is to bring all the mountain sides of our country under forest control; to protect the watersheds; to replace mere lumbering and the reckless waste of wood with careful conservation methods; to restore the beauty of the wild-woods, and to protect the game and birds which seek their cover. To the student forestry means a delightful profession, salary, and promotion, perhaps, to General Supervisor of his Forest District. If he reaches this coveted position, he will have to win his way patiently. For the Forestry Service is graded like the army, and promotions are made on merit. To become a supervisor, the forester must have experience and business ability. He must not only have a good working knowledge of the trees, but he must know all about forest products and the best market for them. He

THE BALSAM FIR HAS A BLUEISH-GREEN FOLIAGE WITH A SILVERY UNDER SURFACE

AMONG THE PINES THE WHITE PINE IS THE TALLEST, STATELIEST AND BEST-KNOWN

must have at his fingers' end all the items of road and trail building, the mining business, the stock business, etc. Moreover, it is thought desirable that he should be a college graduate, and that he must have taken a special course in forestry work.

Our first foresters found it necessary to go to Europe for special training. Some twenty years ago, two forestry schools were established in the U. S., one at Cornell University, and one at Biltmore, in the mountains of North Carolina. Two years later, a third school was organized at Yale, and others have sprung up since, till we have something over twenty schools of forestry in our land. Some of these give short courses, especially intended for the training of rangers.

A ranger is next in rank below the supervisor, his deputy, and his assistant. These men, like their superiors, must be sufficient unto themselves. Their home is usually in the heart of the forest, far from the comforts of civilization. They have all the routine work to do, and some of it is the hardest kind of labor. They have to know how to provide for themselves and their horse under all sorts of trying circumstances, and to ride over rough country all day, and all night, too, if necessary. They must

know how to shoot and to fight fire. They must be able to pack and saddle with all possible swiftness, to build cabins and telephone lines, to handle lumber and live stock, and to do compass surveying.

Under the rangers are guards. These are usually temporary men, taken on through the summer to assist in fire control, road and trail making, and general construction work.

In addition to the officers mentioned are logging engineers, lumbermen, scalers, and planting assistants. They are employed in the work of timber appraisal, scaling, cruising, and tree planting. Like the rangers and guards, these officers must be able to meet all manner of woodland problems, and to pass a careful civil service examination.

We have three types of forest in our country. First, there is the forest kept as a park and game preserve. These are owned mostly by clubs and private individuals. Several such "forests" are to be found in the Adirondack Mountains. Their management includes little of real forestry problems, for their aim is but to preserve natural conditions and to provide sport for their owners. They are not intended to be self-supporting.

Second, there are the protective forests which

regulate the water supply of large areas and act as irrigation reservoirs, thus preventing floods and excessive erosion. This sort of forestry is adapted to steep and broken mountain regions, and is the kind most practised in the Rocky Mountain districts, where protective forestry and irrigation problems are matters of great importance.

The third type is the commercial or supply forest, whose object is primarily the raising and harvesting of wood for profit. This type of forestry is self-supporting and requires skilful management in every particular. It rests upon a purely commercial basis, just as farming does, and is really a department of agriculture. It is carried on upon a scale large enough to warrant the employment of a large force of men and the building of a railroad. The employees in this type of forest plant for the future and reap the harvests of by-gone ages.

Forestry is made up of three great branches: *Silviculture,* which is the growing of forest trees; *Lumbering,* which is the harvesting and marketing of the crop; and *Dendrology,* which includes the sciences upon which the art of forestry is based. The latter branch is really tree botany, and is made up of no end of interesting details concerning the life processes of the trees

in health and decay, their structure and species, their natural requirements, uses, etc. A well-known forest products laboratory is that maintained in cooperation with the University of Wisconsin. Here all the physical properties of wood are investigated. Tests are made as to its strength, its seasoning and kiln drying, its use in the production of fiber board, paper pulp, and so on. Studies are made in the manufacture of wood alcohol, turpentine, tar, resin, and other chemical products. Advices are also furnished the Bureau of Wood Utilization concerning valuable uses for waste products, such, for example, as the making of methyl (wood) alcohol and acetic acid by the distillation of sawdust. It is the business of this bureau to know what sorts of wood are needed in special industries, and which factories can use odd and ends of lumber. For example, a maker of brush backs told the Bureau that he could use only the heartwood of the birch tree; within less than a hundred miles was a spoolmaker who could use only the sapwood. These two parties were brought together, and each made use of the other's waste. A maker of veneer wrote in to know what he could do with the cores which remained after he had pared off the outer surface of the logs which were used in his factory. It hap-

pened that these cores were just the right length and thickness of the regulation mine roller for carrying cable in the coal mines. It was only necessary to bore a hole in the center of them for the fitting of a metal rod. Now this manufacturer receives almost as much for his mine rollers as for the veneer itself. Thus, while the Bureau has been in operation less than a decade, it has proved its worth over and over, and has been the means of saving countless trees throughout the country.

The first aim of the Forest Service is to protect the resources of the National Forests so that they will always give service, and at the same time to see that the greatest number of people have an equal chance to reap their benefits. Such wise administration involves a multitude of cares and duties:

*Fire Patrol.* In all the National Forests, throughout the summer months, men patrol the woods, and are stationed here and there on high open spots, to keep a constant and careful outlook for the rise of smoke and the beginnings of fire in every direction. For it is a Service maxim that: "The best time to fight a fire is before it has time to spread." A delay of even a few minutes may permit a fire that at first could easily have been put out to gather headway and

get altogether beyond control. Many forests preserve fire lines—strips kept bare and free from inflammable material of every sort. These are very useful in checking small fires, and are of great value as lines of defense in fighting larger ones.

*Grazing.* Each National Forest has its "stock allotment," that is a certain number of grazing animals, and no more, may pasture there. This regulation pasturing is a real protection to the trees, for the cattle and sheep keep down weeds and grass which would dry and might later serve as food for flames. Cattle pastured in the National Forests are so well fed that they are said to bring a higher price on the market than others. They are sure, too, of being well watered, for the forest officers must see to the condition of the watering places. The National Forests of the West serve as ranges for thousands of horses, cattle, and sheep, which would otherwise find decidedly poor picking in that land of little rain. There are "drift fences" along the boundaries of the National Forests, which keep cattle from straying in or out, and Forest Service employees must see that these fences are kept up. Stock owners must pay a specified sum per head for grazing privileges.

*Destruction of Beasts of Prey.* In 1911, Forest Service men killed nearly eight thousand beasts of prey—mountain lions, wildcats, bears, wolves, lynxes, and coyotes. This was an inestimable service to the people in the vicinity of their reserves. In the Rocky Mountain section it is claimed that a single bear has been known to destroy $800 worth of stock in a year's time; a timber wolf has been estimated as even more destructive.

*Tree Planting.* A community of trees is an exceedingly interesting one. Behind the relentless competition for light, water, and food—the three things trees need most, is a spirit of mutual helpfulness that furnishes interesting study for the forester. Each tree helps to protect its neighbors against fierce onslaughts of wind and the warm overtures of the sun, which stands ready to bake the soil about the roots and to crack the bark by shining too hotly upon it. Each one contributes to the general welfare by enriching the soil with its annual fall of leaves and twigs and by serving as a canopy for the protection of seedlings. Here and there certain species show a tendency to gregariousness: that is, they occupy the ground to the exclusion of all others. Perhaps they are able to thrive with less water, or to

grow on thinner soil; their rate of growth or their power of reproduction may be greater—there is some reason why they are better fitted for their surroundings. It is the forester's business to understand this. He must know what trees are best suited for certain conditions, for he cannot afford to make mistakes. A crop of trees takes the lifetime of a man to bring to harvest. It would be folly to plant beech or black walnut on dry, barren ridges: they are trees with a passion for rich, moist soil and damp situations. So, too, are the black gum and the red maple, but on the other hand the latter often do well on dry, stony soils at a distance from water. The seeds of some trees may be scattered broadcast and grow with very little attention, others require careful handling, and many of the seedlings must have "nurse trees" for the first few years of their existence. Some trees are really "weeds." They provide shade but do little else. Their places might better be filled by trees having timber and food values. It is a knowledge of such qualities as these which makes the valuable forester.

"Direct" or broadcast seeding has so many disadvantages, that the transplanting of seedlings is rapidly finding favor in most Forests. The government maintains twenty-nine seed-

ling nurseries. Because most of our National Forests are on high mountain land, where only evergreens can endure the fierce gales and heavy snows, and because pine lumber is so useful and in such constant demand, most of the seeds planted in these nurseries are seeds of the pines.

*Sale of Timber.* The Forest Service is always on the lookout to improve the timber stand. This is best accomplished by the removal of trees that are no longer growing at a profitable rate. From time to time an expert selects the "ripe" trees and tickets them "U. S." These trees are offered to homestead settlers and farmers for their own use at the actual cost of making the sale, with no charge whatever for the timber itself. The purchaser is required to cut the trunk close to the ground and to clear away all rubbish that might feed a fire. Care must be taken also not to break or interfere with young trees that may be growing near.

The Forest Service holds out every inducement to settlers within their borders. However, little of the National Forest lands are such as farmers and ranchmen desire. They are rocky and barren and so high above sea level that the snow lies in them nine months of the year.

Mineral deposits on National Forests are open to development exactly as on unreserved public land. A prospector may stake a claim wherever he finds evidence of valuable minerals. Moreover, the Forest Service will give him free timber for the development of his mines, and assist him in every way it can.

*Camping Grounds.* Many of the National Forests offer ideal grounds for recreation. Campers are welcomed on the most liberal terms, and there are no "keep out" signs. The only bit of red tape necessary is a camping permit from the district forester. Los Angeles and Fresno, California, Portland, Oregon, and Denver, Colorado, are Western cities which lie near attractive National Forests. Lists of other Forests which offer inducements to campers may be obtained by writing the Chief Forester, Washington, D. C., for information.

*Work of Investigation.* The Forest Service conducts a number of experiment stations, where scientific investigations are continually being made of various problems relative to the growth and management of forests and their utilization. It cooperates with states in studying their forest conditions, and in developing forest policies, and with private owners by fur-

nishing advice concerning the best methods of managing and protecting their timber holdings.

Our National Forests number something over 162,000,000 acres, and the industry of forestry has grown to such proportions that it is second to that of agriculture in the number of people and amount of capital employed and in the value of product. However, it is not always possible for a man who has passed the Forest Service examination to get employment under the government. But the need of trained foresters is steadily rising. They are wanted by railroad companies, lumbering companies, manufacturing concerns of one sort and another, holders of large estates, and so on. Foresters, like farmers, are born, not made, and there must always be room for the young man who goes into the work for the love of it and who is determined to win. Forestry also offers many opportunities to girls and women, in the laboratories, at the field and experiment stations, in the quarantine and plant propagation departments, in the work of foreign seed and plant introduction, as landscape gardeners, as experts in the problems of forest management, and the like. The industry of forestry and the work of the forester are so new and untried that they must be tinged

with magic for many years to come. They suggest all manner of delightful possibilities to those who love the woodlands and a life in the open.